

2019

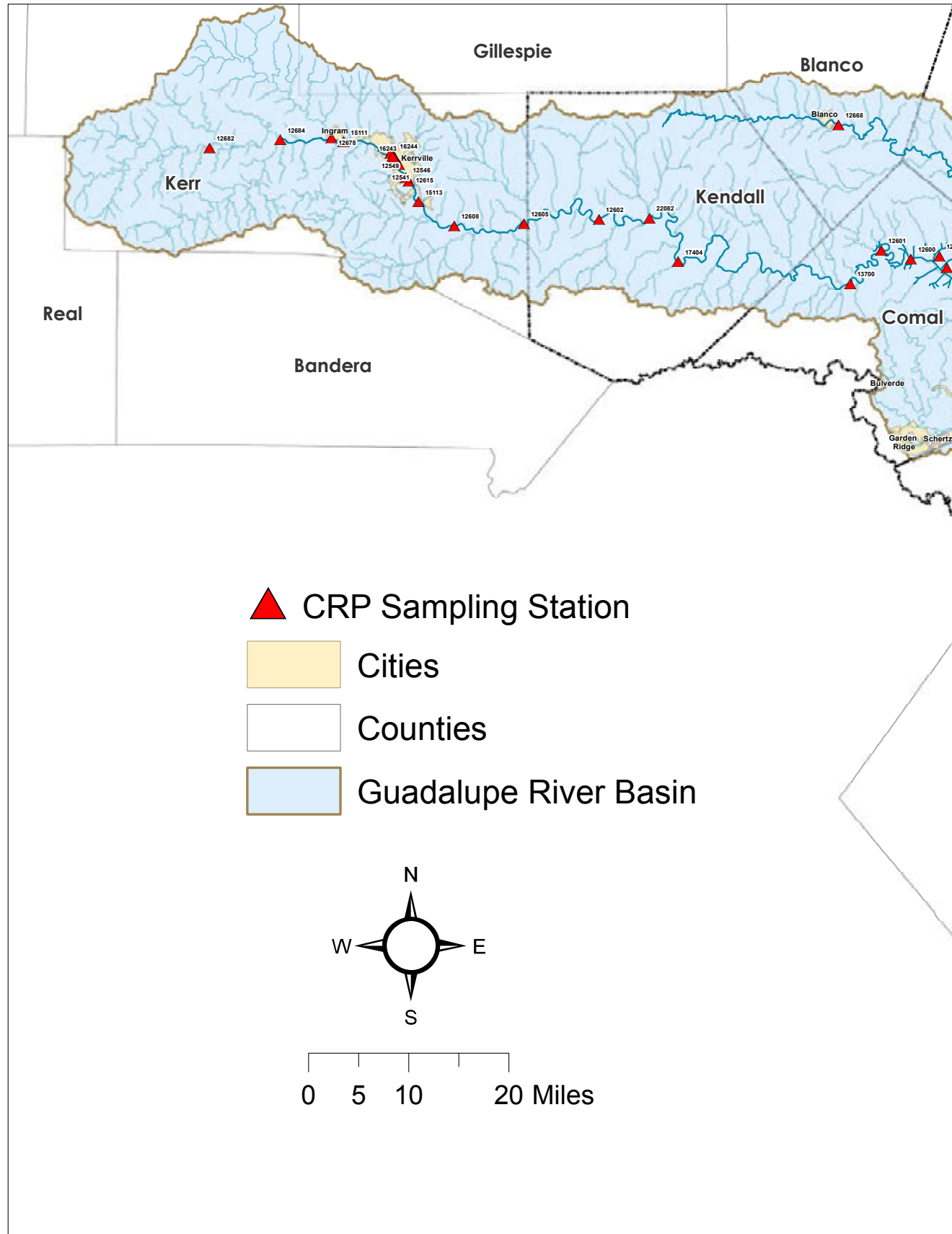
Basin Highlights

R E P O R T



CLEAN RIVERS PROGRAM

Guadalupe River and Lavaca-Guadalupe Coastal Basins



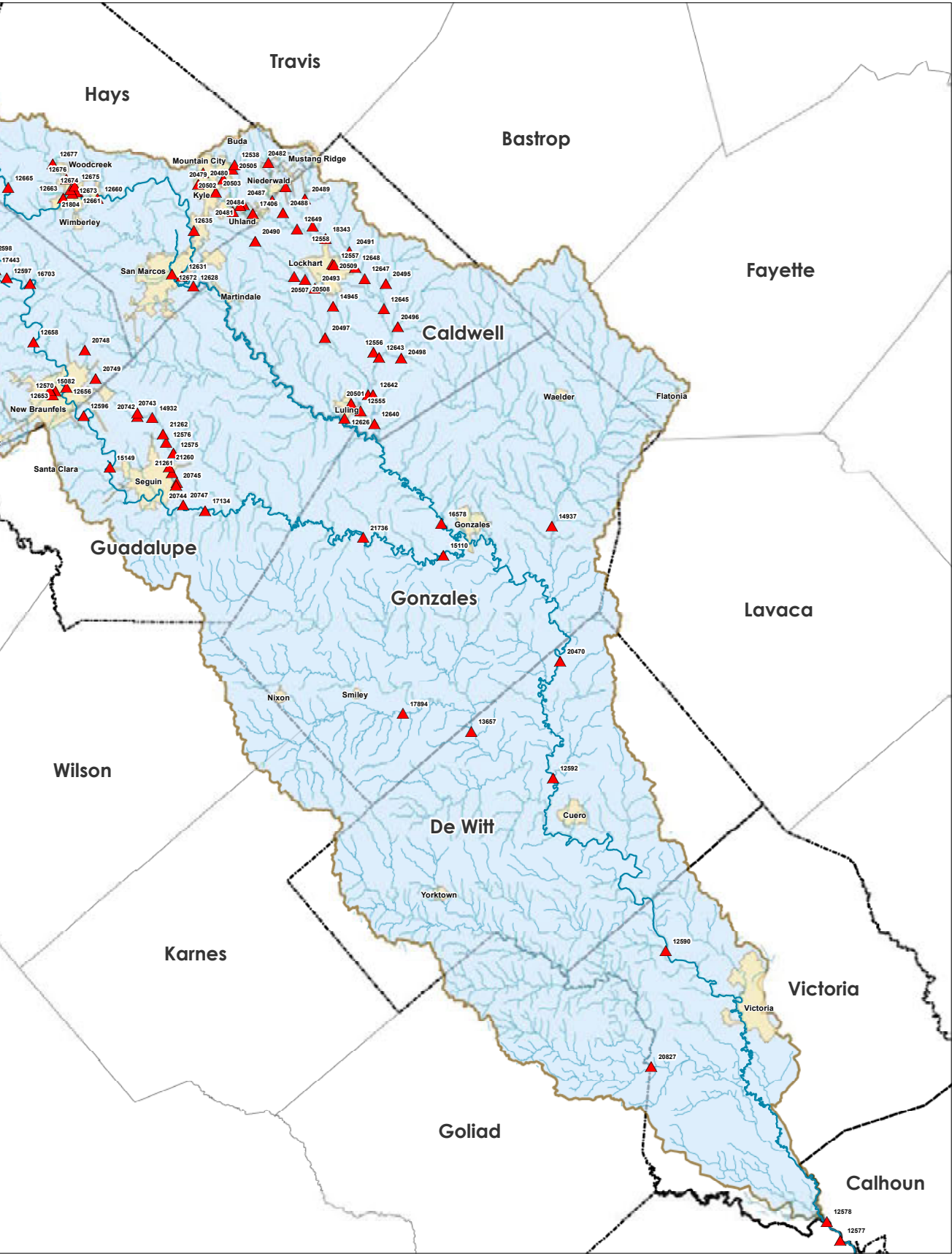


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2019 BASIN HIGHLIGHTS REPORT

This report highlights the activities of the Guadalupe River Basin and the Lavaca-Guadalupe Coastal Basin under the Clean Rivers Program (CRP) in 2018. CRP is a statewide program established by the Texas legislature in 1991 and administered by the Texas Commission on Environmental Quality (TCEQ) to holistically manage water quality issues throughout the state. The CRP objectives provide quality assured data for regulatory decisions, identify and evaluate water quality issues, promote cooperative watershed planning, recommend management strategies and inform and engage stakeholders. State fees assessed to water rights and wastewater discharge permit holders are used by TCEQ to fund the program. The Guadalupe-Blanco River Authority (GBRA), together with the Upper

Guadalupe River Authority (UGRA), are contracted by TCEQ to conduct water quality monitoring, assessment and stakeholder outreach activities in the Guadalupe-Blanco River Basin. This report includes a description of the major basin events (Table 1), water quality monitoring (Table 2), public outreach and education, watershed planning, and stewardship activities in the River Basin. The 2019 Basin Highlights Report also includes a map of water quality sampling sites and a review of the water quality impairments and concerns in the Draft 2016 Texas Integrated Report for the Clean Water Act section 305(b) and 303(d) (Table 3). Additional information on the Guadalupe River Basin and the Lavaca-Guadalupe Coastal Basin Clean Rivers Program can be found at www.gbra.org/crp.



Overview of Water Quality Monitoring

One of the key roles of the Clean Rivers Program is fostering coordination and cooperation in monitoring efforts. Coordinated monitoring meetings are held annually and are attended by the entities collecting water quality data on the Guadalupe River and its tributaries. The coordination of monitoring efforts and discussion of the areas in need of additional data maximizes the limited resources available to these entities. Table 2 outlines the types and amounts of water quality monitoring underway in the Guadalupe River Basin and the Lavaca-Guadalupe Coastal Basin under a TCEQ-approved Quality Assurance Project Plan for September 2018 through August 2019.

In addition to the monitoring programs conducted by the GBRA and the UGRA, the Wimberley Valley Watershed Association (WVWA) and the Meadows Center for Water and the Environment are conducting water quality monitoring in the Upper Blanco and Cypress Creek watersheds. The goals of the WVWA Upper Blanco monitoring program are to establish baseline water quality data, identify potential pollution problems, document spatial and temporal changes, determine impacts of point and nonpoint source pollution and assess compliance with water quality standards. The goal of the Meadows Center Cypress Creek monitoring program is to assess changes in water quality through the implementation of activities associated with the Cypress Creek Watershed Protection Plan. These programs will also provide recommendations for local planning efforts to protect water quality. GBRA provides laboratory analysis, technical assistance and oversight of the quality assurance aspects of the WVWA and UGRA programs. The complete monitoring schedule is available at <http://cms.lcra.org>.

TABLE 1**Clean Rivers Program Guadalupe River and Lavaca-Guadalupe Coastal Basins Inventory of 2018 Events**

Event	Segment/ Sub-watershed	Comments
Drought conditions	All	The majority of the Guadalupe Watershed experienced mild to moderate drought conditions from January to September 2018. Canyon Reservoir dropped to 85% of capacity at the beginning of September and many of the smaller streams in the watershed diminished to little or no flow. The watershed recovered during the last quarter of 2018. Significant precipitation events during September and October refilled Canyon Lake to 100% of capacity in October 2018.
Water Hyacinth treatments in the Guadalupe River at Lake Gonzales	1804	Texas Parks and Wildlife Department (TPWD) and GBRA collaborated in the treatment of water hyacinth that blocked public access and created poor water quality conditions in the Guadalupe River at Lake Gonzales (H-4 Lake). GBRA contracted the treatment of over 100 acres with glyphosate during the summer of 2018.
Invasive Zebra Mussels continue to spread	1805, 1812	Employees of Crane's Mill Marina discovered Zebra Mussels during the summer of 2017 on the western portion of Canyon Lake. Following initial discovery, TPWD determined Canyon Lake was infested with a reproducing population of this non-native species. In 2018, TPWD biologists found live Zebra Mussels in the portion the Guadalupe River below Canyon Dam. The species has continued to spread despite an intensive educational outreach effort by GBRA and TPWD encouraging the public to decontaminate boats through the statewide Clean, Drain & Dry campaign. Zebra Mussels are of particular concern to the Guadalupe River Basin because of their potential to damage infrastructure such as pipes and boats below the waterline as well as their potential to damage and outcompete native freshwater mussel species.
Guadalupe River above Canyon Reservoir stops flowing due to severe drought	1806	The Guadalupe River above Spring Branch stopped flowing during August and September 2018 due to moderate drought conditions. Stream flow in this portion of the Guadalupe River resumed on September 9, 2018, following a 2" rainfall event.

TABLE 1 - continued

New wastewater treatment facility planned for Guadalupe watershed upstream of Canyon Lake	1806	Silesia Properties has applied for a new wastewater treatment discharge permit (WQ0015688001). If approved by TCEQ, the facility would be permitted to discharge up to 500,000 gallons per day of treated wastewater into a dry tributary of Honey Creek into the Guadalupe River Watershed. The proposed plant would provide wastewater treatment for the planned Honey Creek Ranch Subdivision and be located on State Highway 46 West in Spring Branch, Texas. The TCEQ found the permit application to be administratively complete and is currently conducting a technical review of the permit prior to a decision by the executive director.
Watershed Protection Plan completed for Comal River and Dry Comal Creek	1811, 1811A	The Dry Comal Creek and Comal River Watershed Partnership developed a Watershed Protection Plan (WPP) to address E. coli bacteria loading in these watersheds. The City of New Braunfels and stakeholders of these watersheds completed the plan in August 2018. The WPP summarizes previous efforts to characterize the quantity and sources of bacteria, as well as identifies best management practices to reduce bacteria loads in these water bodies.
Upper San Marcos River Watershed Protection Plan accepted by EPA	1814	The San Marcos Watershed Initiative Stakeholder Committee and the Meadows Center for Water and the Environment developed a WPP to identify sources of pollution, improve and protect water quality in the Upper San Marcos River. The plan was accepted by the United States Environmental Protection Agency (USEPA) in 2018. The WPP includes implementation best management practices (BMPs) such as conservation of undeveloped land and storm water mitigation in a rapidly urbanizing watershed.
Cypress Creek Watershed Protection Plan begins implementation monitoring	1815	The Cypress Creek WPP identified BMPs to improve water quality during the second phase of a TCEQ nonpoint source implementation grant. In December 2018, the Meadows Center for Water and the Environment began monitoring and documenting changes in water quality as recommended BMPs are implemented throughout the watershed.
Giant reed controls initiated in Kerr County	1806, 1816, 1817, & 1818	TPWD began implementing the Healthy Creeks Initiative in 2015 to control the spread of Giant Reed (<i>Arundo Donax</i>) in the Texas Hill Country. The TPWD partnered with the Nature Conservancy, Hill Country Alliance and local landowners to identify and spray the plants with approved aquatic herbicides. In 2018, the TPWD partnered with the Upper Guadalupe River Authority (UGRA) to expand this effort into the headwaters of the Guadalupe River Basin.

TABLE 2

Monitoring parameters and frequencies conducted by monitoring partners in the Guadalupe River Basin in FY2019.

Sampling Entity	Field Parameters	Conventional Parameters	Bacteria	Biological and Habitat	24 Hr. Dissolved Oxygen
GBRA	19 sites monthly; 13 sites quarterly	19 sites monthly; 13 sites quarterly	19 sites monthly; 13 sites quarterly	3 sites 2x/year	3 sites 5x/year
UGRA	6 sites monthly; 10 sites quarterly	6 sites quarterly	6 sites monthly; 10 sites quarterly		1 site 2x/year
TCEQ	8 sites quarterly	8 sites quarterly	8 sites quarterly		
WVWA (Blanco River)	5 sites quarterly	5 sites quarterly	5 sites quarterly		
Meadows Center (Cypress Creek)	6 sites quarterly	6 sites quarterly	6 sites quarterly		2 sites 2x/year
TSSWCB-Funded GBRA (Plum Creek & Geronimo Creek)	12 sites-monthly; 33 sites 6x/year; 4 sites 4x/year	12 sites-monthly; 33 sites 6x/year; 4 sites 4x/year	12 sites-monthly; 49 sites 6x/year; 4 sites 4x/year		8 sites 5x/year

2016 Draft Texas Integrated Report*

TCEQ performs ongoing assessments of the water quality in all of the classified and many of the unclassified water bodies in the state of Texas that have sufficient monitoring data. Every two years, TCEQ completes a report detailing the results of these assessments that describe the designated uses and level of support for every water body assessed. The results of these assessments are used by TCEQ to determine if a water body will be listed on the 303(d) list of impaired water bodies. Table 3 identifies all of the water quality impairments and concerns TCEQ identified for the Guadalupe River Basin in the most recent draft 2016 Texas Integrated Report.

* The TCEQ adopted the 2016 integrated report draft on October 17, 2018; however, the report will remain a draft until it receives EPA approval.



Clean Rivers Program station
21998 on Rebecca Creek in
Comal County

TABLE 3

Table of Water Quality Impairments and Concerns described in the Draft 2016 Texas Integrated Report for the Clean Water Act Section 303(d) and 305(b)

Segment Number	Water Body	Impairment (Draft 2016 Integrated Report)	Concern
1801	Guadalupe River Tidal		Bacteria; Nitrate
1802	Guadalupe River below San Antonio River		Nitrate
1803	Guadalupe River below San Marcos River		Bacteria; Nitrate
1803A	Elm Creek	Depressed Dissolved Oxygen 24-hour Average & Minimum; Depressed Dissolved Oxygen Grab Minimum	Depressed Dissolved Oxygen Grab Screening Level; Chlorophyll <i>a</i>
1803B	Sandies Creek	Hour Average & Minimum; Depressed Dissolved Oxygen Grab Minimum; Impaired Macrobenthic and Fish Communities; Bacteria	Impaired Habitat; Depressed Dissolved Oxygen Grab Minimum & Screening Level;
1803C	Peach Creek	Depressed Dissolved Oxygen Grab Minimum & Screening Level; Bacteria	Impaired Fish Community; Total Phosphorus; Chlorophyll <i>a</i>
1804A	Geronimo Creek	Bacteria	Nitrate
1804D	Baer Creek		Bacteria
1805	Canyon Lake	Mercury in Edible Fish Tissue	
1806	Guadalupe above Canyon		Impaired Habitat
1806A	Camp Meeting Creek		Depressed Dissolved Oxygen Grab Screening Level
1806D	Quinlan Creek	Bacteria	Depressed Dissolved Oxygen Grab Screening Level
1806E	Town Creek	Bacteria	Depressed Dissolved Oxygen Grab Minimum & Screening Level

TABLE 3 - continued

1810	Plum Creek	Bacteria	Depressed Dissolved Oxygen 24 Hour Average & Grab Screening Level; Nitrate; Total Phosphorus
1810A	Town Branch		Depressed Dissolved Oxygen Grab Screening Level; Nitrate; Bacteria
1811	Comal River	Bacteria	Bacteria (Above Dry Comal Confluence)
1811A	Dry Comal Creek	Bacteria	
1815	Cypress Creek		Depressed Dissolved Oxygen Grab Minimum
1818	South Fork Guadalupe River		Depressed Dissolved Oxygen Grab Screening Level

GBRA water quality technician Jana Gray performing CRP monitoring at station 22080 (Guadalupe River in Kendall County)



GBRA EDUCATION EFFORTS

GBRA staff continues to have a high level of visibility in schools throughout the Guadalupe River Basin. During school year 2017-18, GBRA presented to hundreds of varying school-age groups, totaling more than 13,000 students. Water quality education and monitoring are introduced to fourth and fifth grade students at outdoor nature education sites such as the Irma Lewis Seguin Outdoor Learning Center, Lockhart State Park, Jacob's Well Natural Area, Meadows Center for Water and the Environment, Coletto Creek Park and Canyon Lake Gorge. GBRA staff also address watersheds and water quality in seventh grade science classes throughout the river basin. High school students are reached through working with Aquatic Science and Environmental Science classes.



(Above) GBRA staff and local students use a kick net to find macroinvertebrates in the Geronimo Creek at the ILSOLC



(Left) Local students identify macroinvertebrates at the ILSOLC



Focus: Irma Lewis Seguin Outdoor Learning Center

GBRA's water quality education is paramount at the Irma Lewis Seguin Outdoor Learning Center (ILSOLC). The ILSOLC is located on Geronimo Creek and encompasses over 300 acres of recreation and environmental education opportunities. Most of the water quality activities are coordinated through the Environmental Science Center which is outfitted with technology and equipment including GPS units, water quality probes and software, nets, and other tools for macroinvertebrate investigations, and water quality test kits. Funding from a TCEQ 319 nonpoint source (NPS) pollution grant in 2015 provided opportunities to develop water quality lessons, and lessons focusing on riparian systems. School age students have been introduced to water quality through hands-on learning.

Activities include geocaching, stream tables, watershed model, NPS Attacks! and Exploring the Riparian Zone. A second 319 NPS grant in 2018 provided additional funding, enabling the addition of a part-time Environmental Education Site Coordinator (EESC). Funds will also be used for the development of a stream table trailer to demonstrate stream flows and erosion. New interactive water quality lessons are being developed for various grade levels. These lessons are being marketed to schools in the Geronimo Creek watershed (Seguin ISD and Navarro ISD). Teachers from these two districts are coordinating plans alongside the EESC to develop grade-level specific outdoor classroom events for all grade levels. Future plans are for these comprehensive events to be offered to other school districts in the region.

Focus: Canyon Lake Gorge Fifth Grade Outdoor Classroom

School year 2018-19 marks the fourth year GBRA has hosted area students to Outdoor Classroom events at the Canyon Lake Gorge. Students rotate through six stations, two of which support water quality initiatives. Students learn about aquatic life through investigations in the Gorge's aquifer channels and discuss the importance of clean water to all aquatic life. Students also learn about erosion and sedimentation through an interactive stream table lesson and participate in discussions about how erosion can be harmful to our creeks and rivers. This program has grown tremendously over the years. The first year (SY 2015-16), six schools and almost 500 students participated in the Outdoor Classroom. The program has expanded a great deal - this school year (SY 2018-19) students from 12 campuses have been scheduled, totaling 1,200 students.

(Left) Students learn and explore the riparian area at the ILSOLC

For more information about GBRA Education Programs, contact
Cinde Thomas-Jimenez, GBRA Environmental Education
Administrator at cthomas-jimenez@gbra.org



(Right) Comal ISD students visit the Outdoor Classrooms at Canyon Lake Gorge to learn about earth science



FRESHWATER MUSSELS OF THE GUADALUPE RIVER

by Lee Gudgell

Visitors to the waters of the Guadalupe River Basin commonly see hard, asymmetrical wedges and discs mixed amongst the rocks and sediment on riverbanks. These unusual “rocks” are actually the shells of freshwater mussels.

The two halves, or valves, of these shellfish often separate from their connecting ligament and internal soft tissues. The mother-of-pearl calcium carbonate nacre that covers the inner surface of the shells can diffract spectacular iridescent colors from the light of the sun. High flows or predatory animals such as raccoons deposit the mussel shells along the shorelines of the river. Other than these shell remnants, the lives of freshwater mussels have largely gone unnoticed beneath the surface of our rivers and streams. Although the casual observer rarely sees these animals, they serve a very important role in freshwater ecosystems.

Mussels are filter feeders that bury themselves in the substrate of water body where they siphon plankton and other organic particles out of the water for nutrition. They also have a unique life cycle, in which the larval form parasitizes the gills of a fish host before it develops into a juvenile. Their specialized water quality, habitat and stream flow needs, combined with overall immobility and dependence on fish interactions, make freshwater mussels an important indicator of the healthiness of our rivers and streams. Recent scientific studies of these species have now brought freshwater mussels in the Guadalupe River to the forefront of public awareness.

The waters of the Guadalupe River Basin have historically been home to 23 different species of freshwater mussels. In October 2008, WildEarth Guardians petitioned six species of freshwater mussels to the U.S. Fish and Wildlife Service (USFWS) for listing under the U.S. Endangered Species Act (ESA). These petitions spurred a flurry of research by the scientific community to discover the current abundance, diversity and ecological requirements needed for the petitioned species and freshwater mussels as a whole. In 2010, the Texas Parks and Wildlife Department (TPWD) included four species found in the Guadalupe River on the state threatened species list. The State of Texas currently provides protection for the False Spike, Texas Fatmucket, Texas Pimpleback and Golden Orb. The USFWS performed a 90-day review for all four candidate species and determined that the petitions were “substantial.” In 2011, USFWS completed a 12-month review of the Texas Pimpleback, Golden Orb and Texas Fatmucket and issued a “warranted” finding. A 12-month review of the False Spike has not been completed. The regulatory considerations of the TPWD & USFWS have spurred scientific research to investigate the status and ecological needs of these species.

In 2018, several studies of population genetics in freshwater mussels resulted in substantial discoveries regarding the species of the Guadalupe River. Lyubov Burlakova, Alexander Karatayev and their team performed molecular analysis of Texas Pimpleback (*Cyclonaias petrina*) species collected in the Guadalupe River Basin and the Colorado River



Joint agency collaborative mussel monitoring on Johnson Creek in Kerr County

Basin. These scientists concluded that the pimplebacks of the Guadalupe River were genetically unique enough to be a separate species which they named the Guadalupe Orb (*Cyclonaias Necki*). Following this conclusion, a team lead by Nathan Johnson and Charles Randklev further investigated the genetic diversity among the *Cyclonaias* genus. The molecular analysis from this study confirmed the findings of Burlakova et al., while also proposing that the Golden Orb (*Cyclonaias aurea*) found in the Guadalupe River, the Smooth Pimpleback (*Cyclonaias houstonensis*), Western Pimpleback (*Cyclonaias mortani*) and Pimpleback (*Cyclonaias pustulosa*) species found across multiple river basins were genetically similar enough to combine into a single Pimpleback species. A separate USFWS funded molecular analysis study by Inoue, Pieri, and Randklev identified the Texas Fatmucket (*Lampsilis bracteata*) of the Guadalupe River as a unique species described as the Guadalupe Fatmucket (*Lampsilis sp. cf. bracteata*).

The genetic studies of the ESA candidates provided a great deal of insight into distribution of these species at the watershed level, but information regarding the range and abundance of these species within the Guadalupe River Basin was still lacking. In 2018, the Texas Commission on Environmental Quality (TCEQ) Surface Water Quality Monitoring Team drafted freshwater mussel monitoring methodologies for use in biological assessments. These protocols consisted of qualitative time surveys which occur at pre-designated transects over a minimum of five person hours. In May 2018, the Guadalupe-Blanco River Authority (GBRA) and the Upper Guadalupe River Authority (UGRA) assisted TCEQ with testing these qualitative protocols in the Guadalupe River Basin. GBRA and TCEQ integrated



Freshwater mussel species discovered during joint agency collaborative monitoring on the South Fork of the Guadalupe River in Kerr County

these procedures into scheduled GBRA seasonal biological monitoring events on the North Fork of the Guadalupe River and the Rebecca Creek Tributary of Canyon Lake. The results of these tests was a resounding success. GRBRA, UGRA and TCEQ discovered live Guadalupe Fatmucket specimens several miles upstream of their previously documented range on the North Fork of the Guadalupe. In July 2018, GBRA, UGRA, TCEQ, TPWD and USFWS employed additional qualitative studies to document new distribution ranges for the Guadalupe Orb on the South Fork of the Guadalupe and the Guadalupe Fatmucket on the Johnson Creek Tributary of the Guadalupe River near Mountain Home. This monitoring confirmed the scientific community needs more information to define the known distribution and abundance of the USFWS ESA candidate species. Additional Guadalupe River Basin monitoring will likely be necessary to track the current and future conditions of these candidate species.

GBRA understands the importance of freshwater mussels to the people and

ecology of the Guadalupe River Basin. The river authority is taking several proactive steps to ensure the long-term health of these species. The organization is currently working with the USFWS, TPWD, UGRA and other stakeholders of the basin to develop a mussel conservation plan. The plan will attempt to identify potential threats to mussel species and identify measures needed to conserve them. GBRA is a sponsor of the 11th Biennial Symposium of the Freshwater Mussel Conservation Society in April 2019. The focus of the symposium is to reconcile the coexisting needs of humans and mussels in order to ensure the persistence of these animals in our rivers and streams. GBRA staff continues to increase their knowledge of these species in the basin through additional professional development training and targeted mussel-sampling events throughout the year.

CITY OF NEW BRAUNFELS: DRY COMAL CREEK AND COMAL RIVER WATERSHED

The City of New Braunfels (CoNB) is continuously working to protect and improve water quality of the Comal and Guadalupe Rivers and their tributaries that flow through the City and its extraterritorial jurisdiction. In September 2018 the Dry Comal Creek and Comal River Watershed Protection Plan (WPP), developed by the City and its project partners, was approved by the United States Environmental Protection Agency and the Texas Commission on Environmental Quality (TCEQ). The WPP includes management strategies to reduce bacteria loading to the Dry Comal Creek and the Comal River. Federal 319 grant funding has been secured for the enactment of bacteria management measures to be applied over the first three years of WPP implementation. These measures include but are not limited to urban wildlife management, management of pet waste and community education and outreach. As of late 2018, the City and its project partners are moving forward with implementation of the WPP.

A significant step in the effort to reduce bacteria loading in the watershed was the adoption of a city ordinance prohibiting the feeding of wildlife within the city limits. It was determined via bacteria source tracking analyses conducted during the development of the WPP that animal waste from deer and avian wildlife was a significant source of bacteria in both



(Left) Citizens participate in the Dos Rios Watershed Cleanup



**Dos Rios
Clean-up
Volunteers**

the Dry Comal Creek and the Comal River. It is believed that by removing the anthropogenic source of food, wildlife will forage elsewhere thereby reducing the high-density concentrations of wildlife that currently exist within the city and the local watersheds. The CoNB's wildlife feeding ordinance was passed by its city council in September 2018 and will become effective in March 2019. The City and its WPP project partners will be supporting the ordinance with community education and outreach initiatives that will aim to inform residents and visitors on the negative impacts of feeding wildlife.

The CoNB has also recently taken significant steps towards reducing litter in local rivers and creeks that are part of the Guadalupe River watershed. In 2017, the CoNB hosted the first Dos Rios Watershed Clean-up, a volunteer-based event focusing on the collection of litter in parks and riparian areas throughout the city. This annual event continued in October 2018 when the CoNB hosted the 2nd Annual Dos Rios Watershed Clean-up. Over 120 volunteers participated in the 2018 clean-up event collecting approximately 500 pounds of trash from 10 different locations throughout the city. The CoNB is aiming to hold the 3rd annual Dos Rios Watershed Clean-up in the Fall of 2019.



**Old Channel
Volunteer Planting**



(Above) Boy Scout Troop 413 EAHCP Volunteer Riparian Restoration Project



Left) Dos Rios Watershed volunteers driving out the trash and cleaning up the wreckage during the Dos Rios Watershed Clean-up

In 2018, the CoNB reinstated the disposable container ordinance that effectively prohibits the use of disposable containers on the Comal and Guadalupe Rivers within the city limits. This city ordinance requires river enthusiasts to use non-disposable containers for the storage and consumption of food and beverages while recreating on the rivers within the city limits. This ordinance also restricts the size of coolers allowed on the rivers within the city limits. This ordinance is designed to aid in the reduction of litter that is often disposed of in the rivers during recreational activities. More information on the rules related to river recreation in the city limits can be found at <http://tubeinnewbraunfels.com/rules>.

The CoNB has also continued its participation in the Edwards Aquifer Habitat Conservation Plan (EAHCP). The City, through the EAHCP program, conducts a variety of restoration and monitoring activities that are designed to protect the habitat of several endangered species such as the Fountain Darter (*Etheostoma fonticola*) and the Comal Springs Riffle Beetle (*Heterelmis comalensis*) that are found in the Comal River system. Ongoing EAHCP habitat restoration activities conducted by the CoNB include riparian habitat restoration along the banks of Landa Lake and the Old Channel of the Comal River, non-native flora and fauna species management and removal, aquatic plant restoration and stormwater management projects that focus on decreasing the amount nonpoint source pollutants entering the Comal River system during rain events.

More information on the CoNB's watershed management activities can be found via the City's website at <http://www.nbtexas.org/watershed>.



**Spring Run #3 in
Landa Park prior to
riparian restoration**



**Riparian restoration
along Spring Run #3
in Landa Park**

GERONIMO CREEK WATERSHED

After Geronimo Creek was placed on the 2008 303(d) list of Impaired Waters for contact recreation and nutrient enrichment concerns, the Geronimo and Alligator Creeks Watershed Partnership was formed in 2010 and development of the Watershed Protection Plan was initiated. The plan was accepted by the EPA September 13, 2012, and implementation began immediately afterwards. Implementation efforts in fiscal year 2018 included a variety of programs to address the bacteria impairment and nutrient concerns in the watershed. Programs included a Texas Well Owner Network workshop for over 120 private water well owners, three Homeowner Maintenance of Septic System workshops for 127 homeowners, a Lone Star Healthy Streams workshop, two Healthy Lawns Healthy Waters programs, a Smart Growth Workshop, a soil testing campaign and an Urban Riparian and Stream Restoration Workshop.

The 6th Annual Creek Clean-up Event took place on a blustery and chilly Saturday in April 2018. One hundred fourteen volunteers braved the cold front that moved in overnight, and removed 1,800 pounds of trash and debris from the watershed. The network of sponsors and volunteers within the community are what makes the event a success every year. Since its inception of the annual event, over 1,100 volunteers have removed 15,950 pounds of trash and debris from the watershed.

The Partnership took part in an Urban Riparian and Stream Restoration grant



administered through Texas Water Resources Institute, which provided revegetation with native species in a section of Geronimo Creek at the Irma Lewis Seguin Outdoor Learning Center (ILSOLC). The study will evaluate possible differences in erosion rates between restored areas and the rest of the creek. Automatic water samplers were installed and will collect water quality data over the next two years to document any changes. Also included in the grant, an Urban Riparian and Stream Restoration workshop was conducted along the banks of Geronimo Creek at the ILSOLC to bring awareness, education and the value of stream restoration to the watershed.



The Partnership coordinated with Guadalupe County and the Meadows Center for Water and the Environment, and made an application to Texas A&M AgriLife Extension Service Wildlife Services. Financial assistance was awarded to create a feral hog bounty program and to provide educational programming and financial assistance for trapping supplies to area landowners. Feral hogs are a growing problem in the watershed and this program will hopefully provide some much needed reduction in the local feral hog population.

Geronimo Creek



**Healthy Lawns
Healthy Waters
class at ILSOLC**

The Partnership coordinated with GBRA to conduct a Low Impact Development (LID) Workshop in the fall of 2018. Attendees from the area represented eight area municipalities. The half-day workshop consisted of in-class presentations and an outdoor walking tour of LID structures and practices at the Learning Center.

The USGS, in partnership with the GBRA and TSSWCB, and funded by a Clean Water Act Section 319 grant, completed its investigation into the sources of the nitrates found in Geronimo Creek. The study analyzed water sources in the Plum Creek and Geronimo Creek watersheds, including groundwater from the Leona Aquifer, surface water from Plum Creek and Geronimo Creek, precipitation and wastewater effluent, for nitrate-nitrogen and its isotopes of nitrogen and oxygen to determine possible sources of nitrate-nitrogen. The goals of the project were to increase the understanding of the interaction between surface water and underlying groundwater, to evaluate strategies and practices for reducing nitrate levels in the surface water and groundwater and to provide results to agricultural and water resource managers in two watersheds. Results indicate the nitrates in Geronimo Creek are predominately from fertilizer applications, as well as from septic systems. The final report can be viewed at:

<https://pubs.er.usgs.gov/publication/sir20175121>



**(Left and Below)
Volunteers
revegetating native
species at Geronimo
Creek at the ILSOLC**



CYPRESS CREEK WATERSHED

2018 was more than prosperous for the Cypress Creek Watershed Protection Plan (CCWPP). After welcoming new Watershed Services Program Director Nick Dornak earlier in the year, the Cypress Creek Project (CCP) hit the ground running. The year consisted of new and rekindled partnerships, assisting with Hill Country wastewater efforts, workshops and implementing best management practices (BMPs) throughout the watershed. BMPs assist with slowing down stormwater runoff while removing pollutants before they enter area tributaries. The total BMP count includes four rainwater harvesting systems and two permeable paver projects.

More recent efforts from the Cypress Creek Project team include collaborating with the Wimberley Independent School District (WISD) to demonstrate the value of a One Water approach with the design and construction of a new primary school for the Wimberley Valley. This water smart school will significantly reduce demand on water sources by valuing water at every phase of the water cycle. Such implementation will include stormwater management, water capture and re-use, and water conservation efforts. The image below displays a rough sketch of the new school with these One Water efforts such as sustainable fixtures, a potable rainwater harvesting cistern and more. This will be





**Blue Hole rainwater
harvesting tank**

the first school of its kind in Texas and will serve as a model for the Wimberley Valley and other communities throughout the Texas Hill Country.

The CCWPP finished the year off strong as continued funds from the Texas Commission on Environmental Quality (TCEQ) were granted for years four through six of project implementation. This means the CCWPP will continue through 2023! This new contract will include continued watershed coordination, outreach programs, more BMPs and a long-term sustainability plan. To learn more about the Cypress Creek Project or get involved, visit <http://cypresscreekproject.net> or send an email to cypresscreek@txstate.edu.



THE MEADOWS CENTER
FOR WATER AND THE ENVIRONMENT
TEXAS STATE UNIVERSITY

SAN MARCOS WATERSHED INITIATIVE



The U.S. Environmental Protection Agency (EPA) has accepted the Upper San Marcos Watershed Protection Plan (WPP) developed by The Meadows Center for Water and the Environment at Texas State University and the San Marcos Watershed Initiative (SMWI) Stakeholder Committee.

The Upper San Marcos WPP is designed to ensure the future health of the San Marcos watershed by addressing biodiversity, population growth, recreational use and changing water quality. The plan outlines strategies to mitigate nonpoint source pollutants, protect spring flow and improve water quality in the watershed.

“The Upper San Marcos WPP was a collaborative effort, resulting from many hours of hard work and the diligence, perseverance and vision of stakeholders and partners,” Watershed Services Program Manager Jenna Walker said. “Creating this plan would not have been possible without the level of community involvement and dedication we have seen from individuals and organizations who are dedicated to the protection of the San Marcos River.”

The Upper San Marcos watershed spans 94.6 square miles and contains 4.5 miles of the Upper San Marcos River. A majority of the flow in the Upper San Marcos River is comprised of groundwater from the Edwards Aquifer, which emerges through hundreds of springs that form Spring Lake and the headwaters of the San Marcos River.

“Because the San Marcos River is a groundwater driven system, stakeholders identified groundwater and spring flow protection as a high priority goal,” Walker said.

San Marcos River







**San Marcos river at
Sewell Park near
Texas State University**

While land use is predominantly rangeland and undeveloped land, dense urbanization occurs in the southeastern portion of the watershed. Rapid urbanization and development of the San Marcos area have led to water quality concerns including bacteria and contaminants such as oil and grease.

“The main stem of the Upper San Marcos River lies within the City of San Marcos, making it vulnerable to the effects of urbanization such as pollution, bank erosion and flooding,” Walker said. “The plan will address water quality impairments brought on by this urbanization.”

Initial implementation activities will focus on coordinating efforts, employing on-the-ground best management practices, protecting undeveloped land necessary for recharge and mitigating stormflow in urban areas. For more information about the Upper San Marcos Watershed Initiative and to read the Upper San Marcos WPP, visit smwatershedinitiative.net.

HOW MUCH WATER IS IN THE GUADALUPE?

by Jenna Walker

The Meadows Center for Water and the Environment

Hill Country rivers, aquifers and springs are a complex hydrogeologic system and are largely unknown. Over the past several years, the Meadows Center's "How Much Water is in the Hill Country?" research efforts have focused on developing baseline surface water/groundwater interaction and water quality data on Onion Creek, and the Blanco and Pedernales Rivers to gain a clearer understanding of Hill Country rivers, aquifers, and springs.

The implications of the findings help quantify how much of the surface flows of the rivers come directly from groundwater and vice versa. These findings have direct relevance to many communities that rely on Hill Country streams and rivers as the source of their drinking water and livelihood and to the aquatic organisms living in the river.

Guadalupe River,
photo by K. Perkins





Guadalupe River,
photo by Mary PK Burns

Once a better understanding of the groundwater-surface water dynamics of the Blanco, Onion and Pedernales Rivers was achieved, the Meadows Center sought to expand its research in the Guadalupe River Basin in 2018. This initial year of research included a data and gap analysis of the great work that has been done to study rivers and aquifers in the Hill Country by many organizations, including GBRA. A summary of the findings is below.

Spring Contributions

The headwaters of the Guadalupe River originate in the Edwards Plateau ecosystem of Central Texas and flow approximately 480 miles to San Antonio Bay in the Gulf of Mexico. The Blanco/San Marcos River system and the San Antonio River are the largest tributaries of the Guadalupe River. Surface water/groundwater interactions within the 480 river miles are dominated by the flow contribution of several major springs

including the Edwards Plateau headwaters spring system, Comal Springs, San Marcos Springs, and Hueco Springs. There are unquantified gains due to shallow groundwater inflow along the river, but the major springs provide the majority of base flow to the river. There are no major documented losing reaches on the river, though localized losses occur.

Flow Trends

The United States Geological Survey (USGS) maintains 21 stream gages on the main channel of the Guadalupe River as well as tributary and spring gages. Long-term historic trends in flow in the main channel are difficult to assess due to the varying lengths of the period of record for many of the USGS gages. For gages more than 70 years old, such as those in Hunt, Spring Branch and Victoria, flow

trends remain the same with no indication of decline over time. All gages, including major springs, installed in 2000 or later indicate decreasing flow trends. The cause of the declines may be from increased withdrawals and/or extreme weather patterns due to increasing temperatures and decreasing precipitation. Researchers have predicted continuing declines in the discharge from major springs due to extreme weather. In addition, population and water demand are projected to double by 2070. Additional permanent stream gages are necessary to capture flow trends at significant points along the river.

The percentage of total major spring flows (Comal, San Marcos, and Hueco Springs) to river flows at Victoria ranged from one percent during Hurricane Harvey in 2017 to over 190 percent during the drought of 2011. Any percentage over 100 percent represents water losses (diversions, losses to groundwater, and evapotranspiration) between the springs and Victoria. The average contribution is 62 percent of the flow measured at Victoria. Spring flow was greater than river flow at Victoria 11 percent of the time from 2003 to 2017.

**Guadalupe River,
photo by Patrick Lewis**





Guadalupe River,
photo by Jerrylee Pierson

Water Rights

There are over 600 assigned water rights (diversions) on the Guadalupe River totaling over six million acre-feet of water per year, or over 8,700 cubic feet per second (cfs) of consumptive and non-consumptive use. This volume of water is significantly greater than the average of the mean daily flow as measured at Victoria for the years 1934 to 2017 of 2,113 cfs, indicating the river is oversubscribed. However, the actual use is likely lower than the total assigned diversions. Rights held for hydroelectric power generation are the largest class of rights holders, followed by industries and agriculture. The largest number of water rights occur near headwater springs in Kerr County.

Next Steps

The Meadows Center is positioned to continue research that seeks to answer the question, how much water is in the Hill Country? to inform policy, regulatory, growth, and source water protection planning, and land conservation decisions that will ensure future sustainability of water resources in the Hill Country.

In the next phase of this research, The Meadow Center has the opportunity to further investigate the data gaps identified in this initial year of the project, along with consideration of anthropogenic and natural trends of basinwide flow rates of tributaries, contributing aquifers and the main stem of the Guadalupe River.

This research is made possible through a generous gift from the Mitchell Foundation. For more information or to read the full reports, visit www.meadowswater.org.

UGRA PROMOTES RESPONSIBLE GROWTH

As the lead water resource planning agency for the Upper Guadalupe River Basin, the Upper Guadalupe River Authority (UGRA) partners with municipal and county governments, communities, civic groups, schools and citizens to preserve and protect all Kerr County surface waterbodies. 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. This is carried out, in part, through frequent presentations to community groups to teach about a variety of water resource topics and by participating in local and regional planning processes.

**North Fork
Guadalupe River at
Benson Crossing**





**(Left) Johnson Creek
in Ingram**



**(Above) Eastern Pondhawk
(*Erythemis simplicicollis*) on
Fessenden Branch in Kerr County**

In 2018, UGRA staff and board members participated in the development process for the Kerrville 2050 Comprehensive Plan. The plan highlights the importance of the Guadalupe River and the city's water resources in its vision statement by noting that as the city grows it will respect and protect the surrounding natural environment. Indeed, guiding principles in the plan include preserving the all-important riparian areas, developing and maintaining a long-range plan for stormwater and drainage management and enhancing water conservation. While this is only a planning document, it's a giant step forward in recognizing that all growth doesn't have to come at the expense of the environment. The plan offers the community the opportunity to work together to save water and to prevent stormwater runoff from polluting the Guadalupe River and streams.

In general, urban watersheds have a greater impact on waterbodies than undeveloped land. Traditional urban landscapes are covered by impervious surfaces such as parking lots, roads, buildings and rooftops. When rain falls on these surfaces, it doesn't soak in and replenish soil moisture, it simply runs off. Often, this runoff water rushes downhill quickly and picks up contaminants along the way washing them into pristine rivers and streams. For this reason, urban runoff is one of the leading causes of surface water pollution.

Fortunately, as our urban footprint grows, there are multiple ways for individuals and businesses to initiate practices that can reduce stormwater runoff and prevent these types of pollution by capturing water that falls on impervious surfaces and dedicating it to a specific use. To build on the responsible growth momentum in the Kerrville

2050 Comprehensive Plan, this past year, UGRA installed an educational landscape called the UGRA EduScape. The landscape presents 15 water-saving features in addition to 30 interpretative and water conservation tip signs. A quarter-mile walking trail leisurely meanders through several different plant zones highlighting a simulated Hill County spring feature, a 30,000-gallon rainwater collection tank, a 3,000-gallon condensate collection tank, a 50-gallon rain barrel, terracing, rain gardens, a dry creek bed, pervious walkways, and native, adaptive and faux plants.

The development of the EduScape also reaffirms UGRA's commitment to working with community partners.

The planning, design, implementation and maintenance of the landscape project was a collaboration with the Hill Country Master Gardeners and the Hill Country Master Naturalists. These invaluable partnerships will help maximize the landscape's ability to mitigate stormwater runoff and function as an educational tool.

The UGRA EduScape is designed for either a self-guided tour or a guided tour can be arranged for your group. Visitors are welcome to stop by and walk the new trail or call UGRA for more information. Together we can protect and enhance our central asset, the Guadalupe River, and make sure we have enough water for the future (830-896-5445; ugra.org/major-initiatives/eduscape).



(Above) The combination of hardscapes and drought tolerant plants demonstrate xeriscape principals in the EduScape

(Left) Diverse pervious walkways intersect with the dry creek bed in the EduScape

NBU HEADWATERS

This past year New Braunfels Utilities' legacy conservation project, the Headwaters at the Comal, opened for educational programs and tours. Situated on the banks of the Comal Springs and Blieders Creek, the Headwaters at the Comal highlights the hydrological, environmental and cultural history of the region and is a living demonstration of sustainable practices for the local community and nation.

The property, located just outside downtown New Braunfels and contains the headwaters of the Comal River, is the original water source for the community and is a unique riparian habitat. The 16-acre site was used by New Braunfels Utilities (NBU) as a warehouse, fleet and facilities yard, office and inventory storage from 1940 until 2004.

The headwaters of the Comal River were used as the water source for the city of New Braunfels starting in the early 1900s





The April 2018 Earth Day Celebration brought 450 visitors to the site to take part in a variety of activities

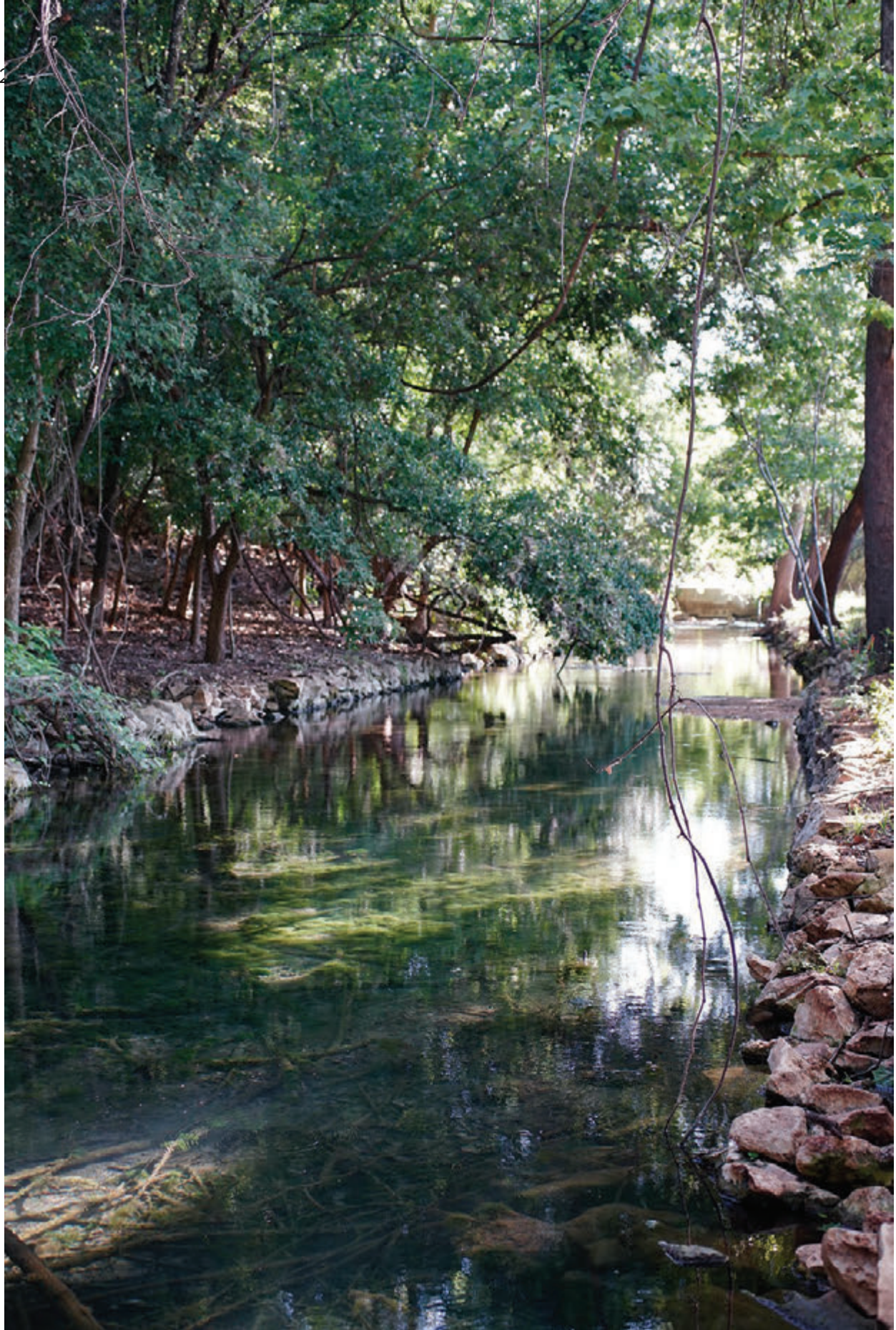
In keeping with a longstanding commitment to the environment and to the community, NBU is restoring and developing this site into a multi-use facility which enhances the community's relationship with nature. The development will be a teaching tool honoring the cultural and environmental history of the site and area while encouraging future stewardship of the environment, water and community.



Phase I of the Headwaters at the Comal project began in August 2016 and was completed in November 2017 with the help of over \$1 million in donations from the local community. This phase included landscape restoration, creation of a spring run observation deck and the conversion of an old maintenance building into an outdoor event and education pavilion. Another component of Phase I was the addition of walking trails and interpretative signage highlighting the springs' endangered species, history and environmental significance of the property. Since opening, the site has been available for a variety of programs including an Earth Day Celebration, water resources education and native landscaping classes and has seen over 2,300 visitors.

As part of the restoration of the site the Headwaters springs were uncapped, an overlook was installed and interpretive signage created

Fundraising for Phase II is currently underway. The transformation in Phase II will include the removal of the remaining asphalt surfaces and completing the reduction of total suspended solids entering the Comal River from this property by 94 percent. Public amenities built in this phase will include a central courtyard, event lawn, display gardens, additional walking trails and outdoor classrooms, wastewater treatment wetlands, composting facilities and more.



The Comal Springs Run

The most exciting aspect of the Headwaters project will be the creation of a Comal Springs Environmental Education Center. This stunning feature and unique, engaging education tool will recreate the aquifer ecosystem of the Texas Hill Country. The Center will be open air, covered with vines and pollinator attracting plants and use sail cloths representing clouds to catch dew and condensation which is then channeled down rain chains to an elaborate and beautiful recreated wetlands system, an integral part of the main building's innovative black water re-use system. A bubbling spring and adjoining education classroom and outdoor amphitheater will delight and educate visitors for years to come!

To learn more about the project and ways you can get involved, including volunteering, memberships and upcoming programs, visit www.headwatersatthecomal.com.

**Architectural rendering
of the completed
Headwaters at the
Comal site plan**



THE IMPACT

A snapshot of the impact the Headwaters at the Comal project will have.

Ecological Restoration

- 85% reduction of impervious cover on the property
- 94% reduction in total suspended solids entering the Comal River at the headwaters
- Uncapped and restored spring orifice and spring run
- Restored natural riparian habitats for numerous endangered and threatened species
- Removed invasive plants and restored native plant communities

Demonstration

- Capture and reuse of rainwater for irrigation
- Capture and polishing of storm water through natural system of berms, swales and bio retention ponds
- Black water re-use system for toilets through innovative constructed wetlands
- Low-impact development principles with drought tolerant plants, terracing and water features
- Pervious pavement options
- Reuse of existing structures and materials on site
- Commercial and residential conservation techniques and technologies including use of natural lighting and ventilation
- Solar panels allow for “Net-Zero” energy use
- Electric vehicle charging

Education and Community

- Innovative Comal Springs Environmental Education Center
- Event Center (9,000 sq. ft.)
- Covered, open-air learning pavilion (2,800 sq. ft.)
- Multiple education classrooms
- Grand gathering lawn and sycamore grove
- Picnic areas with permeable walkways and natural shading
- 2 open-air amphitheaters
- Walking trails
- Natural spring overlook
- Archaeology exhibits
- Interpretive signage
- Robust program offerings including but not limited to: STEAM topics, geography, geology, hydrology, biology, history, art, music, cultural, anthropology, and archaeology

Technical Advisory Committee

The newly formed TAC is developing a plan for applied research which will contribute to assessing and monitoring the Headwaters resources and help guide efforts to protect those assets for the benefit of the community. The proposed plan - the Headwaters Research Program (HWRP) - will provide a structured, collaborative process through which to guide and measure conservation and educational work at the site.

PLUM CREEK LOW IMPACT DEVELOPMENT

Storm water management has become an increasingly important topic of concern among Central Texans. Effectively managing runoff can be one of the most complex challenges facing urban municipalities. Usually, a wastewater approach has been employed to manage storm water: large, centralized systems are used to collect and convey storm water away from urban centers. Water quality treatment may be provided for a small portion of run-off, but storm water volume reduction is not. Impervious surfaces and changes in land cover responsible for storm water runoff go largely unaddressed and municipalities are faced with an increasing amount of storm water to manage and mitigate.

Construction of the 2,000 sq. ft. rain garden at the Caldwell County Justice Center that will absorb run off up to 40% more efficiently than a standard lawn





Caldwell County Justice Center rain garden capable of draining and filtering up to 2.26 acres of runoff after completion

One management practice technique called Low Impact Development (LID) is on the cutting edge of the latest best management practices. LID, also known as green infrastructure, refers to systems and practices that use or mimic natural processes that result in the infiltration, evapotranspiration or use of storm water in order to protect water quality and associated aquatic habitat. There are many practices that have been used to adhere to these principles such as bioretention facilities, rain gardens, vegetated rooftops, rainwater harvesters and permeable pavements. By implementing LID principles and practices, water can be managed in a way that reduces the impact of built areas and promotes the natural movement of water within an ecosystem or watershed.



CLEAN RIVERS PROGRAM

**Caldwell County Justice Center
rainwater harvesting cistern
capable of catching and storing
10,000 gallons of rainwater**

Clean Water Act (CWA) section 319(h) funding from the Texas Commission on Environmental Quality (TCEQ) covers up to 60 percent of the cost for installations such as LID, leaving municipalities and or counties with 40 percent to match. Two LID projects are taking place in the City of Lockhart, totaling more than \$500,000, that are paid for by Caldwell County, the City of Lockhart and Clean Water Act (CWA) 319(h) grant funds. The City of Lockhart has also completed an evaluation of Town Branch's riparian areas and is currently instituting improvements in best management practices to include LID. Along with resources put forth by Caldwell County, the CWA 319(h) grant has enabled Caldwell County to retrofit the Justice Center in Lockhart with drought resistant xeriscaping, a 10,000 gallon cistern for rainwater harvesting, a rain garden that will filter over two acres surrounding the site and a 13,250 sq. ft. porous pavement parking lot. Funding secured through CWA 319(h) is empowering organizations large and small to install multiple high-visibility LID practices throughout the Plum Creek watershed. Applied on a broad scale, LID can maintain and/or restore a watershed's hydrologic and ecological functions.



**Dedicated volunteers installing
drought resistant xeriscape**



**Completed xeriscape planter
at the Caldwell County Justice
Center. Xeriscape installed here
will no need any supplemental
from irrigation**

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

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GUADALUPE-BLANCO RIVER AUTHORITY

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