Brazos River Basin Summary Report 2022

Brazos River Authority

Executive Summary

Introduction

The principal aim of the Texas Clean Rivers Program (CRP) is to ensure safe, clean water supplies for the future of Texans' drinking water needs, industry, agriculture, healthy ecosystems, and recreation and for all other uses of this valuable state resource. The Brazos River Authority, as a member of the Texas Clean Rivers Program, works to answer questions about the quality of our local streams, rivers and lakes in the Brazos River Basin Summary Report 2022. The report also summarizes the results of the ongoing water quality assessment activities in the Brazos River basin under the Texas Clean Rivers Program. Based on an evaluation of recent water quality monitoring data from the Brazos River basin, various impairments and concerns are highlighted for particular rivers, lakes and creeks.

In the 14 major watersheds of the Brazos River Basin one can find examples of both high-quality waters, as well as streams that have been degraded by human settlement and development activities. Amid an overall trend of generally good water quality in the basin, there are problem areas to address and issues on which management agencies and stakeholders must focus.

Water Quality Monitoring Activities

Although the Brazos River Authority is the primary agency collecting water quality monitoring data in the Brazos River basin, it also works closely with the Texas Commission on Environmental Quality (TCEQ) and other CRP Partners. All data is collected under TCEQ approved Quality Assurance Project Plans with all laboratory analysis performed by NELAP accredited laboratories and undergoes a rigorous quality assurance and quality control process.

Ambient water quality monitoring is coordinated through the Authority's Clean Rivers Program Technical Advisory Committee. A Coordinated Monitoring Schedule for the Brazos River Basin is developed in the spring of each year and is implemented in September of each year. The purpose of this Coordinated Monitoring Schedule is to reduce duplication of effort between agencies, to maximize limited monitoring funds and ensure monitoring coverage of the entire basin.

Currently, there are approximately 225 active routine, ambient water quality monitoring stations in the 14 watersheds. Parameters monitored vary by station depending on the concerns of the waterbody. A core set of field parameters is collected at each site and includes: water temperature, dissolved oxygen, conductivity, salinity and pH. In addition to ambient water quality monitoring, the Authority has aided in and conducted special studies throughout the basin that required targeted monitoring to address specific pollutants as well as biological and habitat assessments. Each special study was selected because it was a basin priority.

Data Analysis

Having data to analyze is the objective of these monitoring activities. Data analysis results are shared with the TCEQ and basin CRP Stakeholders on a routine basis and are used to develop future monitoring programs and to identify issues. Data collected through CRP are available to the public at the BRA hosted webpage http://crpdata.brazos.org as well as the TCEQ webpage https://www80.tceq.texas.gov/SwqmisWeb/public/crpweb.faces or https://www80.tceq.texas.gov/SwqmisPublic/index.htm.

Top 10 Water Quality Management Issues Facing the Brazos River Basin

Exceedance of State Standards

- Concerns for recreation due to elevated bacteria levels are pervasive throughout the Brazos River Basin.
- Dissolved oxygen depletion is an issue which may negatively impact aquatic life.
- Natural salt impacts the usability of water for human consumption in the Brazos River.

Lack of Data

- Sufficient data is needed to enable assessment of all segments meeting the criteria for assessment.
- Sufficient data is needed to enable response (support or refute) to listings of segments on the 303(d) List and in the 305(b) Report.
- Without data elements such as rainfall, flow, and other climatic and geographic conditions it is difficult to determine if a listed or suspected impairment is naturally occurring, especially in relatively undeveloped watersheds.

Nonpoint Source Pollution, Stormwater Discharge and Runoff

- Accumulation of pesticides, fertilizers and animal waste from residential properties and agricultural practices are problematic.
- Sedimentation and turbidity from soil and bank erosion, quarrying and construction activities, along with the transport of other pollutants with sediment are sources of nonpoint source pollution in the Basin.
- Accumulation of trash and other debris from littering and illegal dumping has been observed.

Wastewater

- There are issues caused by inadequately operated smaller plants that are dispersed across the basin and the problems caused by the high concentration of aging, poorly functioning on-site sewage disposal systems in population growth centers.
- There is a burden on local governments to finance and accomplish major capital improvements, especially in response to state and federal mandates, budget cuts, and the problems caused by aging infrastructure.

Watershed Management

- Continuing to use watershed-based management strategies built on stakeholder involvement.
- Continuing to coordinate and integrate concurrent assessment and management programs whenever possible.
- Remaining focused on microwatershed concerns for nonpoint source runoff, point source discharges, accidental spills and illegal dumping.
- Achieving a coordinated, watershed-based effort to determine continuous sources of contamination.

Ecosystems

- Inadequate management of shoreline and riparian areas adjacent to waterways.
- Physical alteration and disruption of waterways and their associated natural drainage systems, wetlands, floodplains, and riparian areas:
    - Erosion and sedimentation
    - Loss of stabilizing, filtering, and shading vegetation
    - Stream diversions

    - Man-made, dead-end canals and channels
    - Impacts on boating traffic
    - Impacts of degraded water quality on aquatic life and on species abundance and diversity.

Funding

- Unstable, inadequately funded, long-term water quality monitoring programs.
- Little funding to address problems in areas where small communities or low-income residents do not have the resources.
- Little funding to help communities improve aging infrastructure.

Public Education

- Public resistance to land use regulation and other measures that would impact individuals and private property.
- Difficult to achieve buy-in for voluntary water quality protection efforts on private lands, particularly for agricultural lands and residential properties.

Enforcement

- Difficulty of illegal dumping prevention and enforcement of ordinances already in place.
- Difficulty of identifying illegal dischargers and enforcement of regulations already in place.

Natural Salt

- Brine springs in the upper region of the basin impact the Brazos River with elevated chloride levels affecting water use and availability.
- Burden on local governments and industry to finance advanced treatment technologies to produce potable water from the Brazos River.
- Difficulty of disposal of highly concentrated brine from the advanced treatment process.

Results

Table 1.0 summarizes impairments, concerns, and trends in the Brazos River Basin. Impairments and concerns are as described in the 2020 Texas Integrated Report. Trends indicated in this table are based on analysis of all data collected from fiscal year 1990 through 2021 with a minimum 10-year data set and at least 20 samples unless otherwise specified. A trend was considered statistically significant at $p \leq 0.05$ with an R-value of 0.2 to 1. In some fields, parameters are aggregated for summarizing purposes, therefore there may be multiple trends per field and one or more parameters in an aggregated field may have a trend.

Table 1.0 Summary of impairments, concerns, and trends for the Brazos River Basin

Segment or portion of segment impaired

Segment or portion of segment impaired, but TMDLs have been completed and approved by EPA

↑ Statistically significant increasing trend

* Excessive algal growth in water impairment, but TMDLs have been completed and approved by EPA

Segment or portion of segment has a concern for the standard or screening level

↓ Statistically significant decreasing trend

Watershed	Segment Name	Segment ID	Bacteria	DO	Dissolved Solids	pH	Chlorophyll *a*	Nutrients	Other
Salt and Double Mountain Forks of the Brazos River Watershed	Brazos River Above Possum Kingdom Lake	1208			↑	↓			↓
	Millers Creek Reservoir	1208A							
	Salt Fork Brazos River	1238		↓	↑	↑		↓	
	Croton Creek	1238A							
	Duck Creek	1238B							
	White River	1239							
	White River Lake	1240							
	White River above White River Reservoir	1240A							
	Double Mountain Fork Brazos River	1241		↑	↓↑	↑			↑
	North Fork Double Mountain Fork Brazos River	1241A	↑		↓	↑		↑	
	Lake Alan Henry	1241B			↑				
	Buffalo Springs Lake	1241C			↓				↑
	South Fork Double Mountain Fork Brazos River	1241D							
	Lake Ransom Canyon	1241E							
Clear Fork of the Brazos River Watershed	Clear Fork Brazos River	1232			↑				
	California Creek	1232A			↓				
	Deadman Creek	1232B	↓		↑	↑		↓	
	Paint Creek	1232C							
	Lake Daniel	1232D							
	Hubbard Creek Reservoir	1233							
	Big Sandy Creek	1233A							
	Hubbard Creek	1233B							
	Lake Cisco	1234			↓				
	Lake Stamford	1235			↓		↑		
	Fort Phantom Hill Reservoir	1236		↑	↓		↑		

Watershed	Segment Name	Segment ID	Bacteria	DO	Dissolved Solids	pH	Chlorophyll *a*	Nutrients	Other
	Cedar Creek	1236A							
	Lake Sweetwater	1237							
Upper Brazos River Watershed	Whitney Lake	1203							
	Steele Creek	1203A							
	Brazos River Below Lake Granbury	1204		↑	↓	↑			
	Camp Creek	1204A							
	Lake Granbury	1205			↓			↑	
	McCarthy Branch	1205A							
	Bee Creek	1205B							
	Walnut Creek	1205C							
	Contrary Creek	1205D							
	Rucker Creek	1205E							
	Strouds Creek	1205F							
	Robinson Creek	1205G							
	Long Creek	1205H							
	Brazos River Below Possum Kingdom Lake	1206			↓	↑			
	Kickapoo Creek	1206A							
	Rock Creek	1206B							
	Unnamed Tributary of Rock Creek	1206C							
	Palo Pinto Creek	1206D			↑	↑		↓	
	Lake Mineral Wells	1206E							
	Possum Kingdom Lake	1207			↓				
	Brazos River Above Possum Kingdom Lake	1208	↓		↓		↑		
	Nolan River	1227	↑		↑				
	Buffalo Creek	1227A							
	Mustang Creek	1227B							
	Lake Pat Cleburne	1228				↑	↑	↓	
	Paluxy River /North Paluxy River	1229							
	Squaw Creek Reservoir	1229A							
	Lake Palo Pinto	1230							
	Palo Pinto Creek above Lake Palo Pinto	1230A							
	Lake Graham	1231			↓		↑		
	Brazos River Below Lake Whitney	1257	↓	↑	↓	↑		↑	
Aquilla Creek Watershed	Aquilla Reservoir	1254			↓		↑	↑	
	Hackberry Creek	1254A							

Watershed	Segment Name	Segment ID	Bacteria	DO	Dissolved Solids	pH	Chlorophyll *a*	Nutrients	Other
	Aquilla Creek upstream of Aquilla Reservoir	1254B							
	Aquilla Creek	1256A							
Bosque River Watershed	Waco Lake	1225			↓		↑	↓	
	Hog Creek	1225A		↑			↓		
	North Bosque River	1226			↑	↑		↓	*
	Duffau Creek	1226A			↓	↓			
	Green Creek	1226B			↑	↑			
	Meridian Creek	1226C			↓	↑		↓	
	Neils Creek	1226D				↑		↓	
	Indian Creek	1226E							
	Sims Creek	1226F						↓	
	Spring Creek	1226G							
	Alarm Creek	1226H							
	Gilmore Creek	1226I							
	Honey Creek	1226J							
	Little Duffau Creek	1226K							
	South Fork Little Green Creek	1226L							
	Little Green Creek	1226M							
	Indian Creek Reservoir	1226N							
	Sims Creek Reservoir	1226O							
	Spring Creek Reservoir	1226P							
	Walker Branch	1226Q							
	Middle Bosque/South Bosque River	1246	↓		↑	↑	↓		
	Harris Creek	1246A							
	Comanche Springs Spring Brook	1246B							
	Unnamed Tributary of South Bosque River	1246C							
	Tonk Creek	1246D	↓						
	Wasp Creek	1246E				↑	↓	↑	
	Upper North Bosque River	1255	↓	↑	↑	↑		↑↓	*
	Goose Branch	1255A							
	North Fork Upper North Bosque River	1255B							
	Scarborough Creek	1255C							
	South Fork North Bosque River	1255D							
	Unnamed Tributary of Goose Branch	1255E							
	Unnamed Tributary of Scarborough Creek	1255F							

Watershed	Segment Name	Segment ID	Bacteria	DO	Dissolved Solids	pH	Chlorophyll *a*	Nutrients	Other
	Woodhollow Branch	1255G							
	South Fork Upper North Bosque River Reservoir	1255H							
	Dry Branch	1255I							
	Goose Branch Reservoir	1255J							
	Scarborough Creek Reservoir	1255K							
	Brazos River/Lake Brazos	1256							
Leon River Watershed	Nolan Creek/ South Nolan Creek	1218		↓	↑	↓		↑	
	Unnamed Tributary to Little Nolan Creek	1218A							
	South Nolan Creek	1218B							
	Little Nolan Creek	1218C							
	Long Branch	1218D							
	Leon River Below Belton Lake	1219						↑	
	Belton Lake	1220			↓				
	Cowhouse Creek	1220A			↓			↓	
	Leon River Below Proctor Lake	1221			↑	↑			
	Resley Creek	1221A				↑	↑	↑	
	South Leon River	1221B			↓				
	Pecan Creek	1221C							
	Indian Creek	1221D		↑		↑			
	Plum Creek	1221E							
	Walnut Creek	1221F				↑		↑	
	Coryell Creek	1221G		↓	↓				
	Proctor Lake	1222			↓		↑	↑	
	Duncan Creek	1222A							
	Rush-Copperas Creek	1222B							
	Sabana River	1222C					↓	↓	
	Sowells Creek	1222D							
	Sweetwater Creek	1222E							
	Hackberry Creek	1222F							
	Leon River Below Leon Reservoir	1223			↑				↓
	Armstrong Creek	1223A							
	Cow Creek	1223B							
	Leon Reservoir	1224							
	Leon River Above Leon Reservoir	1224A							

Watershed	Segment Name	Segment ID	Bacteria	DO	Dissolved Solids	pH	Chlorophyll *a*	Nutrients	Other
	South Fork Leon River	1224C							
	Leon River Above Belton Lake	1259		↑		↑	↑		
Lampasas River Watershed	Lampasas River Below Stillhouse Hollow Lake	1215			↓				
	Stillhouse Hollow Lake	1216							
	Trimmier Creek	1216A				↑			
	Onion Creek	1216B							
	Pleasant Branch	1216C							
	Unnamed tributary of Trimmier Creek	1216D							
	Lampasas River Above Stillhouse Hollow Lake	1217			↑↓				
	Rocky Creek	1217A			↑				
	Sulphur Creek	1217B							
	Simms Creek	1217C							
	North Fork Rocky Creek	1217D							
	South Rocky Creek	1217E							
	Reese Creek	1217F							
	Clear Creek	1217G				↑			
	Salado Creek	1243	↓	↓				↑	
Little River Watershed	Little River	1213				↑		↑	
	Big Elm Creek	1213A			↓				
	Little Elm Creek	1213B							
	Unnamed Tributary of Little Elm Creek	1213C							
	San Gabriel River	1214						↑	
	Brushy Creek	1244	↑					↑	
	Brushy Creek Above South Brushy Creek	1244A							
	Lake Creek	1244B							
	Mustang Creek	1244C							
	South Brushy Creek	1244D							
	Granger Lake	1247		↑	↑		↑	↓	
	Willis Creek	1247A	↑		↓	↑			
	San Gabriel/North Fork San Gabriel River	1248			↑	↑		↑	
	Berry Creek	1248A			↑	↑			
	Huddleston Branch	1248B							
	Mankins Branch	1248C			↑		↓	↑	
	Middle Fork San Gabriel River	1248D							
	Lake Georgetown	1249			↑	↑	↑		

Watershed	Segment Name	Segment ID	Bacteria	DO	Dissolved Solids	pH	Chlorophyll *a*	Nutrients	Other
	South Fork San Gabriel River	1250						↑	
	North Fork San Gabriel River	1251			↑				
Central Brazos River Watershed	Brazos River Above Navasota River	1242			↑				
	Marlin City Lake System	1242A	↑			↓		↑	
	Cottonwood Branch	1242B	↑		↑	↑			
	Still Creek	1242C				↑		↑	
	Thompsons Creek	1242D	↑				↑	↑	
	Little Brazos River	1242E			↑				
	Pond Creek	1242F							
	Unnamed Tributary of Cottonwood Branch	1242G							
	Tradinghouse Reservoir	1242H			↓				
	Campbells Creek	1242I							
	Deer Creek	1242J							
	Mud Creek	1242K							
	Pin Oak Creek	1242L							
	Spring Creek	1242M							
	Tehuacana Creek	1242N							
	Walnut Creek	1242O							
	Big Creek	1242P							
	Bull Hide Creek	1242Q							
	Cow Bayou	1242R							
	Brazos River/Lake Brazos	1256			↓				
Navasota River Watershed	Navasota River Below Lake Limestone	1209				↑		↑	
	Country Club Lake	1209A							
	Fin Feather Lake	1209B							
	Carters Creek	1209C		↑	↓				
	Country Club Branch	1209D							
	Wickson Creek	1209E							
	Wolfpen Creek	1209F							
	Cedar Creek	1209G							
	Duck Creek	1209H							
	Gibbons Creek	1209I				↑			
	Shepherd Creek	1209J							
	Steele Creek	1209K							
	Burton Creek	1209L							

Watershed	Segment Name	Segment ID	Bacteria	DO	Dissolved Solids	pH	Chlorophyll *a*	Nutrients	Other
	Gibbons Creek Reservoir	1209N							
	Normangee Lake	1209O							
	Clear Creek	1209P							
	Lake Mexia	1210							
	Navasota River Above Lake Mexia	1210A							
	Lake Limestone	1252			↓	↑	↑		
	Navasota River Below Lake Mexia	1253			↓	↑			
	Springfield Lake	1253A			↓		↑		
Yegua Creek Watershed	Yegua Creek	1211					↑		
	Davidson Creek	1211A				↑			
	Somerville Lake	1212			↓				
	Middle Yegua Creek	1212A							
	East Yegua Creek	1212B		↓	↓				
	Nail Creek	1212C							
	Cedar Creek	1212D							
	McCain Creek	1212E							
	Burns Creek	1212F							
	Jerdelle Creek	1212G							
	Sandy Branch	1212H							
	Birch Creek	1212I							
	Big Creek	1212J							
	Brushy Creek	1212K							
	Yegua Creek	1212L							
Lower Brazos River Watershed	Brazos River Tidal	1201							
	Brazos River Below Navasota River	1202			↓	↑	↑	↑	
	Beason Creek	1202A							
	Rabbs Bayou	1202B							
	Hog Branch	1202C							
	New Year Creek	1202D							
	Little Sandy Creek	1202E							
	Brookshire Creek	1202G							
	Allen's Creek	1202H			↑	↑		↑	
	Bessie's Creek	1202I							
	Big Creek	1202J	↑	↓	↓		↓	↑	
	Mill Creek	1202K			↑			↑	

Watershed	Segment Name	Segment ID	Bacteria	DO	Dissolved Solids	pH	Chlorophyll *a*	Nutrients	Other
	Pond Creek	1202P							
	Clear Creek	1202Q							
	Upper Oyster Creek	1245		↑		↑		↑	
	Brown's Bayou	1245B							
	Bullhead Bayou	1245C							
	Unnamed Tributary of Bullhead Bayou	1245D							
	Alcorn Bayou	1245F							
	Steep Bank Creek	1245I							
Upper and Middle Oyster Creek Watersheds	Upper Oyster Creek	1245		↑		↑		↑	
	Middle Oyster Creek	1258							
	Unnamed Oxbow Slough	1202F							
	Red Gully	1245A							
	Flewellen Creek	1245E							
	Brooks Lake	1245G							
	Alkire Lake	1245H							
	Stafford Run	1245J							

Overall, there is a good understanding of the water quality problems that exist in the basin. Focus will remain on the known problems and the process of working with various other state and federal agencies and local governments and stakeholders to address these problems.

Because water quality issues frequently move downstream, watershed-based planning and education will be the cornerstone to addressing water quality issues. When individuals recognize that their actions have an impact on water quality, remarkable changes will be made in the cumulative impact that individuals have on the quality of water in their communities. As the population grows, human impacts to water quality and quantity will increase. It is going to require the continued efforts of every governmental entity, industry and citizen to resolve issues identified in this report.

Elevated chlorides and total dissolved solids affect water usability along the entire mainstem. Bacteria and nutrients are a problem in over one third of the basin's segments. The problems caused by human activity can be controlled through proper management of wastewater systems and through implementing best management practices in the basin. Throughout this report, the Authority has outlined areas that need more detailed analysis or more information to better assess water quality conditions. The Authority will continue to coordinate with the Technical Advisory Committee and local entities to gather this data. As the Authority gains understanding of the dynamics within each of the watersheds, we are able to better inform and educate the public on water quality in their community. Addressing all the problems identified in this report will require continued participation by local stakeholders in addition to federal, state and regional entities. The most important factor determining the success of activities to improve the waters of the Brazos basin will be the commitment and understanding of individuals in the basin to water quality.

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CLEAN RIVERS PROGRAM
STEERING COMMITTEE PARTICIPANTS 2022

Robert Adams - United States Army Corp of Engineers
Chris Altott - City of Copperas Cove
Edena Atmore - City of Hutto
Ryan Bayle - TXU / Luminant Generation Co.
Paula Bell - City of Temple
Allen Berthold - Texas Water Resources Institute
Terry L. Blodgett - Alcoa, Inc.
Bruce Bodson - Lower Brazos Riverwatch
Doug Box - Post Oak Savannah Groundwater Conservation District
James Boykin - City of College Station
Steve M. Boykin - Brazosport Water Authority
Jay Bragg - Texas Farm Bureau
Liz Branigan - City of Liberty Hill
Carl E. Burch - NRG Texas Power, LLC
Gary Burke - United States Geological Survey
Howard Christian - City of Richmond
Chris Coffman - City of Granbury
Ron Cotton - Acton Municipal Utility District
Amber Dankert - Wildlife Management Team US DOD
Finley deGraffenried - City of Lampasas
Eddie DeLeon – City of Rosenberg
Stephanie de Villeneuve - Texas Water Resources Institute
Timi Dutchuk - Environmental Programs at US Army
Richard English - Acton Municipal Utility District
Kara Escajeda - City of Nolanville
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Sally French - City of Waco
Ricky Garrett - Bell County WCID No. 1
Wesley Gibson - Texas State Soil and Water Conservation Board
Lucas Gregory - Texas Water Resources Institute
Carla Gutherie - Texas Water Development Board
Faith Hambleton - Texas Commission on Environmental Quality
Albert M. Hatton III - Exelon Power
Ryan Haverlah - City of Copperas Cove
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Amber Kelley - City of Temple
Gary Lacy - Upper Leon River Municipal Water District
Ward Ling - Texas Water Resources Institute
Sam Listi - City of Belton
John Maresh - City of Rosenberg
Mike E. Marshall - Natural Resources Institute
Mike Massey - Citizen/Landowner
Candilyn McLean - Brazos Valley Council of Governments
Jimmy Millican - Texas Institute of Applied Environmental Research
David Mitchell - City of Harker Heights
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Brynn Myers - City of Temple
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Anthony Paddock - City of Taylor
Jason Pinchback - Texas General Land Office
Kristina M. Ramirez - City of Harker Heights
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Megan Wilson - Texas Commission on Environmental Quality
Julie Winchell - City of Cleburne
Chris Wingert - West Central Texas Municipal Water District
Blake Woodall - West Central Texas Municipal Water District
Kyle Wright - US Department of Agriculture-NRCS
Joe Yelderman - Baylor University
David Young - Texas Parks and Wildlife
Riki Young - Directorate of Public Works, Fort Hood

CLEAN RIVERS PROGRAM
TECHNICAL ADVISORY COMMITTEE PARTICIPANTS 2022

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Kayla Ayala - Texas Commission on Environmental Quality
Jennifer Bronson-Warren - Texas Parks and Wildlife Department
Chase Carpenter - Texas Commission on Environmental Quality
Sarah Eagle - Texas Commission on Environmental Quality
Kirk Fleener - Texas Commission on Environmental Quality
Kyle Girten - Texas Commission on Environmental Quality
Marty Kelly - Texas Parks and Wildlife Department
Elizabeth Kompanik - Texas Commission on Environmental Quality
Cliff Moore - Texas Commission on Environmental Quality
Mindy McDonough - Texas Commission on Environmental Quality
Lacy Miller - Texas Commission on Environmental Quality
Christine Pearson - Texas Commission on Environmental Quality
Lisa Prcin - Texas AgriLife Research, Blackland Research and Extension Center
Robin Pugh – Texas Commission on Environmental Quality
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Ryan Pircher – Aquatic Scientist
Britt Reese – Aquatic Scientist
Calvin Smith – Aquatic Scientist

BRAZOS RIVER AUTHORITY

P.O. Box 7555
Waco, TX 76714-7555
(254) 761 – 3100

David Collinsworth
General Manager/CEO

The Brazos River Authority was created by the Texas Legislature in 1929 as the first state agency in our nation specifically created for the purpose of developing and managing the water resources of an entire river basin.

Today, the Authority's staff of around 250 develops and distributes water supplies, provides water and wastewater treatment, monitors water quality and pursues water conservation through public education programs.

This report was funded by the Texas Commission on Environmental Quality's Clean Rivers Program.

Brazos River Basin Summary Report 2022

1.0 INTRODUCTION

The principal aim of the Texas Clean Rivers Program (CRP) is to ensure safe, clean water supplies for the future of Texans' drinking water needs, industry, agriculture, healthy ecosystems, recreation and for all other uses of this valuable state resource.

According to the Mission Statement contained in the Clean Rivers Program Long Term Action Plan, 2019: The goal of the CRP is to maintain and improve the quality of water within each river basin in Texas through an ongoing partnership involving the Texas Commission on Environmental Quality, river authorities, other agencies, regional entities, local governments, industry, and citizens. The program's watershed management approach will identify and evaluate water quality issues, establish priorities for corrective action, work to implement those actions and adapt to changing priorities.

Meeting the above goal requires addressing water quality problems through a watershed-based approach. A watershed- based approach provides a means to resolve and/or prevent water quality problems and considers all potentially harmful activities, from industrial activities to every-day household activities in the watershed.

This comprehensive approach is increasingly important as the United States moves beyond its effort to bring point sources, such as industrial discharges, under control and begins to focus more on the difficult nonpoint pollution issues like stormwater runoff. A watershed approach is critical since government responds to most problems within various jurisdictional lines while environmental problems occur within natural settings unrelated to political boundaries. The CRP and its participants have become leaders of watershed management in Texas. Watershed management includes such initiatives as developing basin-wide water quality monitoring strategies, simultaneous expiration of wastewater permits within watersheds to allow for more informed permitting and working with local stakeholders to identify and implement best management practices.

In order to meet its goals, the CRP has focused on consensus building in each major river basin. To aid in achieving consensus within river basins, the TCEQ contracts with local agencies to administer the program within their respective river basins. These agencies, primarily river authorities, are called "CRP Planning Agencies." It is their task to conduct the CRP requirements within each basin. The Planning Agencies work closely with local municipalities and other agencies to document and improve water quality across the state. The Brazos River Authority (or Authority or BRA) is the Planning Agency in the Brazos River Basin. To help guide the planning agencies in this effort, each basin has a Steering Committee composed of interested individuals and stakeholders. Within the Brazos basin, this Steering Committee meets annually and is relied upon to provide input regarding issues of priority that deserve special attention. With the size of the Brazos River Basin, the Steering Committee allows the Authority and the CRP to hear from the varied local interests across the basin. By having stakeholders that represent specific parts of the basin, the CRP is able to gather vital local knowledge of water issues that the Authority would not have otherwise.

The results of the Steering Committee process help the Authority set the agenda for the CRP in the Brazos River Basin and provide the baseline data needed by TCEQ for a variety of processes, including: monitoring, standards development, permitting, enforcement, public outreach, field investigations and research. At the same time, these programs must take advantage of the basin assessment process to see that TCEQ's information needs are addressed and in line with local priorities. In the end, the underlying goal of the entire Clean Rivers process is to make the most effective use possible of the valuable public funds already directed toward water quality protection.

1.1 Texas Clean Rivers Act

In 1991, the Texas Legislature passed the Texas Clean Rivers Act (Act) (Texas Water Code, Section 26.0135) which has subsequently been reauthorized in 1997. The Act established the CRP and statewide coalition of water monitoring agencies to collect data and disseminate water quality information on a regional level. The data collected through the CRP are used for many reasons including development of Texas Surface Water Quality Standards (TSWQS), determining if water bodies meet TSWQS, modeling trends, baseline data for water quality protection projects and to help establish wastewater permit limits. The Act was intended to move Texas toward comprehensive water resources planning and management to ensure the integrity of the state's water supply for the future.

The water needs of approximately 29.7 million Texans are currently being met, however; some forecasts estimate that the state's population will grow by 73 percent to near 51.5 million Texans between 2020 and 2070. Texas' water demands are projected to increase somewhat less significantly, by approximately 9 percent between 2020 and 2070, from 17.7 million to 19.2 million acre-feet per year. However, Texas' existing water supplies are projected to decline by approximately 18 percent between 2020 and 2070, from 16.8 million to 13.8 million acre-feet per year. In fact, in the event of severe drought conditions, the state faces a potential water shortage of 3.1 million acre-feet per year in 2022 and 6.9 million acre-feet per year by 2070 (2022 State Water Plan, TWDB). Water is a precious commodity in Texas, and the quality of that water must also be protected. Various water pollution concerns remain to be addressed across the state even after several decades of substantial progress in restoring the quality of Texas waters.

The Clean Rivers Act requires an ongoing assessment of water quality issues and development of management strategies statewide to guide Texas water resources policy in the future. The Act established the Texas Clean Rivers Program under the Texas Water Commission (now the TCEQ). The program is funded by fees assessed on wastewater discharge permittees and water rights holders. Steering committees provide input on local water quality concerns and help guide CRP activities.

1.2 Objectives of the Clean Rivers Program

- Provide quality-assured data to TCEQ for use in decision-making
- Identify and evaluate water quality issues
- Promote cooperative watershed planning
- Recommend management strategies
- Inform and engage stakeholders (any individual or group who has in interest in the water quality of the basin)
- Maintain efficient use of public funds

1.3 Brazos River Authority's Involvement in the Clean Rivers Program

The Authority leverages as many resources as possible to help the Clean River Program achieve its goal of maintaining and improving the quality of water within the Brazos River basin. Using the watershed management approach, the Authority and CRP work to identify and evaluate water quality issues, establish priorities for corrective action and work to implement those actions. The Authority was designated by the Texas Legislature through the Clean Rivers Act as the lead agency responsible for conducting the regional water quality assessment for the Brazos River Basin. As the first river authority in the state, the Authority has over 93 years of water resource planning and public outreach experience. Importantly, the Authority also has a continuously updated Geographic Information System and surface water quality database for the basin, which are valuable data management, analysis, and mapping tools for the basin assessment process. As the lead agency for the Brazos River Basin, the Authority oversees all aspects of the Clean Rivers process in the basin. This includes: serving as liaison between TCEQ and the stakeholders, participating in state-wide

CRP task forces, performing all administrative and project tasks, supporting the Brazos River Basin CRP Steering Committee and Technical Advisory Committee, and maintaining regular contacts with other Planning Agencies.

1.4 Purpose of the Basin Summary Report

This report presents the results of the Authority's assessment work for the Brazos River basin and its 14 major watersheds. This includes specific findings and recommendations from the basin assessment process, stakeholder input and public outreach activities.

The Brazos River Authority (BRA) carries out the water quality management efforts in the basin under contract with TCEQ. The activities described in this report include water quality monitoring results, a review of the 2020 Integrated Report (IR), a summary of factors affecting water quality and proposed or on-going efforts to address water quality concerns in each watershed within the Brazos River Basin.

The digital version of this report is imbedded with hyperlinks so that you can easily access more detailed information on projects in the Brazos River Basin. So wherever you see a word that looks like this, just click and see where it takes you. You can also click the Table of Contents to navigate to your desired section. After having been directed to another page in the document or to an internet page, either close the web page or press Alt+←and you will return to where you were in the document.

The Clean Rivers Act requires that planning agencies prepare written reports every five years for the governor, TCEQ, the Texas State Soil and Water Conservation Board and the Texas Parks and Wildlife Department. This reporting process began in 1997 and is ongoing. The purpose of the Basin Summary Report (BSR) is to outline water quality issues confronting the entire basin as well as individual streams and lakes. These issues are compiled based on public and stakeholder committee input as well as technical analysis of historical and current trends in water quality. This work is performed in accordance with TCEQ guidance, which specifies a range of parameters to be examined to achieve a comprehensive assessment.

The BSR also complements the TCEQ's 305(b) Texas Water Quality Inventory Report and 303(d) List of Impaired Waterbodies. The State's Integrated Report (IR) provides an assessment of waters throughout the state and is conducted on even numbered years. However, not all streams and lakes are assessed in every report. The assessment is conducted to evaluate stream and lake compliance with their respective designated water quality standards and uses. Streams that are not in compliance with their designated standards or uses are placed on the 303(d) List.

1.5 Brazos River Basin Clean Rivers Program Priorities

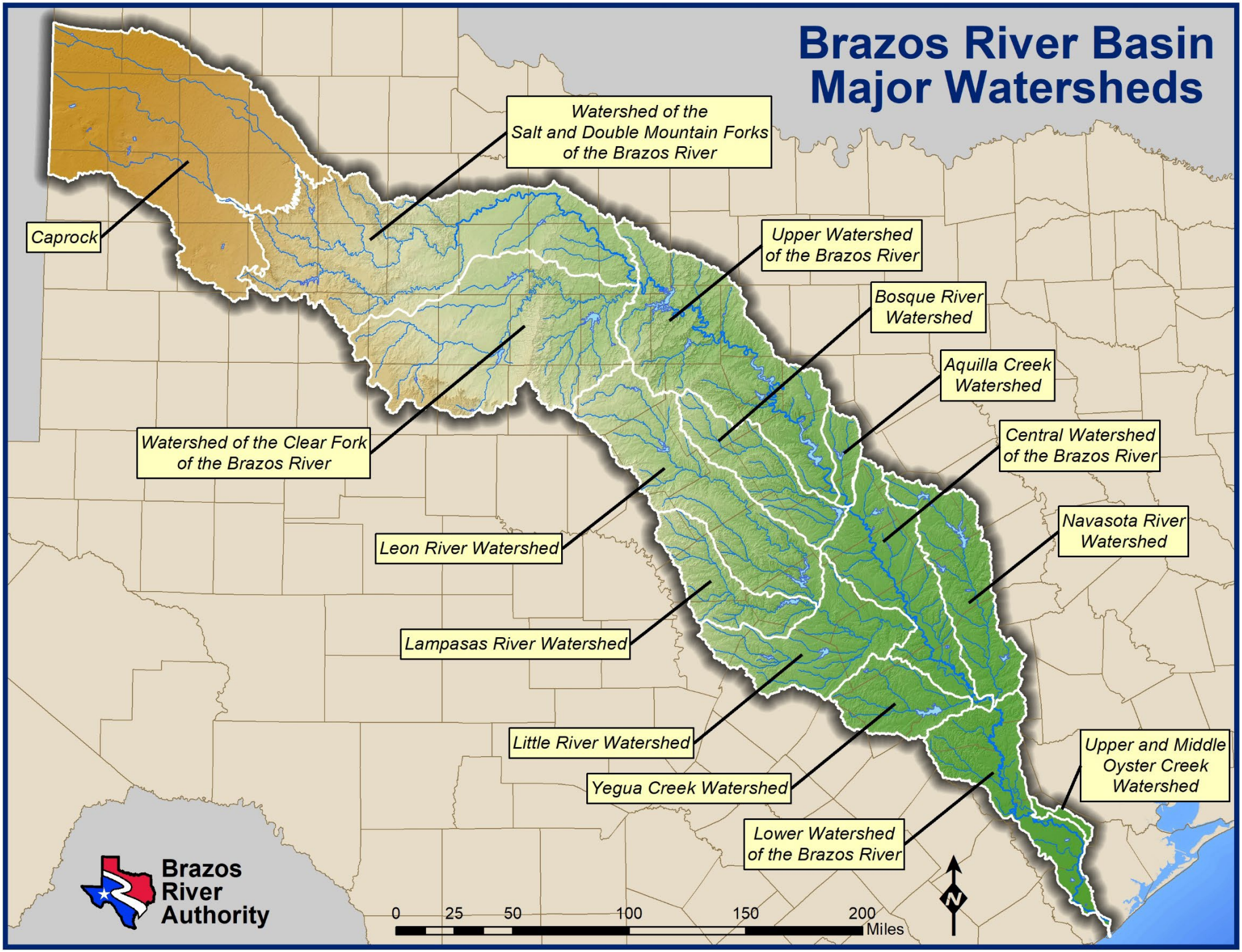
- Identify water quality issues
- Inventory basin features to verify where activities could impact water quality
- Analyze trend data to identify potential water quality concerns and determine where more information is needed
- Participate in state-wide task forces which establish the direction of the Clean Rivers Program
- Participate in the Watershed Action Planning Process
- Monitor other key programs and special interest groups with similar missions
- Pursue special studies and other recommended actions resulting from the basin assessment process

1.6 Brazos River Basin Characteristics

The Brazos River Basin can be divided into 14 major watersheds that fall within the 42,000 square miles and portions of 70 counties that make up the basin. The 14 major watersheds include:

- the Caprock of the Brazos watershed;
- the Double Mountain Fork/Salt Fork of the Brazos watershed;
- the Clear Fork of the Brazos watershed;
- the Upper Brazos River watershed;
- the Lampasas River watershed;
- the Leon River watershed;
- the Bosque River watershed;
- the Aquilla Creek watershed;
- the Little River watershed;
- the Central Brazos River watershed;
- the Navasota River watershed;
- the Yegua Creek watershed;
- the Lower Brazos River watershed; and
- the Upper Oyster Creek watershed.

The Caprock of the Brazos watershed is a non-contributing watershed to the Brazos River Basin due to lack of rainfall and high evaporative rates in northwest Texas. Precipitation in this area is either absorbed by area soils or is contained in the hundreds of playa lakes in this part of the state. Playa lakes are shallow, round depressions that fill after storms then rapidly dry due to evaporation. These temporary lakes provide water for wildlife and flood control for municipalities. However, due to their ephemeral natures, these lakes are not monitored or assessed as part of the CRP.


Brazos River Basin
Major Watersheds
Watershed of the
Salt and Double Mountain Forks
of the Brazos River
Caprock
Upper Watershed
of the Brazos River
Bosque River
Watershed
Aquilla Creek
Watershed
Central Watershed
of the Brazos River
Watershed of the Clear Fork
of the Brazos River
Navasota River
Watershed
Leon River Watershed
Lampasas River Watershed
Little River Watershed
Upper and Middle
Oyster Creek
Watershed
Yegua Creek Watershed
Lower Watershed
of the Brazos River
Brazos
River
Authority
0
25
50
100
150
200
Miles
N

Regional Geography

The Brazos River marks its headwaters at the foot of the south plains near the Texas-New Mexico border. While providing boating, swimming and fishing for more than 840 river miles, the Brazos River also serves as a water source for cities, agriculture, industry and mining. The Brazos River serves more than 4 million Texans living within its basin. The more than 42,000 square miles that make up the Brazos River basin are divided into 14 major watersheds each with distinctive climate, topography, land uses, and water needs. The Brazos River basin is one of the most diverse river basins in the state spanning eight distinct ecoregions each with unique soils, vegetation, mineral resources, climate and geology. The basin spans three climatological zones: the Continental Steppe characterized by large variations in daily temperatures, low humidity and irregularly-spaced rainfall of moderate amounts; the Subtropical Subhumid zone characterized by hot summers and dry winters; and the Subtropical Humid zone characterized by warm summers and high humidity. Average annual precipitation in the basin varies from 15 to 25 inches per year in the northern part of the basin, 35 to 40 inches per year in the central part of the basin and 45 to 50 inches per year in the southern part of the basin. Topography ranges from just over 4,385 feet in the northern portion of the basin to near sea level at the confluence with the Gulf of Mexico with rugged, uneven terrain in the northwestern part of the basin to flat, forested areas with rich soils and the Gulf Prairies in the southern portion of the basin.

Land Cover and Ecosystems

In addition to the diverse natural setting, the region contains a variety of land cover and land use types and a wide range of ecosystems. Land uses range from extreme rural areas with little to no development to areas of scattered development to areas with dense industrial, commercial and residential development. This range of land use types creates a challenging array of issues for water quality management. Most areas of the Brazos River basin are undeveloped and land is used primarily for grazing and other agricultural activities. Lubbock, Taylor, Hood, Johnson, McLennan, Bell, Williamson, Brazos and Fort Bend Counties all have areas of dense development around the major population centers of the basin.

Rural and Undeveloped Areas

The watersheds of the Brazos River basin are primarily undeveloped areas with scattered small towns and communities. Land uses are generally a mix of residential and commercial, with large acreages used for grazing and wildlife.

Urban

The major urban areas of the basin include the following cities and associated suburban communities: Lubbock, Abilene, Cleburne, Granbury, Waco, Temple/Belton, Georgetown/Round Rock, Bryan/College Station, and Sugar Land. These areas contain a wide mix of land uses ranging from residential to commercial to industrial. Williamson and Fort Bend Counties are ranked in the top five counties in the state for population growth.

Industrial

Industrial use in the basin consists of water used for manufacturing, steamelectric cooling during power generation, nuclear power generation, hydropower generation and for mining operations. Industrial activities are scattered throughout the basin but are typically close to the major population centers. The exception to this is the power generation facilities which are more closely associated with lakes rather than major population centers. Lakes in the Brazos River basin associated either historically or currently with power generation facilities include: Millers Creek Reservoir, Lake Palo Pinto, Lake Granbury, Squaw Creek Reservoir, Lake Whitney, Tradinghouse Creek Reservoir, Lake Limestone, Twin Oaks Reservoir, Gibbons Creek Reservoir, and Alcoa Lake. Industrial activities in the lowest two counties, Fort Bend and Brazoria Counties, are dominated by the petrochemical industry. Natural gas

exploration including the process of hydraulic fracturing is rapidly increasing basinwide. With these efforts comes an increased need for water to support these operations.

Agriculture

Agriculture is the mainstay of the Brazos Basin's rural economy. In the upper region, the major dryland products are extensive row-crops, such as cotton and wheat. Hay and silage are also produced in the upper region: however, due to low rainfall, their acreage is much less than other regions of the basin. There is a slow migration of dairy related confined animal feeding operations (CAFOs) from the central to the northern areas of the basin. Dairy operators have found the arid climate and reduced rainfall amounts in the northern area conducive to production. Moreover, the reduced stormwater runoff in this area allows the permitting process to run smoothly. As dairy operations move north, the central and lower portions of the basin are experiencing growth in the poultry industry ranging from producers to major processing facilities. The central region of the Brazos River Basin is noted for its dryland production of a variety of crops. The major crops produced in the central region include: hay, silage, peanuts, pecans, vegetables, corn, wheat and cotton. Comanche, Eastland, Erath, and Somervell Counties combined lead the state in dairy production. This is due to several factors such as available groundwater, soils suitable for forage production, topography and existing infrastructure. The lower region of the Brazos River Basin has limited row-crop agriculture due to lack of suitable topography and soils. Hay and silage are the major agricultural products. The Brazos River Bottoms counties (Brazos, Burleson and Robertson) produce most of the crops in the region, including corn, sorghum and cotton. The fertile soils of the Gulf Prairies in Fort Bend and Brazoria Counties support the production of rice.

Water Quality Management

From the dry, arid north to the Gulf Prairie in the far south, the setting for the Brazos River Basin is quite diverse. This creates a multitude of challenges for water quality assessment and planning. While some of the land cover types, such as wetlands, contain properties that provide self-purification and buffering capabilities, many of the waterways are affected by man-made impacts. The Authority collects water quality monitoring data from across the basin in an effort to assess the quality of the watersheds and determine sources of impairment for those waterbodies that exhibit compromised water quality. Through the CRP, the Authority has committed to the goal of maintaining or improving water quality. After reviewing available data throughout the basin, the Authority has compiled a list of findings and recommendations for the entire basin as well as findings for each individual major watershed of the Brazos Basin. These can be found in Section 4.0 Recommendations and Conclusions.

Water Resource Issues

Through its assessment activities, Steering Committee and public input, the Authority continues to maintain an inventory of issues facing the basin's water quality management agencies and residents. The overriding, long-term challenge for basin water quality management will be to maintain and, where possible, improve water quality of basin waterways despite the cumulative impacts that will come with projected population growth and ongoing urban development and agricultural activities. Among the challenges are:

- Increased wastewater generation that impacts already stressed wastewater systems that are at or near capacity along with the continued proliferation of on-site sewage disposal systems,
- Protection of source water for increased water supply needs from the lakes of the Brazos River Basin,
- Increased demand on waters for contact recreational uses such as swimming, boating and fishing,
- Increased land disturbance and more impervious surfaces associated with ongoing development, that generate more nonpoint source pollution from a wider geographic area, and

- Altered drainage patterns resulting from land development activities and encroachment into the floodplain.

1.7 Water Quality Management Issues Facing the Brazos River Basin

Exceedance of State Standards

- Concerns for recreation due to elevated bacteria levels are pervasive throughout the Brazos River Basin.
- Dissolved oxygen depletion is an issue which may negatively impact aquatic life.
- Natural salt impacts the usability of water for human consumption in the Brazos River.

Lack of Data

- Sufficient data is needed to enable assessment of all segments meeting the criteria for assessment.
- Sufficient data is needed to enable response (support or refute) to listings of segments on the 303(d) List and in the 305(b) Report.
- Without data elements such as rainfall, flow, and other climatic and geographic conditions it is difficult to determine if a listed or suspected impairment is naturally occurring, especially in relatively undeveloped watersheds.

Nonpoint Source Pollution, Stormwater Discharge and Runoff

- Accumulation of pesticides, fertilizers and animal waste from residential properties and agricultural practices are problematic.
- Sedimentation and turbidity from soil and bank erosion, quarrying and construction activities, along with the transport of other pollutants with sediment are sources of nonpoint source pollution in the Basin.
- Accumulation of trash and other debris from littering and illegal dumping has been observed.

Wastewater

- There are issues caused by inadequately-operated smaller plants that are dispersed across the basin and the problems caused by the high concentration of aging, poorly functioning on-site sewage disposal systems in population growth centers.
- There is a burden on local governments to finance and accomplish major capital improvements, especially in response to state and federal mandates, budget cuts, and the problems caused by aging infrastructure.

Watershed Management

- Continuing to use watershed-based management strategies built on stakeholder involvement.
- Continuing to coordinate and integrate concurrent assessment and management programs whenever possible.
- Remaining focused on microwatershed concerns for nonpoint source runoff, point source discharges, accidental spills and illegal dumping.
- Achieving a coordinated, watershed-based effort to determine continuous sources of contamination.

Ecosystems

- Inadequate management of shoreline and riparian areas adjacent to waterways.
- Physical alteration and disruption of waterways and their associated natural drainage systems, wetlands, floodplains, and riparian areas:

- Erosion and sedimentation
- Loss of stabilizing, filtering, and shading vegetation
- Stream diversions
- Man-made, dead-end canals and channels
- Impacts on boating traffic
- Impacts of degraded water quality on aquatic life and on species abundance and diversity.

Funding

- Unstable, inadequately-funded, long-term water quality monitoring programs.
- Little funding to address problems in areas where small communities or low-income residents do not have the resources.
- Little funding to help communities improve aging infrastructure.

Public Education

- Public resistance to land use regulation and other measures that would impact individuals and private property.
- Difficult to achieve buy-in for voluntary water quality protection efforts on private lands, particularly for agricultural lands and residential properties.

Enforcement

- Difficulty of illegal dumping prevention and enforcement of ordinances already in place.
- Difficulty of identifying illegal dischargers and enforcement of regulations already in place.

Natural Salt

- Brine springs in the upper region of the basin impact the Brazos River with elevated chloride levels affecting water use and availability.
- Burden on local governments and industry to finance advanced treatment technologies to produce potable water from the Brazos River.
- Difficulty of disposal of highly concentrated brine from the advanced treatment process.

2.0 PUBLIC INVOLVEMENT

2.1 Brazos River Basin Clean Rivers Program Steering Committee

The size and diversity of issues across the Brazos River basin continues to present a challenge for the large group of stakeholders in our basin. The Brazos River Clean Rivers Program (CRP) Steering Committee participants represent diverse interests that are represented by government agencies, municipalities, industry, agriculture, organized local stakeholder groups, individuals, and environmental groups.

The BRA holds an annual meeting that provides the Steering Committee with an opportunity to hear results of water quality monitoring and CRP special studies and gives them a forum where they may voice opinions, make recommendations and interact with other stakeholder participants and BRA staff. Steering Committee members also participate by providing input into planning

water quality monitoring activities, prioritizing problems within the basin for prospective CRP special studies, identifying problem areas, developing actions to address potential problem areas in the basin and commenting on the current year's draft Basin Highlights or Summary Report.

How to get involved with the Brazos Basin CRP?

BRA promotes communication and participation from the general public. If you are interested in serving on the Brazos River Basin CRP Steering Committee, send an email to jenna.olson@brazos.org. Please indicate what topics you are interested in and provide an email address so that you can receive electronic notices of meetings and reports. In addition, the information you provide will help us to develop more effective meetings and provide direction to the program. We highly encourage participation in our meetings and input on water quality issues in the basin.

2.2 Brazos Basin CRP Website

The BRA maintains both a river authority website with a dedicated CRP webpage as a mechanism to keep the public informed via the internet. These websites provide information on topics of interest in the basin. The websites provide links to a range of information, including:

Environmental

Clickable buttons provide information on Brazos River Watershed, Environmental Services, Water and Wastewater Treatment, Species in the Brazos Basin, Water Quality, the Texas Clean Rivers Program, and "What you can do?"

Texas Clean Rivers Program

Clicking on the Texas Clean Rivers Program button will take you to the BRA hosted CRP webpage. There is a clickable map with water quality data generated by the BRA available in a searchable format that can be easily downloaded to an Excel file. This site is updated weekly. This is also where all of the required CRP information and documents can be found. Including:

The most current Basin Summary Report
CRP Public Outreach – Information on becoming a Steering Committee member
CRP Calendar of Events – Steering Committee Meetings are announced
Program Documents – Required program documents

- Quality Assurance Project Plan including current workplan
- Coordinated Monitoring Schedule
- TCEQ CRP Data Tool

Reports, Presentations and Meeting Minutes – Basin Highlights Reports and past Steering Committee Meeting agendas and presentations
Links to other CRP Resources – Links to other CRP partners and the TCEQ
CRP Data – Direct link to the searchable database of BRA collected CRP data
Watershed Action Planning – Link to the TCEQ hosted Watershed Action Planning webpage

Water Supply
Clickable buttons provide information on the Drought, Conservation, Planning, Contracting, System Operations, and a Reservoir Accounting Summary.

Reservoirs
Clickable buttons provide information on Possum Kingdom Lake, Lake Granbury, Lake Limestone, Allen's Creek Reservoir (proposed), Federal Reservoirs, and Lake Safety.

Water Levels
Clickable buttons provide information on River and Reservoir Levels, Water Supply and Reservoir Data and River Safety.

News
Information is provided on current BRA news, the BRA newsletters and the BRA News Room.

Education
Information is provided on all things water (Water School), a Speakers Bureau, the Major Rivers Program, and a Resource Library.

3.0 WATER QUALITY REVIEW

3.1 Descriptions of Water Quality Parameters and Terminology

Following are typical terms that are used when discussing water quality with descriptions of several water quality parameters and how they relate to achieving water quality standards. There are two groups of parameters:

Field parameters are those water quality constituents that can be obtained on-site and generally include:

PARAMETER	POTENTIAL IMPACTS WHEN STATE STANDARDS ARE NOT MET	POTENTIAL CAUSES OF STATE STANDARDS NOT BEING MET
Temperature	Water temperature affects the oxygen content of the water, with warmer water unable to hold as much oxygen. When water temperature is too cold, cold-blooded organisms may either die or become weaker and more susceptible to other stresses, such as disease or parasites.	Colder water can be caused by reservoir releases. Warmer water can be caused by removing trees from the riparian zone, soil erosion, or use of water to cool manufacturing equipment.
Specific Conductance	Specific conductance is a measure of the waterbody's ability to conduct electricity and indicates the approximate levels of dissolved salts, such as	Naturally occurring salts, agricultural and stormwater runoff, outfall from industrial or sewage treatment

PARAMETER	POTENTIAL IMPACTS WHEN STATE STANDARDS ARE NOT MET	POTENTIAL CAUSES OF STATE STANDARDS NOT BEING MET
	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.	plants, and weathering and dissolution of certain rocks and soils can impact conductivity.
pH	Most aquatic life is adapted to live within a narrow pH range. Different organisms can live at and adjust to differing pH ranges, but pH levels below four (the acidity of orange juice) or above 12 (the pH of ammonia) are lethal to most fish species.	Algal blooms produce diel swings in dissolved oxygen causing super-saturation during the day while respiration can cause night-time oxygen levels to crash. Chemical byproducts of this photosynthesis/respiration process cause swings also in pH, with lower levels (acidic conditions) during the day and higher levels (alkaline conditions) at night. Industrial and wastewater discharge, runoff from quarry operations and accidental spills can also be a cause.
Dissolved Oxygen (DO)	Organisms that live in the water need oxygen to live. In stream segments where DO is low, organisms may not have sufficient oxygen to survive.	DO levels may be low due to no primary productivity, stagnant, pooled or low-flow conditions. Modifications to the riparian zone, human activity that causes water temperatures to increase, increases in organic matter, bacteria and over abundant algae may also cause DO levels to decrease. Algal blooms produce diel swings in dissolved oxygen causing super-saturation during the day while respiration can cause night-time oxygen levels to crash.
Stream Flow	Flow is an important parameter affecting water quality. Low flow conditions common in the warm summer months create critical conditions for aquatic organisms. At low flows, the stream has a lower assimilative capacity for waste inputs from point and nonpoint sources. DO concentrations can also decrease as flow decreases.	Changes in flow can be natural or man-made. Natural changes include drought, beaver dams, log jams and the overgrowth of vegetation in times of low flow. Man-made changes could include new bridges restricting flow and new construction altering landscapes and runoff.
Transparency and Secchi Disk Depth	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. Transparency or secchi disc depth is an estimate of turbidity. Decreased transparency can reduce light penetration and photosynthesis and affect aquatic life.	Decreases in transparency are caused by suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter, plankton and other microscopic organisms.

Conventional Parameters are typical water quality constituents that require laboratory analysis and generally include:

PARAMETER	POTENTIAL IMPACTS WHEN STATE STANDARDS ARE NOT MET	POTENTIAL CAUSES OF STATE STANDARDS NOT BEING MET
Turbidity	Turbidity is a measure of the water clarity or light transmitting properties. Increased transparency can reduce light penetration and photosynthesis and affect aquatic life.	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	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	Higher hardness concentrations in the receiving stream can result in reduced toxicity of heavy metals.
Chloride	Chloride is an essential element for maintaining normal physiological functions in all organisms. Elevated chloride concentrations can disrupt osmotic pressure, water balance and acid/base balances in aquatic organisms which can adversely affect survival, growth and/or reproduction.	Natural weathering and leaching of sedimentary rocks, soils and salt deposits can release chloride into the environment. Other sources can be attributed to oil exploration and storage, sewage, and industrial discharges, run off from dumps and landfills and saltwater intrusion.
Sulfate	Effects of high sulfate levels in the environment have not been fully documented. However, sulfate contamination may contribute to the decline of native plants by altering chemical conditions in the sediment.	Due to abundance of elemental and organic sulfur and sulfide mineral, soluble sulfate occurs in almost all-natural water. Other sources are the burning of sulfur containing fossil fuels, steel mills and fertilizers.
Total Dissolved Solids	High total dissolved solids may affect the aesthetic quality of the water, interfere with washing clothes, and corrode plumbing fixtures. High total dissolved solids in the environment can also affect the permeability of ions in aquatic organisms.	Mineral springs, carbonate deposits, salt deposits and sea water intrusion are sources for natural occurring high concentration TDS levels. Other sources can be attributed to oil exploration, drinking water treatment chemicals, storm water and agricultural runoff and point/nonpoint wastewater discharges.
Total Suspended Solids (TSS)	Suspended solids increase turbidity which reduces light penetration and decreases the production of oxygen by plants. They can also clog fish gills. Eventually, the suspended solids settle to the bottom	Excessive TSS is the result of accelerated erosion and is often associated with high flows where riverbanks are cut, or sediment is resuspended. It can also be the result of sheet erosion, where over

PARAMETER	POTENTIAL IMPACTS WHEN STATE STANDARDS ARE NOT MET	POTENTIAL CAUSES OF STATE STANDARDS NOT BEING MET
	of the stream or lake, creating sediment. Excessive sediment in the water column can also reduce growth of algae and can transport other contaminants such as nutrients and bacteria. Habitat for aquatic organisms can also be reduced.	land flow of water causes a thin layer of soil to be carried by the water to the stream. Disturbing vegetation without a proper barrier to slow down overland flow (such as construction sites or row cropping) increases TSS.
Bacteria • ***Escherichia coli* (*E. coli*)** • **Enterococcus**	Although certain species of bacteria may not themselves be harmful to human beings, their presence is an indicator of recent fecal matter contamination and that other pathogens dangerous to human beings may be present.	Present naturally in the digestive system of all warm-blooded animals, these bacteria are in all surface waters. Poorly maintained or ineffective septic systems, overflow of domestic sewage or nonpoint sources and runoff from animal feedlots can elevate bacteria levels.
Ammonia Nitrogen	Elevated levels of ammonia in the environment can adversely affect fish and invertebrate reproductive capacity and reduce the growth of young.	Ammonia is excreted by animals and is produced during the decomposition of plants and animals. Ammonia is an ingredient in many fertilizers and is also present in sewage, storm water runoff, certain industrial wastewaters, and runoff from animal feedlots.
Nutrients • **Total Kjeldahl Nitrogen** • **Nitrate Nitrogen** • **Nitrite Nitrogen** • **Total Phosphorus** • **Ortho-phosphate phosphorus**	Nutrients increase plant and algae growth. When plants and algae die, the bacteria that decompose them use oxygen. This reduces the dissolved oxygen in the water. High levels of nitrates and nitrites can produce nitrite toxicity, or "brown blood disease," in fish. This disease reduces the ability of blood to transport oxygen throughout the body.	Nutrients are found in effluent released from wastewater treatment plants (WWTPs), fertilizers and agricultural runoff carrying animal waste from farms and ranches. Soil erosion and runoff from farms, lawns and gardens can add nutrients to the water.
Chlorophyll *a*	High levels of nutrients in relatively stable waters can cause algae blooms, decrease water clarity, and cause swings in dissolved oxygen and pH due to photosynthesis. This is most commonly measured using chlorophyll *a* concentrations.	Algal blooms can result in elevated chlorophyll *a* concentrations indicating an increase in nutrients that increase growth and reproduction in algal species.

Biological and Habitat Assessment the three components evaluated during a biological assessment include: measurement of physical habitat parameters, collection of fish community and the benthic macroinvertebrate community data. Each component, depending on the nature of a particular waterbody and its biota, is classified as having limited, intermediate, high, or exceptional aquatic life. Assessments are conducted to provide baseline data on environmental conditions or to determine if the designated aquatic life use for the stream is being attained. Data collected as part of a biological assessment are used for the IR.

24-hr Dissolved Oxygen studies perform measurements of DO in frequent intervals in a 24-hr period. This type of monitoring is conducted to measure the diurnal variation of DO and its impacts on the biological community. This monitoring is frequently paired with biological and habitat assessments.

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.

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

3.2 Data Review Methodology

All data discussed in this report has been collected under TCEQ approved Quality Assurance Project Plans using National Environmental Laboratory Accreditation Program (NELAP) accredited laboratories for chemical analyses.

Water quality information in this report was derived from two assessment methods:

- The 2020 Integrated Report (IR) – a comparison of a seven-year data set to the State Water Quality Standards
- A trend analysis using the historical data set beginning fiscal year 1990 with a 10-year minimum to detect changes in water quality over time.

2020 Integrated Report

The TCEQ assesses the condition of the state's waterbodies on a periodic basis under the Clean Water Act (CWA) Section 305(b). The results of the assessment are contained within the Texas Water Quality Inventory and 303(d) List and are comprised of a complete listing of all water quality concerns in the state. This report is referred to as the Integrated Report. As required by the CWA, the IR is updated every two years and includes the review of the past seven years of data (with a lag-time of two years) collected by many organizations statewide, including the BRA. The IR remains a draft document until approval by Environmental Protection Agency (EPA). Specific assessment methodologies are described in the 2020 Guidance for Assessing and Reporting Surface Water Quality in Texas. The 2020 IR, on which the following information is based, provides an assessment of water quality results using data acquired from December 1, 2011 through November 30, 2018. Please click here for more information and to review the 2020 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d). On May 12, 2020, the 2020 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) was approved by the USEPA.

The 2020 IR provides an overview of surface water quality throughout the state, including issues relating to public health, fitness for use by aquatic species and other wildlife, specific pollutants and their possible sources. These water quality issues are identified by comparing concentrations in the water to numerical criteria that represent the state's water quality standards or screening levels to determine if the waterbody supports its designated uses, such as suitability for aquatic life, for contact recreation, or for public water supply. Waterbodies that do not meet established water quality standards are placed on the 303(d) List and are referred to as "impaired," "not supporting," or "NS." Once placed on the list the waterbody is targeted for special study and/or corrective action.

The TCEQ identifies segments where the data conditions are such that the waterbody is close to violating water quality standards as having a "concern for near non-attainment of standards" or "CN." These CN segments are then targeted for increased monitoring to better understand the conditions in the stream.

Water quality standard numerical criteria are used by TCEQ as the maximum or minimum instream concentration that may result from permitted discharges and/or nonpoint sources and still meet designated uses. To resolve the issues of regional and geological diversity of the state, standards are developed for classified segments. Classified segments are defined segments of waterways that are unique from other segments. Each classified segment has been designated a four-digit code. The Brazos River Basin is designated by the number 12. Each classified segment is distinguished by the next two numbers, for example, the Brazos River Tidal Segment: 1201. Appropriate water uses such as contact recreation, public water supply, and aquatic life are then applied to the segments. Site-specific water quality criteria have been developed for water temperature, dissolved oxygen, pH, bacteria, chloride, sulfate and total dissolved solids for classified segments. Site-specific chlorophyll *a* has been developed for several reservoirs. Many streams that are not classified segments are assessed throughout the state and are considered unclassified waterbodies. Unclassified waterbodies are coded with the four-digit designation followed by a letter, such as 1201A. These unclassified waterbodies do not have specific water quality standards developed for them. For assessment purposes, unclassified streams are assessed using the numeric criteria developed for the classified segment into which the stream flows unless site-specific criteria have been developed. Site-specific water quality criteria have been developed for dissolved oxygen and bacteria for several unclassified waterbodies. Use support is reported at both the segment and assessment unit (AU). An AU is defined as the smallest geographic area of use support reported in the assessment. Support of criteria and uses are examined for each AU. To address water quality regulatory activity such as permitting, standards development, and remediation, use support information applies to the AU level. The 303(d) list is reported at the level of the AU for each waterbody. Each AU within a waterbody segment is given a number following an underscore after the segment designation, such as 1201_01. A segment may consist of one or more AUs.

Numeric quality standards have not been developed for nutrients and chlorophyll *a* (although chlorophyll *a* criteria has been developed for certain reservoirs). Instead, the water quality standards for nutrients and chlorophyll *a* are expressed as narrative criteria. In the absence of segment-specific numeric water quality criteria, the state has developed screening levels for these parameters in order to identify areas where elevated concentrations may cause water quality concerns. These screening levels are applied to waterbodies statewide, and are based on the 85th percentile of nutrient values in the statewide water quality database. Waterbodies that exhibit frequent (>20% of the time) elevated concentrations of nutrients or chlorophyll *a* are referred to as having a "concern for screening level violations" or "CS" and are often targeted for continued and increased monitoring to better understand the effects of the elevated concentrations.

Impairments and selected concerns are illustrated in the Watershed Summaries chapter of this report for each watershed in maps entitled "**FY22 Water Quality Monitoring and 2020 IR Status**". There is also a table for each watershed entitled "**Segment Specific Water Quality Standards with Indications of Impairment and/or Concern from the 2020 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) and Significant Long-term Trends.**" This table lists each classified and unclassified waterbody in the respective watershed with its descriptive name, type and attainability of its use, surface water quality standard, and nutrient screening criteria. The table is color-coded: red indicates that a segment or portion of segment (AU) is impaired for that standard, yellow indicates that a segment or portion of segment (AU) has a concern for the standard or the screening level, orange indicates that a segment or portion of a segment is impaired, but Total Maximum Daily Loads (TMDLs) have been completed and

approved by EPA. This table also offers one more piece of information, trend information. ↑indicates a statistically significant increasing trend, while ↓indicates a statistically significant decreasing trend.

Trend Analysis

Trend analysis was conducted following procedures outlined by the TCEQ. Data was obtained through the Surface Water Quality Monitoring Information System (SWQMIS), the state's database of water quality data and BRA's Laboratory Inventory Management System (LIMS), BRA's Environmental Services Laboratory database of water quality data. Trends described in this report are based on analysis of all data collected from fiscal year 1990 through 2021 with a minimum 10-year data set and at least 20 samples unless otherwise specified. Long-term data sets are more useful for estimating trends due to recurrent drought effects. A representative station was chosen for each segment. If multiple measurements or data at multiple stations were collected in a segment in the same month, the sample set with the most complete data was used. If there was a complete data set at multiple stations within a segment, the most downstream station was chosen as representative. If different but comparable analytical methods were used, they were consolidated to create sufficiently large data sets. To avoid creating trends based on changing reporting and detection limits, the greater than or less than sign was dropped from censored data. Linear regression was used to detect trends and ANOVA to determine if the trend was statistically significant. A trend was considered statistically significant at $p \leq 0.05$ with an R-value of 0.2 to 1. Correlation of one parameter to another was determined using Pearson Correlation, significant at $p \leq 0.05$. The statistical analysis was performed with SPSS Version 28.0.1.0. The detection of trends is important for many environmental studies and monitoring programs.

Trends were examined for the following water quality parameters:

- Temperature
- Transparency
- Specific Conductance
- Dissloved Oxygen (DO)
- pH
- Total Suspended Solids (TSS)
- Ammonia-Nitrogen (NH_3)
- Total Kjeldahl Nitrogen (TKN)
- Nitrate-Nitrogen (NO_3)
- Total Phosphorus (TP)
- Orthophosphate-Phosphorus (OPO_4)
- Chloride
- Sulfate
- Bacteria (*E. coli* or Enterococcus)
- Chlorophyll *a* (Chl *a*)
- Total Dissolved Solids (TDS)
- Turbidity

3.3 Watershed Summaries

The purpose of the Watershed Summary section is to gain a better understanding of each watershed within the larger basin. A technical data analysis and discussion, watershed maps, selected time-series plots and descriptive statistics for each watershed are presented in the Watershed Summaries. At the beginning of each Watershed chapter, there is a table containing information on watershed area, number of active surface water monitoring stations, current monitoring agencies, number of permitted discharges, potential stakeholders and number of classified segments. Following this table are full descriptions of each segment, names of unclassified waterbodies, AU designations with stations indicated in each that are used in TCEQ's assessment for the IR as well as

any new stations that may have been added following the publication of the 2020 IR. Stations currently monitored in FY 2022 by either BRA, TCEQ, Texas Institute of Applied Environmental Research (TIAER), Texas Water Resources Institute (TWRI) or other entity are indicated in **blue bold**. There is then a basemap depicting watershed boundaries, segments with names and AUs, county boundaries, cities and major roads, monitoring locations, discharge locations (although there are various types of permitted discharges: municipal, domestic, industrial, etc., for the purpose of this report, the Authority has listed all discharges in one category - Wastewater Outfalls), water quality impairments and selected water quality concerns.

The Watershed Summaries section of this report contains water quality assessment information about each of the classified segments in the Brazos Basin Clean Rivers Program assessment area. This section is presented as a result of Texas Commission on Environmental Quality and Brazos River Authority screening. This information is summarized in each watershed in a table entitled "**Segment Specific Water Quality Standards with Indications of Impairment and/or Concern from the 2020 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) and Significant Long-term Trends.**" This table lists each classified segment and unclassified waterbody in the respective watershed with its descriptive name, type and attainability of its use, surface water quality standard, and nutrient screening criteria from the 2018 revision of the Texas Surface Water Quality Standards. It is important to remember that the information presented represents a snapshot in time and that water quality conditions are dynamic and can change over time. Furthermore, segments identified as having no impairments or concerns are not necessarily without problem. Rather, there may have been limited or no data available and all uses may not have been assessed.

3.3.1 Watershed of the Salt and Double Mountain Forks of the Brazos River Watershed

Watershed Area	Active Surface Water Monitoring Stations	Monitoring Agencies	Permitted Discharges	Potential Stakeholders	Classified Segments
6,500 mi^2	14	BRA, TCEQ	10	Cities of Lubbock, Aspermont, Throckmorton, Seymour, Goree, Munday, Know City, O'Brien	1208, 1238, 1239, 1240, 1241

Description of Segments:

1208: Brazos River Above Possum Kingdom Lake – From a point immediately upstream of the confluence of Cove Creek at Salem Bend in Young County to the confluence of the Double Mountain Fork Brazos River and the Salt Fork Brazos River in Stonewall County.

Segment Length: 189 miles
*Assessment Units (Stations): A small upstream portion of 1208_02 (None); the remainder of 1208_02 is in the Upper Watershed of the Brazos Basin, 1208_03 (None), 1208_04 (**11870**), 1208_05 (**11871**), 1208_06 (**21531**)*

Unclassified waterbody: **1208A**_01: Millers Creek Reservoir
Assessment Units (Stations): 1208A_01 (11679)

1238: Salt Fork of the Brazos River – From the confluence of the Double Mountain Fork Brazos River in Stonewall County to the most upstream crossing of SH 207 in Crosby County

Segment Area: 178 miles
*Assessment Units (Stations): 1238_01 (**12022**), 1238_02 (13683), 1238_03 (**12023**)*

Unclassified waterbody: **1238A**_01: Croton Creek
Assessment Units (Stations): 1238_01 (11553)

Unclassified waterbody: **1238B**_01: Duck Creek
*Assessment Units (Stations): 1238_01 (**21560**)*

1239: White River – From the confluence of the Salt Fork Brazos River in Kent County to White River Dam in Crosby County.

Segment Length: 25 miles
Assessment Units (Stations): 1239_01 (None)

1240: White River Lake – From White River Dam in Crosby County up to the normal pool elevation of 2,369 feet (impounds White River).

Segment Area: 2,020 acres
*Assessment Units (Stations): 1240_01 (**12027**, 16880, 16881)*

Unclassified waterbody: **1240A**_01: White River above White River Reservoir
Assessment Units (Stations): 1240A_01 (None)

1241: Double Mountain Fork Brazos River – From the confluence with the Salt Fork Brazos River in Stonewall County to the confluence of the North Fork Double Mountain Fork Brazos River in Kent County.

Segment Area: 145 miles
*Assessment Units (Stations): 1241_01 (**12029**), 1241_02 (None)*

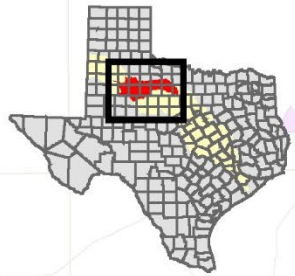
Unclassified waterbody: **1241A**_01: North Fork Double Mountain Fork Brazos River
*Assessment Units (Stations): 1241A_01 (**11523**, 11524, **11525**, **11527**), 1241A_02 (**11534**)*

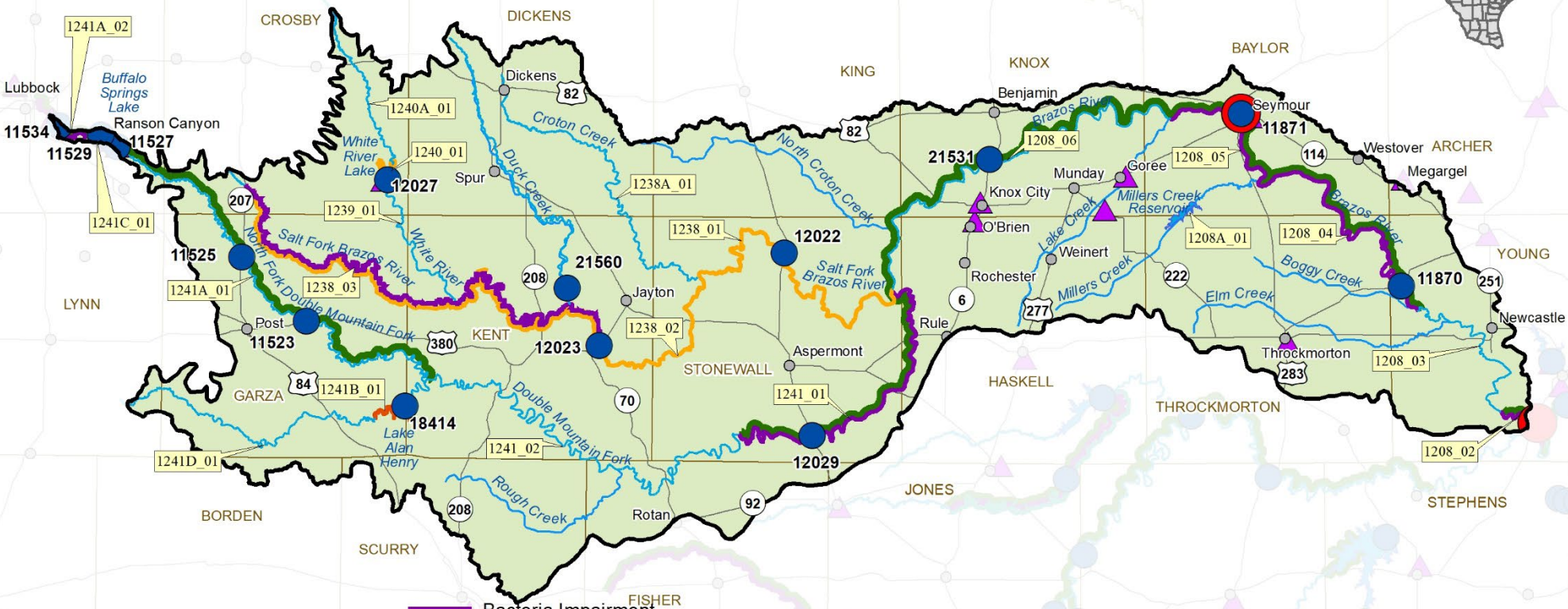
Unclassified waterbody: **1241B**_01: Lake Alan Henry
*Assessment Units (Stations): 1241B_01 (**18414**)*

Unclassified waterbody: **1241C**_01: Buffalo Springs Lake
*Assessment Units (Stations): 1241C_01 (**11529**)*

Unclassified waterbody: **1241D**_01: South Fork Double Mountain Fork Brazos River upstream of confluence with North Fork Double Mountain Fork
Assessment Units (Stations): 1241D_01 (11554)

Watershed of the Salt and Double Mountain Forks of the Brazos River
FY22 Water Quality Monitoring and 2020 IR Status





- Bacteria Impairment
- Total Dissolved Solids/Chloride Impairment
- Mercury in Edible Tissue
- Chlorophyll a and/or Nutrient Concern
- TCEQ Routine Monitoring Station
- BRA Routine Monitoring Station
- Wastewater Outfall
- Watershed Boundary

Brazos River Authority

0 10 20 Miles

N

Table 3.3.1.1 Segment Specific Water Quality Standards with Indications of Impairment and/or Concern from the 2020 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) and Significant Long-term Trends[1]

Salt Fork Double Mountain Fork Watershed		Uses		Surface Water Quality Standards								Nutrient Screening Levels[5]			
Segment	Name	Recreation[2]	Aquatic Life[3]	Cl (mg/L)	SO4 (mg/L)	TDS (mg/L)	Dissolved Oxygen Average/ Minimum (mg/L)	pH	Bacteria[4] (MPN/100ml)	Temperature (°F)	Chlorophyll *a* (µg/l)	Ammonia - N (mg/l)	Nitrate - N (mg/l)	Total Phosphorus (mg/l)	Chlorophyll *a* (µg/l)
1208	**Brazos River Above Possum Kingdom Lake**	**PCR**	**H**	**5,000**	**2,000**	**12,000 ↑**	**5.0/3.0**	**6.5-9.0 ↓**	**33**	**95 ↓**		**0.33**	**1.95**	**0.69**	**14.1**
1208A	Millers Creek Reservoir	PCR	H	5,000	2,000	12,000	5.0/3.0	6.5-9.0	126	95		0.11	0.69	0.37	26.7
1238	**Salt Fork Brazos River**	**PCR**	**H**	**23000 ↑**	**4000**	**40000 ↑**	**5.0/3.0 ↓**	**6.5-9.0 ↑**	**33**	**93**		**0.33**	**1.95 ↓**	**0.69**	**14.1**
1238A	Croton Creek	PCR	H	23000	4000	40000	5.0/3.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1238B	Duck Creek	PCR	H	23000	4000	40000	5.0/3.0	6.5-9.0	33	93		0.33	1.95	0.69	14.1
1239	**White River**	**PCR**	**H**	**100**	**100**	**500**	**5.0/3.0**	**6.5-9.0**	**126**	**92**		**0.33**	**1.95**	**0.69**	**14.1**
1240	**White River Lake**	**PCR**	**H**	**150**	**100**	**650**	**5.0/3.0**	**6.5-9.0**	**126**	**89**	**13.85**				
1240A	White River above White River Reservoir	PCR	H	150	100	7650	5.0/3.0	6.5-9.0	126	89		0.33	1.95	0.69	14.1
1241	**Double Mountain Fork Brazos River**	**PCR**	**H**	**2500**	**2400 ↓**	**5500 ↑**	**5.0/3.0 ↑**	**6.5-9.0 ↑**	**33**	**95**		**0.33**	**1.95 ↑**	**0.69**	**14.1 ↑**
1241A	North Fork Double Mountain Fork Brazos River	PCR	L	2500 ↓	2400 ↓	5500 ↓	3.0/2.0	6.5-9.0 ↑	126 ↑	95		0.33 ↑	1.95	0.69	14.1
1241B	Lake Alan Henry	PCR	H	2500	2400 ↑	5500 ↑	5.0/3.0	6.5-9.0	126	95		0.11	0.69	0.37	26.7
1241C	Buffalo Springs Lake	PCR	H	2500 ↓	2400 ↓	5500 ↓	5.0/3.0	6.5-9.0	126	95		0.11	0.69	0.37	26.7
1241D	South Fork Double Mountain Fork Brazos River upstream of confluence with North Fork Double Mountain Fork	PCR	H	2500	2400	5500	5.0/3.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1241E	Lake Ransom Canyon	PCR	H	2500	2400	5500	5.0/3.0	6.5-9.0	126	95		0.11	0.69	0.37	26.7

[1]Long-term trends described in this report are based on analysis of all data collected from Fiscal year 1990 through 2021 with a minimum 10-year data set and at least 20 samples unless otherwise specified. A trend was considered statistically significant at p≤0.05 with an R-value of 0.2 to 1.
[2]PCR - Primary Contact Recreation
[3]E-Exceptional, H-High, I-Intermediate, L-Limited
[4]The indicator bacteria for freshwater is *E. coli* and for saltwater is Enterococci. The indicator bacteria for Segments 1208, 1238, and 1241 is Enterococci.
[5] For reservoirs where there is a Chlorophyll *a* Standard, nutrients are evaluated using a line-of-evidence framework described in the 2020 Guidance for Assessing and Reporting Surface Water Quality in Texas

Segment or portion of segment impaired

↑ Statistically significant increasing trend

Segment or portion of segment has a concern for the standard or screening level

↓ Statistically significant decreasing trend

Watershed of the Salt Fork and Double Mountain Forks of the Brazos River

The Watershed of the Salt and Double Mountain Forks of the Brazos River begins with the formation of the Double Mountain Fork of the Brazos River near Tahoka in Lynn County. The Salt Fork of the Brazos River is formed in southeastern Crosby County and flows approximately 175 miles before joining with the Double Mountain Fork in Stonewall County to form the main stem of the Brazos River. The Double Mountain Fork and Salt Fork both flow through rural areas with very little development. The land use is primarily agricultural and rangeland. The North Fork of the Double Mountain Fork does have limited perennial flow immediately below the City of Lubbock where several wastewater outfalls create a continuous flow of water. However, this wastewater driven flow typically does not reach the Double Mountain Fork due to high evaporative rates in this arid part of the state. Both the Double Mountain and Salt Forks are shallow streams that meander within the stream bed. Much of the watershed is underlain by geologic formations that are very high in salt content and contribute to the high levels of dissolved solids in the watershed and also contribute to high salinity in the main stem of the Brazos River.

There is a bacteria impairment in three of the AUs (**1208**_02, _04, _05) of segment **1208** with a concern for bacteria in **1208**_06. Concerns for chlorophyll *a* concentrations exist in AUs _02, _04, _05 and_06 of **1208**. The dominant land cover in the watershed around segment **1208** is herbaceous/shrub land (≈70%) followed by the planted/cultivated category (≈30%). The planted/cultivated category is primarily planted with winter wheat with smaller areas of cotton and sorghum. With much of the of the watershed being covered by herbaceous and shrub vegetation there is likely a significant amount of wildlife activity. New in the 2020IR, is a concern for selenium in **1208**_05. There are no statistically significant trends in any of these segments. The unclassified Millers Creek-**1208A** has no impairments, but there are concerns for both bacteria and dissolved oxygen.

As the name might suggest, the Salt Fork is high in natural salts. Dissolved solids are naturally high in this watershed because of the influence of the many brine springs. The entirety of the Salt Fork of the Brazos River-**1238** is impaired for chloride with the most upstream portion (**1238**_03) also having an impairment for bacteria which was a newly added impairment in the 2020 IR. In the last Brazos Basin Summary Report published in 2017, segment **1238** was not impaired for total dissolved solids (TDS), however there was an increasing trend in dissolved solids concentrations driven by high chlorides leading to the current impairment. The dominant land cover in the watershed is herbaceous and shrub vegetation with over 95% coverage.

The cyclical drought and flood pattern in Texas has quite an impact on the total dissolved solid concentration in this watershed as well as down the mainstem of the Brazos River. Drought conditions frequently affect most of the State of Texas; such was the case from 2005 through early 2007 and again from 2011 through 2014. Over these periods, dissolved solids became even more

concentrated than normal due to evaporation which reduced water levels while leaving dissolved solids in the remaining water. Droughts broke in the spring of 2007 and again in 2014 and rainfall continued through the summer. These rainfall events had a diluting effect on chlorides. In just a few months' time, the chloride levels in the mainstem can go from the highest recorded levels to the lowest recorded. In figure 3.3.1.1 if you look at the trending data over 30 years, there is a statistically significant increasing trend identified. If you compare this to figure 3.3.1.2 which is a shorter data set, the 10 most recent years, it would appear that TDS is making a sharp decline. This is one reason that our data analysis uses the longest period of record when possible.

Figure 3.3.1.1 **1238 Dissolved Solids 1990-2021**

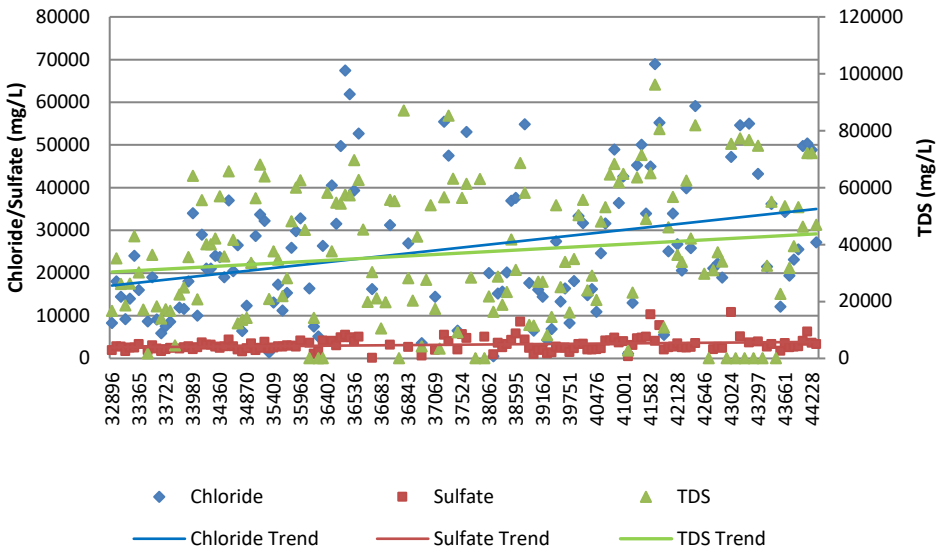
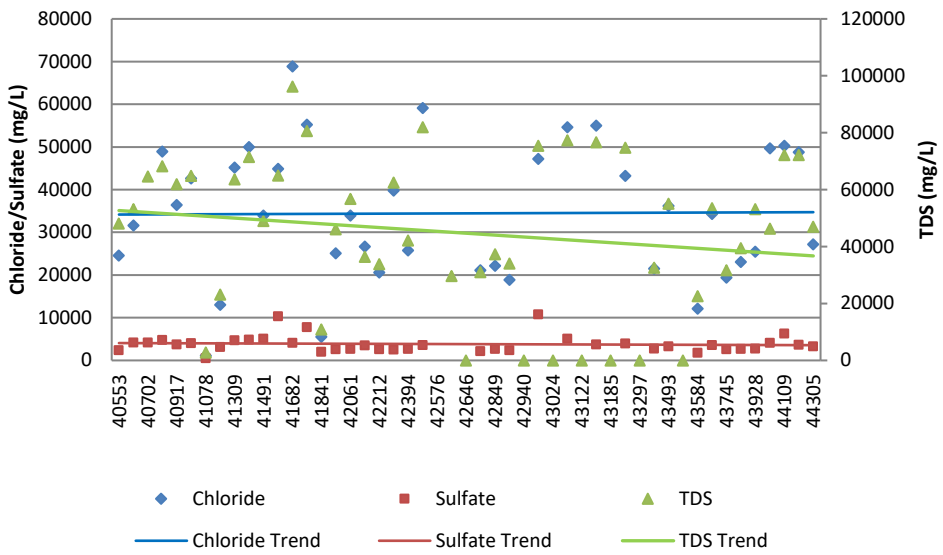


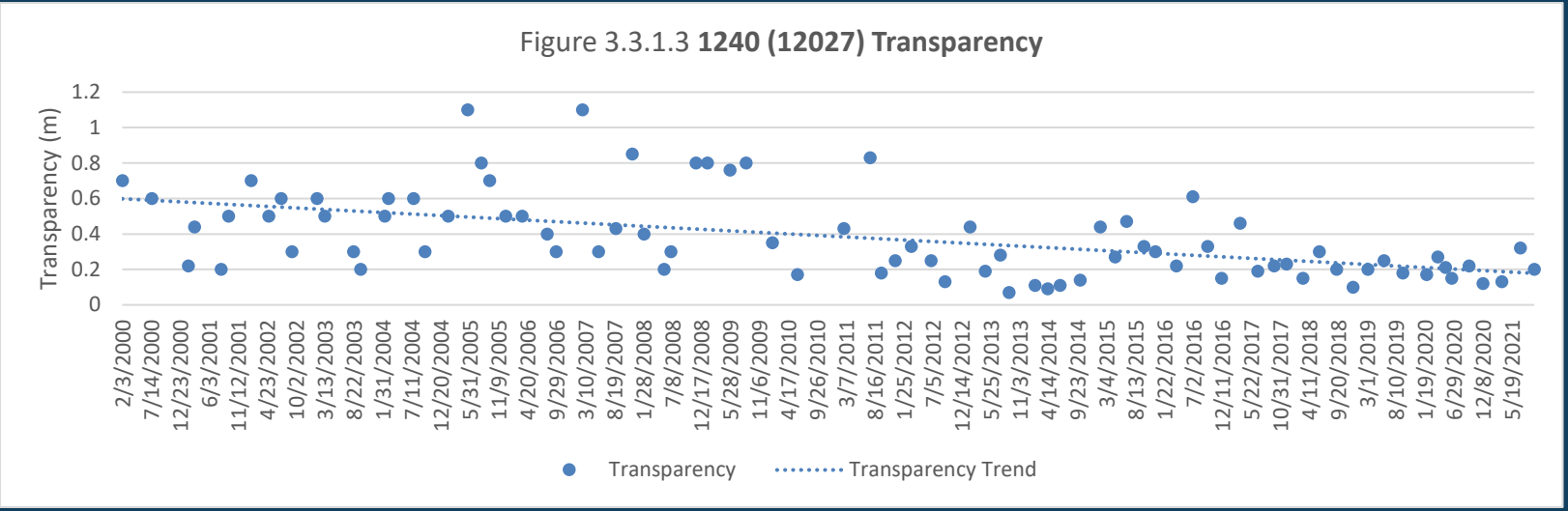
Figure 3.3.1.2 **1238 Dissolved Solids 2011-2021**



Two unclassified waterbodies, Croton Creek-**1238A** and Duck Creek-**1238B** both have concerns for bacteria, but all designated uses are supported.

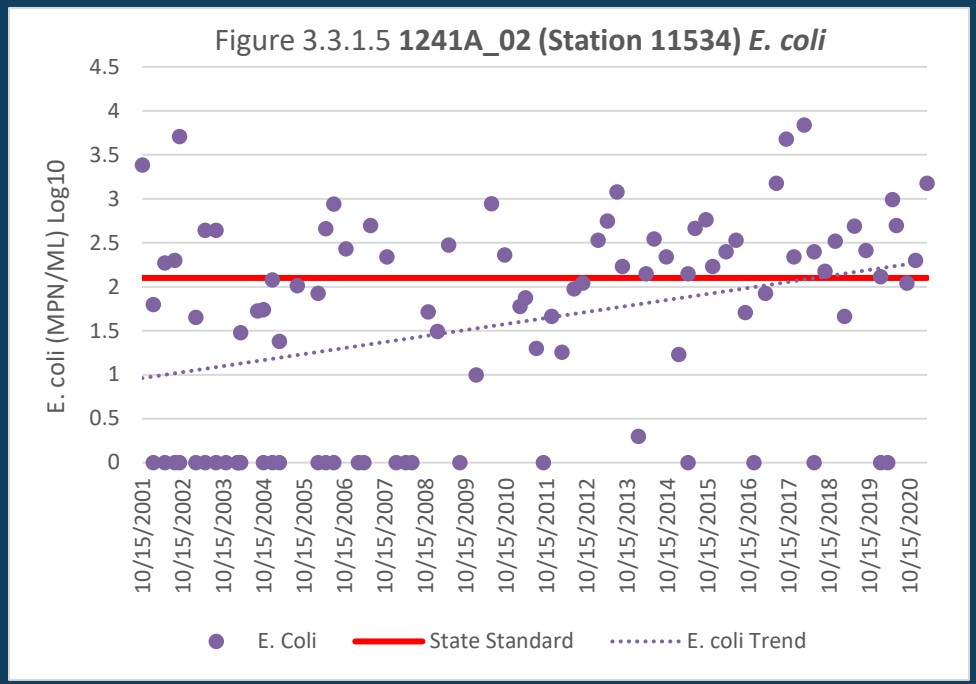
Much like the Salt Fork, White River Lake-**1240** is also impaired for chloride as well as TDS. The fullest White River Lake has been since 2011 is 35.5% full, with an average fullness of 16% when considering data from December 2011 through July 2021. This segment follows the pattern of high chlorides and TDS in dry periods and lower chlorides and TDS in wet periods. There is a statically significant reduction in transparency in this segment (Figure 3.3.1.3). Typically, water is observed to be green or brown. The dominant land cover in the watershed is herbaceous and shrub vegetation (≈96%). There are no sampling stations on the White River above White River Reservoir-**1240A** and this segment is not assessed. There are no impairments or concerns.

There is a bacteria impairment in the most downstream AU (**1241**_01) of the Double Mountain Fork-**1241** as well as a concern for chlorophyll *a*. Data collected at station 12029 (Figure 3.3.1.4) over the 7-year period of assessment demonstrates an impairment for elevated bacteria at station 12029. There is not sufficient data to generate trend results for Enterococcus, as Enterococcus data



collection began in 2013. The North Fork Double Mountain Fork-**1241A** is newly impaired in the 2020 IR for bacteria in AU_02 with concerns for chlorophyll *a* and nitrate. There is a statistically significant increasing trend in *E. coli* concentrations (Figure 3.3.1.5). AU_01 has concerns for bacteria, chlorophyll *a* and nitrate. An impairment for mercury in edible fish tissue is in place for Lake Alan Henry-**1241B**.

Figure 3.3.1.4 Station 12029 - Double Mountain Fork Brazos River 91 meters downstream of US 83 south of Aspermont.



Water quality in Buffalo Springs Lake-**1241C** supports all of its assigned uses. There is a statistically significant decrease in Sulfate, with concentrations being much lower than the state standard. There are no sampling stations on the South Fork Double Mountain Fork Brazos River upstream of confluence with North Fork Double Mountain Fork-**1241D** or Lake Ransom Canyon-**1241E** and these segments are not assessed. There are no impairments or concerns in either.

Special Studies:

No recent special studies have taken place in the watershed.

Table 3.3.1.2 Water Quality Issues Summary

Water Quality Issue	Affected Area	Possible Influences/Concerns	Possible Actions Taken/to be Taken
Impairments			
Chloride/ TDS	• Salt Fork Brazos River • White River Lake	• Natural geologic formations that are very high in salt content • Natural drought /flood cycle • White River Lake is typically at 10-15% capacity and even lower during drought periods	• A Texas Water Quality Standards (WQS) review for total dissolved solids, chloride and sulfate was completed for segment 1240. TCEQ recommends increased criteria values for these parameters. Environmental Protection Agency (EPA) approval of 2010 WQS is pending. • Further water quality standard review may be appropriate.
Bacteria	• Brazos River Above Possum Kingdom Lake • Salt Fork Brazos River • Double Mountain Fork Brazos River • North Fork Double Mountain Fork Brazos River	• There are no known point sources • 90% of the watershed is covered by herbaceous, shrub and forested vegetation therefore there may be a significant amount of wildlife activity.	• Watershed characterization studies, consisting of a set of water and habitat assessments compiling hydrology, geology, wildlife, Land Use Land Cover (LULC), and water quality data to inform on the best way to improve water quality in a watershed, may be appropriate.
Mercury in Edible Tissue	• Lake Alan Henry	• Atmospheric Mercury deposition from point sources	• Information gathered and discussed by the Mercury-Impaired Waters Advisory Group and input received from group members indicate that additional coordination and cooperation is needed to determine the most effective way to reduce mercury impairments in Texas. Information obtained from other states

			also makes it clear that most states are waiting before they pursue any strategies. The report referenced above states that the TCEQ will continue to participate in national air and water programs and initiatives related to mercury and urge EPA to initiate international discussions on mercury control options.
Concerns			
Bacteria	• Miller's Creek Reservoir • Croton Creek • Duck Creek	• There are no known point sources • 90% of the watershed is covered by herbaceous, shrub and forested vegetation therefore there may be a significant amount of wildlife activity.	• Watershed characterization studies, consisting of a set of water and habitat assessments compiling hydrology, geology, wildlife, LULC, and water quality data to inform on the best way to improve water quality in a watershed, may be appropriate.
Chlorophyll *a*/Nutrients	• Brazos River Above Possum Kingdom Lake • Double Mountain Fork Brazos River • North Fork Double Mountain Fork Brazos River	• There are no known point sources • Approximately 90% of the watershed is covered by herbaceous, shrub and forested vegetation therefore there may be a significant amount of wildlife activity. • There is some agriculture in the watershed, approximately 8 percent with only about 2% developed area.	• Watershed characterization studies, consisting of a set of water and habitat assessments compiling hydrology, geology, wildlife, LULC, and water quality data to inform on the best way to improve water quality in a watershed, may be appropriate.
Dissolved Oxygen	• Miller's Creek Reservoir	• Shallow lake with very little inflow	• Conduct 24-hr DO study
Selenium	• Brazos River Above Possum Kingdom Lake	• Naturally occurring and a concentrated by-product of deep well injection	• Continue metals monitoring

3.3.2 Watershed of the Clear Fork of the Brazos River

Watershed Area	Active Surface Water Monitoring Stations	Monitoring Agencies	Permitted Discharges	Potential Stakeholders	Classified Segments
5,728 mi^2	17	TCEQ	19	Cities of Abilene, Baird, Cisco, Merkel, Sweetwater, Albany, Breckenridge, Hamlin, Stamford, Haskell, AEP Texas North Company, Sylvester McCaulley Wsc, South Central Water Co, Lone Star Industries Inc	1232, 1233, 1234, 1235, 1236, 1237

Description of Segments:

1232: Clear Fork of the Brazos River – From the confluence with the Brazos River in Young County to the most upstream crossing of US 180 in Fisher County.

Segment Length: 284 miles

*Assessment Units (Stations): 1232_01 (11982), 1232_02 (**11985**, **11990**, 11991, 18765, **18766**), 1232_03 (**11992**), 1232_04 (**11999**, 12001)*

*Unclassified waterbody: **1232A**: California Creek*

*Assessment Units (Stations): 1232A_01 (**11709**, 22241)*

*Unclassified waterbody: **1232B**: Deadman Creek*

*Assessment Units (Stations): 1232B_01 (11695, 11696, **11697**, 11698), 1232B_02 (11705)*

*Unclassified waterbody: **1232C**: Paint Creek*

Assessment Units (Stations): 1232C_01 (18764)

*Unclassified waterbody: **1232D**: Gonzales Creek (Lake Daniel)*

*Assessment Units (Stations): 1232D_01 (**17941**)*

1233: Hubbard Creek Reservoir – From Hubbard Creek Dam in Stephens County up to the normal pool elevation of 1183 feet (impounds Hubbard Creek)

Segment Area: 15,250 acres

*Assessment Units (Stations): 1233_01 (**12002**, 13888, 13889, 20537), 1233_02 (13881, 13883, 13885, 13886), 1233_03 (13879, 13880, 13882, 13884)*

*Unclassified waterbody: **1233A**: Big Sandy Creek*

*Assessment Units (Stations): 1233A_01 (13640, **22061**)*

*Unclassified waterbody: **1233B**: Hubbard Creek*

*Assessment Units (Stations): 1233B_01 (13639, Off Segment Deep Creek-**22322**)*

1234: Lake Cisco – From Williamson Dam in Eastland County up to the normal pool elevation of 1496 feet (impounds Sandy Creek).

Segment Area: 445 acres
*Assessment Units (Stations): 1234_01 (**12005**, 18436, 18510)*

1235: Lake Stamford – From Stamford Dam in Haskell County up to the normal pool elevation of 1416.8 feet (impounds Paint Creek).

Segment Area: 4,690 acres
*Assessment Units (Stations): 1235_01 (**12006**)*

1236: Fort Phantom Hill Reservoir – From Fort Phantom Hill Dam in Jones County up to the normal pool elevation of 1,636 feet (impounds Elm Creek).

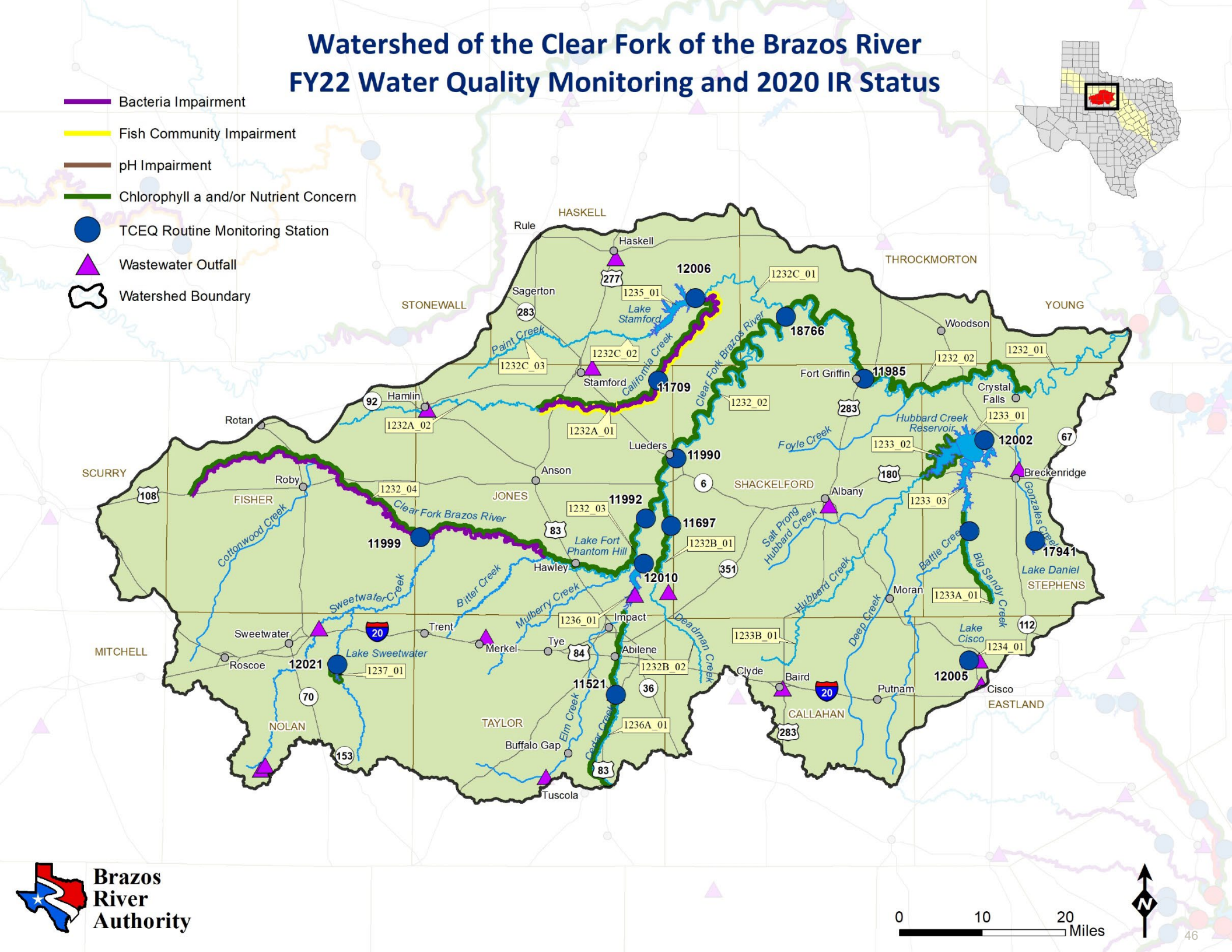
Segment Area: 14,246 acres
*Assessment Units (Stations): 1236_01 (**12010**, 12013, 20183, Off Segment Elm Creek-**11629**)*

*Unclassified waterbody: **1236A**: Cedar Creek*
*Assessment Units (Stations): 1236A_01 (**11521**)*

1237: Lake Sweetwater – From Sweetwater Dam in Nolan County up to the normal pool elevation of 2,116.5 feet (impounds Bitter Creek).

Segment Area: 621 acres
*Assessment Units (Stations): 1237_01 (**12021**)*

Watershed of the Clear Fork of the Brazos River
FY22 Water Quality Monitoring and 2020 IR Status



Brazos River Authority

Table 3.3.2.1 Segment Specific Water Quality Standards with Indications of Impairment and/or Concern from the 2020 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) and Significant Long-term Trends[1]

Clear Fork Watershed		Uses		Surface Water Quality Standards								Nutrient Screening Levels[5]			
Segment	Name	Recreation[2]	Aquatic Life[3]	Cl (mg/L)	SO4 (mg/L)	TDS (mg/L)	Dissolved Oxygen Average/ Minimum (mg/L)	pH	Bacteria[4] (MPN/100ml)	Temperature (°F)	Chlorophyll *a* (µg/l)	Ammonia - N (mg/l)	Nitrate - N (mg/l)	Total Phosphorus (mg/l)	Chlorophyll *a* (µg/l)
1232	**Clear Fork Brazos River**	**PCR**	**H**	**1250↑**	**2200**	**4900**	**5.0/3.0**	**6.5-9.0**	126	**93**		**0.33**	**1.95**	**0.69**	**14.1**
1232A	California Creek	PCR	H	1250↓	2200	4900	5.0/3.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1232B	Deadman Creek	PCR	I	1250	2200↑	4900	5.0/3.0	6.5-9.0↑	126↓	93		0.33↓	1.95	0.69↓	14.1
1232C	Paint Creek	PCR	H	1250	2200	4900	5.0/3.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1232D	Lake Daniel	PCR	H	350	150	900	5.0/3.0	6.5-9.0	126	93		0.11	0.37	0.20	26.7
1233	**Hubbard Creek Reservoir**	**PCR**	**H**	**350**	**150**	**900**	**5.0/3.0**	**6.5-9.0**	**126**	**93**	**5.61**				
1233A	Big Sandy Creek	PCR	L	350	150	900	3.0/2.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1233B	Hubbard Creek	PCR	H	350	150	900	5.0/3.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1234	**Lake Cisco**	**PCR**	**H**	**75↓**	**75↓**	**350↓**	**5.0/3.0**	**6.5-9.0**	**126**	**93**	**5.00**				
1235	**Lake Stamford**	**PCR**	**H**	**580**	**400↓**	**2100**	**5.0/3.0**	**6.5-9.0**	**126**	**93**	**16.85↑**				
1236	**Fort Phantom Hill Reservoir**	**PCR**	**H**	**130**	**150↓**	**550**	**5.0/3.0↑**	**6.5-9.0**	**126**	**93**		**0.11**	**0.37**	**0.20**	**26.7↑**
1236A	Cedar Creek	PCR	H	110	310	600	5.0/3.0	6.5/9.0	126	93		0.33	1.95	0.69	14.1
1237	**Lake Sweetwater**	**PCR**	**H**	**250**	**225**	**730**	**5.0/3.0**	**6.5-9.0**	**126**	**93**		0.11	0.37	0.20	26.7

[1]Long-term trends described in this report are based on analysis of all data collected from Fiscal year 1990 through 2021 with a minimum 10-year data set and at least 20 samples unless otherwise specified. A trend was considered statistically significant at p≤0.05 with an R-value of 0.2 to 1.
[2]PCR-Primary Contact Recreation
[3]E-Exceptional, H-High, I-Intermediate, L-Limited
[4]The criteria numbers represent the geometric mean for *E. coli*
[5]For reservoirs where there is a Chlorophyll *a* Standard, nutrients are evaluated using a line-of-evidence framework described in the 2020 Guidance for Assessing and Reporting Surface Water Quality in Texas

Segment or portion of segment impaired

Segment or portion of segment has a concern for the standard or screening level

↑ Statistically significant increasing trend

↓ Statistically significant decreasing trend

Watershed of the Clear Fork of the Brazos River

The Clear Fork of the Brazos River begins in Fisher County and flows 284 miles east through Jones, Shackelford, Throckmorton, Stephens, and Young Counties, to its mouth on the Brazos River, near South Bend in southern Young County. The watershed drains approximately 5,728 square miles in the Central Great and Central Oklahoma/Texas plains, EPA Level III ecoregion. Land use is predominantly agricultural with Abilene representing the only urban area. There are five drinking water supply reservoirs within this watershed including Hubbard Creek Reservoir, Lake Cisco, Lake Stamford, Fort Phantom Hill Reservoir, and Lake Sweetwater.

All but one classified segment within the Clear Fork Watershed of the Brazos River meet water quality standards to support their designated uses. Segment **1232_04** (Clear Fork Brazos River) was listed in 2018 as impaired for bacteria. In addition, the Clear Fork of the Brazos has concerns for nitrate and chlorophyll *a* (Figure 3.3.2.2) along with an increasing trend in chloride concentrations (Figure 3.3.2.3). Chloride concentrations in this region are natural feature and weather dependent. There are increasing concerns for nutrient levels throughout the segment of **1232.**

Figure 3.3.2.2 **1232_04 (Station 11999) Nitrate and Chlorophyll *a***

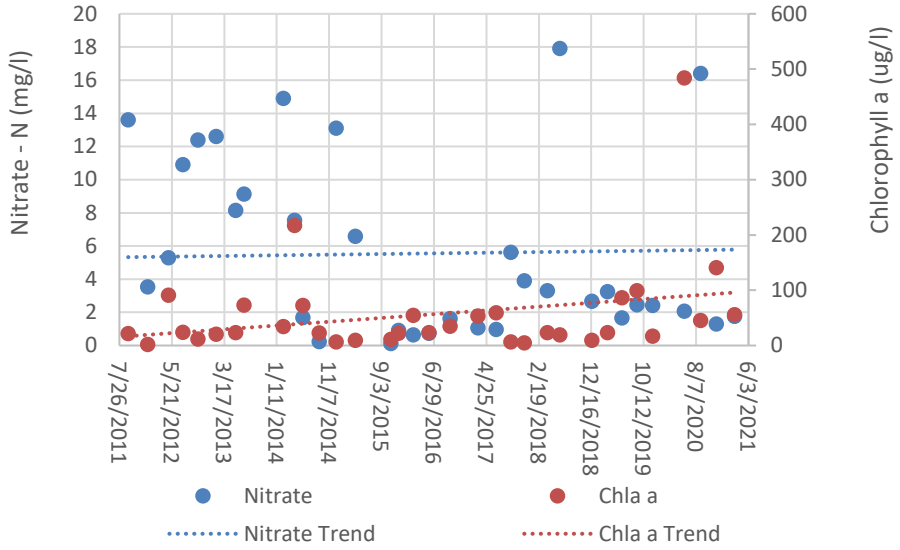
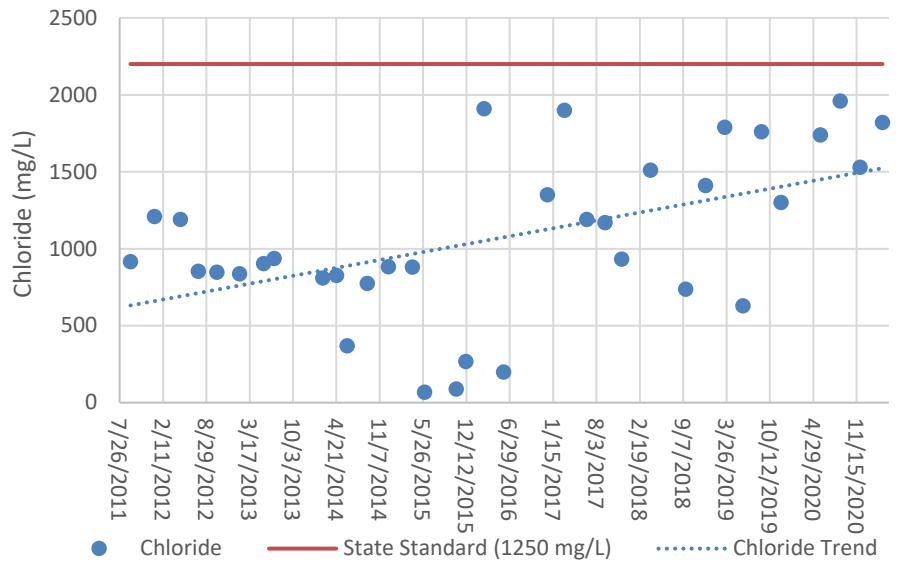


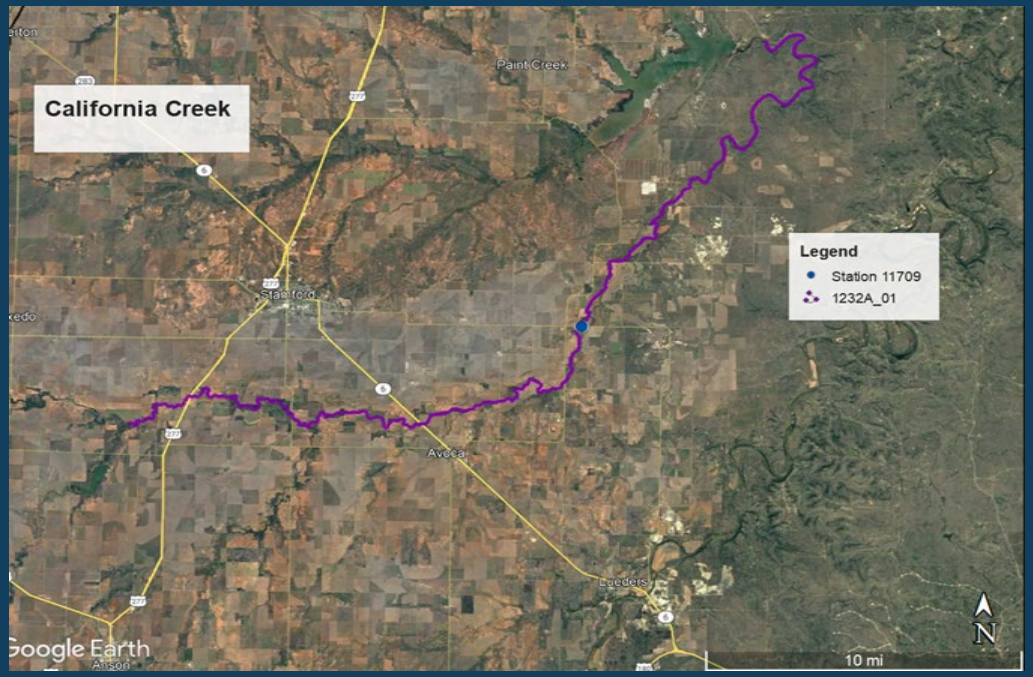
Figure 3.3.2.3 **1232_04 (Station 11999) Chloride**

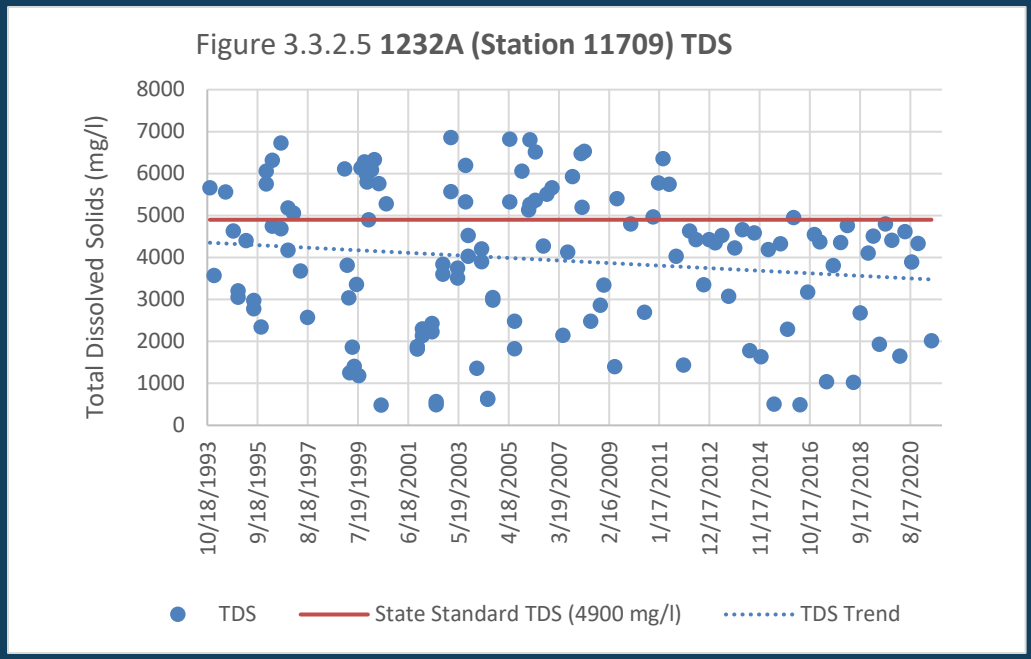


A bacterial impairment is in place (Figure 3.3.2.4) for one unclassified waterbody **1232A** (California Creek) along with an impaired fish community impairment which was first listed on the 303(d) list in 2016. California Creek also possess concerns for

nitrate and chlorophyll *a* within this segment. 32% of total dissolved solids data collected at monitoring station 11709 (Figure 3.3.2.4) have exceeded the state standard of 4900 mg/l and there is a downward trend in total dissolved solid concentrations (Figure 3.3.2.5).

Figure 3.3.2.4 11709-CALIFORNIA CREEK AT FM 142 EAST OF STAMFORD





Unclassified waterbody **1232B** Deadman Creek (Figure 3.3.2.6) has a concern for bacteria but otherwise meets all designated uses. Parameters exhibiting a downward trend include ammonia, total phosphorus (Figure 3.3.2.7), and bacteria concentrations at monitoring station 11697. This could be attributed to improved agricultural practices in the area. However, concerns for nitrate and total phosphorus remain.

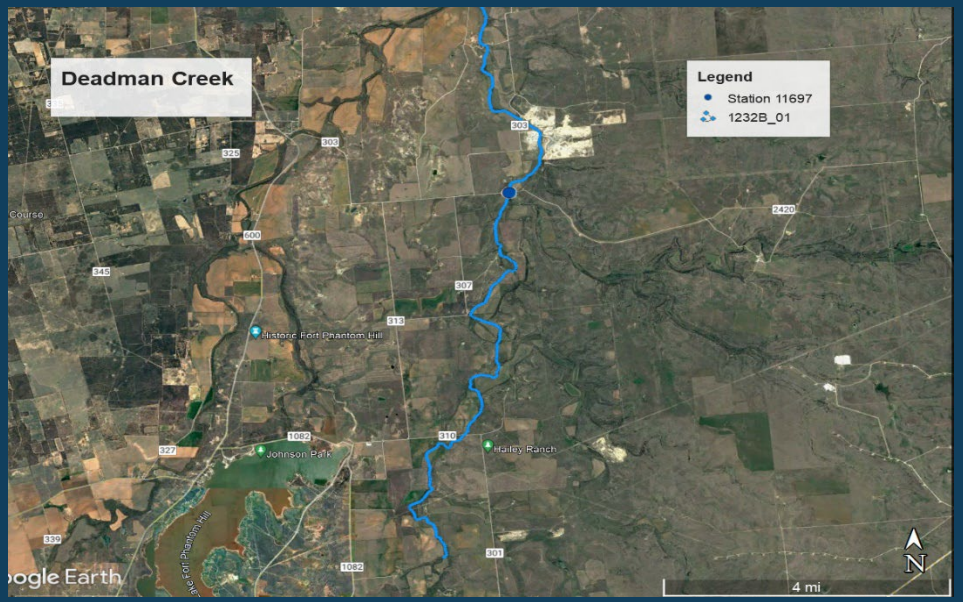
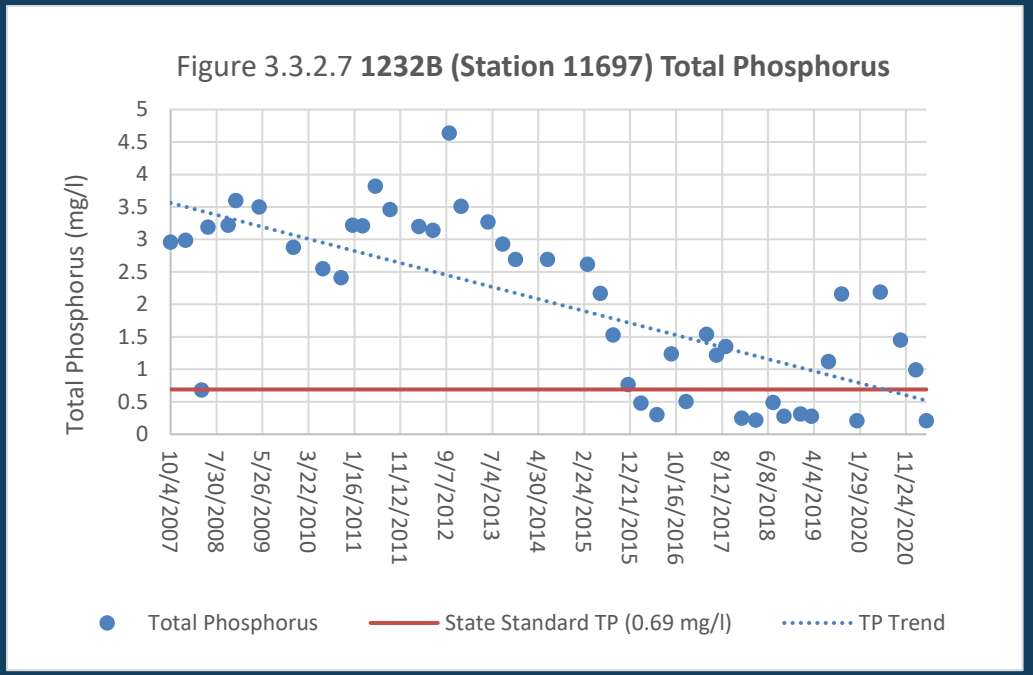


Figure 3.3.2.6 11697-DEADMAN CREEK IMMEDIATELY UPSTREAM OF BUCK NAIL RANCH ROAD 3 MILES SOUTHEAST OF NUGENT



Hubbard Creek Reservoir (**1233**), Hubbard Creek (**1233B**), Lake Cisco (**1234**) , Lake Stamford (**1235**), Fort Phantom Hill Reservoir (**1236**) have no impairments or concerns. There are concerns for bacteria and chlorophyll *a* in Big Sandy Creek. The dominant land cover in the watershed for Big Sandy Creek is herbaceous/shrub land and there are no known sources contributing to the concerns. In Lake Cisco (**1234**) there are statistically significant decreases in chloride, sulfate, and TDS due to the natural drought/drought recovery cycle common in these upper regions of the Brazos River Basin. Similarly, Lake Stamford (**1235**) and Fort Phantom Hill Reservoir (**1236**) both have declining trends in sulfate. Both of these reservoirs also have increasing trends in chlorophyll *a* concentrations. Cedar Creek (**1236A**) has a concern for chlorophyll *a*. Lake Sweetwater (**1237**) has concern for chloride, sulfate, and TDS.

Special Studies

Biological Assessments:

Segment **1232A** (California Creek) is listed on the 2020 303(d) list for impaired fish community as well as a concern for microbenthic community. During the index period of 2009, BRA completed an aquatic life monitoring event. Limited biological integrity was

achieved and it was concluded that the relatively harsh instream flow conditions and a combination of stressful environmental factors resulted in the limited biological integrity finding. Sensitive taxa were scarce, tolerant taxa predominated, and IBI scores were depressed. TCEQ conducted an aquatic life monitoring and habitat assessment event at stations 11709-California Creek at FM 142 East of Stamford and 22241-California Creek Immediately Upstream at FM 1226 N South of Stamford in March and September of 2021. California Creek at 11709 achieved a limited fish community index score in the March event and an intermediate fish community index score in the September event. California Creek at 22241 achieved an intermediate fish community index score in the March event and a high fish community index score in the September event. The Benthic macroinvertebrate community scored an intermediate index at both events and a high habitat index score at both events for both stations.

Table 3.3.2.2 Water Quality Issues Summary

Water Quality Issue	Affected Area	Possible Influences/Concerns	Possible Actions Taken/to be Taken
Impairments			
Bacteria	• Clear Fork Brazos River • California Creek	• Municipal discharges • Non-point sources (NPS): agricultural runoff, animal feeding operations, urban runoff, and wildlife	• 1232A and 1232B are currently on the Watershed Action Plan table for discussion and evaluation. Input from regional water quality monitors is obtained during yearly coordinated monitoring meetings • More data collection • Watershed Review • Standards Review
Concerns			
Bacteria Nutrient/Chlorophyll *a* Dissolved Solids	• Clear Fork Brazos River • California Creek • Deadman Creek • Cedar Creek • Lake Sweetwater • Big Sandy Creek	• Municipal discharges • Non-point sources (NPS): agricultural runoff, animal feeding operations, urban runoff, and wildlife • Natural geologic formations that are very high in salt content • Natural drought/flood cycle	• Continue to implement a Watershed Action Plan which involves input from regional water quality monitors • More data collection • Watershed review • Standards review

3.3.3 Upper Watershed of the Brazos River

Watershed Area	Active Surface Water Monitoring Stations	Monitoring Agencies	Permitted Discharges	Potential Stakeholders	Classified Segments
4,725 mi^2	37	BRA, TCEQ	85	Cities of Whitney, Granbury, Morgan, Walnut Springs, Blum, Rio Vista, Glen Rose, Cleburne, Acton, Tolar, Godley, Ranger, Lipan, Cresson, Strawn, Mineral Wells, Graford, Graham, Olney; TXU Generation, Metroplex Quarries, Luminant Generation	1203, 1204, 1205, 1206, 1207, 1208, 1227, 1228, 1229, 1230, 1231, 1257

Description of Segments:

1203: Whitney Lake – From Whitney Dam in Bosque/Hill County to a point immediately upstream of the confluence of Camp Creek on the Brazos River Arm in Bosque/Johnson County and to a point immediately upstream of the confluence of Rock Creek on the Nolan River Arm in Hill County, up to the normal pool elevation of 533 feet (impounds Brazos River).

Segment Area: 23,560 acres

*Assessment Units (Stations): 1203_01 (11851, **13987**, 13988, 18443), 1203_02 (11855, 13989, **13990**, 13992, 13993, 18788, 18789), 1203_03 (13991, **18654**, 18790), 1203_04 (13994, 18791), 1203_05 (**11854**), 1203_06 (**11853**)*

Unclassified waterbody: **1203A**: Steele Creek

Assessment Units (Stations): 1203A_01 (16411, 11834, 11835, 11836)

1204: Brazos Below Lake Granbury – From a point immediately upstream of the confluence of Camp Creek in Bosque/Johnson County to DeCordova Bend Dam in Hood County.

Segment Length: 52 miles

*Assessment Units (Stations): 1204_01 (12029), 1204_02 (11856, **20213**, **21486**)*

Unclassified waterbody: **1204A**: Camp Creek

*Assessment Units (Stations): 1204A_01 (**17533**)*

1205: Lake Granbury – From DeCordova Bend Dam in Hood County to a point 100 meters upstream of FM 2580 in Parker County, up to normal pool elevation of 693 feet (impounds Brazos River).

Segment Area: 8,700 acres

*Assessment Units (Stations): 1205_01 (20230), 1205_02 (**11862**, **20307**), 1205_03 (11861), 1205_04 (None), 1205_05 (**11860**, 18740), 1205_SA1 (17930, 17931, 18004, 18005, 18851), 1205_SA2 (18006, 18007, 18008, 18009, 18010, 18011, 18012, 18013, 18014, 18015, 20221), 1205_SA3 (18017, 18018, 18019, 18020, 18021, 20214, 20219), 1205_SA4 (18022, 18023, 18024, 18025, 18026, 18027, 18028, 18029, 18030, 18031, 18032, 18033, 18034, 18035, 18036, 18037, 18038, 18039, 18040, 18739, 20215, 20216, 20217, 20223, 20224, 20225, 20226, 20231), 1205_SA5 (18041, 18042, 18043, 18044, 18045, 18738, 18741, 18742)*

Unclassified waterbody: **1205B**: Bee Creek
Assessment Units (Stations): 1205B_01 (18016)

Unclassified waterbody: **1205C**: Walnut Creek
Assessment Units (Stations): 1205C_01 (20229)

Unclassified waterbody: **1205D**: Contrary Creek
Assessment Units (Stations): 1205D_01 (20218)

Unclassified waterbody: **1205E**: Rucker Creek
*Assessment Units (Stations): 1205E_01 (**20222**)*

Unclassified waterbody: **1205F**: Strouds Creek
Assessment Units (Stations): 1205F_01 (20228)

Unclassified waterbody: **1205G**: Robinson Creek
Assessment Units (Stations): 1205G_01 (20227)

Unclassified waterbody: **1205H**: Long Creek
Assessment Units (Stations): 1205H_01 (20220)

1206: Brazos River Below Possum Kingdom Lake – From a point 100 meters upstream of FM 2580 in Parker County to Morris Sheppard Dam in Palo Pinto County.

Segment Length: 109 miles
*Assessment Units (Stations): 1206_01 (**13543**, 18743, 18744, 18749), 1206_02 (**11863**, **18745**, 18746), 1206_03 (**11864**, 13696, **18748**)*

Unclassified waterbody: **1206D**: Palo Pinto Creek
*Assessment Units (Stations): 1206D_01 (**11074**, 16408, 18747)*

Unclassified waterbody: **1206E**: Lake Mineral Wells
Assessment Units (Stations): 1206E_01 (20160)

1207: Possum Kingdom Lake – From Morris Sheppard Dam in Palo Pinto County to a point immediately upstream of the confluence of Cove Creek at Salem Bend in Young County, up to the normal pool elevation of 1000 feet (impounds Brazos River).

Segment Area: 19,800 acres
*Assessment Units (Stations): 1207_01 (14029), 1207_02 (**11868**), 1207_03 (14028), 1207_04 (14027), 1207_05 (**11867**), 1207_06 (**14025**, **21995**, **21996**, **21997**), 1207_07 (None), 1207_08 (14019), 1207_09 (14020), 1207_10 (**11866**), 1207_11 (14023, 14024), 1207_12 (**11865**, 14022)*

1208: Brazos River Above Possum Kingdom Lake – From a point immediately upstream of the confluence of Cove Creek at Salem Bend in Young County to the confluence of the Double Mountain Fork Brazos River and the Salt Fork Brazos River in Stonewall County.

Segment Length: 189 miles (for the entire segment, portions of which are in the Watershed of the Salt and Double Mountain Forks)
*Assessment Units (Stations): 1208_01 (**11869**), 1208_02 (partial) (**13641**)*

1227: Nolan River – From a point immediately upstream of the confluence of Rock Creek in Hill County to Cleburne Dam in Johnson County.

Segment Length: 16 miles
*Assessment Units (Stations): 1227_01 (11966, **11967**), 1227_02 (11968, 11970, **11971**, 11972, 14450)*

Unclassified waterbody: **1227A**: Buffalo Creek
Assessment Units (Stations): 1227A_01 (11780)

1228: Lake Pat Cleburne – From Cleburne Dam in Johnson County up to the normal pool elevation of 733.5 feet (impounds Nolan River).

Segment Area: 1,500 acres
*Assessment Units (Stations): 1228_01 (**11974**, 11975, 14447)*

1229: Paluxy River/North Paluxy River – From the confluence with the Brazos River in Somervell County to the confluence of Rough Creek in Erath County.

Segment Length: 57 miles
*Assessment Units (Stations): 1229_01 (11976, **20232**), 1229_02 (14481, **20343**), 1229_03 (14245)*

Unclassified waterbody: **1229A**: Squaw Creek Reservoir
Assessment Units (Stations): 1229A_01 (17110)

1230: Lake Palo Pinto – From Palo Pinto Dam in Palo Pinto County up to the normal pool elevation of 867 feet (impounds Palo Pinto Creek).

Segment Area: 2,661 acres
*Assessment Units (Stations): 1230_01 (**11977**)*

1231: Lake Graham – From Graham Dam and Eddleman Dam in Young County up to the normal pool elevation of 1076.3 feet (impounds Salt Creek and Flint Creek).

Segment Area: 2,550 acres
*Assessment Units (Stations): 1231_01 (**11979**)*

1257: Brazos River Below Lake Whitney – From a point immediately upstream of the confluence of Aquilla Creek in McLennan County to Whitney Dam in Bosque/Hill County.

Segment Length: 27 miles
*Assessment Units (Stations): 1257_01 (**12044**, **16782**), 1257_02 (13642)*

Upper Watershed of the Brazos River
FY22 Water Quality Monitoring and 2020 IR Status

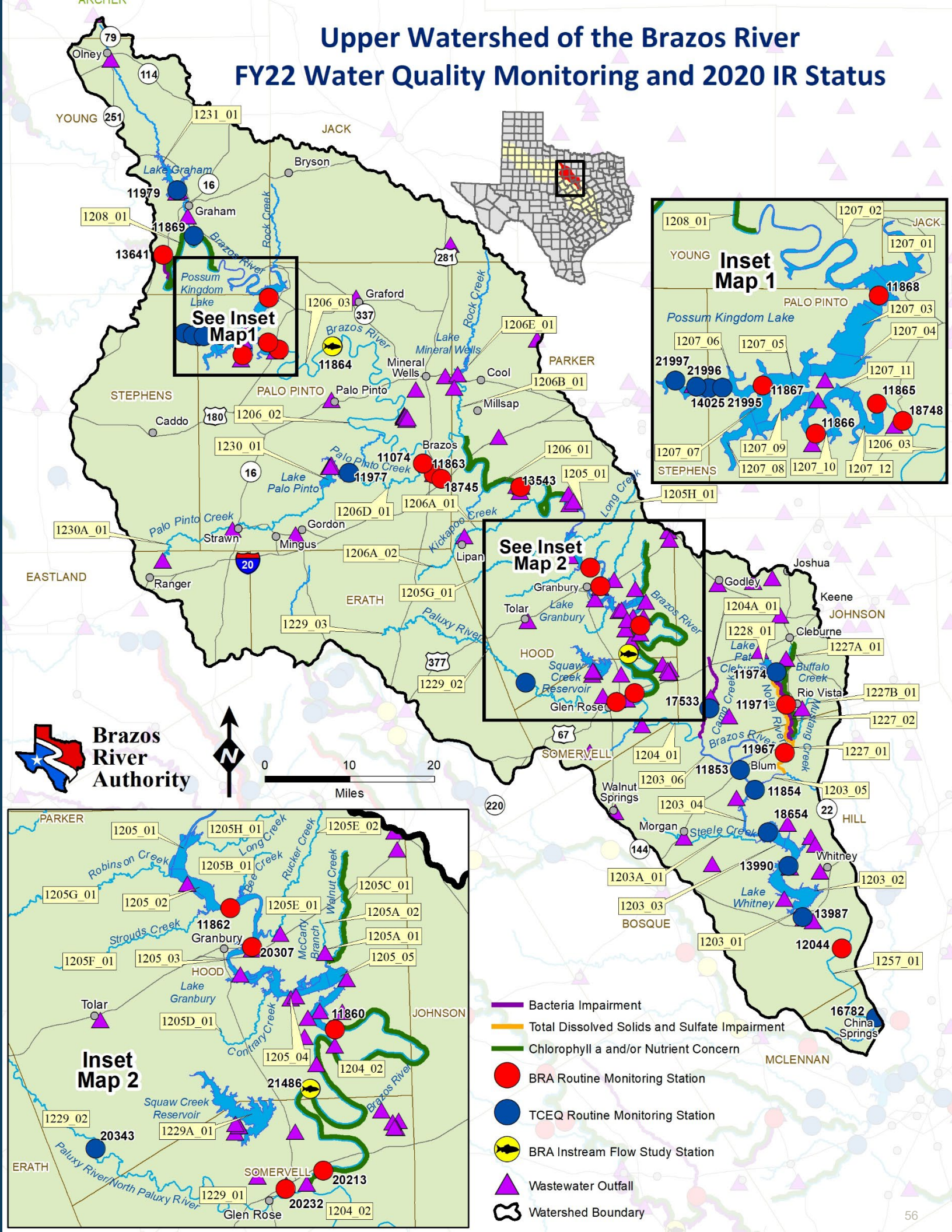


Table 3.3.3.1 Segment Specific Water Quality Standards with Indications of Impairment and/or Concern from the 2020 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) and Significant Long-term Trends[1]

Upper Brazos Watershed		Uses		Surface Water Quality Standards								Nutrient Screening Levels[5]			
Segment	Name	Recreation[2]	Aquatic Life[3]	Cl (mg/L)	SO4 (mg/L)	TDS (mg/L)	Dissolved Oxygen Average/ Minimum (mg/L)	pH	Bacteria[4] (MPN/100ml)	Temperature (°F)	Chlorophyll *a* (µg/l)	Ammonia - N (mg/l)	Nitrate - N (mg/l)	Total Phosphorus (mg/l)	Chlorophyll *a* (µg/l)
1203	**Whitney Lake**	PCR	H	670	320	1,500	5.0/3.0	6.5-9.0	126	93		0.11	0.37	0.20	26.7
1203A	Steele Creek	PCR	H	670	320	1,500	5.0/3.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1204	**Brazos Below Lake Granbury**	PCR	H	750↓	380↓	1,600↓	5.0/3.0↑	6.5-9.0↑	126	91		0.33	1.95	0.69	14.1
1204A	Camp Creek	PCR	L	750	380	1,600	3.0/2.0	6.5-9.0	126	91		0.33	1.95	0.69	14.1
1205	**Lake Granbury**	PCR	H	1,000↓	600↓	2,500↓	5.0/3.0	6.5-9.0	126	93		0.11	0.37	0.20	26.7
1205B	Bee Creek	PCR	L	1,000	600	2,500	3.0/2.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1205C	Walnut Creek	PCR	L	1,000	600	2,500	3.0/2.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1205D	Contrary Creek	PCR	L	1,000	600	2,500	3.0/2.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1205E	Rucker Creek	PCR	M	1,000	600	2,500	2.0/1.5	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1205F	Strouds Creek	PCR	L	1,000	600	2,500	3.0/2.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1205G	Robinson Creek	PCR	L	1,000	600	2,500	3.0/2.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1205H	Long Creek	PCR	L	1,000	600	2,500	3.0/2.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1206	**Brazos River Below Possum Kingdom Lake**	PCR	H	1,020↓	500	2,300	5.0/3.0	6.5-9.0↑	126	90		0.33	1.95	0.69	14.1
1206D	Palo Pinto Creek	PCR	H	1,020↑	500	2,300	5.0/3.0	6.5-9.0↑	126	90		0.33	1.95↓	0.69	14.1
1206E	Lake Mineral Wells	PCR	H	1,020	500	2,300	5.0/3.0	6.5-9.0	126	90		0.11	0.37	0.20	26.7
1207	**Possum Kingdom Lake**	PCR	H	1,200↓	500↓	3,500↓	5.0/3.0	6.5-9.0	126	93	10.74				
1208	**Brazos River Above Possum Kingdom Lake**	PCR	H	5,000↓	2,000↓	12,000	5.0/3.0	6.5-9.0	33↓	95		0.33	1.95	0.69	14.1↑
1227	**Nolan River**	PCR	I	75↑	75↑	500↑	4.0/3.0	6.5-9.0	126↑	95		0.33	1.95	0.69	14.1

1227A	Buffalo Creek	PCR	L	75	75	500	3.0/2.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1228	**Lake Pat Cleburne**	**PCR**	**H**	**100**	**100**	**300**	**5.0/3.0**	**6.5-9.0 ↑**	**126**	**93**	**19.04 ↑**			**↓**	
1229	**Paluxy River/North Paluxy River**	**PCR**	**H**	**50**	**100**	**500**	**5.0/3.0**	**6.5-9.0**	**126**	**91**		**0.33**	**1.95**	**0.69**	**14.1**
1229A	Squaw Creek Reservoir	PCR	H	50	100	500	5.0/3.0	6.5-9.0	126	91		0.11	0.37	0.20	26.7
1230	**Lake Palo Pinto**	**PCR**	**H**	**100**	**100**	**450**	**5.0/3.0**	**6.5-9.0**	**126**	**93**		**0.11**	**0.37**	**0.20**	**26.7**
1231	**Lake Graham**	**PCR**	**H**	**200 ↓**	**75 ↓**	**500 ↓**	**5.0/3.0**	**6.5-9.0**	**126**	**95**	**6.07 ↑**				
1257	**Brazos River Below Lake Whitney**	**PCR**	**H**	**450 ↓**	**250 ↓**	**1,450 ↓**	**5.0/3.0 ↑**	**6.5-9.0 ↑**	**126 ↓**	**95**		**0.33**	**1.95**	**0.69 ↑**	**14.1**

[1]Long-term trends described in this report are based on analysis of all data collected from Fiscal year 1990 through 2021 with a minimum 10-year data set and at least 20 samples unless otherwise specified. A trend was considered statistically significant at p≤0.05 with an R-value of 0.2 to 1.
[2]PCR-Primary Contact Recreation
[3]E-Exceptional, H-High, I-Intermediate, L-Limited, M-Minimal
[4]The criteria numbers represent the geometric mean for *E. coli*
[5]For reservoirs where there is a Chlorophyll *a* standard, Nutrients are evaluated using a line-of-evidence framework described in the 2020 Guidance for Assessing and Reporting Surface Water Quality in Texas

Segment or portion of segment impaired

Segment or portion of segment has a concern for the standard or screening level

↑ Statistically significant increasing trend

↓ Statistically significant decreasing trend

Upper Watershed of the Brazos River

The Upper Watershed of the Brazos River is one of the largest watersheds of the Brazos River, with the Brazos River stretching from Salt and Double Mountain Fork confluence to the impoundment at the Lake Whitney Dam. Some of the most scenic country along the Brazos River is found in the stretch of river downstream of Possum Kingdom Reservoir, where canoeing and kayaking are activities. The river remains wide with heavily vegetated banks that consist of elm, willow, oak, and juniper trees. The land use is largely agricultural with row-crop agriculture, rangeland and pasture land. Urban areas in close proximity to the river include the cities of Granbury, Mineral Wells and Glen Rose.

Impairments in the Upper Watershed of the Brazos River consists of bacteria in the upper most portion of segment **1208** (Brazos River above Possum Kingdom), unclassified waterbody **1204A** (Camp Creek), and in segment **1227** (Nolan River). The Brazos River above Possum Kingdom is listed as having a concern for chlorophyll *a* in portions of the segment upstream which include **1208**_01, **1208**_02, **1208**_04, **1208**_05, **1208**_06. The nutrient sources in some portions of the segment can be attributed to non-point sources and municipal point source discharges while the other remaining portions have nutrient influences that are still unknown. The most upstream portion of the segment in this watershed, AU **1208**_02, **1208**_04, **1208**_05 are listed as not supporting for bacteria (Figure 3.3.3.1) whereas AU **1208**_01 has been removed from the 303(d) list according to the 2020 IR. Elevated levels of bacteria are attributed to general nonpoint source pollution. Concerns for elevated levels of bacteria and depressed oxygen levels are present in segment **1208A**. Currently, there are no concerns for non-attainment of the chlorophyll *a* and nutrient standards in reservoir

segments **1203**, **1205**, **1206E**, **1207**, **1228**, **1229A**, **1230**, **1231**. It should be noted that there is a statically significant decrease in chloride, sulfate, and total dissolved solids concentrations within the Possum Kingdom Lake and Lake Granbury. Nutrient and chlorophyll *a* concerns are evident in several stream segments including **1204**, **1205C**, **1206**, **1208**, **1227**, **1227A** (Table3.3.3.1).

Water quality data collected for segment **1208** indicate a bacteria impairment (Figure 3.3.3.1 and Figure 3.3.3.2) at monitoring station 13641 in **1208**_02 (3.3.3.3 and 3.3.3.4) and no concern for monitoring station 11869 in **1208**_01. Combined enterococcus data for stations 11869 and 13641 show a geometric mean of 692 MPN/100ml for values collected from 2013 through 2021. In addition, segment **1208** at station 13641 has a significant statistical decreasing trend in chloride and sulfate concentrations (Figure 3.3.3.1) along with a decreasing trend in total dissolved solids (Figure 3.3.3.5).

Figure 3.3.3.2 **1208 Enterococcus (Stations 11869 & 13641)**

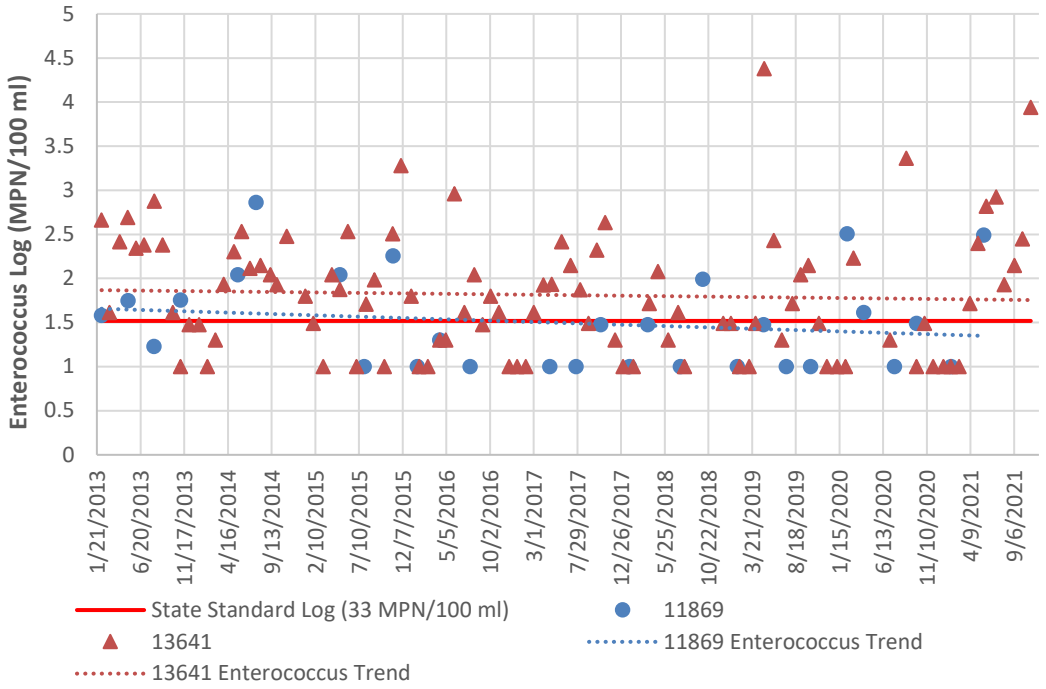
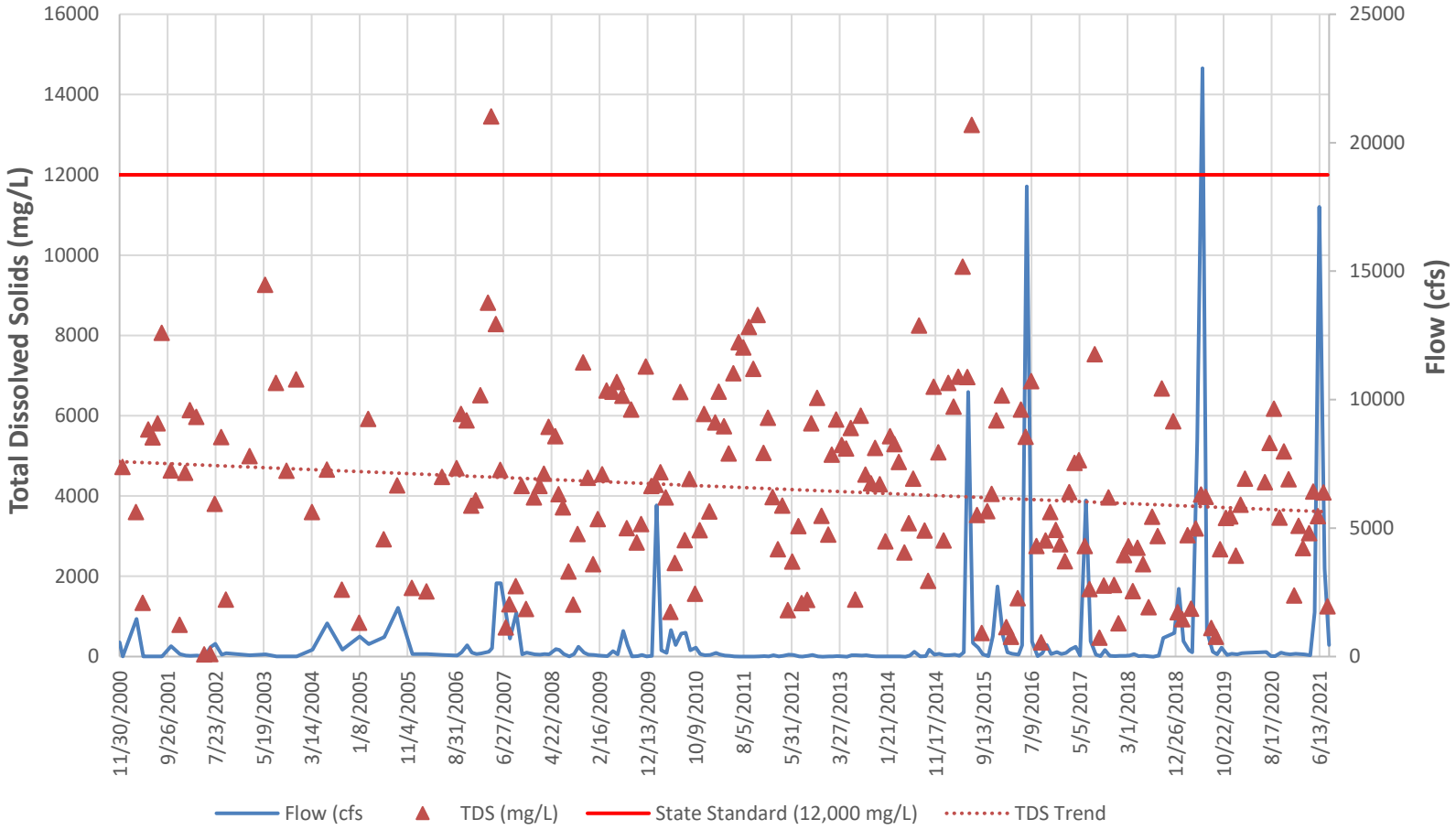


Figure 3.3.3.3 Data collected at Station13641 is used to assess Segment 1208_02. Picture is looking upstream.

Figure 3.3.3.4 Data collected at Station13641 is used to assess Segment 1208_02. Picture is looking downstream.

Figure 3.3.3.5 **1208 TDS with Flow at Station 13641**

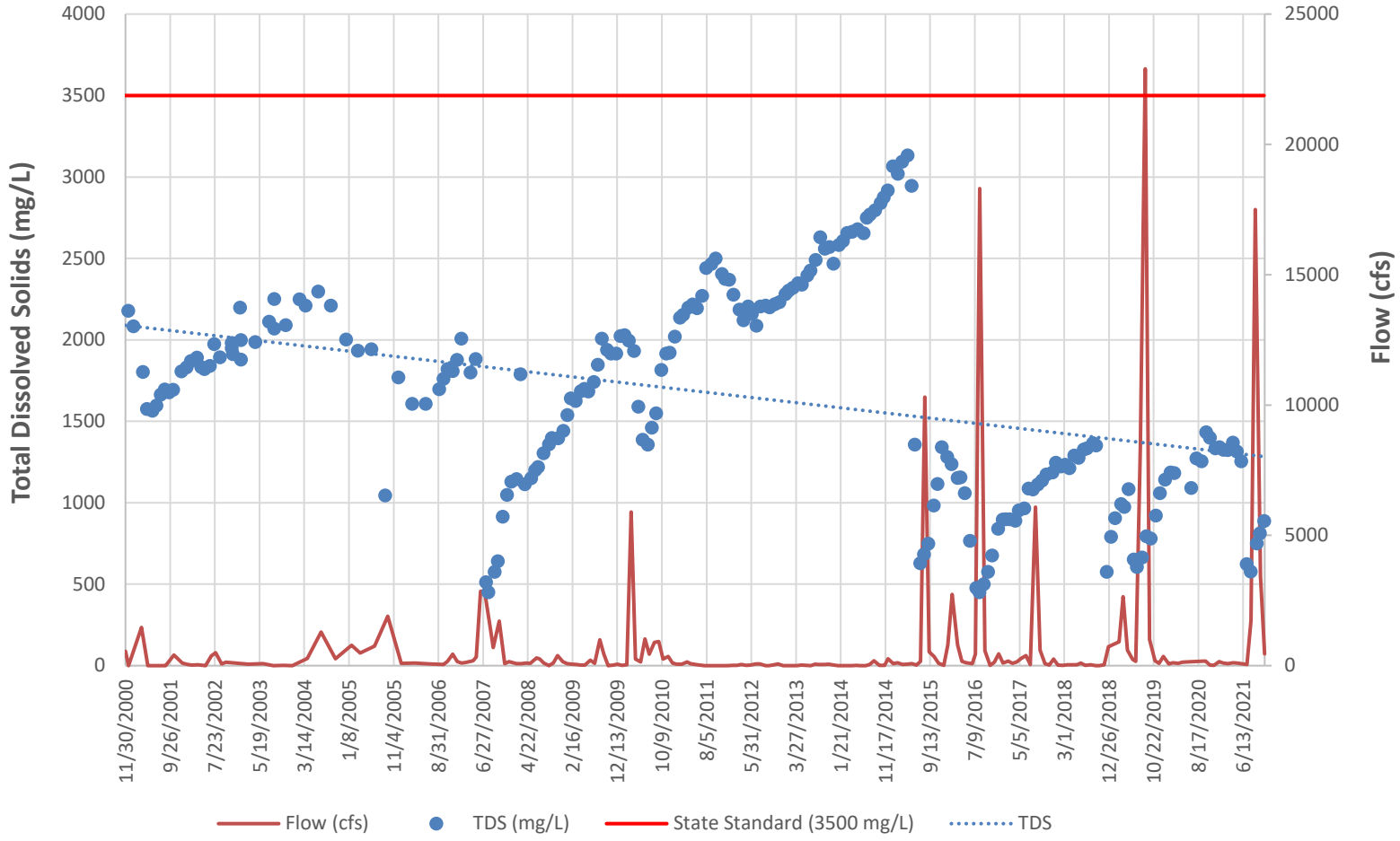


Possum Kingdom Lake (segment **1207**) is a large, scenic reservoir that is a source of drinking water and offers many recreational opportunities.

Segment **1207** is not listed as impaired and has no parameters on the concerns list. Historical data indicated that there was an increasing trend in total dissolved solids levels throughout the reservoir but since the summer of 2015 data indicates that total dissolved solids levels within the reservoir are decreasing (Figure 3.3.3.6). Before 2015 seasonal fluctuations in flow were not as pronounced and flows were low which caused higher concentrations of total dissolved solids within the reservoir. The highest levels of total dissolved solids occurred at the culmination of a drought that occurred between 2011 to 2015 with levels of TDS that reached 3094 mg/L. This is part of a larger pattern in the Upper Brazos Basin that shows a general rise in dissolved solid concentration

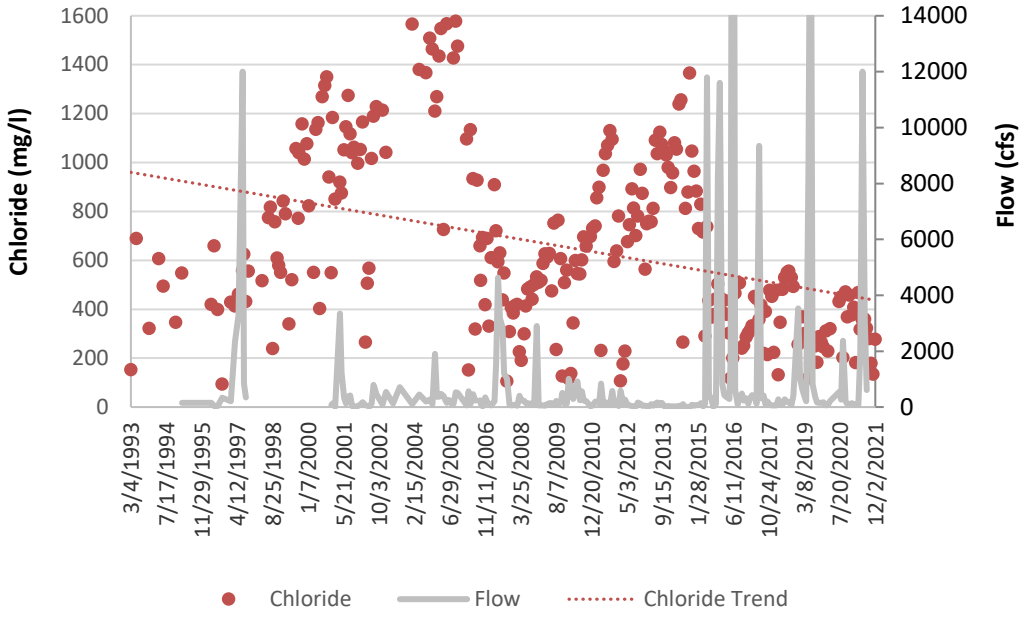
during dry, low flow periods. Naturally occurring salt-bearing geologic formations located in the Salt and Double Mountain Forks of the Brazos are the brine source responsible for the elevated levels of chloride and other dissolved solids found in the Upper Brazos River Basin and throughout the main stem of the Brazos River. Chloride levels, and in turn TDS levels, often fluctuate and are largely influenced by flow. During extended dry periods, flows are low and chloride becomes concentrated. Conversely, periods of high flow often have a diluting effect on chloride concentrations. With high flow events following periods of drought, there is a decrease in dissolved solids (Figure 3.3.3.6).

Figure 3.3.3.6 **TDS data from 1207** (Station 11865)
with Flow data from 1208 (Station 13641)



There are no impairments for the Brazos River below Possum Kingdom Lake (segment **1206**) however; concerns do exist for near non-attainment of macrobenthic communities and impaired habitat from degradation of riparian areas. The biological concerns documented in segment **1206** may be attributed in part to changes in the historical flow regime and from quarry operations in close proximity to the river. In addition, data indicates a decreasing trend in chloride concentrations throughout segment **1206** (Figure 3.3.3.6). Two periods of historical data from 1993 through 2006 and 2008 through 2015 suggested increased trends in chloride concentrations which were likely caused by a combination of increased periods of low flow conditions, increased water resource demands, and an increase in the number of wastewater and industrial discharges, which are necessary to meet the needs of a growing population. Chloride data collected after 2015 show a decreasing trend in chloride which is likely caused by a return to more of seasonal precipitation events and flow regimes.

Figure 3.3.3.6 **1206 (Station 13543) Chloride and Flow**



Lake Granbury (segment **1205**) is a popular central Texas reservoir that serves as an important source of water and provides recreational opportunities to surrounding communities. Lake Granbury has had issues in the past regarding golden algae and more recently an event occurred in in early June 2020 (Table 3.3.2 and Figure 3.3.3.7). The table below illustrates algae cells counts for a site that had high amounts of dead fish in the water. Although *P. parvum* (Golden Algae) was not the dominant algal class from this sample, our sampling event occurred a few days after the fish kill leading us to believe that there were much higher counts prior to our sampling event.

Table 3.3.3.2 Algal cell densities for a cove in Lake Granbury June

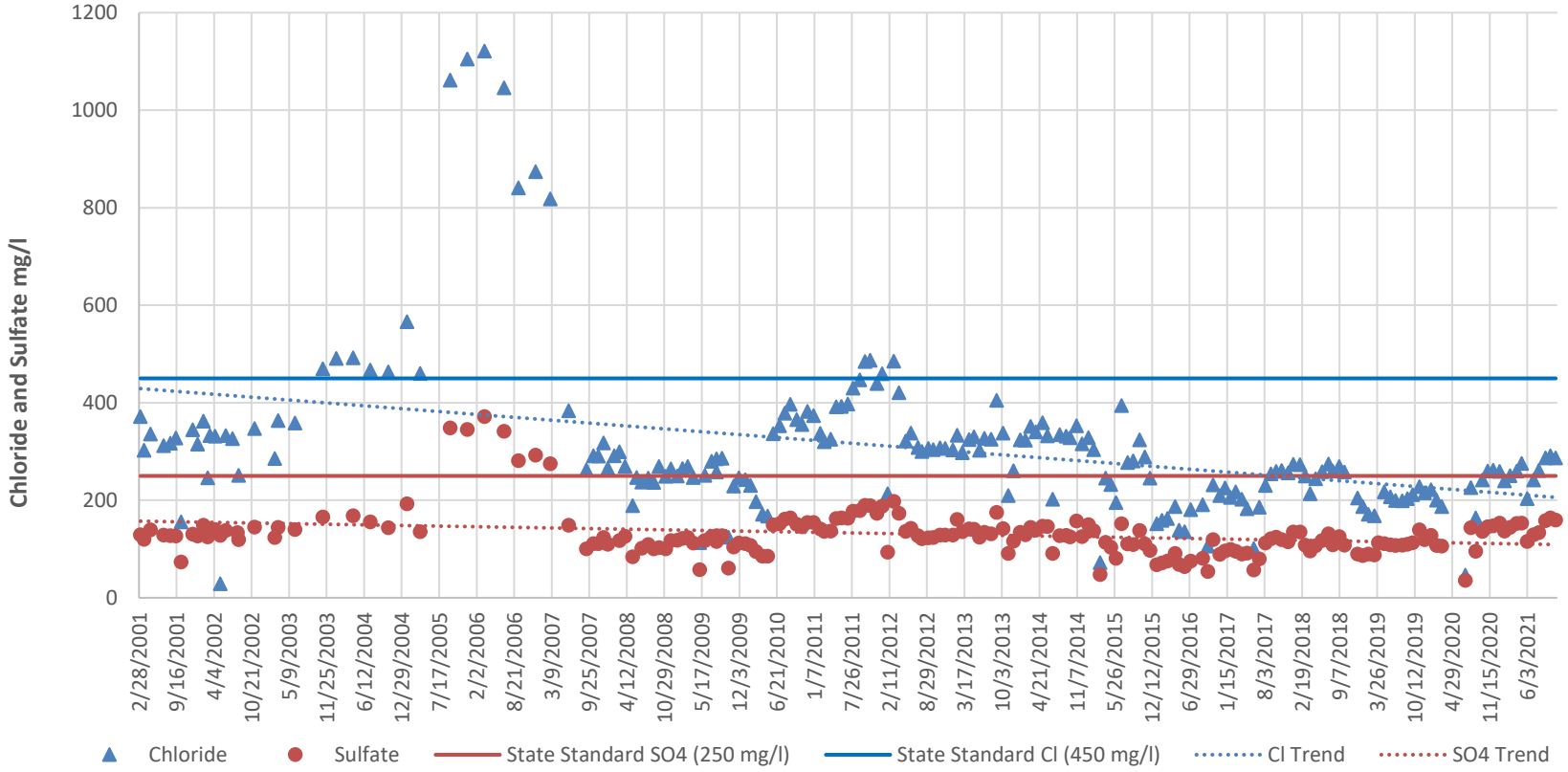
Date	Algal Class	Density (cells/ml)
6/1/20	Chlorophyta	18000
6/1/20	*P. parvum*	10000
6/1/20	Cyanophyta	5000
6/1/20	Diatom	5000

Figure 3.3.3.7 Dead fish due to Golden Algae in a cove in Lake Granbury

Lake Granbury (**1205**) is not impaired for any water quality uses. Long-term routinely monitored stations on the main body of the lake (stations 11860, 11861 and 11862) do not indicate elevated levels of bacteria. However, elevated levels of bacteria have been documented in many of the man-made canals and coves in Lake Granbury and local concerns for the water quality in these areas eventually led to the development of the Lake Granbury Watershed Protection Plan (LGWPP). The LGWPP was a coordinated effort that included the cooperation of TCEQ, BRA, and local stakeholders on the identification and development of management measures to address the bacteria concerns. The LGWPP identified on-site sewage facilities as the primary source of bacterial contamination. In addition, the majority of the septic systems are located along the many canals and coves, where poor circulation creates stagnant conditions with little water exchange with the main body of the lake.

The Nolan River, segment **1227** is listed as impaired for sulfate, total dissolved solids (Figure 3.3.3.9) and bacteria. The Nolan River is an effluent dominated stream and the contributing WWTP gets its source water from groundwater wells where the water contains a higher concentration of dissolved solids. Due to the naturally occurring nature of the increased solids concentrations, in 2010 a TDS standard change was proposed which could increase the standard for dissolved solids in **1227**. However these changes have not yet been approved by the EPA therefore the segment cannot be assessed based on the higher concentrations. The 2020 IR lists segment **1227** as having concerns for nutrient enrichment that is likely the result of municipal point source discharges.

Figure 3.3.3.10 **1257 (Station 12044) Chloride and Sulfate**



Segment **1204**, the Brazos River between Lake Granbury and Lake Whitney is currently not listed as impaired but there is concern for elevated chlorophyll *a* concentrations. The nutrient sources causing the excessive algal growth can be attributed to non-point sources such as agriculture land use. Camp Creek (segment **1204A**) is listed on the 303(d) as impaired for bacteria.

Lake Whitney, segment **1203**, is a large flood control reservoir that serves as an important source of recreation and hydropower. Although not impaired, Lake Whitney had previous concerns for elevated levels of chlorophyll *a* but according to the 2020 IR chlorophyll *a* has been removed. Most nutrient inputs into Lake Whitney responsible for the elevated levels of chlorophyll *a* are attributed to nonpoint sources.

Lake Pat Cleburne, segment **1228**, is not impaired for any parameter but there is a statically significant increasing trend for elevated chlorophyll *a* concentrations over the site specific state criterion of 19.04 µg/l. The cause the elevated concentrations are unknown. It may be due to the shallow nature of the reservoir. There are also no impairments or concerns for elevated total dissolved solids and nutrients concentrations in **1257**, Brazos River Below Lake Whitney, and there is a downward trend in chloride, sulfate (Figure 3.3.3.10), total dissolved solids and bacteria levels.

There are no impairments or concerns in segments **1229**, **1230** or **1231**. Water quality in Paluxy River/North Paluxy River (**1229)** is generally good and consistent with no trends revealed over the period of record. There is limited water quality data for Squaw Creek Reservoir (**1229A**) with only 16 sampling events from 2000 to 2003. Water quality data has been consistently collected since 2018 in Lake Palo Pinto (**1230**), but there is not enough data to develop trends. Lake Graham (**1231**) has decreasing trends in sulfate, chloride and TDS and an increasing trend in chlorophyll *a* although there are no impairments or concerns.

Special Studies:

Reservoir Fisheries Habitat Improvement Project

Beginning in 2016, the BRA and TPWD Inland Fisheries Staff entered into a partnership to perform habitat improvement projects on Possum Kingdom Lake, Lake Granbury, Lake Proctor, Lake Aquilla, Lake Whitney, Lake Belton, Stillhouse Hollow Lake, Lake Georgetown, Lake Granger, Lake Limestone and Lake Somerville.

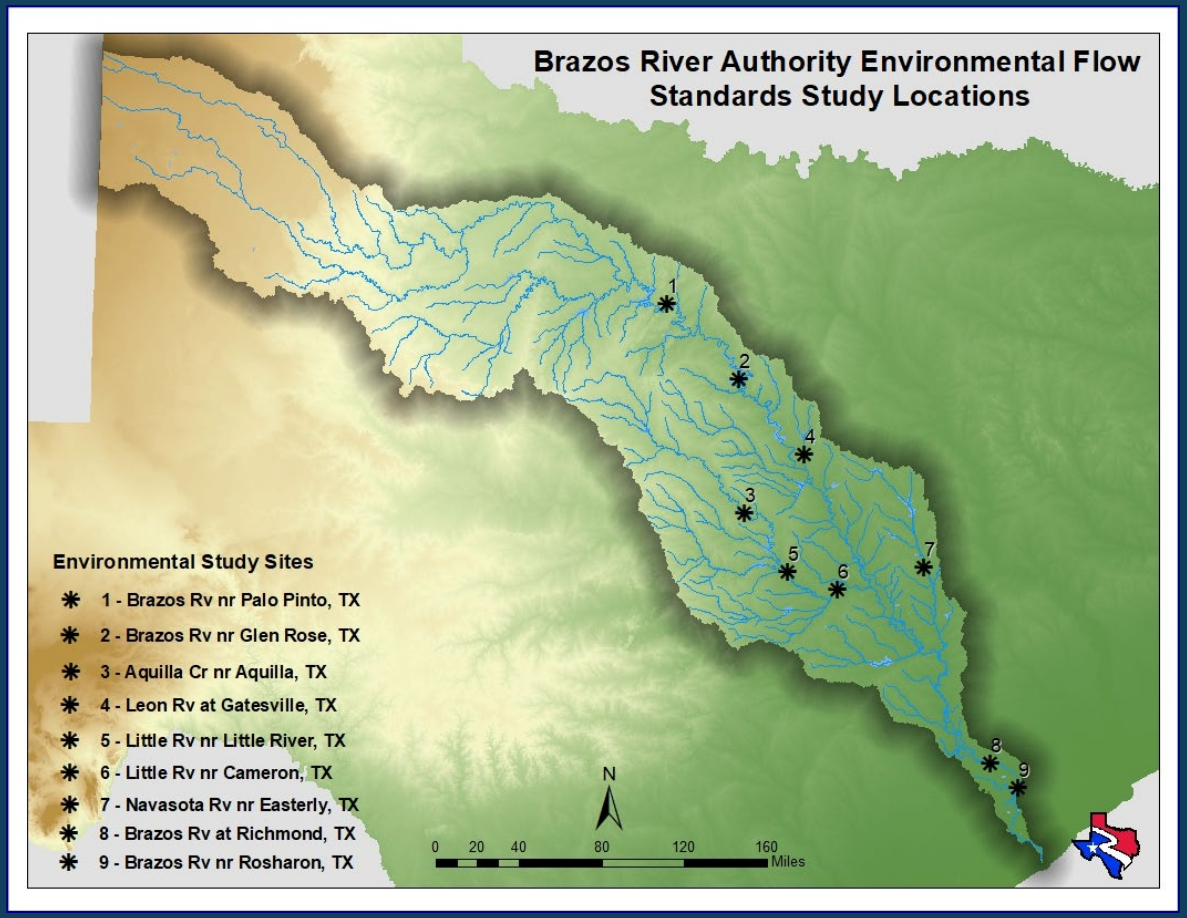
The goal is to improve fishery habitat, and thus resiliency, and to proactively mitigate the negative effects that future reduced water levels may have on reservoir fisheries. Due to differences in fisheries, native habitat, and lake usage, a different plan will be developed and implemented for each lake.

Figure 3.3.3.11 Looking into a Mossback Trophy Tree Kit showing the areas from which Largemouth Bass and crappie spp. can ambush prey.

In 2021 sixteen Mossback Trophy Tree Kits were constructed and placed in Possum Kingdom (Figure 3.3.3.11). Selected locations provided easy access for boat anglers while minimizing the potential for boating hazards and providing a larger reef for fish to congregate. Trophy Tree Kits when deployed cover approximately 60 square feet. The Kits were placed at a depth of 14 to 16 feet (when full) around previously placed Mossback Reef Kits (for habitat improvement locations visit https://tpwd.texas.gov/fishboat/fish/recreational/lakes/possum_kingdom/structure.phtml. Habitat enhancement locations were determined from previous observations of the Reef Kits with side scan sonar and angling. Reef kits that showed fish activity or produced catches, but had limited habitat nearby, were chosen to receive the additional Trophy Trees. A Trophy Tree Kit consists of 3 vertical trunks standing 40 inches tall on a single base with 12 limbs each to provide cover for Largemouth Bass, crappie spp. and sunfish spp. to ambush prey that is holding on the Reef Kits. To date, 164 artificial structures have been deployed in the reservoir. These structures enhance the habitat from the Peanut Patch area of the reservoir into Cedar Creek and continue toward the dam on inside bends of the original Brazos River channel. These structures have been documented to hold fish and support a thriving fishery in and around the structures.

Brazos Basin Instream Flow Monitoring Program to Inform on Environmental Flow Standards

In 2012, the BRA initiated a program to perform extensive environmental studies at select locations in the Brazos River basin to gather data related to the Texas Commission on Environmental Quality's adopted Senate Bill 3 (SB3) environmental flow baseline. The goal of these studies is to develop a baseline data set documenting habitat and species present in the river and riparian zones across the range of adopted subsistence and base flows for each selected location. When the next review of the environmental flow standards is commenced, all data will be provided to the Brazos Basin and Bay Expert Science Team (BBEST) and Basin and Bay Area Stakeholder Committee (BBASC) for their consideration when determining whether revisions to the environmental flow



These studies are highly dependent on the occurrence of specific flow levels, so an accurate timeline for completion of all studies is difficult to predict. Table 3.3.3.3 displays the number of each type of sampling event that BRA has completed to date.

standards are warranted.

Because many of the studies require access to private property and because some United States Geological Survey (USGS) gage locations may not have much variety in habitat, the BRA may not be able to complete all studies at the exact location of the USGS gage. On the sites where studies have begun, the BRA has made every effort to site the studies as close to the proposed gage locations as prudent and as close to each other as prudent. There are two stations in the Upper Brazos Watershed – (1) Brazos River near Palo Pinto, TX and (2) the Brazos River near Glen Rose, TX.

Components of the studies performed at each site include:

- Discharge, velocity and depth point measurements
- Temperature, pH, Conductivity, and Dissolved Oxygen Concentration
- Fixed photography, instream cover, habitat types, and channel surveys
- Macroinvertebrates, mussels (if present), and fish assemblage
- Riparian tree surveys
- Channel cross-section surveys
- Sediment sampling at the cross-sections

Table 3.3.3.3 Number of each type of sampling event that BRA has completed to date for the Brazos Basin Instream Flow Monitoring Program to Inform on Environmental Flow Standards project.

Site	Water Quality	Instream Habitat Mapping	Micro-Habitat Fish	Meso-Habitat Fish	Mussels	Invertebrates	Riparian Assessment	Channel Surveys	Sediment Samples
Brazos River near Palo Pinto	114	11	9	11	14	14	5	5	3
Brazos River near Glen Rose	114	5	4	5	5	7	5	5	3
Aquilla Creek near Aquilla	38	11	8	10	11	11	5	5	4
Leon River near Gatesville	107	3		3	3	3	3	3	3
Little River near Little River	26								
Little River near Cameron	113								
Navasota River near Easterly	37	9	5	8	8	8	5	5	5
Brazos River near Richmond	113	7	5	6	5	5	3	3	2
Brazos River near Rosharon	82	4	2	3	4	4	5	4	4

Challenges persisted for the completion of field sampling events due to COVID-19 related constraints in FY21. As restrictions eased in FY22 the BRA ramped up field sampling efforts. So far in FY22 BRA has completed riparian assessments at Brazos River near Rosharon and Leon River near Gatesville, and one biological assessment at Leon River near Gatesville.

Baseline data collection has been completed at three sites, the Brazos River near Palo Pinto, Aquilla Creek near Aquilla and the Brazos River near Rosharon. Collection of baseline data will continue at the remaining sites and a new site on the Leon River near Gatesville was added in 2018. Initial analysis of physical, aquatic, and riparian data has been completed for Aquilla Creek near Aquillia and Brazos River near Palo Pinto. Sediment and channel cross sections were analyzed as a part of the physical dataset. Because of the variability of the sediment data, it was determined that a sediment metric would not be suitable for establishing baseline conditions. However, collection of this data would be valuable for future studies related to sediment modeling or in connecting possible aquatic species variation to sediment changes. An analysis of cross section changes was conducted , quantifying cross sectional area changes, vertical shifts and horizontal shifts. These three metrics encompass overall changes to each cross section and may be suitable for identifying a range of acceptable variability within the channel.

Table 3.3.3.4 Water Quality Issues Summary

Water Quality Issue	Affected Area	Possible Influences/Concerns	Possible Actions Taken/to be Taken
Impairments			
Bacteria	• Camp Creek • Brazos River Above Possum Kingdom Lake • Nolan River	• There are three wastewater outfalls in the Camp Creek Watershed, four in the Brazos River Above Possum Kingdom Lake watershed and seven in the Nolan River watershed • Likely nonpoint sources (NPS) as LULC calculations have determined that herbaceous/shrub and forested areas (suitable for wildlife) are the dominant land cover in the areas of the watershed with bacterial impairments	• A watershed evaluation may be appropriate due to unknown NPS • There had been no data collected in 1204A_01 since 2008. Continue the monitoring that resumed in FY 2020 for station 17533 • Continue routine monitoring of the established long-term stations in this watershed
Sulfate/Total Dissolved Solids	• Nolan River	• Natural geologic formations that are very high in salt content • Natural drought/flood cycle	• A Texas Water Quality Standards (WQS) review for total dissolved solids and sulfate is underway for segments 1227_01 and 1227_02. Environmental Protection Agency (EPA) approval of 2010 WQS is pending.
Concerns			
Nutrient /Chlorophyll *a*	• Brazos Below Lake Granbury • Walnut Creek • Brazos River Below Possum Kingdom Lake • Brazos River Above Possum Kingdom Lake • Nolan River • Buffalo Creek	• Municipal discharges • Non-point sources (NPS) including agricultural runoff, animal feeding operations, urban runoff, and wildlife	• A watershed evaluation may be appropriate due to unknown NPS

3.3.4 Aquilla Creek Watershed

Watershed Area	Active Surface Water Monitoring Stations	Monitoring Agencies	Permitted Discharges	Potential Stakeholders	Classified Segments
466 mi^2	6	BRA, TCEQ	3	Cities of Aquilla, Gholson, Hillsboro, Carl's Corner, Itasca, Covington	1254, 1256

Description of Segments:

1254: Aquilla Reservoir - From Aquilla Dam in Hill County up to the normal pool elevation of 537.5 feet (impounds Aquilla Creek)

Segment Area: 3,935 acres

*Assessment Units (Stations): 1254_01 (**12127**, 13821, 13824), 1254_02 (**12128**, 13827), 1254_03 (**12129**, 13825, **17321**), 1254_SA1 (None), 1254_SA2, (13828, 18461, 18462, 18463, 18464), 1254_SA3 (13826, 18466, 18467, 18468)*

Unclassified waterbody: **1254A:** Hackberry Creek 20 miles

Assessment Units (Stations): 1254A_01 (13654), 1254A_02 (None)

Unclassified waterbody: **1254B:** Aquilla Creek upstream of Aquilla Reservoir 28.1 miles

Assessment Units (Stations): 1254B_01 (13643)

Unclassified waterbody: **1256A***: Aquilla Creek 24.7 miles*

*Assessment Units (Stations): 1256A_01 (11592, **11593**, 13646, **21124**)*

Figure 3.3.4.1. Data collected at Station 11593 - AQUILLA CREEK AT FM 933 is used to assess Segment 1256A_01.

Aquilla Creek Watershed
FY22
Water Quality Monitoring and 2020 IR Status

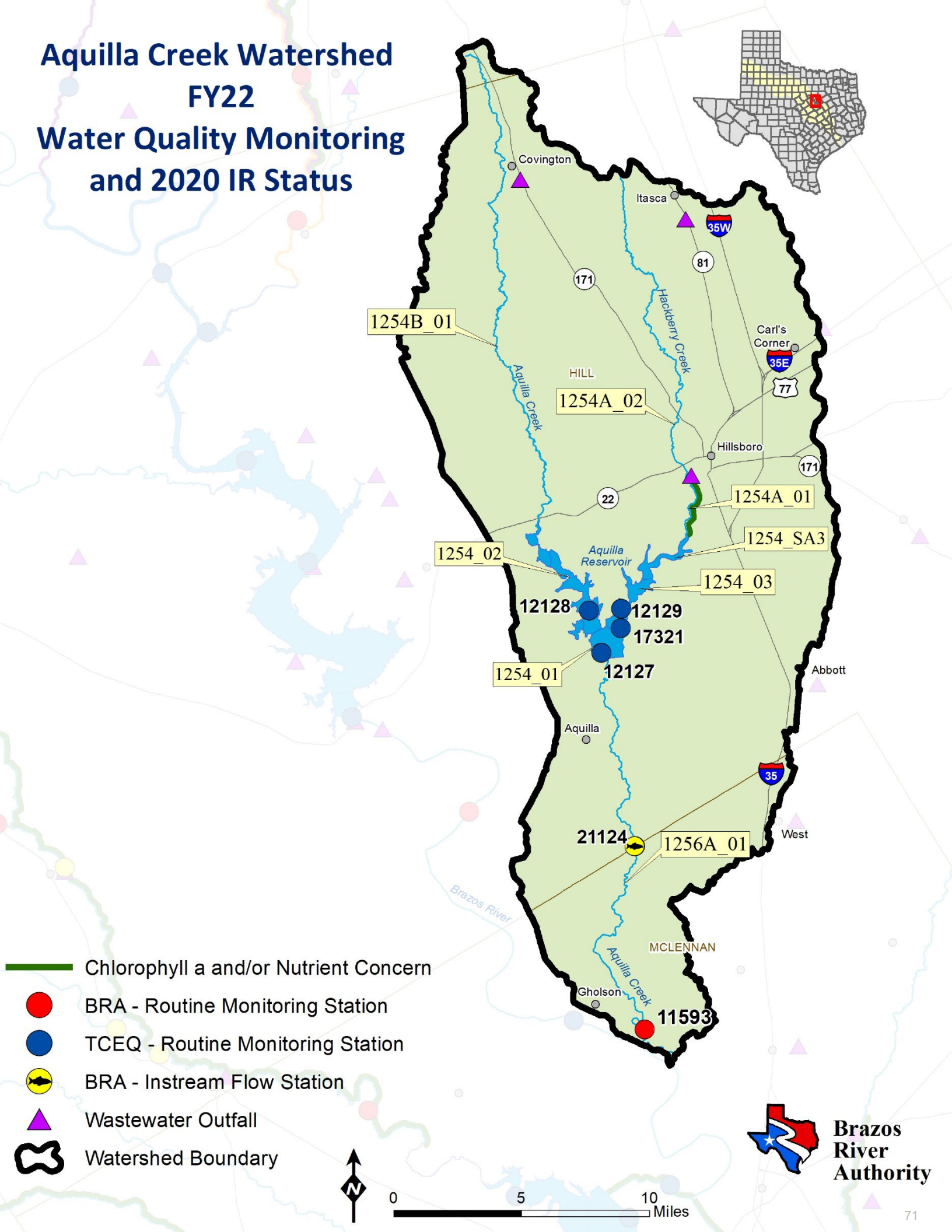


Table 3.3.4.1 Segment Specific Water Quality Standards with Indications of Impairment and/or Concern from the 2020 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) and Significant Long-term Trends[1]

Aquilla Watershed		Uses		Surface Water Quality Standards								Nutrient Screening Levels			
Segment	Name	Recreation[2]	Aquatic Life[3]	Cl (mg/L)	SO4 (mg/L)	TDS (mg/L)	Dissolved Oxygen Average/ Minimum (mg/L)	pH	Bacteria[4] (MPN/100ml)	Temperature (°F)	Chlorophyll *a* (µg/l)	Ammonia - N (mg/l)	Nitrate - N (mg/l)	Total Phosphorus (mg/l)	Chlorophyll *a* (µg/l)
1254	**Aquilla Reservoir**	**PCR**	**H**	**110**	**310↓**	**600**	**5.0/3.0**	**6.5-9.0**	**126**	**90**		**0.11**	**0.37**	**0.20↑**	**26.7**
1254A	Hackberry Creek	PCR	H	110	310	600	5.0/3.0	6.5-9.0	126	90		0.33	1.95	0.69	14.10
1254B	Aquilla Creek Upstream of Aquilla Reservoir	PCR	**H**	110	310	600	5.0/3.0	6.5-9.0	126	90		0.33	1.95	0.69	14.10
1256A	Aquilla Creek	PCR	L	400	200	1,150	3.0/2.0	6.5-9.0	126	95		0.33	1.95	0.69	14.10

[1]Long-term trends described in this report are based on analysis of all data collected from Fiscal year 1990 through 2021 with a minimum 10-year data set and at least 20 samples unless otherwise specified. A trend was considered statistically significant at p≤0.05 with an R-value of 0.2 to 1.
[2]PCR-Primary Contact Recreation
[3]E-Exceptional, H-High, I-Intermediate, L-Limited
[4] The criteria numbers represent the geometric mean for *E. coli*

Segment or portion of segment has a concern for the standard or screening level

↑ Statistically significant increasing trend

↓ Statistically significant decreasing trend

Aquilla Watershed

Aquilla Reservoir is a 3,066-acre impoundment constructed in 1982 and is the major drinking water source for Hill County. A land use land cover analysis in the watershed showed approximately 40 percent is used for pasture, hay, grassland, row crops and small grains; approximately 45 percent is deciduous and evergreen forest and herbaceous/shrub; and approximately 10 percent is commercial, industrial, transportation, residential, and urban uses with another approximate 5 percent being water or wetland area. Previous concerns over high atrazine levels were addressed by TCEQ and the Texas State Soil and Water Conservation Board (TSSWCB) by means of a TMDL and cooperation of local producers in implementing best management practices (BMPs) for the application of atrazine. Aquilla Reservoir no longer has a concern for nitrate levels. It should be noted that there are no significant trends towards increasing nitrate concentrations. The Hackberry Creek arm (**1254**_03) has concerns for arsenic in sediment. It is suspected that the arsenic came from the arsenic acid cotton defoliant used for decades in the highly agricultural area around Aquilla Reservoir. This is a legacy pollutant that traces back to bad practices in the 1960s and 70s. Arsenic tends to be encapsulated in the sediment and has little effect on the quality of the water within the lake.

The 2020 assessment finds concerns for depressed dissolved oxygen in Hackberry Creek (**1254A**_01) as well as concerns for ammonia and nitrate. The elevated nutrients are carried forward concerns that were not assessed due to inadequate data.

Aquilla Creek (**1256A**_01) is in full support of its limited aquatic life use classification and primary contact recreation status. There are no concerns based on screening levels for any nutrients or chlorophyll *a*.

Special Studies:

A Total Maximum Daily Load for Atrazine in Aquilla Reservoir
A TMDL for atrazine has been implemented. More information can be viewed here: https://www.tceq.texas.gov/waterquality/tmdl/10-aquilla.html

Brazos Basin Instream Flow Monitoring Program to Inform on Environmental Flow Standards
In 2012, the BRA initiated a program to perform extensive environmental studies at select locations in the Brazos River basin to gather data related to the Texas Commission on Environmental Quality's adopted Senate Bill 3 (SB3) environmental flow baseline. The goal of these studies is to develop a baseline data set documenting habitat and species present in the river and riparian zones across the range of adopted subsistence and base flows for each selected location. When the next review of the environmental flow standards is commenced, all data will be provided to the Brazos Basin and Bay Expert Science Team (BBEST) and Basin and Bay Area Stakeholder Committee (BBASC) for their consideration when determining whether revisions to the environmental flow standards are warranted.

Figure 3.3.4.2 Station 21124 AQUILLA CREEK AT FM 2114/COUNTY LINE RD is the instream study location on Aquilla Creek.

Aquilla Creek (**1256A_01**) station 21124 (Figure 3.3.4.2) is part of the Brazos Basin Instream Flow Monitoring Program to Inform on Environmental Flow Standards. Thirteen sampling events on Aquilla Creek occurred between May 2012 and June 2019. Flow targets ranged from subsistence (0.25 cfs) to high base (30.9 cfs). Fish IBI values were calculated for eleven events. Nine events achieved ALU values of exceptional and two events achieved a high ALU. Invertebrate ALU values for eleven sampling events were calculated. Four events achieved a high IBI score, six events achieved an intermediate IBI score and one event resulted in a limited IBI score.

Fisheries Habitat Improvement Project

Beginning in 2016, the BRA and TPWD Inland Fisheries Staff entered into a partnership to perform habitat improvement projects on Possum Kingdom Lake, Lake Granbury, Lake Proctor, Lake Aquilla, Lake Whitney, Lake Belton, Stillhouse Hollow Lake, Lake Georgetown, Lake Granger, Lake Limestone and Lake Somerville.

The goal is to improve fishery habitat, and thus resiliency, and to proactively mitigate the negative effects that future reduced water levels may have on reservoir fisheries. Due to differences in fisheries, native habitat, and lake usage, a different plan will be developed and implemented for each lake.

A structural habitat survey in 2010 revealed that most of the shoreline of Aquilla Reservoir was natural with large stands of flooded timber. The Texas Water Development Board estimated annual losses in volume due to sedimentation of 84 to 218 acre-feet for Aquilla Reservoir. This directly impacts habitat availability as littoral habitat is covered with sediment and buried. The most recent Texas Parks and Wildlife Department management plan called for planting emergent vegetation and installing fish habitat to help combat this loss. Aquilla Reservoir is unique among area reservoirs in that it provides a quality crappie population that is utilized heavier than black bass. Both species orient to habitat either in the littoral zone or above the thermocline. Crappie condos installed in 2014 were well received by anglers with reports of improved catches. Adding more durable habitat structures/attractors, marked with GPS coordinates would help improve catch for most anglers, while providing cover habitat for many species.

Brazos River Authority partnered with TPWD and on September 7, 2017, four reefs were constructed using commercial artificial habitat structures (Fishiding stake beds). Forty structures were placed at each location and the outside perimeter of the reef was delineated. The locations for the four reefs were selected to provide easy access for anglers and also to prevent these from becoming boating hazards. Fishiding Stake Bed structures stand approximately 4 ft tall and are held in place with a small concrete disk of about 8 lbs. A total of 160 habitat structures were deployed into Aquilla Reservoir in this effort. In addition, native aquatic plants were also relocated from an existing colony within the reservoir to three new spots to improve habitat availability. On July 6, 2017, 240 water willow plants were relocated from a single existing colony near the Old School Boat Ramp, to three new locations. The new colonies were inspected on September 7, 2017 and survival of the transplants was at least 90% at that time.

Table 3.3.4.2 Water Quality Issues Summary

Water Quality Issue	Affected Area	Possible Influences/Concerns	Possible Actions Taken/to be Taken
Concerns			
Nutrient/Chlorophyll a	• Hackberry Creek	• Sources have not been determined but may include permitted discharges, agricultural runoff and other nonpoint source runoff especially under low flow conditions	• Continue routine water quality monitoring
Dissolved Oxygen	• Hackberry Creek	• Increased nutrients and chlorophyll *a* increase primary productivity which can increase oxygen demand	• Conduct 24-hr DO study • Continue routine water quality monitoring
Arsenic in Sediment	• Hackberry Creek	• Legacy pollutant that traces back to bad practices in the 1960s and 70s	• Continue routine water quality monitoring

3.3.5 Bosque River Watershed

Watershed Area	Active Surface Water Monitoring Stations	Monitoring Agencies	Permitted Discharges	Potential Stakeholders	Classified Segments
1,652 mi^2	27	BRA, TCEQ, TIAER	13	Cities of Stephenville, Iredell, Hico, Meridian, Clifton, Cranfills Gap, Valley Mills, Crawford, McGregor	1225, 1226, 1246, 1255, 1256 (partial)

Description of Segments:

1225: Lake Waco – From Lake Waco Dam in McLennan County to a point 100 meters upstream of FM 185 on the North Bosque River Arm in McLennan County and the confluence of the Middle Bosque River on the South Bosque River Arm in McLennan County, up to the normal pool elevation of 461 feet (impounds Bosque River)

Segment Area: 7,178 acres

*Assessment Units (Stations): 1225_01 (11945, 11946, 11947, 11950, 16995, **17204**, 17205, 17206, 18543, 18544), 1225_02 (**11942**, 11943, 11944, 16996, 17207, 17208, 17209, 18541, 18542), 1225_03 (11599, 11600, **11948**, 12094, 16997, 17210, 17211, 18539, 18540)*

Unclassified waterbody: **1225A**: Hog Creek

*Assessment Units (Stations): 1225A_01 (11601, **17212**, 18849), 1225A_02 (None)*

1226: North Bosque River – From a point 100 meters upstream of FM 185 in McLennan County to a point immediately above the confluence of Indian Creek in Erath County

Segment Length: 103 miles

*Assessment Units (Stations): 1226_01 (**11951** (Figure 3.3.5.1), 11953, **11954**, 17605), 1226_02 (**11956**, 17500, 18379, 18380), 1226_03 (11958, **11960**, **18003**), 1226_04 (**11961**, 11962, 15123, 15694)*

Unclassified waterbody: **1226A**: Duffau Creek

*Assessment Units (Stations): 1226A _01 (11810, **17607**)*

Unclassified waterbody: **1226B**: Green Creek

Assessment Units (Stations): 1226B_01 (13486, 17609)

Unclassified waterbody: **1226C**: Meridian Creek

*Assessment Units (Stations): 1226C_01 (**14908**, 17243)*

Unclassified waterbody: **1226D**: Neils Creek
*Assessment Units (Stations): 1226D_01 (**11826**)*

Unclassified waterbody: **1226E**: Indian Creek
Assessment Units (Stations): 1226E_01 (17235)

Unclassified waterbody: **1226F**: Sims Creek
*Assessment Units (Stations): 1226F_01 (**17240**)*

Unclassified waterbody: **1226G**: Spring Creek
Assessment Units (Stations): 1226G_01 (17242)

Unclassified waterbody: **1226H**: Alarm Creek
Assessment Units (Stations): 1226H_01 (17604)

Unclassified waterbody: **1226I**: Gilmore Creek
Assessment Units (Stations): 1226I_01 (17610)

Unclassified waterbody: **1226J**: Honey Creek
Assessment Units (Stations): 1226J_01 (17611)

Unclassified waterbody: **1226K**: Little Duffau Creek
*Assessment Units (Stations): 1226K_01 (17608, **20322**, **20323**)*

Unclassified waterbody: **1226L**: South Fork Little Green Creek
Assessment Units (Stations): 1226L_01 (13488)

Unclassified waterbody: **1226M**: Little Green Creek
Assessment Units (Stations): 1226M_01 (17606)

Unclassified waterbody: **1226N**: Indian Creek Reservoir
Assessment Units (Stations): 1226N_01 (17234)

Unclassified waterbody: **1226O**: Sims Creek Reservoir
Assessment Units (Stations): 1226O_01 (17239)

Unclassified waterbody: **1226P**: Spring Creek Reservoir
Assessment Units (Stations): 1226P_01 (17241)

Unclassified waterbody: **1226Q**: Walker Branch
Assessment Units (Stations):1226Q_01 (20533)

1246: Middle Bosque/South Bosque River – From the confluence with the South Bosque River in McLennan County to the confluence of Cave Creek and Middle Bosque Creek on the Middle Bosque River in McLennan County to FM 2671 on the South Bosque River in McLennan County

Segment Length: 47 miles
*Assessment Units (Stations): 1246_01 (12093, **17612**), 1246_02 (12094, 17228, 17229, **20308**)*

Unclassified waterbody: **1246A**: Harris Creek
Assessment Units (Stations): 1246A_01 (None)

Unclassified waterbody: **1246B**: Commanche Springs Spring Brook
Assessment Units (Stations): 1246B_01 (None)

Unclassified waterbody: **1246C**: Unnamed Tributary of South Bosque River
Assessment Units (Stations): 1246C_01 (11617), 1246C _02 (None)

Unclassified waterbody: **1246D**: Tonk Creek
Assessment Units (Stations): 1246D_01 (17232)

Unclassified waterbody: **1246E**: Wasp Creek
*Assessment Units (Stations): 1246E_01 (17233, **18802**)*

1255: Upper North Bosque River – From a point immediately above the confluence of Indian Creek in Erath County to the confluence of the North Fork and South Fork of the Bosque River in Erath County

Segment Length: 17.5 miles
*Assessment Units (Stations): 1255_01 (**11963**, 11964, 11965), 1255_02 (**17226**)*

Unclassified waterbody: **1255A**: Goose Branch
*Assessment Units (Stations): 1255A_01 (**17215**)*

Unclassified waterbody: **1255B**: North Fork Upper North Bosque River
Assessment Units (Stations): 1255B_01 (17413)

Unclassified waterbody: **1255C**: Scarborough Creek
*Assessment Units (Stations): 1255C_01 (**17221**, **17222**)*

Unclassified waterbody: **1255D**: South Fork North Bosque River
Assessment Units (Stations): 1255D_01 (17218, 17602)

Unclassified waterbody: **1255E**: Unnamed Tributary of Goose Branch
Assessment Units (Stations): 1255E_01 (17213, 17214)

Unclassified waterbody: **1255F**: Unnamed Tributary of Scarborough Creek
Assessment Units (Stations): 1255F_01 (17223)

Unclassified waterbody: **1255G**: Woodhollow Branch
Assessment Units (Stations): 1255G_01 (17217)

Unclassified waterbody: **1255H**: South Fork Upper North Bosque River Reservoir
Assessment Units (Stations): 1255H_01 (17219)

Unclassified waterbody: **1255I**: Dry Branch
Assessment Units (Stations): 1255I_01 (17603)

Unclassified waterbody: **1255J**: Goose Branch Reservoir
Assessment Units (Stations): 1255J_01 (17216)

Unclassified waterbody: **1255K**: Scarborough Creek Reservoir
Assessment Units (Stations): 1255K_01 (17224)

1256: Brazos River/Lake Brazos – From the low water dam forming Lake Brazos in McLennan County to a point immediately upstream of the confluence of Aquilla Creek in McLennan County (includes the Bosque River Arm to the Waco Lake Dam). The portion of 1256 in the Bosque Watershed is the Bosque River portion of the segment

Segment Portion Length in Bosque Watershed: 7.5 Miles
Assessment Units (Stations): 1256_03 (11626, 14948, 18521)

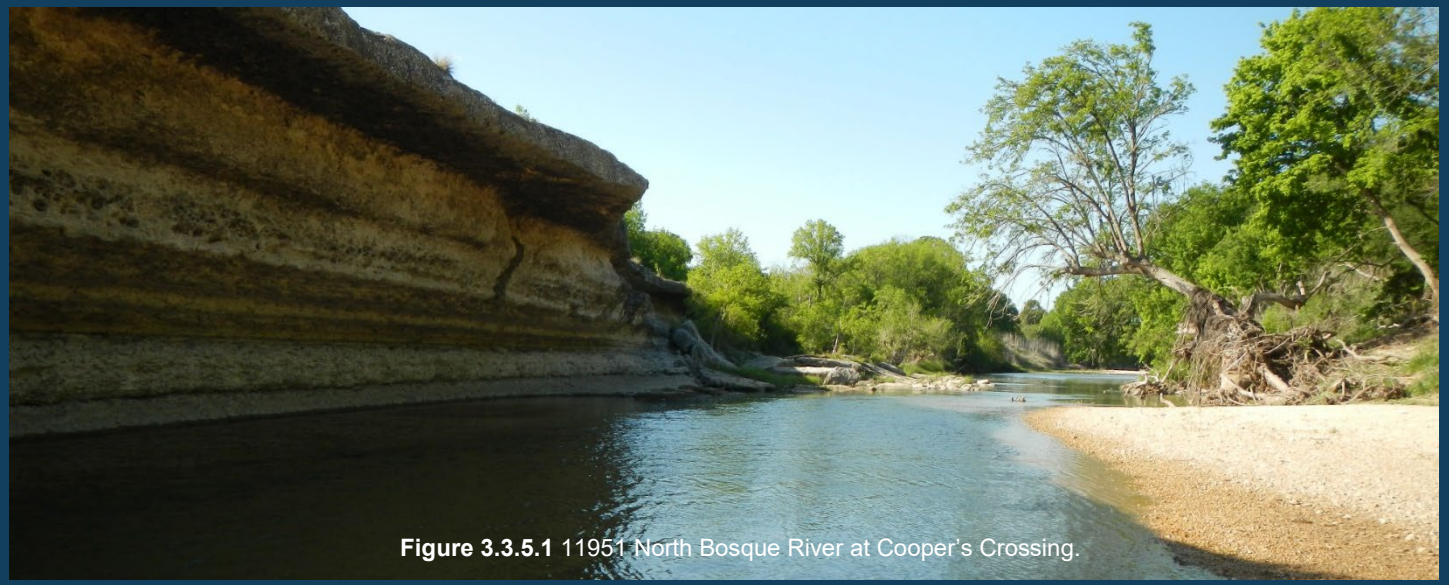


Figure 3.3.5.1 11951 North Bosque River at Cooper's Crossing.

Bosque River Watershed
FY22 Water Quality Monitoring and 2020 IR Status

Table 3.3.5.1 Segment Specific Water Quality Standards with Indications of Impairment and/or Concern from the 2020 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) and Significant Long-term Trends[1]

Bosque River Watershed		Uses		Surface Water Quality Standards								Nutrient Screening Levels			
Segment	Name	Recreation[2]	Aquatic Life[3]	Cl (mg/L)	SO4 (mg/L)	TDS (mg/L)	Dissolved Oxygen Average/ Minimum (mg/L)	pH	Bacteria[4] (MPN/100ml)	Temperature (°F)	Chlorophyll *a* (µg/l)	Ammonia - N (mg/l)	Nitrate - N (mg/l)	Total Phosphorus (mg/l)	Chlorophyll *a* (µg/l)
1225	**Waco Lake**	**PCR**	**H**	**60↓**	**60↓**	**400**	**5.0/3.0**	**6.5-9.0**	**126**	**93**		**0.11**	**0.37↓**	**0.20↓**	**26.7↑**
1225A	Hog Creek	PCR	L	60	60	400	3.0/2.0↑	6.5-9.0	126	93		0.33	1.95	0.69	14.1↓
1226	**North Bosque River**	**PCR**	**H**	**100**	**100**	**540↑**	**5.0/3.0**	**6.5-9.0↑**	**126**	**91**		**0.33**	**1.95↓**	**0.69**	**14.1**
1226A	Duffau Creek	PCR	H	100	100	540	5.0/3.0↓	6.5-9.0↓	126	91		0.33	1.95	0.69	14.1
1226B	Green Creek	PCR	L	100	100	540	3.0/2.0↑	6.5-9.0↑	126	91		0.33	1.95	0.69	14.1
1226C	Meridian Creek	PCR	L	100	100	540↓	3.0/2.0	6.5-9.0↑	126	91		0.33	1.95↓	0.69	14.1
1226D	Neils Creek	PCR	L	100	100	540	3.0/2.0	6.5-9.0↑	126	91		0.33	1.95↓	0.69	14.1
1226E	Indian Creek	SCR1	M	100	100	540	2.0/1.5	6.5-9.0	630	91		0.33	1.95	0.69	14.1
1226F	Sims Creek	SCR1	M	100	100	540	2.0/1.5	6.5-9.0	630	91		0.33	1.95	0.69↓	14.1
1226G	Spring Creek	PCR	M	100	100	540	2.0/1.5	6.5-9.0	126	91		0.33	1.95	0.69	14.1
1226H	Alarm Creek	SCR1	M	100	100	540	2.0/1.5	6.5-9.0	630	91		0.33	1.95	0.69	14.1
1226I	Gilmore Creek	PCR	M	100	100	540	2.0/1.5	6.5-9.0	126	91		0.33	1.95	0.69	14.1
1226J	Honey Creek	PCR	M	100	100	540	2.0/1.5	6.5-9.0	126	91		0.33	1.95	0.69	14.1
1226K	Little Duffau Creek	PCR	M	100	100	540	2.0/1.5	6.5-9.0	126	91		0.33	1.95	0.69	14.1
1226M	Little Green Creek	SCR1	M	100	100	540	2.0/1.5	6.5-9.0	630	91		0.33	1.95	0.69	14.1

1226N	Indian Creek Reservoir	PCR	H	100	100	540	5.0/3.0	6.5-9.0	126	91		0.11	0.37	0.20	26.7
1226O	Sims Creek Reservoir	PCR	H	100	100	540	5.0/3.0	6.5-9.0	126	91		0.11	0.37	0.20	26.7
1226P	Spring Creek Reservoir	PCR	H	100	100	540	5.0/3.0	6.5-9.0	126	91		0.11	0.37	0.20	26.7
1226Q	Walker Branch	PCR	H	100	100	540	5.0/3.0	6.5/9.0	126	91		0.33	1.95	0.69	14.1
1246	**Middle/South Bosque**	**PCR**	**H**	**50**	**260**	**700**	**5.0/3.0 ↑**	**6.5-9.0 ↑**	**126 ↓**	**91**		**0.33**	**1.95**	**0.69**	**14.1 ↓**
1246A	Harris Creek	PCR	H	50	260	700	5.0/3.0	6.5-9.0	126	91		0.33	1.95	0.69	14.1
1246B	Comanche Springs Spring Brook	PCR	H	50	260	700	5.0/3.0	6.5-9.0	126	91		0.33	1.95	0.69	14.1
1246C	Unnamed Tributary of South Bosque River	PCR	I	50	260	700	4.0/3.0	6.5-9.0	126	91		0.33	1.95	0.69	14.1
1246D	Tonk Creek	PCR	H	50	260	700	5.0/3.0	6.5-9.0	126 ↓	91		0.33	1.95	0.69	14.1
1246E	Wasp Creek	PCR	M	50	260	700	2.0/1.5	6.5-9.0 ↑	126	91		0.33	1.95 ↑	0.69	14.1 ↓
1255	**Upper North Bosque River**	**PCR**	**I**	**200**	**150 ↑**	**1000**	**4.0/3.0 ↑**	**6.5-9.0 ↑**	**126 ↓**	**91**		**0.33**	**1.95 ↑**	**0.69 ↓**	**14.1**
1255A	Goose Branch	SCR2	M	200	150	1000	2.0/1.5	6.5-9.0	1030	91		0.33	1.95	0.69	14.1
1255B	North Fork Upper North Bosque River	SCR2	M	200	150	1000	2.0/1.5	6.5-9.0	1030	91		0.33	1.95	0.69	14.1
1255C	Scarborough Creek	SCR2	M	200	150	1000	2.0/1.5	6.5-9.0	1030	91		0.33	1.95	0.69	14.1
1255D	South Fork North Bosque River	PCR	M	200	150	1000	2.0/1.5	6.5-9.0	126	91		0.33	1.95	0.69	14.1
1255E	Unnamed Tributary of Goose Branch	SCR2	M	200	150	1000	2.0/1.5	6.5-9.0	1030	91		0.33	1.95	0.69	14.1
1255F	Unnamed Tributary of Scarborough Creek	SCR1	M	200	150	1000	2.0/1.5	6.5-9.0	630	91		0.33	1.95	0.69	14.1
1255G	Woodhollow Branch	SCR2	M	200	150	1000	2.0/1.5	6.5-9.0	1030	91		0.33	1.95	0.69	14.1

1255H	South Fork Upper North Bosque River Reservoir	PCR	H	200	150	1000	5.0/3.0	6.5-9.0	126	91		0.11	0.37	0.20	26.7
1255I	Dry Branch	SCR1	M	200	150	1000	2.0/1.5	6.5-9.0	630	91		0.33	1.95	0.69	14.1
1255J	Goose Branch Reservoir	PCR	H	200	150	1000	5.0/3.0	6.5-9.0	126	91		0.11	0.37	0.20	26.7
1255K	Scarborough Creek Reservoir	PCR	H	200	150	1000	5.0/3.0	6.5-9.0	126	91		0.11	0.37	0.20	26.7
1256	Brazos River/Lake Brazos	PCR1	H	400	200	1150	5.0/3.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1

[1]Long-term trends described in this report are based on analysis of all data collected from Fiscal year 1990 through 2021 with a minimum 10-year data set and at least 20 samples unless otherwise specified. A trend was considered statistically significant at p≤0.05 with an R-value of 0.2 to 1.
[2]PCR-Primary Contact Recreation, SCR-Secondary Contract Recreation
[3]E-Exceptional, H-High, I-Intermediate, L-Limited. M-Minimal
[4] The criteria numbers represent the geometric mean for *E. coli*

Segment or portion of segment impaired

Segment or portion of segment has a concern for the standard or screening level

↑ Statistically significant increasing trend

↓ Statistically significant decreasing trend

Bosque River Watershed

The Bosque River watershed drains into Waco Lake before discharging into the Brazos River downstream of Waco Lake, in McLennan County. Approximately 74 percent of the drainage area of the Bosque watershed is composed of the North Bosque River watershed. The predominant land use is agricultural, range and pastureland, and Confined Animal Feeding Operations (CAFO). Segment **1255** and many unclassified waterbodies of **1255** (**A, C-E, G**), **1226** (**G** and **K**), and **1246E** are impaired for bacteria and have concerns for elevated levels of nutrients and/or chlorophyll *a* (except **1255G** and **1226G** with no concerns) (Table 3.3.5.1). Segments **1255** and **1226B** remain impaired for dissolved oxygen, and Segments **1226**, **1226O**, and **1255H** have concerns for dissolved oxygen (Table 3.3.5.1).

Segment **1255**, Upper North Bosque River, is located below two permanent outfalls existing north of the Stephenville area, and a dense number of CAFOs are situated within this drainage in Erath County. Long-term trend analyses on this segment indicate a significant decrease in total phosphorous (Figure 3.3.5.1) and *E. coli* bacteria (Figure 3.3.5.2) but a significant increase in nitrate and dissolved oxygen (Table 3.3.5.1). *E. coli* bacteria levels for Segment **1255** do not support the TCEQ water quality standard criteria for this segment but do have a significant downward trend over time (Figure 3.3.5.2). WWTP outfall and CAFO operation in the drainage could account for the high levels of nutrients and *E. coli* bacteria present; however, efforts in the drainage, such as a recent

Figure 3.3.5.1 **1255 (Station 11963) Total Phosphorus**

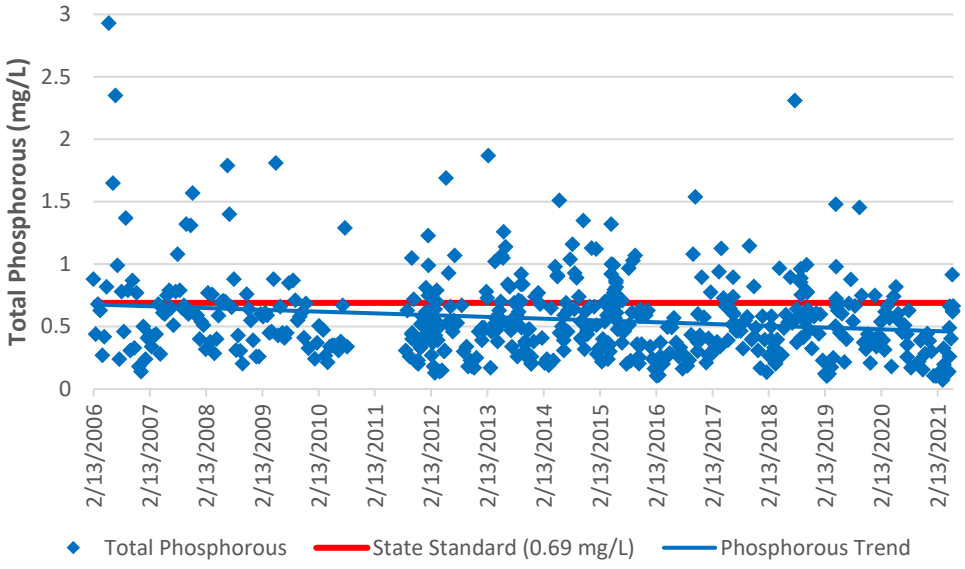
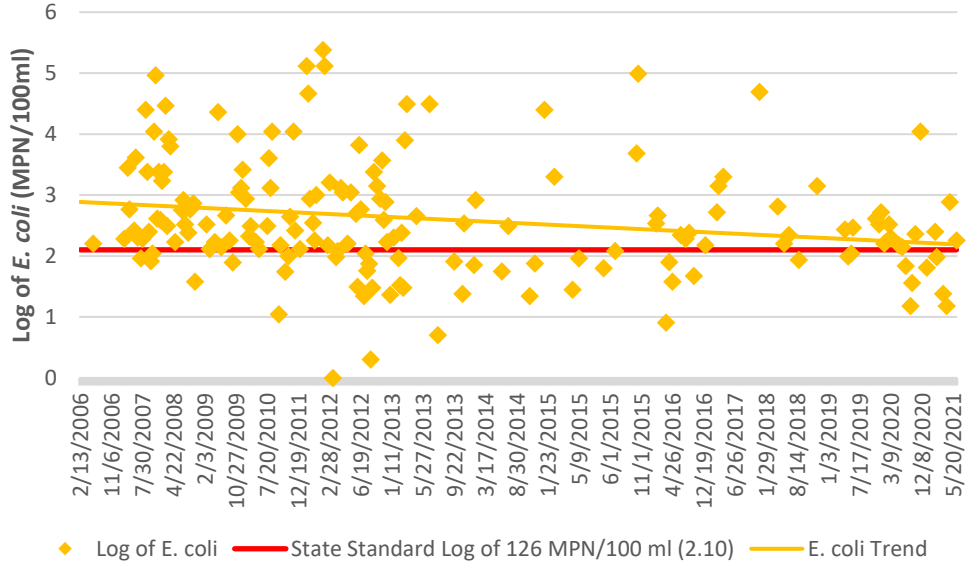


Figure 3.3.5.2 **1255 (Station 11963) *E. coli***



TMDL process, may be responsible for the downward trends in phosphorous and *E. coli*. **1226** of the North Bosque River has concerns related to dissolved oxygen (**1226**_02, **1226O**) and chlorophyll *a* (**1226, 1226B, E, H**) with two unclassified waterbodies that are listed as impaired for bacteria (**1226G, K**) and one impaired for dissolved oxygen (**1226B**). Long-term trend analyses at Station 13486 (**1226B**), Green Creek at Erath CR 269, indicate some improvement to the waterbody, showing a statistically significant upward trend in dissolved oxygen (Figure 3.3.5.3).

Figure 3.3.5.3 **1226B (Station 13486) Dissolved Oxygen**

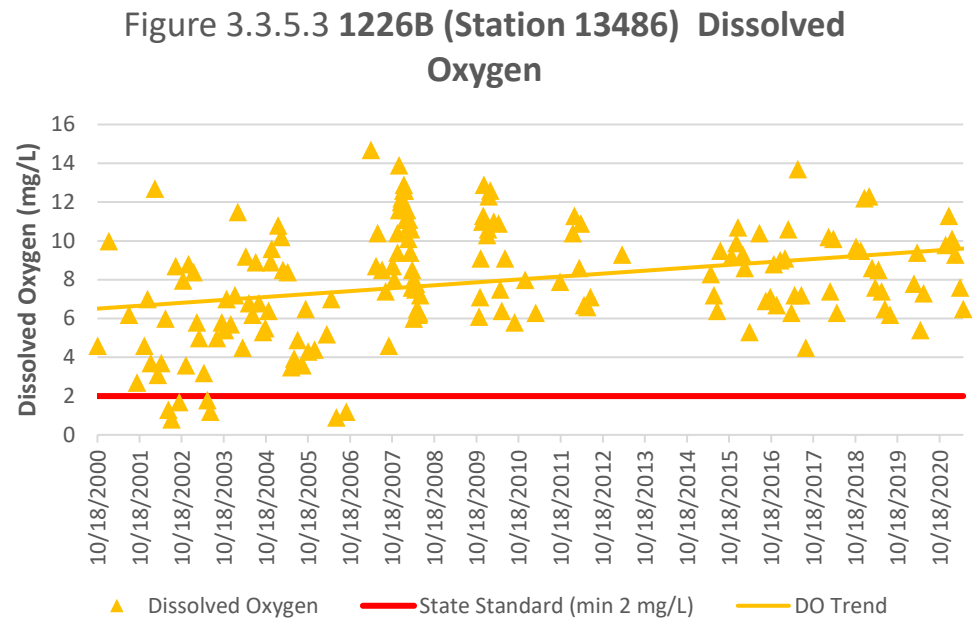
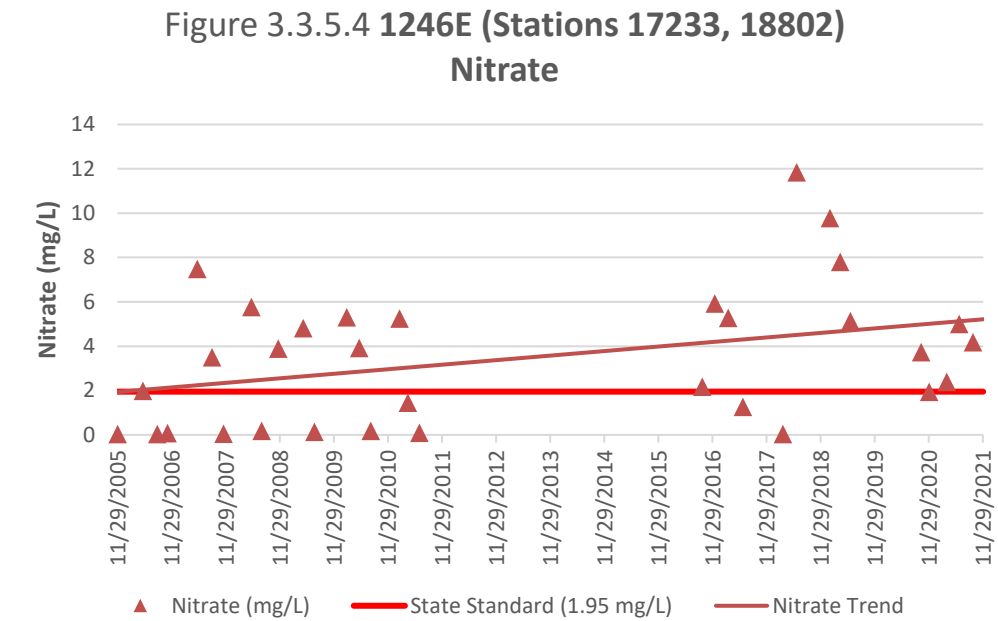


Figure 3.3.5.4 **1246E (Stations 17233, 18802) Nitrate**

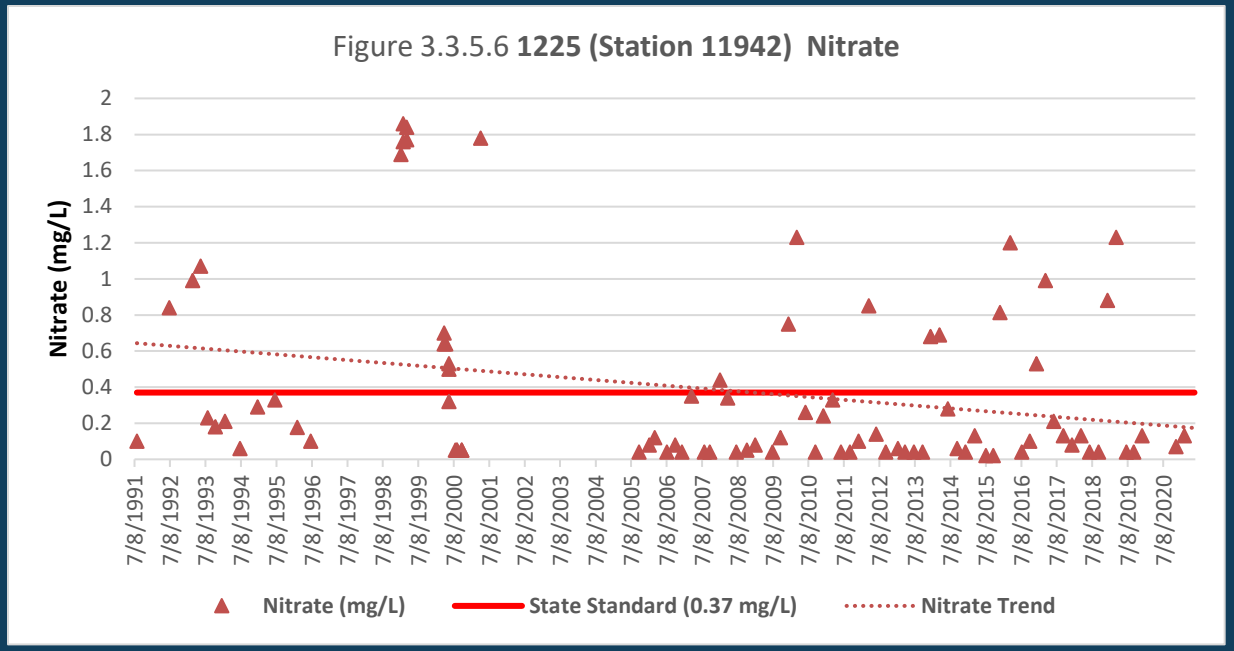


Segment **1226** has no statistically significant trends in dissolved oxygen or chlorophyll *a* data.

Segment **1246** has concerns related to nitrates (**1246**, **D**, **E**) and a bacteria impairment on one unclassified waterbody (**1246E**). Long-term trend analyses on Wasp Creek (**1246E**, stations 17233 and 18802), an unclassified intermittent stream, indicate a significant upward trend in nitrates (Figure 3.3.5.4), and the segment regularly exceeds the TCEQ criteria for bacteria, for which it is impaired (Table 3.3.5.1). This segment is dominated by agricultural lands, including cropland and pastureland with little forested area (Figure 3.3.5.5).

Figure 3.3.5.5 - Segment **1246E**, Wasp Creek, showing one monitoring station and dominant agricultural land use in the watershed.

Segment **1225**, Lake Waco, receives all of the drainage from the Bosque River watershed and is the source of drinking water for the City of Waco and many surrounding communities. Long-term trend analyses indicate a decreasing trend in total nitrate concentrations (Figure 3.3.5.6), and the 2020 IR indicates that nitrate levels are fully supporting the criteria.



Special Studies:

Two Total Maximum Daily Loads for Phosphorus in the North Bosque River
TMDL studies for segments **1226** and **1255** have been implemented to improve water quality and reduce phosphorous in the drainage (North Bosque TMDL homepage at https://www.tceq.texas.gov/waterquality/tmdl/06-bosque.html), the status of which were addressed at stakeholder meetings in September of 2020 and October 2021. To review recommendations of the North Bosque River Work Group please go to https://www.tceq.texas.gov/waterquality/tmdl/06-bosque-tmdl-workgroup.

Biological Assessments
BRA initiated long-term aquatic life monitoring (ALM) on **1226** at station 11951, North Bosque River at Cooper's Crossing, in 2008 in response to historical concerns for water quality and ALU nonattainment in the river and lake, and a shortage of biological data available for the 305(b) assessment. Biological assessments were performed in April and July of 2018 at the site, completing ten events for the ALM. To summarize ALM results, data from nine of ten events have shown that all components met, and generally exceeded, high ALU expectations. Those findings, together with supplemental water quality data, have reflected favorable environmental conditions over the course of the study. Despite historical 305(b) concerns for various constituents in parts of the segment, impacts on aquatic life have not been observed at the Coopers Crossing site (except for negative effects in August 2015 that resulted from severe flooding). As shown in the following figures, three of four major indicators of macroinvertebrate and fish integrity have displayed positive trends (Figures 3.3.5.8-3.3.5.11), providing evidence that nonpoint source and point source control measures as described in "An

Implementation Plan for Soluble Reactive Phosphorus in the North Bosque River Watershed" are having a beneficial effect on instream conditions in the lower portion of the segment.

Figure 3.3.5.8 **1226 (Station 11951) Invertebrate ALU Scores**

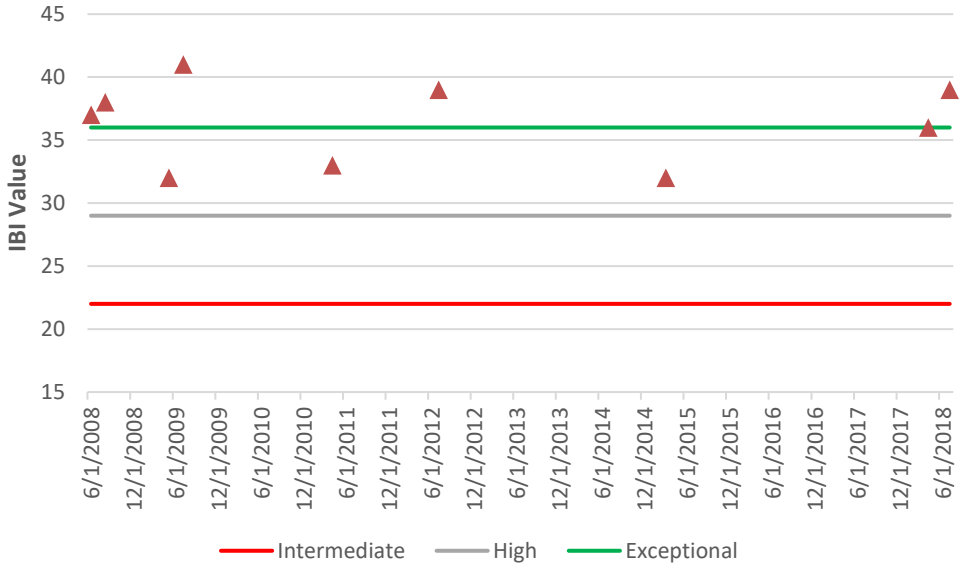


Figure 3.3.5.9 **1226 (Station 11951) Invertebrate Richness**

Figure 3.3.5.10 **1226 (Station 11951) Fish ALU Scores**

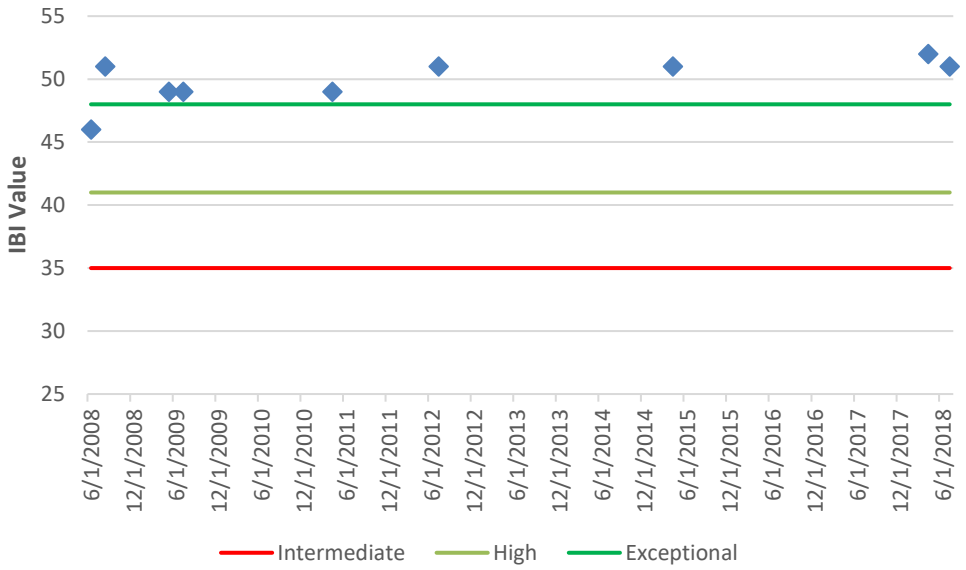


Figure 3.3.5.11 **1226 (Station 11951) Fish Species Richness**

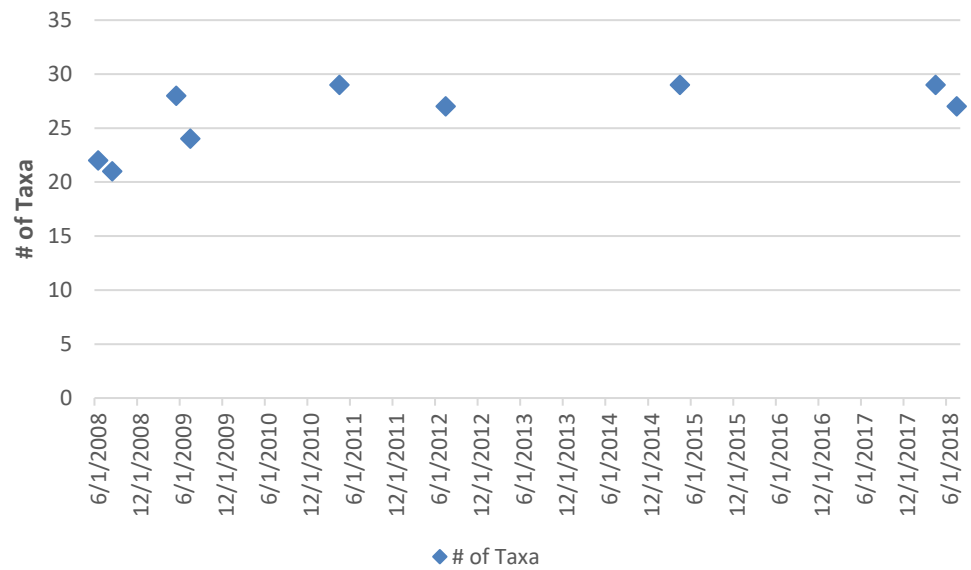


Table 3.3.5.2 Water Quality Issues Summary

Water Quality Issue	Affected Area	Possible Influences/Concerns	Possible Actions Taken/to be Taken
Impairments			
Depressed Dissolved Oxygen	• Green Creek • Upper North Bosque River	• Nonpoint source - Confined animal feeding operations, internal nutrient recycling • Municipal point source discharges • Green Creek classified flow type as intermittent w/ pools	• Complete UAAs to determine if DO standards for these are appropriate • Continue to follow and implement recommended best management practices outlined in the Implementation Plan for Soluble Reactive Phosphorus in the North Bosque River Watershed.
Bacteria	• Spring Creek • Little Duffau Creek • Wasp Creek • Upper North Bosque River • Goose Branch • Scarborough Creek • South Fork North Bosque River • Unnamed Tributary of Goose Branch • Woodhollow Branch	• There are no known point sources • Most of these are small, rural streams with little assimilative capacity, having no to low flow for most of the year. When water is present it is a result of a storm event and associated runoff. • A majority of the watershed is used as agricultural lands, range and pastureland, and Confined Animal Feeding Operations (CAFO).	• More current data should be collected in 1255A_01, 1255B_01, 1255C_01, and 1255E_01E to be used in assessing the segment using the newly approved criteria • Conduct additional watershed evaluations • Conduct an RUAA in 1226G
Concerns			
Chlorophyll *a*/Nutrients	• North Bosque River • Green Creek • Indian Creek • Alarm Creek • Little Duffau Creek • Middle Bosque/South Bosque River • Tonk Creek • Wasp Creek • Upper North Bosque River • Goose Branch • North Fork Upper North Bosque River • Scarborough Creek • South Fork North Bosque River • Unnamed Tributary of Goose Branch	• There are no known point sources • A majority of the watershed is used as agricultural lands, range and pastureland, and Confined Animal Feeding Operations (CAFO).	• Continue to follow and implement recommended best management practices outlined in the Implementation Plan for Soluble Reactive Phosphorus in the North Bosque River Watershed.

	• Brazos River/Lake Brazos		
Bacteria	• Duffau Creek	• There are no known point sources • A majority of the watershed is used as agricultural lands, range and pastureland, and Confined Animal Feeding Operations (CAFO).	• Continue routine monitoring
Dissolved Oxygen	• North Bosque River • Sims Creek Reservoir • Upper North Bosque River • South Fork Upper North Bosque River Reservoir	• Nonpoint source - Confined animal feeding operations, internal nutrient recycling • Municipal point source discharges	• Continue routine monitoring
Macrobenthic Community	• North Bosque River	• Nonpoint source - Confined animal feeding operations, internal nutrient recycling	• Review the ALM that was completed at station 11951 in 2018 and update the ALU status.

3.3.6 Leon River Watershed

Watershed Area	Active Surface Water Monitoring Stations	Monitoring Agencies	Permitted Discharges	Potential Stakeholders	Classified Segments
3730 mi2	37	BRA, TCEQ	36	Cities of Killeen, Harker Heights, Copperas Cove, Morgan's Point, Gatesville, Moody, Oglesby, Evant, Hamilton, Gustine, Comanche, Dublin, Rising Star, De Leon, Gorman, Eastland; Ft. Hood	1218, 1219, 1220, 1221, 1222, 1223, 1224, 1259

Description of Segments:

1224: Leon Reservoir – From Leon Dam in Eastland County up to the normal pool elevation of 1375 feet (impounds Leon River)

Segment Area: 1663 acres
*Assessment Units (Stations): 1224_01 (**11939**), 1224_02 (**11941**)*

Unclassified waterbody: **1224A**: Lake Olden
Assessment Units (Stations): 1224A_01 (none)

Unclassified waterbody: **1224B**: Leon River above Leon Reservoir
Assessment Units (Stations): 1224B_01 (none)

Unclassified waterbody: **1224C**: South Fork Leon River
Assessment Units (Stations): 1224C_01 (none)

1223: Leon River below Leon Reservoir – From a point immediately upstream of the confluence of Mill Branch in Comanche County to Leon Dam in Eastland County

Segment Length: 33.1 miles
*Assessment Units (Stations): 1223_01 (**11938**)*

Unclassified waterbody: **1223A**: Armstrong Creek
*Assessment Units (Stations): 1223A_01 (**15065**, **15765**, 17539)*

Unclassified waterbody: **1223B**: Cow Creek
Assessment Units (Stations): 1223B_01 (17540, 18046)

1222: Proctor Lake – From Proctor Dam in Comanche County to a point immediately upstream of the confluence of Mill Branch in Comanche County, up to the normal pool elevation of 1162 feet (impounds Leon River)

Segment Length: 4,610 acres
*Assessment Units (Stations): 1222_01 (**11936**, 14036, 14037, 14038), 1222_02 (**11937**, 14034, 14035), 1222_03 (**11935**, 14032, 14033, 18434)*

Unclassified waterbody: **1222A**: Duncan Creek
*Assessment Units (Stations): 1222A_01 (11825, **17544**)*

Unclassified waterbody: **1222B**: Rush-Copperas Creek
*Assessment Units (Stations): 1222B_01 (11824, **17538**)*

Unclassified waterbody: **1222C**: Sabana River
*Assessment Units (Stations): 1222C_01 (**13647**), 1222C _02 (None)*

Unclassified waterbody: **1222D**: Sowells Creek
Assessment Units (Stations): 1222D_01 (11827)

Unclassified waterbody: **1222E**: Sweetwater Creek
*Assessment Units (Stations): 1222E_01 (**17541**)*

Unclassified waterbody: **1222F**: Hackberry Creek
Assessment Units (Stations): 1222F_01 (17543)

1259: Leon River Above Belton Lake – From a point 100 meters (110 yards) upstream of FM 236 in Coryell County to the confluence with Plum Creek in Coryell County

Segment Length: 66.5 miles
*Assessment Units (Stations): 1259_01 (**11925**, 11926, 11927, **11804**), 1259_02 (11928, 17501), 1259_03 (17545)*

1221: Leon River below Proctor Lake – From a point immediately upstream of the confluence of Plum Creek in Coryell County to Proctor Dam in Comanche County

Segment Length: 123.3 miles
*Assessment Units (Stations): 1221_04 (**11929**, **11930**), 1221_05 (11932, 15769, **18781**, **20905**), 1221_06 (**17591**), 1221_07 (**11934**)*

Unclassified waterbody: **1221A**: Resley Creek
*Assessment Units (Stations): 1221A_01 (**11808**, **17377**, 17477), 1221A _02 (17376)*

Unclassified waterbody: **1221B**: South Leon River
*Assessment Units (Stations): 1221B_01 (**11817**)*

Unclassified waterbody: **1221C**: Pecan Creek
*Assessment Units (Stations): 1221C_01 (11807, **17547**)*

Unclassified waterbody: **1221D**: Indian Creek
*Assessment Units (Stations): 1221D_01 (**11818**), 1221D_02 (**17542**)*

Unclassified waterbody: **1221E**: Plum Creek
*Assessment Units (Stations): 1221E_01 (**18405**)*

Unclassified waterbody: **1221F**: Walnut Creek
*Assessment Units (Stations): 1221F_01 (**17379**, 18406)*

Unclassified waterbody: **1221G**: Coryell Creek
*Assessment Units (Stations): 1221G_01 (**11804**)*

1220: Belton Lake – From Belton Dam in Bell County to a point 100 meters (110 yards) upstream of FM 236 in Coryell County, up to the normal pool elevation of 594 feet (impounds Leon River)

Segment Length: 12,300 acres
*Assessment Units (Stations): 1220_01 (**11921**, 15676, **20835**), 1220_02 (**11922**), 1220_03 (**11923**, **18798**)*

Unclassified waterbody: **1220A**: Cowhouse Creek
*Assessment Units (Stations): 1220A_01 (None), 1220A_02 (**11805**), 1220A _03 (17546)*

1219: Leon River below Belton Lake – From the confluence with the Lampasas River in Bell County to Belton Dam in Bell County

Segment Length: 16.6 miles
*Assessment Units (Stations): 1219_01 (**11916**)*

1218: Nolan Creek/South Nolan Creek – From the confluence with the Leon River in Bell County to a point 100 meters (110 yards) upstream to the most upstream crossing of US 190 and Loop 172 in Bell County

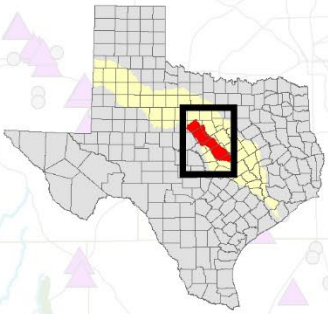
Segment Length: 28.4 miles
*Assessment Units (Stations): 1218_01 (None), 1218_02 (**11907**, 11913, 18826, 18827, 18828), 1218_03 (15271)*

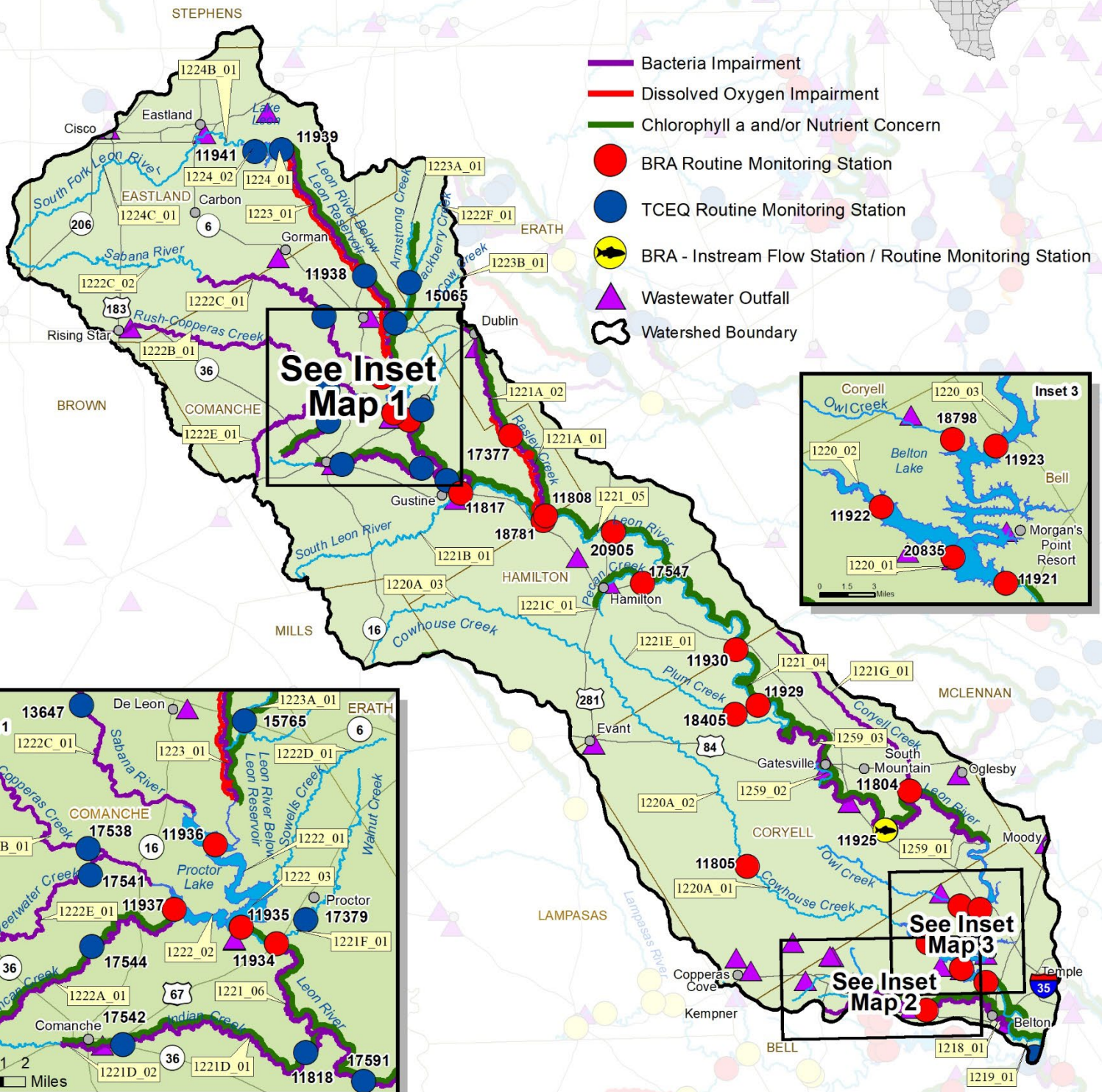
Unclassified waterbody: **1218A**: Unnamed Tributary to Little Nolan Creek
Assessment Units (Stations): 1218A_01 (18833)

Unclassified waterbody: **1218B**: South Nolan Creek
Assessment Units (Stations): 1218B_01 (18829)

Unclassified waterbody: **1218C**: Little Nolan Creek
*Assessment Units (Stations): 1218C_01 (18834, **21437**)*

Leon River Watershed
FY22 Water Quality Monitoring and 2020 IR Status





Brazos River Authority

Table 3.3.6.1 Segment Specific Water Quality Standards with Indications of Impairment and/or Concern from the 2020 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) and Significant Long-term Trends[1]

Leon River Watershed		Uses		Surface Water Quality Standards								Nutrient Screening Levels[5]			
Segment	Name	Recreation[2]	Aquatic Life[3]	Cl (mg/L)	SO4 (mg/L)	TDS (mg/L)	Dissolved Oxygen Average/ Minimum (mg/L)	pH	Bacteria[4] (MPN/100ml)	Temperature (°F)	Chlorophyll *a* (µg/l)	Ammonia - N (mg/l)	Nitrate - N (mg/l)	Total Phosphorus (mg/l)	Chlorophyll *a* (µg/l)
1218	**Nolan Creek/South Nolan Creek**	**PCR**	**H**	**100**	**75↑**	**500**	**5.0/3.0↓**	**6.5-9.0↓**	**126**	**93**		**0.33**	**1.95↑**	**0.69↑**	**14.1**
1218A	Unnamed tributary to Little Nolan Creek	PCR	L	100	75	500	3.0/2.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1218B	South Nolan Creek	PCR	H	100	75	500	5.0/3.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1218C	Little Nolan Creek	PCR	L	100	75	500	3.0/2.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1218D	Long Branch	PCR	H	100	75	500	5.0/3.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1219	**Leon River Below Belton Lake**	**PCR**	**H**	**150**	**75**	**500**	**5.0/3.0**	**6.5-9.0**	**126**	**91**		**0.33**	**1.95↑**	**0.69↑**	**14.1**
1220	**Belton Lake**	**PCR**	**H**	**100↓**	**75↓**	**500↓**	**5.0/3.0**	**6.5-9.0**	**126**	**93**	**6.38**				
1220A	Cowhouse Creek	PCR	L	100	75↓	500	3.0/2.0	6.5-9.0	126	93		0.33	1.95↓	0.69	14.1
1221	**Leon River below Proctor Lake**	**PCR**	**H**	**150↑**	**100↑**	**900**	**5.0/3.0**	**6.5-9.0↑**	**126**	**90**		**0.33**	**1.95**	**0.69**	**14.1**
1221A	Resley Creek	PCR	M	150	100	900	2.0/1.5	6.5-9.0↑	126	90		0.33	1.95	0.69↑	14.1↑
1221B	South Leon River	SCR1	H	150↓	100↓	900↓	5.0/3.0	6.5-9.0	126	90		0.33	1.95	0.69	14.1
1221C	Pecan Creek	PCR	I	150	100	900	4.0/3.0	6.5-9.0	126	90		0.33	1.95	0.69	14.1
1221D	Indian Creek	SCR2	I-H	150	100	900	5.0/3.0↑	6.5-9.0↑	126	90		0.33	1.95	0.69	14.1
1221E	Plum Creek	PCR	H	150	100	900	5.0/3.0	6.5-9.0	126	90		0.33	1.95	0.69	14.1
1221F	Walnut Creek	SCR2	L	150	100	900	3.0/2.0	6.5-9.0↑	1030	90		0.33	1.95↑	0.69	14.1
1221G	Coryell Creek	PCR	H	150↓	100	900	5.0/3.0↓	6.5/9.0	126	90		0.33	1.95	0.69	14.1
1222	**Proctor Lake**	**PCR**	**H**	**200↓**	**75↓**	**500↓**	**5.0/3.0**	**6.5-9.0**	**126**	**93**		**0.11↑**	**0.37**	**0.20**	**26.70↑**
1222A	Duncan Creek	SCR1	M	200	75	500	2.0/1.5	6.5-9.0	630	93		0.33	1.95	0.69	14.1

1222B	Rush-Copperas Creek	PCR	L	200	75	500	3.0/2.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1222C	Sabana River	PCR	M	200	75	500	2.0/1.5	6.5-9.0	126	93		0.33	1.95↓	0.69	14.1↓
1222D	Sowells Creek	PCR	M	200	75	500	2.0/1.5	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1222E	Sweetwater Creek	PCR	M	200	75	500	2.0/1.5	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1222F	Hackberry Creek	PCR	M	200	75	500	2.0/1.5	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1223	**Leon River Below Leon Reservoir**	**PCR**	**H**	**480**	**130↑**	**1240**	**5.0/3.0**	**6.5-9.0**	**126**	**93↓**		**0.33**	**1.95**	**0.69**	**14.1**
1223A	Armstrong Creek	SCR2	M	480	130	1240	2.0/1.5	6.5-9.0	1030	93		0.33	1.95	0.69	14.1
1223B	Cow Creek	PCR	M	480	130	1240	2.0/1.5	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1224	**Leon Reservoir**	**PCR**	**H**	**150**	**75**	**500**	**5.0/3.0**	**6.5-9.0**	**126**	**93**		**0.11**	**0.37**	**0.20**	**26.70**
1224A	Lake Olden	PCR	H	150	75	500	5.0/3.0	6.5-9.0	126	93		0.11	0.37	0.20	26.70
1224B	Leon River above Leon Reservoir	PCR	H	150	75	500	5.0/3.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1224C	South Fork Leon River	PCR	H	150	75	500	5.0/3.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1259	Leon River Above Belton Lake	PCR	H	150	100	900	5.0/3.0↑	6.5-9.0↑	126	90		0.33	1.95	0.69	14.1↑

[1]Long-term trends described in this report are based on analysis of all data collected from Fiscal year 1990 through 2021 with a minimum 10-year data set and at least 20 samples unless otherwise specified. A trend was considered statistically significant at p≤0.05 with an R-value of 0.2 to 1.
[2]PCR-Primary Contact Recreation, SCR-Secondary Contact Recreation
[3]E-Exceptional, H-High, I-Intermediate, L-Limited. M-Minimal
[4] The criteria numbers represent the geometric mean for *E. coli*
[5]For reservoirs where there is a Chlorophyll a standard, Nutrients are evaluated using a line-of-evidence framework described in the 2020 Guidance for Assessing and Reporting Surface Water Q Water Quality in Texas

Segment or portion of segment impaired

Segment or portion of segment has a concern for the standard or screening level

↑ Statistically significant increasing trend

↓ Statistically significant decreasing trend

Leon River Watershed

The northernmost tributaries of the Leon River watershed originate in the eastern portion of Callahan County and flows into the mainstem Leon River in Eastland County. From this confluence, the river courses through Comanche, Coryell, Hamilton, and finally reaches Bell, encompassing a total area of 3,533 square miles. There are three impoundments on the mainstem, Leon Reservoir, Proctor Lake, and Lake Belton. These waterbodies are used primarily for recreation, flood control and municipal water supply. Land use in the watershed is primarily rangeland and improved pastureland with areas of mixed forestland. The watershed also hosts a number of municipalities, approximately 50 confined animal feeding operations and row crop agriculture, along with being home to Fort Hood military base. Fort Hood is approximately 214,000 acres and is situated in the Southeast corner of the Leon River watershed.

Primary impairments in this watershed include bacterial and depressed dissolved oxygen impairments with concerns for nutrient enrichment and increased chlorophyll *a*. There are three classified segments and eight unclassified waterbodies on the 303(d) list for only bacteria (Segments **1218**, **1218C**, **1218D**, **1221**, **1221D**, **1221G**, **1222A**, **1222B**, **1222C**, **1222E**,**1259**) or both bacteria and depressed dissolved oxygen (Segments **1221A**, **1223**). Several classified and unclassified waterbodies have concerns for use based on increased levels of nitrate, total phosphorus, chlorophyll *a*, and depressed dissolved oxygen levels.

Segments **1220** and **1224** of the Leon River watershed are the only segments of the eight that do not have any impairments or concerns within the watershed. However, there are seven unclassified segments that do not have any impairments or concerns which include **1218B**, **1220A**, **1221E**, **1221F**, **1224A**, **1224B**, **1224C.** While Lake Proctor (**1222**) has a statistically significantly increasing trend of chlorophyll *a*, it is not a concern at this time.

The segment **1259** is impaired for bacteria and was first listed on the 303(d) in 1996 (Table 3.3.6.1). In addition, there are concerns for nitrate and chlorophyll *a* along with statistically significant trends in increasing dissolved oxygen and pH when using station 11925 (Figure 3.3.6.1) as the representative station. Although there are two WWTPs near Gatesville, the majority of the nutrient loading and pollution can be attributed to non-point input which include wildlife, confined animal feeding operations and agriculture land use. The increasing trends of dissolved oxygen (Figure 3.3.6.2) and increasing pH (Figure 3.3.6.3) are likely due to the concerns for nitrates and chlorophyll *a* within this segment. Currently dissolved oxygen and chlorophyll *a* concentrations are rising together; however if the nutrient enrichment and chlorophyll *a* concentrations get too great, the dissolved oxygen concentrations may decline.

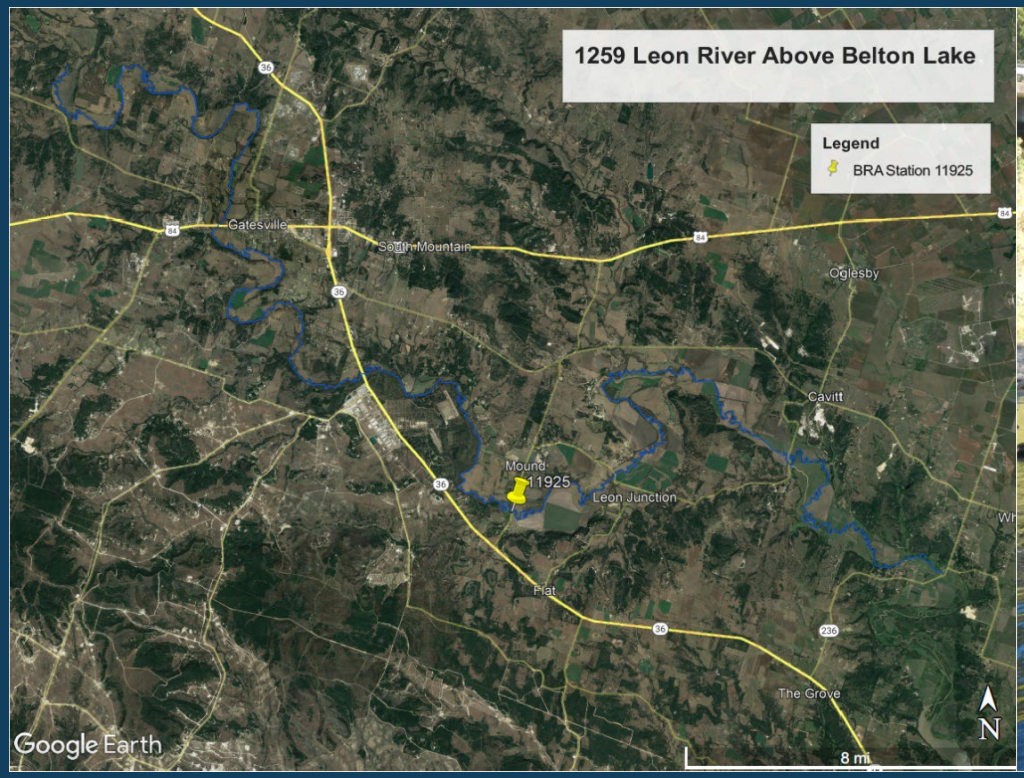


Figure 3.3.6.1 11925 - LEON RIVER IMMEDIATELY DOWNSTREAM OF FM 1829 SOUTHEAST OF NORTH FORT HOOD

Figure 3.3.6.2 **1259 (Station 11925) DO and Chlorophyll *a***

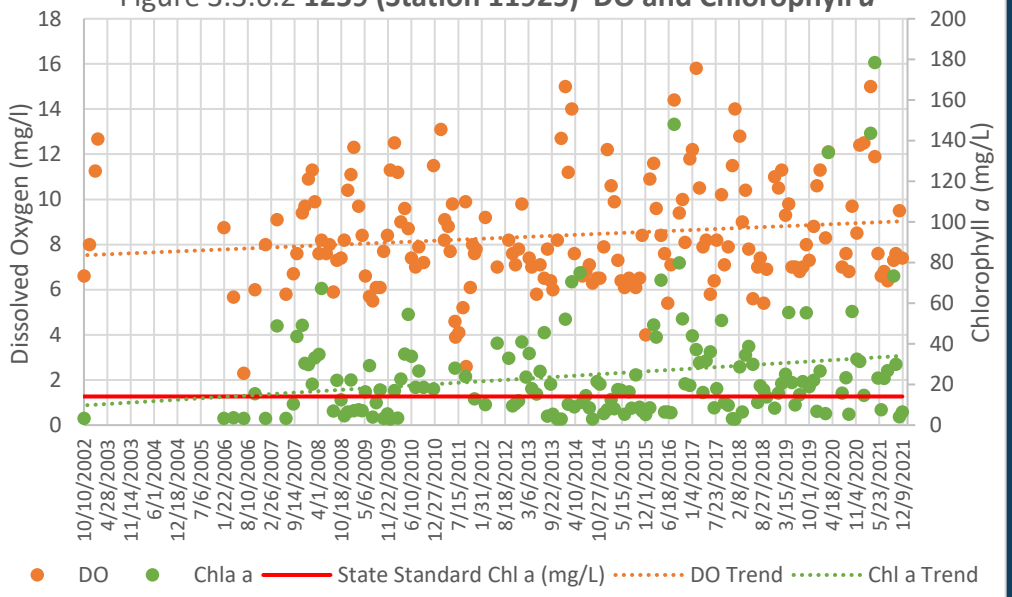
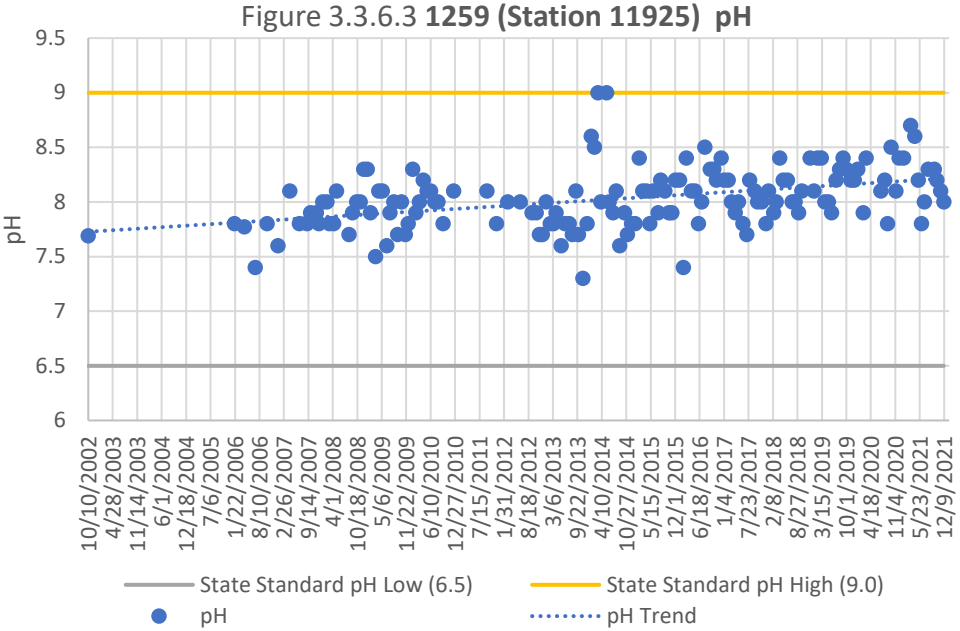


Figure 3.3.6.3 **1259 (Station 11925) pH**



The segment **1223** is impaired for bacteria and depressed dissolved oxygen and is listed on the 303(d) list along with a concern for chlorophyll *a* although there are no statistically significant increases or decreases for any of these parameters. Segment **1223A** has a use of Secondary Contact Recreation 2 and a bacteria criterion of 1030 MPN/100mL and is not considered impaired. **1223A** also has a concern for nitrate concentrations. It should be noted that no additional data has been collected in **1223B** since 2007 and there is a concern for bacteria. There are WWTPs that discharge effluent into this segment; however, the majority of the pollution can be attributed to nonpoint source input. There are a number of animal feeding operations located in the area, as well as an abundance of agricultural land in use, and abundant wildlife which may contribute to the NPS pollution contribution. The impairment of dissolved oxygen in segment **1223** is likely due to the presence of primary producers in the water indicated by increased chlorophyll *a* concentrations. An abundance of aquatic vegetations or algae in a system leads to large variations in levels of dissolved oxygen. Depending on temperature and sunlight, ranges can reach relatively high dissolved oxygen levels at the height of photosynthesis, and very low levels at the base of this process.

Segment **1222**, Proctor Lake, has one screening level concern for dissolved oxygen. This concern can most likely be attributed to the agricultural and grazing landscape that surrounds the lake along with the increase of algal biomass within the area of concern on the lake. Evidence for this is that there is a statistically significant increasing trend of chlorophyll *a* in **1222** (Figure 3.3.6.4). While there is no impairment for bacteria in the lake itself, four of the six unclassified segments have an impairment for bacteria, and the remaining have concerns. Segments **1222A**, **B**, **C**, and **E** have all been listed on the 303(d) list as impaired.

Analysis of historical data does not show a statistically significant trend in either direction for the levels of bacteria. The majority of these tributaries flow through rural land where farming is a common practice and wildlife habitat is abundant.

Figure 3.3.6.4 **1222 (Station 11935) Chlorophyll *a***

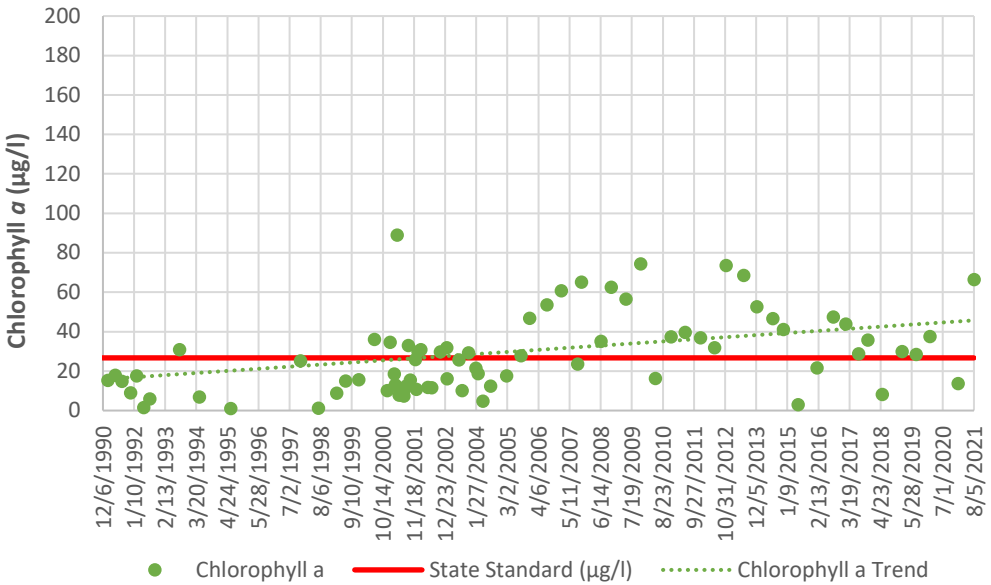
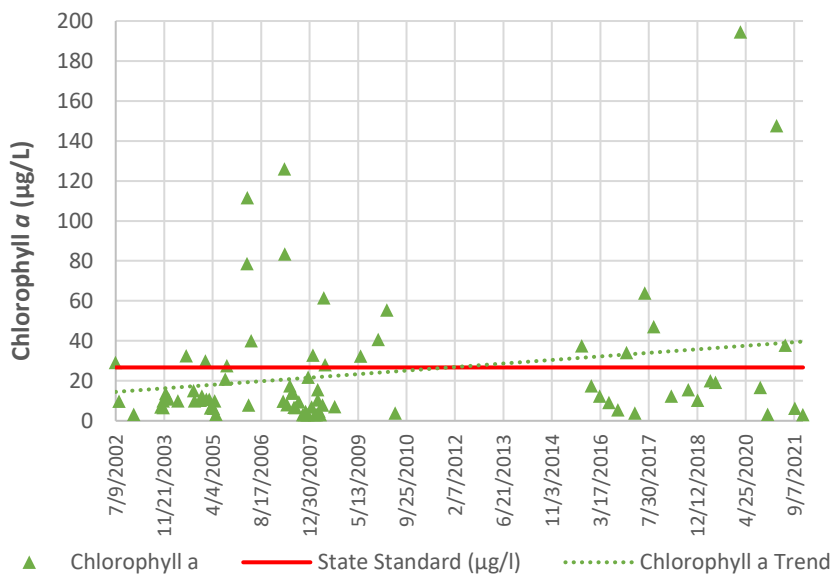


Figure 3.3.6.5 **1221A (Station 17377) - Chlorophyll *a***



Segment **1221** has several impairments and concerns as well. Impairments for bacteria can be found in **1221**_06 and **1221A**, **D**, **G** all of which are listed on the 303(d) list. Segment **1221A** is also listed on the 303(d) list for depressed dissolved oxygen. As is common in this watershed, CAFOs are present as well as abundant wildlife in the land around the mainstem and its tributaries. Segment **1221** has screening level concerns based on depressed dissolved oxygen and elevated chlorophyll *a* along with statistically increasing trends in chloride and sulfate concentrations. As aquatic vegetation increases, the levels of dissolved oxygen may be pushed to extremes as well. Segment **1221A** shows a screening level concern based upon the high level of chlorophyll *a* with an increasing statistically significant trend (Figure 3.3.6.5), and impairments for depressed dissolved oxygen and bacteria. One improvement in this segment is the delisting of segment **1221C** which was previously impaired for recreational use due to high bacteria levels. Although **1221C** may remain delisted for high bacteria levels it does have a concern for chlorophyll *a*.

Segment **1220** is composed of Belton Lake and Cowhouse Creek. There are no concerns or impairments on Belton Lake regarding water quality. There is a historical trend downward for dissolved solids detected in the lake (Table 3.3.6.1).

Segment **1219**, the Leon River below Belton Lake, has no impairments, but a concern for nitrate, total phosphorus, and bacteria. As this segment of the watershed runs along the eastern side of Belton, much of the concern for these water quality parameters can be attributed to urban runoff, and other nonpoint source pollution.

Figure 3.3.6.6 **1218 (Station 11907) - Log *E.coli***

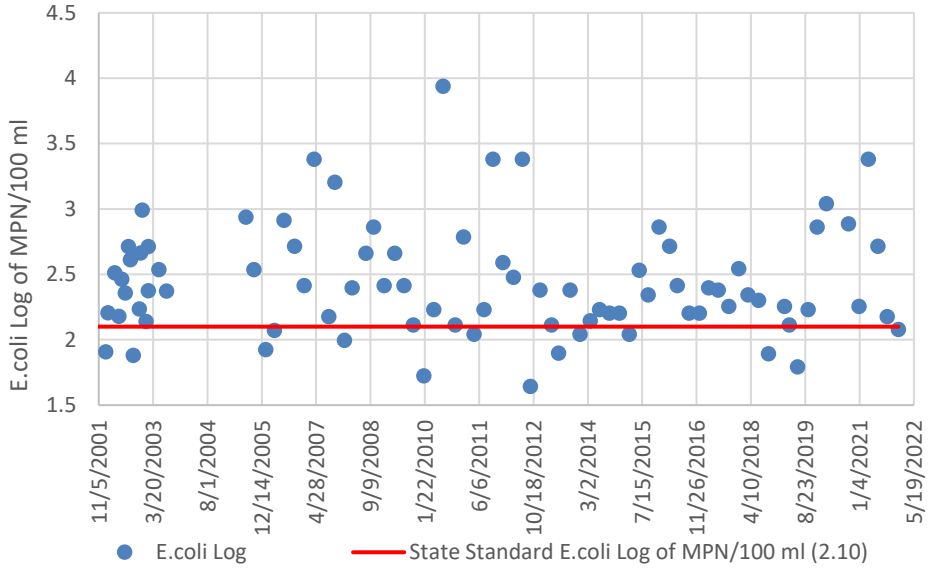
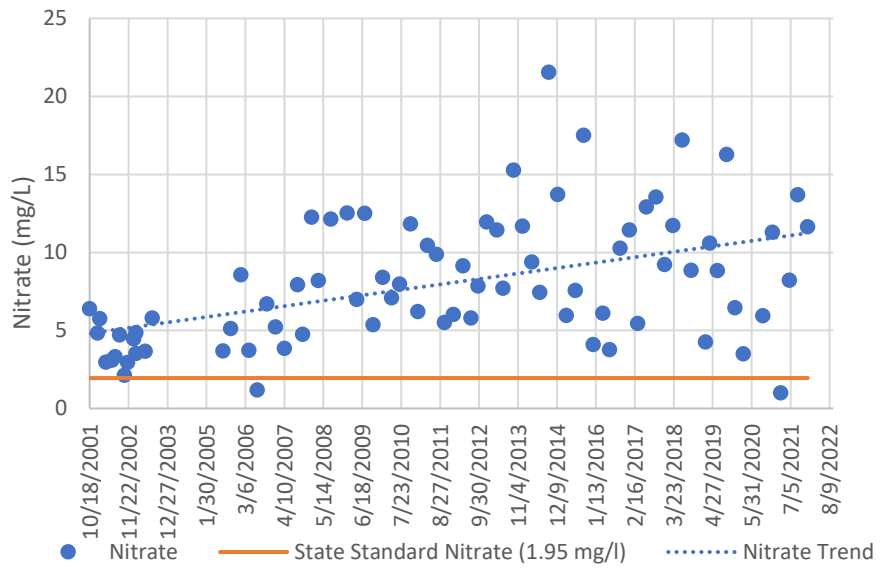


Figure 3.3.6.7 **1218 (Station 11907) - *Nitrate***



Nolan Creek/South Nolan Creek (Segment **1218**) is on the 303(d) list based on high bacteria levels. Figure 3.3.6.6 illustrates the 84% of bacteria samples that exceeded the state standard level, with seven of these samples being above the 1500 MPN/100 mL level (3.18 when Log transformed). This can be attributed to the highly urbanized area, Fort Hood, Killeen, Belton, and Harker Heights, and the runoff associated with it. Also, wastewater discharges and possibly poorly functioning septic systems are located along this segment which can also contribute to the problems associated with elevated bacteria levels. Also associated with the nonpoint source and point source pollution are the concerns for nitrate and total phosphorus. Although there are no statistically significant trends for bacteria in **1218**, there is a statistically significant upward trends for nitrate levels in this segment which could lead to further water quality issues in the system (Figure 3.3.6.7).

Special Studies:

Watershed Protection Plan for the Leon River

The Leon River below Proctor Lake, Segment **1221**, was placed on the State's 303(d) List in 1996 for having high bacteria levels. Placement of the Leon River on the List caused the TCEQ to initiate the development of a Total Maximum Daily Load (TMDL) on the portion of the river downstream of Lake Proctor and upstream of Hamilton in 2002. Upon completion of the TMDL modeling report in 2006, local stakeholders requested the BRA to facilitate the development of a Watershed Protection Plan (WPP) for the Leon River to assist the TCEQ in the selection of appropriate implementation strategies for the watershed. The BRA received funding for the project through the Texas State Soil and Water Conservation Board (TSSWCB) and began hosting stakeholder meetings in 2007. Stakeholders worked diligently toward the development of a WPP document and a draft WPP was completed and released for public comment in December 2011. The WPP was submitted to the EPA in 2012. The Leon River Watershed Protection Plan was

approved by the EPA in early 2015 and is now in the implementation phase. While the primary focus of the WPP was on the impaired reaches, other water quality issues that may come about or are raised by local stakeholders will be addressed by this WPP.

A Watershed Coordinator through a grant from the TSSWCB and contracted through the Central Texas Council of Governments works to coordinate implementation of the voluntary WPP by educating and informing local citizens on local surface water quality issues and encouraging citizens to implement Best Management Practices (BMPs) identified in the WPP on their properties. Examples of identified BMPs in the WPP for implementation in the Leon River watershed involve Feral Hogs, OSSFs, Grazing Management, Urban Strategies, Deer Population Management, and Dead Animal Disposal. You can visit http://leonriver.tamu.edu/ for further information on the Leon Watershed and the WPP or their Facebook page.

Watershed Protection Plan for Nolan Creek/South Nolan Creek

The Nolan Creek/South Nolan Creek, Segment **1218** was first included on the 303(d) list as impaired for elevated bacteria concentrations in 1996. In the 2020 IR Segment **1218** remains listed as impaired for recreational use.
A characterization project, led by TIAER, began in August 2012 and ended in February 2015. The Nolan Creek Watershed Partnership began meeting in 2013 and provided local input for development of the WPP. In February 2019, the Watershed Protection Plan for Nolan Creek/South Nolan Creek was accepted by the EPA. The Texas Institute for Applied Environmental Research facilitated development of this WPP through Clean Water Act 319(h) project funding via the TCEQ. The Nolan Creek/South Nolan Creek WPP focuses on activities to control bacteria contributions as the main water quality impairment, but also addresses concerns related to elevated nutrients. Some of the practices include: education and outreach, adding pet waste stations, promoting low impact development, developing water quality management plans for livestock and horse owners, trapping feral hogs, and organizing creek clean up events. For more information on the Nolan Creek WPP please visit http://www.nolancreekwpp.com/.

Reservoir Fisheries Habitat Improvement

Belton Lake (**1220**) and Proctor Lake (**1222**) are part of the Reservoir Fisheries Habitat Improvement project described in the Upper Watershed of the Brazos River section of this report.

Brazos Basin Instream Flow Monitoring Program to Inform on Environmental Flow Standards.

Leon River near Gatesville is part of the extensive habitat and biological data collection efforts and will occur at various flow regimes to better assess the impact that varying water levels have on aquatic communities.

Biological Assessments

Segment **1221A**, Resley Creek, an unclassified tributary of Leon River Segment **1221**, has not been assigned an aquatic life use (ALU) or dissolved oxygen criteria by TCEQ. In the 305(b) process, the creek has been assessed using a minimal ALU and 24-hour dissolved oxygen criteria of 2.0 mg/L (average) and 1.5 mg/L (minimum), based on a presumption that the creek is intermittent without perennial pools. In late September 2020, continued 24-hour dissolved oxygen measurements at station 17377 (Figure 3.3.6.8) began in order to collect more dissolved oxygen data to inform TCEQ on what standard criteria should be applied to this unclassified segment. Currently, five diel measurements have been completed with the sixth diel measurement scheduled to be completed in the spring of 2022.

Figure 3.3.6.8 Station 17377 24-hr DO deployment location on Resley Creek

Segment **1259**, the Leon River above Belton Lake, has a designated high aquatic life use (ALU), and 24-hour dissolved oxygen criteria of 5.0 mg/L (average) and 3.0 mg/L (minimum) (Texas Surface Water Quality Standards, Appendix A). BRA's aquatic life monitoring site at FM 1829 southeast of Gatesville at station 11925 (Figure 3.3.6.9) integrates effects of most water quality influences in the watershed upstream from Belton Lake. Considering past IR stated concerns for bacteria, dissolved oxygen, nitrate, chlorophyll *a*, and algal growth in portions of the segment, monitoring objectives have been to evaluate the condition of aquatic life and to provide a baseline for evaluating the effectiveness of ongoing water quality improvement projects including the Leon River Watershed Protection Plan and best management practices for dairy operations in the watershed.

Initial assessments in April and September 2008 showed that physical habitat, benthic macroinvertebrates, and dissolved oxygen met or exceeded high ALU expectations, while the fish assemblage rated intermediate. Reduced fish IBI scores were due to over-representation by tolerant species and omnivores, and low numbers of piscivores and individuals per seine haul. Although chlorophyll *a* exceeded TCEQ's screening level during both events, there were no obvious water quality factors which would account for depressed fish IBI scores. Rising flow during the April event may have affected collecting success to some extent, as elevated flow velocities and turbidity may have hindered the collectors' ability to see and net stunned fish during electrofishing. Some undetected water quality variable related to low flow may have been involved during the September event, as was also suggested by a reduction in the benthic IBI score. However, another potentially detrimental factor during September, particularly for benthic macroinvertebrates, was the possibility of incomplete recovery from the scouring effects of a large rise event that occurred approximately one month prior to sampling.

Due to indications that the fish assemblage was slightly impaired in 2008, follow-up assessments were conducted on May 5-6 and August 9-11, 2010, to investigate temporal changes. In the first event, during the non-critical portion of the index period, dissolved oxygen concentrations achieved an exceptional ALU, and physical habitat, benthic macroinvertebrates, and fish a high ALU. In the second event, during the critical portion of the index period, reassessment of one habitat transect showed that characteristics had not changed appreciably; therefore, the 5/5/10 physical habitat data, which reflected achievement of a high ALU, were re-utilized. Dissolved oxygen concentrations achieved an exceptional ALU, and benthic macroinvertebrates and fish a high ALU. Water chemistry data indicated that nitrate and total phosphorus concentrations were below TCEQ screening levels, but chlorophyll a was excessive during both events. However, no adverse effects on dissolved oxygen concentrations or aquatic life were evident. All components of the 2010 assessments met or exceeded high ALU expectations.

Figure 3.3.6.9 Upper section of biological reach of the Leon River at FM 1829.

A third round of assessments were conducted on July 30-August 1 and October 8-10, 2019, to determine whether aquatic life integrity had changed since 2010. In the first event, during the critical portion of the index period, dissolved oxygen concentrations achieved an exceptional ALU, and physical habitat, benthic macroinvertebrates, and fish a high ALU. Indications from the second event, during the non-critical portion of the index period, were similar, as dissolved oxygen concentrations achieved an exceptional ALU, and physical habitat, benthic macroinvertebrates, and fish a high ALU. Water chemistry data indicated that nutrient

parameters were below TCEQ screening levels, except for a slightly elevated chlorophyll a concentration in October. No adverse effects on dissolved oxygen concentrations or aquatic life were evident. All components of the 2019 assessments met or exceeded high ALU expectations.

Figure 3.3.6.10 Dusky darter (*Percina sciera*)

Figure 3.3.6.11 Central Stoneroller (*Campostoma anomalum*)

In summary, the reasons the fish assemblage (Figures 3.3.9.10 and 3.3.6.11) failed to attain a high ALU in 2008 remain unknown, although previously-described hydrological factors, low-flow water quality influences, and/or natural year-to-year variability in fish assemblage structure may have been involved. The most recent results from 2019 indicate that depressed fish assemblage integrity has not persisted, and that present-day environmental conditions are favorable.

Table 3.3.6.2 Biological assessment results for the July/August 2019 event

Site	Dates	Invertebrate ALU rating (IBI Score)	Fish ALU rating (IBI Score)	Habitat ALU rating (HQI Score)	D.O. ALU rating (24-hr mean)	D.O. ALU rating (24-hr min.)
Site Leon River at FM 1829 southeast of Gatesville (11925)	30 Jul 2019-01 Aug 2019	High (33)	High (45)	High (20)	Exceptional (7.0)	Exceptional (6.2)

Table 3.3.6.3 Water Quality Issues Summary

Water Quality Issue	Affected Area	Possible Influences/Concerns	Possible Actions Taken/to be Taken
Impairments			
Bacteria	• Nolan Creek/South Nolan Creek • Little Nolan Creek • Long Branch • Leon River below Proctor Lake • Resley Creek • Indian Creek • Coryell Creek • Duncan Creek • Rush-Copperas Creek • Sabana River • Sweetwater Creek • Leon River Below Leon Reservoir • Leon River Above Belton Lake	• Small rural tributaries, highly influenced by grazing pastures and very little flow. • WWTPs in urbanized and rural areas • Storm water runoff from CAFOs • A majority of the watershed is used as agricultural lands, range and pastureland, and Confined Animal Feeding Operations (CAFOs)	• Continue to follow and implement recommended best management practices outlined in the Leon River WPP and monitor for water quality improvements. • Await EPA review and approval of revised recreational use (SCR2) for 1221A before a management strategy is selected. • More current data should be collected in segments where new criteria have been approved and there is a lack of current data • Conduct additional watershed evaluations where RUAAs have been completed and the segment remains classified as a PCR segment.
DO Impairment	• Resley Creek sub-watershed, and Leon River below Leon Reservoir	• Agricultural land in sub-watershed • Runoff from permitted CAFOs • Municipal point source discharges	• 24-hr DO data is being collected for the Resley Creek sub-watershed • Perform a UAA to determine if the existing ALU and dissolved oxygen criteria are

			appropriate, and if not, provide data for establishing new standards.
Concerns			
Dissolved Oxygen	• Leon River Below Proctor Lake • Indian Creek • Proctor Lake • Hackberry Creek	• Nonpoint source - Confined animal feeding operations, internal nutrient recycling • Small rural tributaries, highly influenced by grazing pastures and very little flow	• Conduct 24-hr DO study
Bacteria	• Unnamed tributary to Little Nolan Creek • Leon River Below Belton Lake • South Leon River • Sowells Creek • Hackberry Creek • Cow Creek	• A majority of the watershed is used as agricultural lands, range and pastureland, and Confined Animal Feeding Operations (CAFOs) • Small rural tributaries, highly influenced by grazing pastures and very little flow.	• Continue routine monitoring • Continue to conduct RUAAs to address all impairments in the system
Chlorophyll *a*/Nutrients	• Nolan Creek/South Nolan Creek • Leon River Below Belton Lake • Leon River Below Proctor Lake • Resley Creek • Pecan Creek • Indian Creek • Duncan Creek • Leon River Below Leon Reservoir • Armstrong Creek • Leon River Above Belton Lake	• A majority of the watershed is used as agricultural lands, range and pastureland, and Confined Animal Feeding Operations (CAFOs) • WWTPs in urbanized and rural areas	• Continue routine monitoring

3.3.7 Lampasas Watershed

Watershed Area	Active Surface Water Monitoring Stations	Monitoring Agencies	Permitted Discharges	Potential Stakeholders	Classified Segments
1,502 mi^2	22	BRA, TCEQ	7	Cities of Lampasas, Salado, Florence, Kempner, Copperas Cove; Central Texas WSC, Salado Utility, Inc., Bell County WCID	1215, 1216, 1217, 1243

Description of Segments:

1215: Lampasas River Below Stillhouse Hollow Lake – From the confluence with Leon River in Bell County to Stillhouse Hollow Lake Dam in Bell County.

Segment Length: 17 miles
*Assessment Units (Stations): 1215_01 (11893, **13547**)*

1216: Stillhouse Hollow Lake – From Stillhouse Hollow Lake Dam in Bell County to a point immediately upstream of the confluence of Rock Creek in Bell County, up to normal pool elevation of 622 feet (impounds Lampasas River)

Segment Area: 6,430 acres at top of conservation pool
*Assessment Units (Stations): 1216_01 (**11894**, **11895**, 14058, 18752, **18753**, 18756, 18757, 18758, 20049), 1216_02 (20046, 20047, 20048), 1216_03 (None), 1216_SA1 (**20051**, 20052)*

Unclassified waterbody: **1216A**: Trimmier Creek
*Assessment Units (Stations): 1216A_01 (**18754**, 20050)*

Unclassified waterbody: **1216B**: Onion Creek
Assessment Units (Stations): 1216B_01 (18755)

Unclassified waterbody: **1216C**: Pleasant Branch
*Assessment Units (Stations): 1216C_01 (**21689**)*

Unclassified waterbody: **1216D**: Pleasant Branch
*Assessment Units (Stations): 1216D_01 (**21690**)*

1217: Lampasas River Above Stillhouse Hollow Lake – From point immediately upstream of the confluence of Rock Creek in Bell County to FM 2005 in Hamilton County

Segment Length: 94 miles

*Assessment Units (Stations): 1217_01 (**11896**, 18761, 20018), 1217_02 (**11897**), 1217_03 (**16404**), 1217_04 (**15770**), 1217_05 (**15762**)*

Unclassified waterbody: **1217A**: Rocky Creek

*Assessment Units (Stations): 1217A_01 (**11724**, 18330, 18331, 18332)*

Unclassified waterbody: **1217B**: Sulphur Creek

*Assessment Units (Stations): 1217B_01 (**15250**, **15781**, 15782, 16358), 1217B _02 (15766, 15780, 18760, **18782**, 18783, 18787)*

Unclassified waterbody: **1217C**: Simms Creek

Assessment Units (Stations): 1217C_01 (15763)

Unclassified waterbody: **1217D**: North Rocky Creek

*Assessment Units (Stations): 1217D_01 (**18334**, 18656)*

Unclassified waterbody: **1217E**: South Rocky Creek

Assessment Units (Stations): 1217E_01 (11725, 18333, 18657)

Unclassified waterbody: **1217F**: Reese Creek

*Assessment Units (Stations): 1217F_01 (**18759**, 18850)*

Unclassified waterbody: **1217G**: Clear Creek

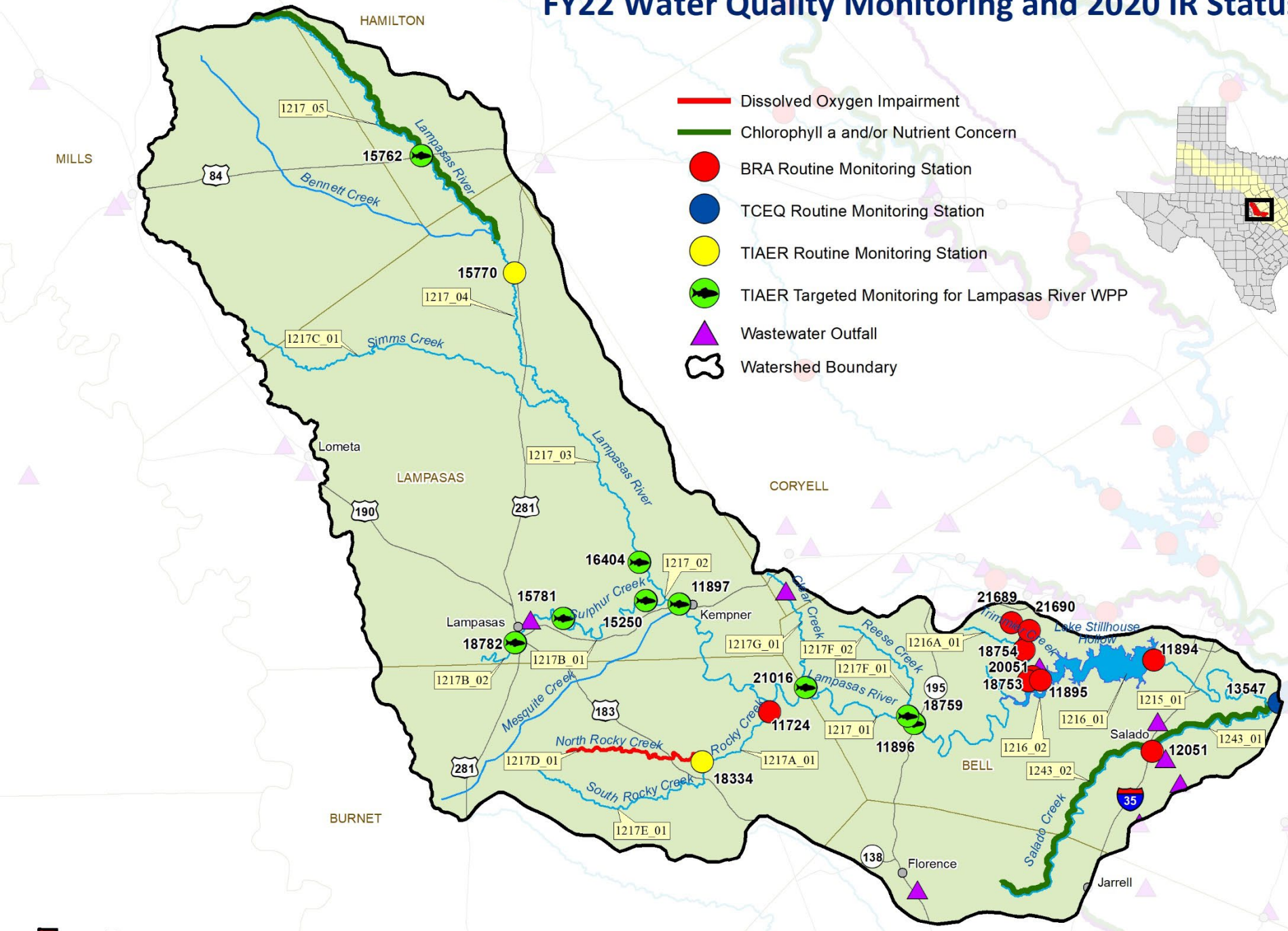
*Assessment Units (Stations): 1217G_01 (**21016**)*

1243: Salado Creek – From the confluence with the Lampasas River in Bell County to the confluence of North/South Fork Salado Creek in Williamson County

Segment Length: 27 miles

*Assessment Units (Stations): 1243_01 (12045, 12047, 12049, 12050, **12051**), 1243_02 (11760, 12052, 12053, 20306)*

Lampasas River Watershed
FY22 Water Quality Monitoring and 2020 IR Status



Brazos River Authority

0 10 20 Miles

Table 3.3.7.1 Segment Specific Water Quality Standards with Indications of Impairment and/or Concern from the 2020 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) and Significant Long-term Trends[1]

Lampasas River Watershed		Uses		Surface Water Quality Standards								Nutrient Screening Levels[6]			
Segment	Name	Recreation[2]	Aquatic Life[3]	Cl (mg/L)	SO4 (mg/L)	TDS (mg/L)	Dissolved Oxygen Average/ Minimum (mg/L)	pH	Bacteria[4] (MPN/100ml)	Temperature (°F)	Chlorophyll *a* (µg/l)	Ammonia - N (mg/l)	Nitrate - N (mg/l)	Total Phosphorus (mg/l)	Chlorophyll *a* (µg/l)
1215	**Lampasas River below Stillhouse Hollow Dam**	**PCR**	**H**	**100** ↓	**75**	**500** ↓	**5.0/3.0**	**6.5-9.0**	**126**	**91**		**0.33**	**1.95**	**0.69**	**14.1**
1216	**Stillhouse Hollow Lake**	**PCR**	**E**	**100**	**75**	**500**	**6.0/4.0**	**6.5-9.0**	**126**	**93**	**5.0**				
1216A	Trimmier Creek	PCR	H	**100**	**75**	**500**	5.0/3.0	6.5-9.0 ↑	126	93		0.33	1.95	0.69	14.1
1216B	Onion Creek	PCR	M	**100**	**75**	**500**	2.0/1.5	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1216C	Pleasant Branch	PCR	M	**100**	**75**	**500**	2.0/1.5	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1216D	Unnamed tributary of Trimmier Creek	PCR	H	**100**	**75**	**500**	5.0/3.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1217	**Lampasas River Above Stillhouse Hollow Lake**	**PCR**	**H**	**500** ↑	**100** ↓	**1200**	**5.0/3.0**	**6.5-9.0**	126	**91**		0.33	**1.95**	**0.69**	**14.1**
1217A	Rocky Creek	PCR	L	500 ↑	100	1200	3.0/2.0	6.5-9.0	126	91		0.33	1.95	0.69	14.1
1217B	Sulphur Creek	PCR	H	500	100	1200	5.0/3.0	6.5-9.0	126	91		0.33	1.95	0.69	14.1
1217C	Simms Creek	PCR	**H**	500	100	1200	5.0/3.0	6.5-9.0	126	91		0.33	1.95	0.69	14.1
1217D	North Rocky Creek	PCR	L	500	100	1200	3.0/2.0[5]	6.5-9.0	126	91		0.33	1.95	0.69	14.1
1217E	South Rocky Creek	PCR	L	500	100	1200	3.0/2.0	6.5-9.0	126	91		0.33	1.95	0.69	14.1
1217F	Reese Creek	PCR	H	500	100	1200	5.0/3.0	6.5-9.0	126	91		0.33	1.95	0.69	14.1
1217G	Clear Creek	PCR	H	500	100	1200	5.0/3.0	6.5-9.0 ↑	126	91		0.33	1.95	0.69	14.1
1243	**Salado Creek**	**PCR**	**H**	**50**	**50** ↑	**400** ↑	**5.0/3.0** ↓	**6.5-9.0**	**126** ↓	**90**		**0.33**	**1.95** ↑	**0.69**	**14.1**

[1]Long-term trends described in this report are based on analysis of all data collected from Fiscal year 1990 through 2021 with a minimum 10-year data set and at least 20 samples unless otherwise specified. A trend was considered statistically significant at p≤0.05 with an R-value of 0.2 to 1
[2]PCR-Primary Contact Recreation
[3]E-Exceptional, H-High, I-Intermediate, L-Limited, M-Minimal
[4]The criteria numbers represent the geometric mean for *E. coli*
[5]A site-specific 24-hour average DO criterion of 2.0 mg/L and a 24-hour minimum dissolved oxygen criterion of 1.0 mg/L apply when stream flows are below 1.5 cfs
[6]For reservoirs where there is a Chlorophyll *a* standard, Nutrients are evaluated using a line-of-evidence framework described in the 2020 Guidance for Assessing and Reporting Surface Water Q Water Quality in Texas

Segment or portion of segment impaired

↑ Statistically significant increasing trend

Segment or portion of segment has a concern for the standard or screening level

↓ Statistically significant decreasing trend

Lampasas River Watershed

The headwaters of the Lampasas River are west of the City of Hamilton. The river courses through Lampasas, Burnett, and Bell counties before being impounded by Stillhouse Hollow Dam. Salado Creek drains into the Lampasas below the dam, and then confluences with the Leon River to form the Little River. The land use in the Lampasas River watershed is predominantly agricultural, although rapid development continues around Kempner, Coppers Cove, Killeen, and Harker Heights. Much of the Lampasas River has heavily vegetated banks and is characterized by low-flow conditions much of the time.

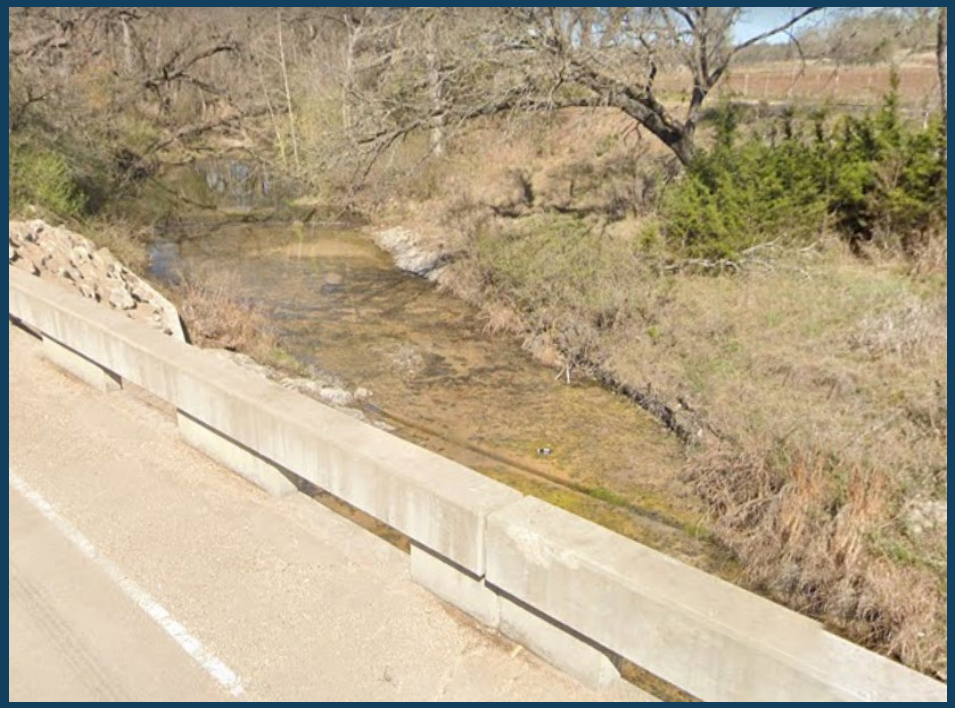


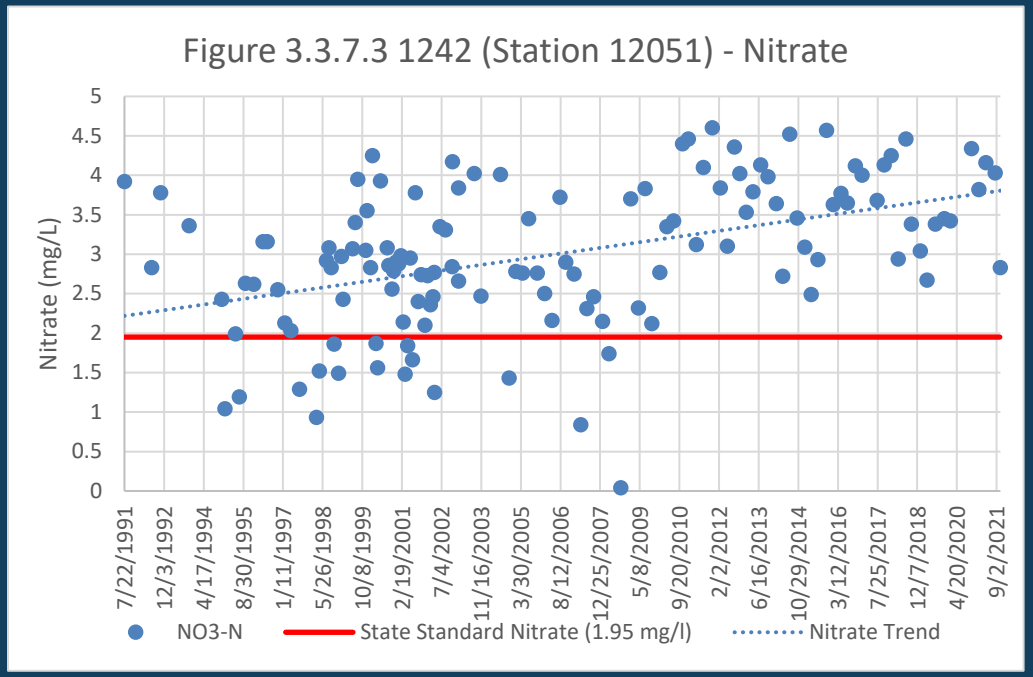
Figure 3.3.7.2 Data collected at Station 18334 – NORTH FORK ROCKY CREEK S FM963 is used to assess segment 1217D.

Lampasas River below Stillhouse Hollow Dam (**1215**) has no impairments or concerns in the 2020 IR. Only one segment, unclassified waterbody **1217D,** North Rocky Creek is impaired in the Lampasas River Watershed. In the 2020 IR, **1217D** is still listed as impaired for depressed dissolved oxygen. This DO impairment is caused by frequent low water levels which hinder its ability to buffer against high ambient air temperatures in the summer and fall reducing the water's capacity to maintain DO levels. Biological data collected over the years indicated that North Rocky Creek supports a relatively healthy biological community even with depressed DO levels. There were no statistically significant water quality trends found in **1217D**.

Sulphur Creek, **1217B** has a concern for depressed dissolved oxygen. Low dissolved oxygen is likely a result of anoxic groundwater influx from the many springs that feed into the stream. There were no statistically significant water quality trends found in **1217B**.

Pleasant Branch (**1216C**), Lampasas River above Stillhouse Hollow (**1217**), and an unnamed tributary of Trimmier Creek (**1216D**) all show concerns for bacteria but no statistically significant trends either increasing or decreasing for parameters of concern or impairment.

There is also a concern for nitrate, at Salado Creek, **1243** with a statistically significant increasing trend (Figure 3.3.7.3) when using station 12051 (Figure 3.3.4) as a representative station. Potential sources of nitrates in Salado Creek are from septic infiltration and applications of nitrate containing fertilizers.



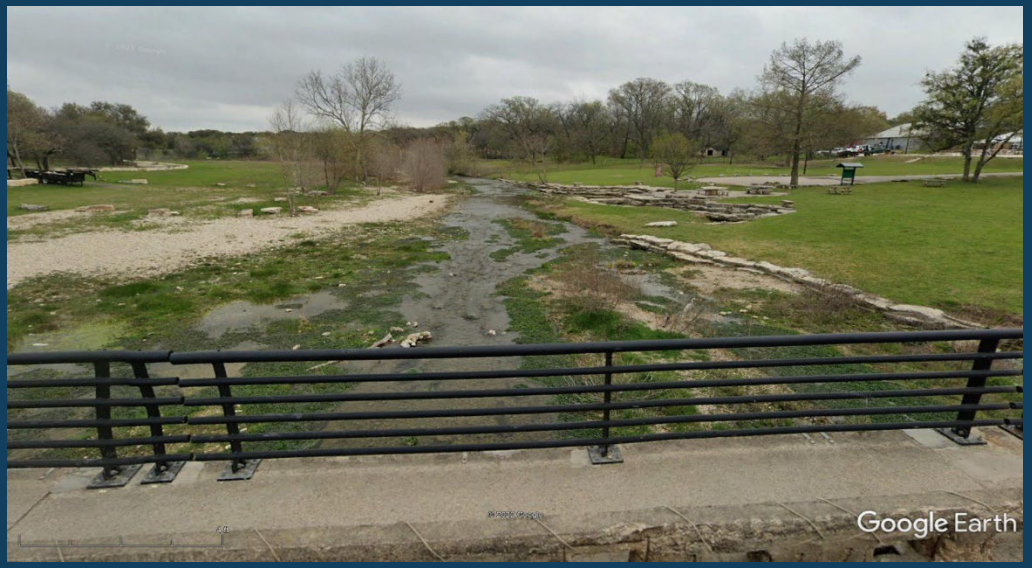


Figure 3.3.7.4 Data collected at Station 12051 – SALADO CREEK DOWNSTRM OF FM 2268 is used to assess segment 1243.

Special Studies:

Lampasas River Watershed Protection Plan

The Lampasas River Watershed Protection Plan process began in 2009 to address bacteria issues in the watershed as segment **1217** had previously been listed as impaired for bacteria. The Watershed Protection Plan was approved by the EPA in May 2013 and by the Steering Committee in September 2013. The project is in the implementation phase. For more information visit the web site at www.lampasasriver.org.

Reservoir Fisheries Habitat Improvement

Stillhouse Hollow Lake (**1216**) is part of the Reservoir Fisheries Habitat Improvement project. The goal is to improve fishery habitat, and thus resiliency, and to proactively mitigate the negative effects that future reduced water levels may have on reservoir fisheries. Due to differences in fisheries, native habitat, and lake usage, a different plan will be developed and implemented for each lake.

Four freshwater fish reefs were deployed into the upper end of the reservoir during September 2018. Each reef was comprised of two types of artificial structure: Fishiding structures (The Stakeout PVC Fish Stakebed) purchased directly from Fishiding.com,

and Georgia Structures, constructed similarly to original Georgia DNR specifications. The Fishiding Stakeout structures were arranged evenly around a 15 ft diameter PVC ring and fastened with heavy duty zip ties to keep the structures grouped when deployed. Holes were drilled in the PVC to negate buoyancy and add weight to the arrangement. Holes were drilled in the PVC frames of the Georgia structures for the same reason. Both structure types were weighted-down further with cinder blocks. The locations of the freshwater fish reefs were selected to provide easy access for anglers and accommodate moderate water elevation changes. Depth at reef locations will range from 18 ft to 28 ft when the reservoir is at conservation pool. Each reef contained one arrangement of ten Fishiding structures plus five individual Georgia Structures. Coordinates (in degrees, decimal minutes or DDM) are provided along with the site descriptions below. A total of 60 fish habitat structures were deployed into Stillhouse Hollow Reservoir in this effort.

Traditional Georgia structures developed by Georgia DNR. Photo courtesy of Bob Maindelle.

Table 3.3.7.2 Water Quality Issues Summary

Water Quality Issue	Affected Area		ible Actions Taken/to be Taken
Impairments			
Dissolved Oxygen	• North Rocky Creek	• Agricultural land use nearby • Natural drought /flood cycle. • Ground water, spring influence.	• More current data should be collected in 1217D_01 to be used in assessing the segment using the newly approved criteria. However, it has proven difficult to obtain the required dissolved oxygen data due to the frequent low water levels inherent to this segment.
Concerns			
Chlorophyll *a*/Nutrients	• Lampasas River Above Stillhouse Hollow Lake • Salado Creek	• There are no known point sources • Approximately 90% of the watershed is covered by herbaceous, shrub and forested vegetation therefore there may be a significant amount of wildlife activity. • Runoff from agriculture in the watershed, as well as decentralized sewage systems.	• A watershed characterization study, consisting of a set of water and habitat assessments compiling hydrology, geology, wildlife, LULC, and water quality data to inform on the best way to improve water quality may be appropriate.
Dissolved Oxygen	• Sulphur Creek	• Agricultural land use nearby • Ground water, spring influence	• Conduct 24-hr DO study
Bacteria	• Pleasant Branch • Brazos River Above Unnamed tributary of Trimmier Creek • Lampasas River Above Stillhouse	• There are no known point sources • 90% of the watershed is covered by herbaceous, shrub and forested vegetation therefore there may be a significant amount of wildlife activity. • Runoff from agricultural land use.	• Continue to follow and implement recommended best management practices outlined in the Lampasas River WPP and monitor for water quality improvements.

3.3.8 Little River Watershed

Watershed Area	Active Surface Water Monitoring Stations	Monitoring Agencies	Permitted Discharges	Potential Stakeholders	Classified Segments
2,351 mi^2	27	BRA, TCEQ	37	City of Round Rock, City of Georgetown, City of Hutto, City of Liberty Hill, City of Temple, City of Cameron, City of Taylor	1213. 1214, 1244, 1247, 1248, 1249, 1250, 1251

Description of Segments:

1213: Little River – from the confluence with the Brazos River in Milam County to the confluence of the Leon River and the Lampasas River in Bell County

Segment Length: 108 miles

*Assessment Units (Stations): 1213_01 (11888, 20526, **22084**), 1213_02 (17499), 1213_03 (**13544**), 1213_04 (**13546**, 16409)*

Unclassified waterbody: **1213A**: Big Elm Creek

*Assessment Units (Stations): 1213A_01 (**16385**), 1213A_02 (None)*

Unclassified waterbody: **1213B**: Little Elm Creek

Assessment Units (Stations): 1213B_01 (13537, 13538), 1213B_02 (None)

Unclassified waterbody: **1213C**: Unnamed tributary of Little Elm Creek

Assessment Units (Stations): 1213C_01 (13536, 13539, 13540)

1214: San Gabriel River – from the confluence with the Little River in Milam County to Granger Lake Dam in Williamson County

Segment Length: 33 miles

*Assessment Units (Stations): 1214_01 (11892, **17651**), 1214_02 (**13648**, 17652)*

1244: Brushy Creek – from the confluence with the San Gabriel River in Milam County to the confluence of South Brushy Creek in Williamson County

Segment Length: 68 miles

*Assessment Units (Stations): 1244_01 (**12054**, 12056), 1244_02 (12058, **12059**), 1244_03 (**12060**), 1244_04 (12067, **12068**)*

Unclassified waterbody: **1244A**: Brushy Creek above South Brushy Creek
Assessment Units (Stations): 1244A_01 (11731, 17374, 18659)

Unclassified waterbody: **1244B**: Lake Creek
Assessment Units (Stations): 1244B_01 (17375)

Unclassified waterbody: **1244C**: Mustang Creek
Assessment Units (Stations): 1244C_01 (None)

Unclassified waterbody: **1244D**: South Brushy Creek
Assessment Units (Stations): 1222D_01 (11735, 20652)

1247 Granger Lake – from Granger Dam in Williamson County to a point 1.9 kilometers (1.2 miles) downstream of SH 95 in Williamson County to North San Gabriel Dam in Williamson County

Segment Area: 4,525 acres
*Assessment Units (Stations): 1247_01 (**12095**, 13868), 1247_02 (**12097**), 1247_03 (**12096**, 13872)*

Unclassified waterbody: **1247A**: Willis Creek
*Assessment Units (Stations): 1247A_01 (11573, 20022, **20305**)*

1248 San Gabriel/North Fork San Gabriel River– from a point 1.9 kilometers (1.2 miles) downstream of SH 95 in Williamson County to North Fork San Gabriel Dam in Williamson County

Segment Length: 24miles
*Assessment Units (Stations): 1248_01 (**12099**, **12102**, 12106, **12108**, 13692)*

Unclassified waterbody: **1248A**: Berry Creek
*Assessment Units (Stations): 1248A_01 (11572, **13496**)*

Unclassified waterbody **1248B**: Huddleston Branch
Assessment Units (Stations): 1248B_01 (17052)

Unclassified waterbody **1248C**: Mankins Branch
*Assessment Units (Stations): 1248C_01 (**13497**, 17051)*

Unclassified waterbody **1248D**: Middle Fork San Gabriel River
*Assessment Units (Stations): 1248D_01 (15754, **18734**)*

1249 **Lake Georgetown** – from North San Gabriel Dam in Williamson County to a point 6.6 kilometers (4.1 miles) downstream of US 183 in Williamson County, up to the normal pool elevation of 791 feet (impounds North Fork San Gabriel River)

Segment Area: 1,668 acres
*Assessment Units (Stations): 1249_01 (**12111**), 1249_02 (**12113**)*

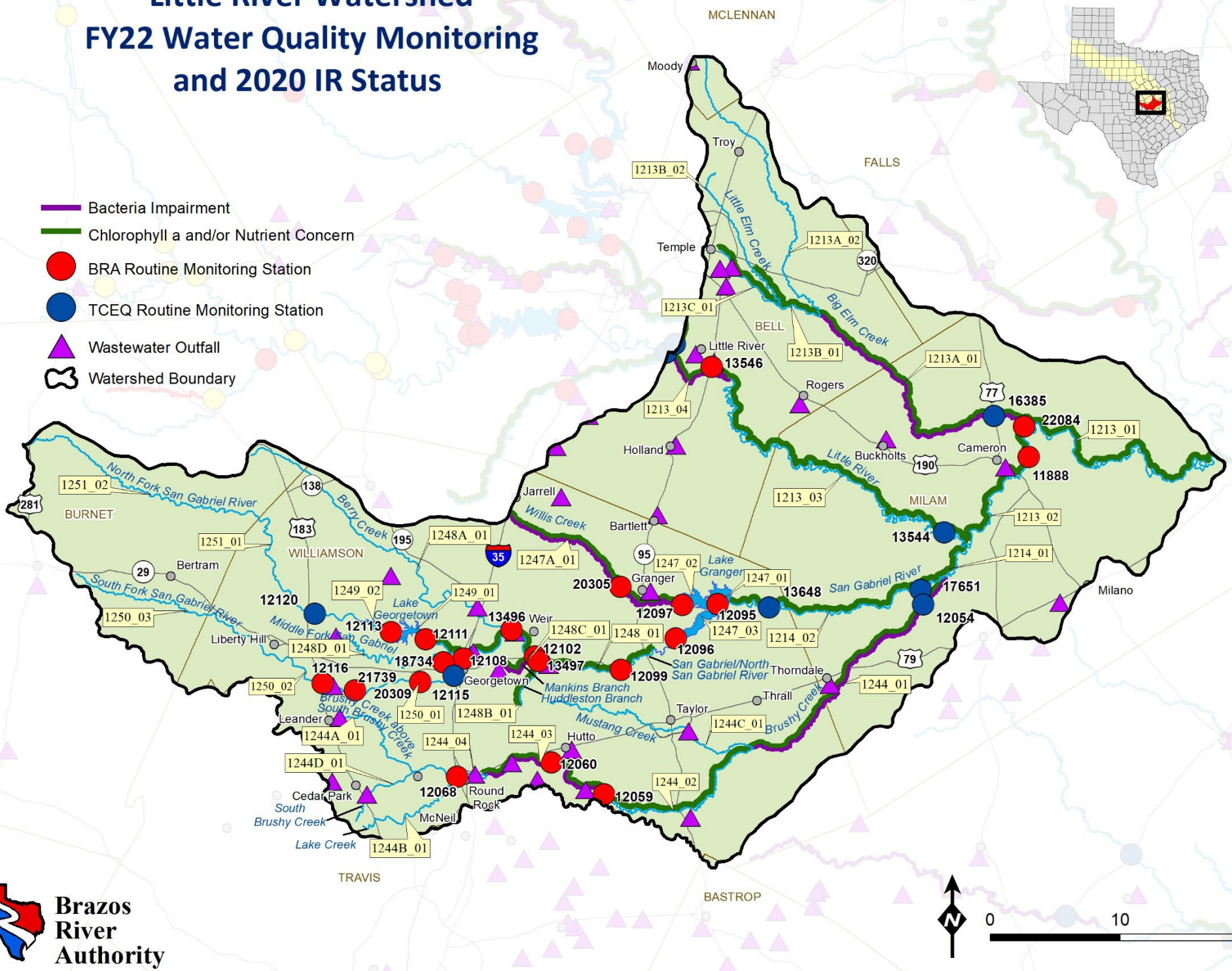
1250 **South Fork San Gabriel River** – from the confluence with the North Fork San Gabriel River in Williamson County to the most upstream crossing of SH 29 in Burnet County

Segment Length: 41 miles
*Assessment Units (Stations): 1250_01 (12114, **12115**, **20309**, **21739**), 1250_02 (**12116**), 1250_03 (12117)*

1251 **North Fork San Gabriel River** – from a point 6.6 kilometers (4.1 miles) downstream of US 183 in Williamson County to the confluence of Allen Branch in Burnet County

Segment Length: 42 miles
*Assessment Units (Stations): 1251_01 (**12120**, 13676), 1251_02 (12122)*

Little River Watershed
FY22 Water Quality Monitoring and 2020 IR Status



Brazos River Authority

Table 3.3.8.1 Segment Specific Water Quality Standards with Indications of Impairment and/or Concern from the 2020 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) and Significant Long-term Trends[1]

Little River Watershed		Uses		Surface Water Quality Standards								Nutrient Screening Levels[5]			
Segment	Name	Recreation[2]	Aquatic Life[3]	Cl (mg/L)	SO4 (mg/L)	TDS (mg/L)	Dissolved Oxygen Average/ Minimum (mg/L)	pH	Bacteria[4] (MPN/100ml)	Temperature (°F)	Chlorophyll *a* (µg/l)	Ammonia - N (mg/l)	Nitrate - N (mg/l)	Total Phosphorus (mg/l)	Chlorophyll *a* (µg/l)
1213	**Little River**	**PCR**	**H**	**75**	**75**	**400**	**5.0/3.0**	**6.5-9.0** ↑	**126**	**90**		**0.33**	**1.95** ↑	**0.69**	**14.1**
1213A	Big Elm Creek	PCR	H	75 ↓	75 ↓	400 ↓	5.0/3.0	6.5-9.0	126	90		0.33	1.95	0.69	14.1
1213B	Little Elm Creek	PCR	L	75	75	400	3.0/2.0	6.5-9.0	126	90		0.33	1.95	0.69	14.1
1213C	Unnamed Tributary	PCR	H	75	75	400	5.0/3.0	6.5-9.0	126	90		0.33	1.95	0.69	14.1
1214	**San Gabriel River**	**PCR**	**H**	**50**	**45**	**550**	**5.0/3.0**	**6.5-9.0**	**126**	**91**		**0.33**	**1.95** ↑	**0.69**	**14.1**
1244	**Brushy Creek**	**PCR**	**H**	**200**	**150**	**800**	**5.0/3.0**	**6.5-9.0**	**126** ↑	**91**		**0.33**	**1.95** ↑	**0.69**	**14.1**
1244A	Brushy Creek above South Brushy Creek	PCR	H	200	150	800	5.0/3.0	6.5-9.0	126	91		0.33	1.95	0.69	14.1
1244B	Lake Creek	PCR	L	200	150	800	3.0/2.0	6.5-9.0	126	91		0.33	1.95	0.69	14.1
1244C	Mustang Creek	PCR	H	200	150	800	5.0/3.0	6.5-9.0	126	91		0.33	1.95	0.69	14.1
1244D	South Brushy Creek	PCR	H	200	150	800	5.0/3.0	6.5-9.0	126	91		0.33	1.95	0.69	14.1
1247	**Granger Lake**	**PCR**	**H**	**50** ↑	**50** ↑	**400** ↑	**5.0/3.0** ↑	**6.5-9.0**	**126**	**90**		**0.11**	**0.37** ↓	**0.20**	**0.11** ↑
1247A	Willis Creek	SCR1	H	50	50 ↓	400 ↓	5.0/3.0	6.5-9.0 ↑	630 ↑	90		0.33	1.95 ↓	0.69	14.1
1248	**San Gabriel/North Fork San Gabriel**	**PCR**	**H**	**50** ↑	**50** ↑	**350** ↑	**5.0/3.0**	**6.5-9.0** ↑	**126**	**95**		**0.33**	**1.95**	**0.69** ↑	**14.1**
1248A	Berry Creek	PCR	H	50 ↑	50	350	5.0/3.0	6.5-9.0 ↑	126	95		0.33	1.95	0.69	14.1
1248B	Huddleston Branch	PCR	M	50	50	350	2.0/1.5	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1248C	Mankins Branch	PCR	H	50	50 ↑	350	5.0/3.0	6.5-9.0	126	95		0.33	1.95 ↑	0.69	14.1 ↓
1248D	Middle Fork San Gabriel River	PCR	L	50	50	350	3.0/2.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1249	**Lake Georgetown**	**PCR**	**H**	**50** ↑	**50** ↑	**350** ↑	**5.0/3.0**	**6.5-9.0** ↑	**126**	**90**	**5.00** ↑				

1250	South Fork San Gabriel	PCR	H	50	50	350	5.0/3.0	6.5-9.0	126	95		0.33	1.95↑	0.69	14.1
1251	North Fork San Gabriel	PCR	H	50↑	50	400	5.0/3.0	6.5-9.0	126	91		0.33	1.95	0.69	14.1

[1]Long-term trends described in this report are based on analysis of all data collected from Fiscal year 1990 through 2021 with a minimum 10-year data set and at least 20 samples unless otherwise specified. A trend was considered statistically significant at p≤0.05 with an R-value of 0.2 to 1.
[2]PCR-Primary Contact Recreation, SCR-Secondary Contact Recreation
[3]E-Exceptional, H-High, I-Intermediate, L-Limited
[4] The criteria numbers represent the geometric mean for *E. coli*
[5]For reservoirs where there is a Chlorophyll *a* standard, Nutrients are evaluated using a line-of-evidence framework described in the 2020 Guidance for Assessing and Reporting Surface Water Q Water Quality in Texas

Segment or portion of segment impaired

Segment or portion of segment has a concern for the standard or screening level

↑ Statistically significant increasing trend

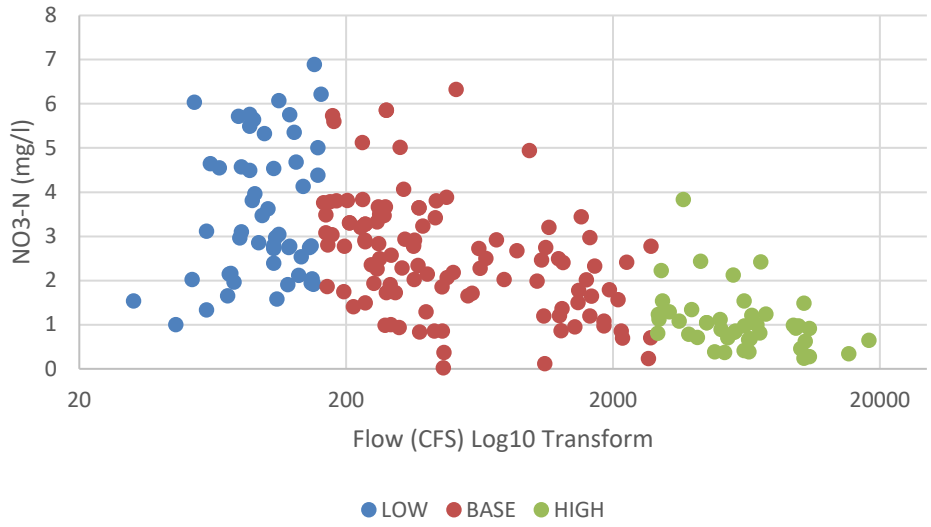
↓ Statistically significant decreasing trend

Little River Watershed

The Little River watershed drains approximately 2,349 square miles, includes Lake Georgetown and Lake Granger and crosses three ecoregions, the Central Texas Plateau, the Texas Blackland Prairie, and the East Central Texas Plains. The western portion of this watershed is rapidly developing while the eastern portion of the watershed remains rural. Recent major industrial manufacturing movements will see urbanization spread even more rapidly eastward. This may lead to additional land application of fertilizers, pesticides, pet waste, septic systems, and new sewage outfalls which can result in increased concentrations of nutrients, bacteria, and organic constituents in the waterbody. Data collected recently indicated that the current water quality in the watershed overall is good and that most segments support their designated use classifications.

The Little River mainstem segment **1213** starts at the confluence of the Leon and Lampasas rivers and ends at the confluence with the Brazos. The 2020 IR identified nutrient and chlorophyll *a* concerns in segment **1213** as well as a recreational use impairment. One assessment unit, **1213**_04, is listed as impaired for non-supporting of recreational uses due to high bacteria concentrations and **1213**_01 has a concern for bacteria as well. Concerns for Nitrate occur in all four AUs, and chlorophyll *a* is of concern in assessment unit **1213**_01. The area is predominantly rural with Little River Academy and Cameron being the major population centers. Elevated nitrate levels are thought to occur due to non-point source agriculture, point source municipal discharges, and other non-point source

Figure 3.3.8.2 Nitrate vs Flow Tiers in 1213_01 (11888 and 22084



means. The data shows a negative relationship between flow and Nitrate levels suggesting point source discharges.

The next section of note is the complex of Big Elm Creek, Little Elm Creek, and Unnamed Tributary of Little Elm Creek (**1213A**, **B**, and **C** respectively). The headwaters of all three occur around the I-35 corridor stretching from Temple, north to Moody. Big Elm Creek, AU **1213A**_01 is impaired for non-support of recreational use due to high bacteria concentrations. A WPP for Big Elm Creek has been prepared by TWRI as of 2021 (Big Elm Creek WPP).

Segment **1214** is comprised of the approximately 33 mile stretch of the San Gabriel River from the Lake Granger dam (Figure 3.3.8.3) to the confluence with the Little River. It is comprised of two assessment units. AU **1214**_01 has concerns for nitrate, and a concern for bacteria with a geomean exceedance of 2.67 CFU above the standard. Possible sources include malfunctioning septic systems, feral hogs, and livestock. AU **1214**_02 also has a concern for nitrate. This segment is the primary home to the Balcones Spike mussel, a basin endemic that is proposed for listing under the Endangered Species Act. The Brazos River Authority in conjunction with the US Fish and Wildlife Service produced the Candidate Conservation Agreement with Assurances for the Balcones Spike and Texas Fawnsfoot in the Brazos River Basin to encourage conservation measures for threatened freshwater mussels in the Brazos River basin. The document focuses a large amount on this segment. Unfortunately, Lake Granger is a constant source of highly invasive zebra mussel infestation for the downstream segment with adults being found at least 5 miles downstream from the dam. Zebra mussels attach themselves to hard objects like rocks, woody debris, or in some cases native mussels (3.3.8.4) competing for resources and in some cases, causing changes in the waterbody itself.

Figure 3.3.8.3 San Gabriel River directly below Lake Granger Dam

Figure 3.3.8.4 Invasive zebra mussel attached to native Pistolgrip mussel

Brushy Creek Segment **1244** is an oddity in the Brazos basin being in one of the most heavily urbanized areas and dominated by wastewater effluent. The cities of Leander, Cedar Park, Austin, Round Rock, and Hutto all have discharges into the tributaries and upper AUs, with Taylor and Thorndale discharging into the lower section. Brushy Creek ends at the confluence with the San Gabriel

Figure 3.3.8.5 Brushy Creek at Engerman Lane (12059) 1244_02

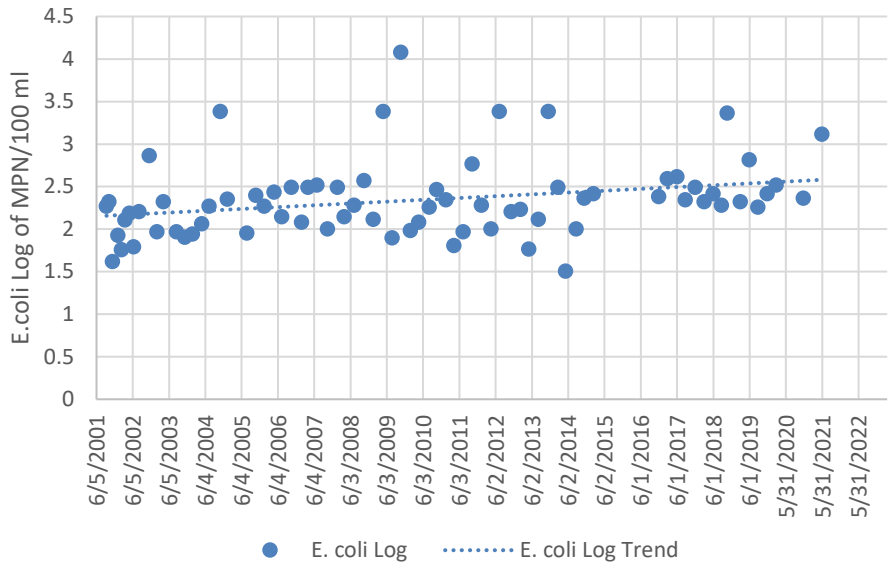
possible source. The stream begins to transition to higher gradient gravel and bedrock in this section.

Elevated nitrate and total phosphorous may be from over application of fertilizers or point source wastewater effluent. The USGS began operation of four stream flow gauging sites in 2014 so it may be possible to draw flow weighted conclusions in the near future. Assessment unit **1244**_04 (Figure 3.3.8.7) is bisected by I35 and is surrounded by commercial and residential development. This area begins the transition to the live oak-mesquite savannah region with a change in soils to a more limestone-based bedrock and gravel substrate. Water is usually clear and areas upstream are in full support or of no concern. Lake Granger (**1247**) continues to be a highly sedimented relatively shallow Blackland Prairie eutrophic reservoir. Chlorophyll *a* levels continue to rise, (Figure 3.3.8.8) but the lake is currently in full support of all standards. Significant trends with rising salts, dissolved oxygen daytime grabs, chlorophyll,

River north of Rockdale. The lower AUs located in the Blackland Prairie are heavily involved in agriculture and livestock production. **1244**_01 is listed as impaired for bacteria and has a concern for Nitrate. The area is known to be heavily infested with wild hogs which may be a large source of fecal bacteria. The stretch near the confluence with the San Gabriel is another high value mussel habitat area. This section will be of interest in the following years as Samsung brings a large chip manufacturing plant to the Taylor area. This could spur further development eastward along the US 79 corridor where there is currently a gap.

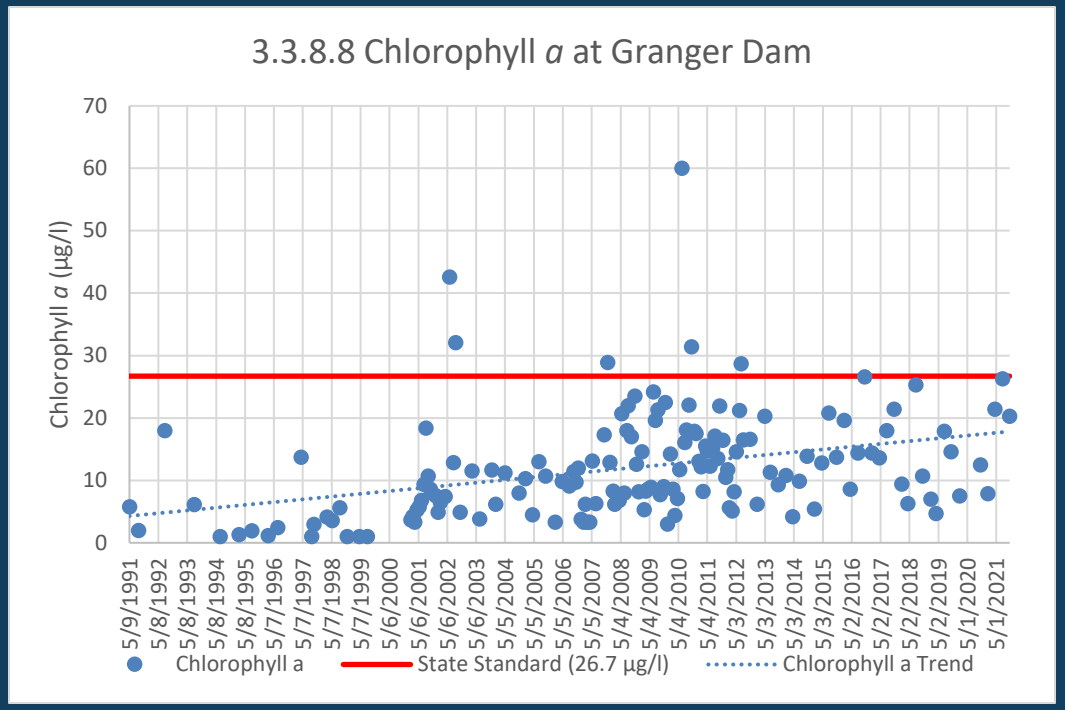
Assessment Unit **1244**_02 (Figure 3.3.8.5) has concerns for bacteria and Nitrate. It is also predominately farm and range land use associated. The stream slope is slightly higher than the downstream sections, but still predominately sand and gravel based. The upstream urbanized areas are utilized with green belts, parks, and hike/bike trails, but AU **1244**_03 is impaired for recreational use due to bacteria and has concerns for high nitrate and total phosphorous levels. Bacteria levels in the urban area have been slowly rising (Figure 3.3.8.6) with further development. Pet waste is a

Figure 3.3.8.6 Log Transformed E.coli AU 1244_03



dissolved and suspended solids as well and decreasing transparency are all sign of an aging reservoir being a sink for nutrients. Adult Zebra mussels were found in late 2019 and have infested most solid surfaces around the lake. They do not appear to have changed water parameters as of yet likely due to the lake mostly being sediment floored thus limiting their ability to grow in significant numbers.

Figure 3.3.8.7 Brushy Creek near Chisolm Trail (12068) 1244_04



Willis Creek (**1247A**) is a small perennial stream starting near I35 and ending in the northwestern arm of Lake Granger (Figure 3.3.8.9). It is currently listed for bacteria at the higher secondary contact recreation level and has a concern for Nitrate. The land use is mostly crop and livestock production. Long term trends show a slight persistent climb in bacteria levels.

Figure 3.3.8.9 Willis Creek (20305) 1247A

Figure 3.3.8.10 Segment 1248 San Gabriel River near SH29 (12102)

The San Gabriel/North Fork San Gabriel River (**1248**) is a 24 mile stretch of river from the Lake Georgetown Dam to Lake Granger Figure 3.3.8.10). This water body runs the gambit of land usage with agricultural, low, medium, and high density residential, commercial, and common park spaces. A large amount of the river is shallow and open to full sun which can cause excess algal growth. It is currently listed as a concern for Nitrate. Satellite photos show algal growth increasing with increase in residential areas suggesting runoff from lawn maintenance along with wastewater effluent to be a likely nutrient source.

Berry creek (**1248A**) stretches 34 miles, beginning northwest of Georgetown with primarily grazing land use classification. Land use becomes more low density residential before crossing I35, to include a park/preserve and crop land before combining with the San Gabriel just east of Georgetown. It is currently in full support of TCEQ standards. To the south, Mankins Branch (**1248C**) (Figure 3.3.8.11) and Huddleston Branch (**1248B)** combine about one quarter mile before flowing into the San Gabriel River. Mankins Branch

has historically high bacteria levels with little change over the ten-year span. It also has concerns for total phosphorous, and nitrate as well as a concern for impaired habitat due to it being predominately bedrock with shallow pools that are not conducive for long term aquatic life use. Huddleston Branch has a limited data set with only 20 collection events taking place between 1999 and 2003. The Middle Fork San Gabriel (**1248D**) (Figure 3.3.8.12) is currently monitored only for flow by BRA to assess stream permanence.

Figure 3.3.8.11 Mankins Branch at CR 100 (13497)

Figure 3.3.8.12 Middle Fork San Gabriel (18734)

Lake Georgetown (**1249**), a borderline mesotrophic lake in Williamson County, is a major water supply source for the area. Drainage from the North Fork San Gabriel is heavily subsidized with transfers from Lake Stillhouse by the Williamson County Regional Raw Water Line. A large amount of this transferred water returns to the system via the area's wastewater treatment plants. Unfortunately, Lake Georgetown ranks twenty first on the 2020 Tropic Classification of Texas Reservoirs Carlson's Trophic State Index (TSI) chlorophyll *a* change rate with a ten-year change of 13.62 meaning it is undergoing eutrophication rapidly. Nutrient enrichment likely comes from the surrounding North Fork San Gabriel River watershed. The small watershed that feeds the lake combined with large consumption leads to a decrease in flushing flows that would reduce salts and nutrients. In 2017 zebra mussels were found in Lake Georgetown, but current trends since that period appear to be stable. With the explosive growth occurring in Williamson County, water supply will be stressed in the future. The BRA plans for another raw water pipeline to connect Lake Belton to Stillhouse Hollow Lake to increase connected storage to efficiently transport water where it is needed.

The South Fork San Gabriel (Segment **1250**) stretches approximately 41 miles from just east of Burnet, to the confluence with the North Fork San Gabriel River in downtown Georgetown. Assessment unit 1250_03 has concerns for instantaneous grab low DO. However, samples have not been collected in that segment since 2003. The other two assessment units currently have no concerns or impairments. The BRA has three quarterly sampling stations on the South Fork and TCEQ samples one.

A large amount of the undeveloped property in the area is in this watershed. There are concerns with increased development and increased discharges into the area.

Figure 3.3.8.13 South Fork San Gabriel Station 20309

The North Fork San Gabriel above Lake Georgetown (**1251)** is a 42-mile stretch draining mostly grazing land and private ranchettes towards the west and developing into more low-density housing as one approaches the lake. There are currently no impairments nor concerns in this stretch.

Special Studies:

Big Elm Watershed Protection Plan
Big Elm Creek, **1213A**, was first identified in the 2010 IR as impaired for primary contact recreation due to elevated bacteria. In the 2020 IR Big Elm Creek remains impaired for bacteria and has a concern for nitrate. In addition to the contact recreation impairment, Little Elm Creek (**1213B**), a tributary to Big Elm Creek, has concerns for dissolved oxygen and nitrate. The Texas Water Resources Institute (TWRI) identified potential sources of pollution, pollution loads, and possible management measures in a previous watershed characterization project.

This project built on the existing watershed characterization project for the larger Little River watershed. Data produced under

the watershed characterization supported the development of this WPP for Big Elm Creek. Data from the characterization also assisted stakeholders in choosing management measures and determine load reductions in the watershed. Management measures include: promoting and implementing Water Quality Management Plans (WQMP) or Conservation Plans, promoting technical and direct operational assistance to landowners for feral hog control, identifying, inspecting and repairing or replacing failing on-site sewage systems, reducing pet waste mixing into waterbodies, implementing and expanding urban and impervious surface stormwater runoff management, identifying potential wastewater conveyance system failure and prioritize system repairs or replacement, reducing illicit dumping and promote street cleanups, conducting soil tests for both agriculture and urban areas, additional monitoring on Big Elm Creek close to the landfill areas, and conducting landowner education workshops. This WPP project built upon existing stakeholder involvement, surveys, and outreach that was initiated during the watershed characterization process. Stakeholder meetings took place February 2019 through September 2019. The final draft plan was accepted by the EPA in February 2021, and implementation of the plan has started.

Brazos Basin Instream Flow Monitoring Program to Inform on Environmental Flow Standards.
The Little River near Little River and the Little River near Cameron stations are part of the Brazos Basin Instream Flow Monitoring Program to Inform on Environmental Flow Standards. Extensive habitat and biological data collection efforts will occur at various flow regimes to better assess the impact that varying water levels have on aquatic communities.

Candidate Conservation Agreement with Assurances for the Balcones Spike and Texas Fawnsfoot in the Brazos River Basin (CCAA)
The Brazos River Authority CCAA requires mussel population monitoring in the San Gabriel, Little River, and portions of Brush Creek.

Sustainable Rivers Program
There are plans underway to bring projects to the Little River System under the US Army Corps of Engineers Sustainable Rivers Project which will evaluate release strategies using the lower fraction of the USACE controlled reservoir flood pool. This would include Georgetown, Granger, Stillhouse Hollow, and Belton reservoirs.

Reservoir Fisheries Habitat Improvement
Lake Georgetown (**1249**) and Granger Lake (**1247**) are part of the Reservoir Fisheries Habitat Improvement project. The goal is to improve fishery habitat, and thus resiliency, and to proactively mitigate the negative effects that future reduced water levels may have on reservoir fisheries. Due to differences in

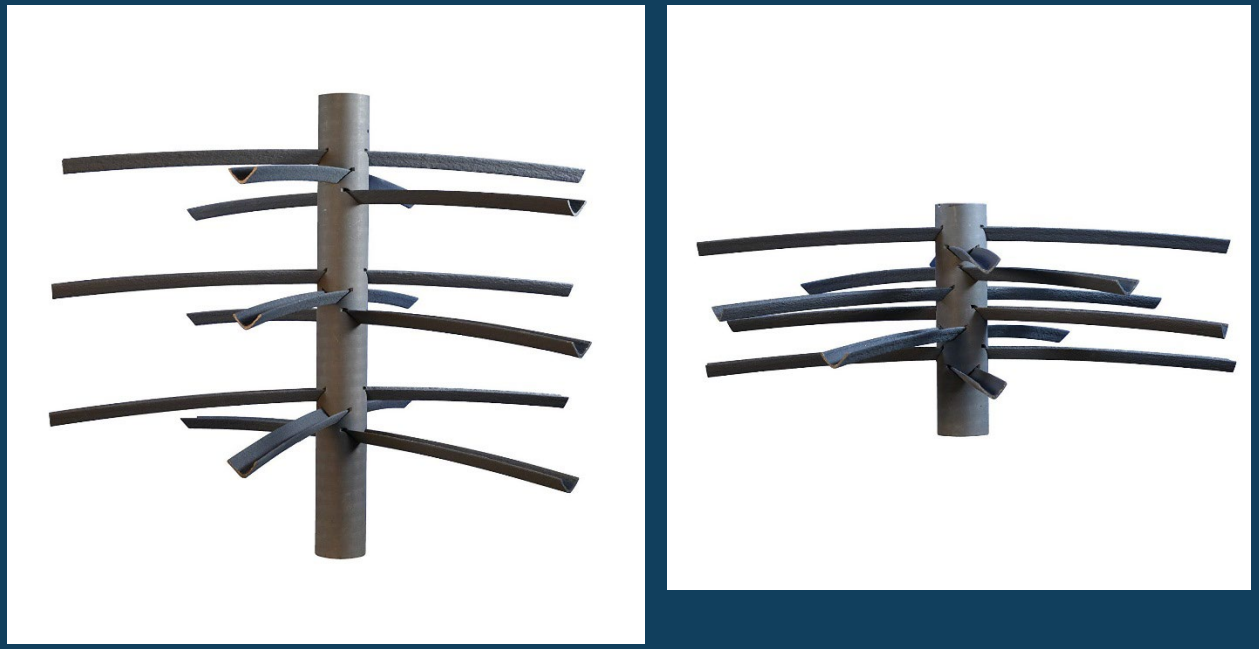


Figure 3.3.8.13 Mossback Trophy Tree (left) and Root Wad (right) used for fish habitat at Georgetown Reservoir

fisheries, native habitat, and lake usage, a different plan will be developed and implemented for each lake.

The Lake Georgetown project took place on November 7, 2017. 30 current habitat sites at Georgetown Reservoir were restored. Mossback artificial structures were purchased. They were composed of 60 Trophy Tree units and 60 Root Wad units (Figure 3.3.8.13). Texas Parks and Wildlife partnered with the Sun City Hunting and Fishing Club (SCHFC), who purchased anchor blocks and ties to sink and anchor the structures. Over 25 SCHFC volunteers assembled and helped TPWD deploy the units. A pair of Mossback structure units (one of each type) was sunk at each of the 30 existing habitat sites in the reservoir.

The Granger Lake project took place on November 21, 2017. 10 new crappie habitat sites were created at Lake Granger. Fishiding artificial structures were purchased, composed of 160 Stakeout units (Figure 3.3.8.14). TPWD partnered with a local troop of the Boy Scouts of America (BSA), led by a prospective Eagle Scout. This project served, in term, as the required team project for the Eagle Scout candidate. The Eagle Scout purchased materials to construct an assembly to join, anchor, and stabilize 4 vertical structure units. The assemblies were completed by the scout troop ahead of the deployment date. Upon the project date, the assemblies were transported by trailer to the reservoir to be deployed. Four assemblies were deployed at each of the 10 sites, predetermined by TPWD and a local fishing guide, who is an expert in crappie fishing at that lake. This totaled 16 structure units sunk at each of the sites, except for the fishing pier at Wilson Fox Park, where 8 extra free units (2 assemblies), donated by the Fishiding Company, were deployed.

Figure 3.3.8.14 Fishinding Stakeout artificial fish habitat structures used at Granger Reservoir to create crappie habitat on Granger Lake

Table 3.3.8.2 Water Quality Issues Summary

Water Quality Issue	Affected Area	Possible Influences/Concerns	Possible Actions Taken/to be Taken
Impairments			
Bacteria	• Little River • Big Elm Creek • Brushy Creek • Willis Creek • Mankins Branch	• Feral hogs in the rural areas • Livestock with access to waterways • Wildlife • Pet waste • On-site treatment systems • Municipal point source discharges	• Feral hog abatement program in progress from TSWCB • Provide alternate water sources and limit Access to stream by livestock • Encourage yard waste removal and promote waste receptacles in public parks • Develop regional wastewater systems as populations increase in density

			• Repair malfunctioning infrastructure • A WPP for the Big Elm has been prepared by TWRI as of 2021 (Big Elm Creek WPP).
Concerns			
Chlorophyll *a*/Nutrients	• Little River • Big Elm Creek • Little Elm Creek • San Gabriel River • Brushy Creek • Granger Lake • Willis Creek • San Gabriel / North Fork San Gabriel • Huddleston Branch • Mankins Branch	• Multiple municipal/industrial discharges • Large amount of low-density housing lawncare product runoff • There is some agriculture in the watershed. • Livestock and associated waste products	• Revise nutrient standards on discharge permits • Public outreach on fertilizer application • Provide alternate water sources and limit access to stream by livestock
Dissolved Oxygen	• Little Elm Creek • South Fork San Gabriel	• Shallow water with low flows	• Perform 24-hour DO monitoring
Bacteria	• San Gabriel River • Huddleston Branch	• Agricultural land use • Wildlife	• Continue routine water quality monitoring • A watershed characterization study, may be appropriate for Huddleston Branch.

3.3.9 Central Watershed of the Brazos River

Watershed Area	Active Surface Water Monitoring Stations	Monitoring Agencies	Permitted Discharges	Potential Stakeholders	Classified Segments
2706 mi^2	22	BRA, TCEQ	51	Cities of Bryan, College Station, Snook, Hearne, Calvert, Franklin, Rosebud, Bremond, Lott, Matlin, Kosse, Lorena, Woodway, Belmeade, Robinson, Mart, Mount Calm, West, Abbott; Sanderson Farms, Altura Power, KT Mining, Luminant Generation, Tradinghouse Power	1242, 1256 (partial)

Description of Segments:

1242: Central Brazos River – Brazos River above Navasota River – From a point immediately upstream of the confluence of the Navasota River in Brazos/Grimes/Washington County to the low water dam forming Lake Brazos in McLennan County.

Segment Length: 185.35 mi

*Assessment Units (Stations): 1242_01 (**12030**, 13666), 1242_02 (12031, **15767**, 20833), 1242_03 (None), 1242_04 (**12032**, 12033, 21041), 1242_05 (12034, 12035, 12036, **12037**), 1242_06 (**12038**)*

Unclassified waterbody: **1242A**: Marlin City Lake System

*Assessment Units (Stations):1242A_01 (16783), 1242A_02 (**16781**)*

Unclassified waterbody: **1242B**: Cottonwood Branch

*Assessment Units (Stations): 1242B_01 (**17598**), 1242B_02 (**17597**)*

Unclassified waterbody: **1242C**: Still Creek

*Assessment Units (Stations): 1242C_01 (**16882**), 1242C_02 (**17378**)*

Unclassified waterbody: **1242D**: Thompsons Creek

*Assessment Units (Stations): 1242D_01 (**16396**, 20530), 1242D_02 (**16397**, 20653)*

Unclassified waterbody: **1242E**: Little Brazos River

*Assessment Units (Stations): 1242E_01 (11581, **11591**), 1242E_02 (None), 1242E_03 (None)*

Unclassified waterbody: **1242F**: Pond Creek

*Assessment Units (Stations): 1242F_01 (**16406**, 22204), 1242F_02 (None)*

Unclassified waterbody: **1242G**: Unnamed tributary of Cottonwood Branch
Assessment Units (Stations): 1242G_01 (None)

Unclassified waterbody: **1242H**: Tradinghouse Reservoir
*Assessment Units (Stations): 1242H_01 (**18457**)*

Unclassified waterbody: **1242I**: Campbells Creek
Assessment Units (Stations): 1242I_01 (16395, 20561)

Unclassified waterbody: **1242J**: Deer Creek
*Assessment Units (Stations): 1242J_01 (**11723**, 16407, **18644**)*

Unclassified waterbody: **1242K**: Mud Creek
*Assessment Units (Stations): 1242K_01 (**16402**, 20562)*

Unclassified waterbody: **1242L**: Pin Oak Creek
*Assessment Units (Stations): 1242L_01 (**16401**, 20563)*

Unclassified waterbody: **1242M**: Spring Creek
Assessment Units (Stations): 1242M_01 (16394, 20564)

Unclassified waterbody: **1242N**: Tehuacana Creek
*Assessment Units (Stations): 1242N_01 (**11609**; 11610; 15771; 18812; 18870; 18871), 1242N_02 (None)*

Unclassified waterbody: **1242O**: Walnut Creek
Assessment Units (Stations): 1242O_01 (16403, 20021, 20565)

Unclassified waterbody: **1242P**: Big Creek
Assessment Units (Stations): 1242P_01 (16400), 1242P_02 (None)

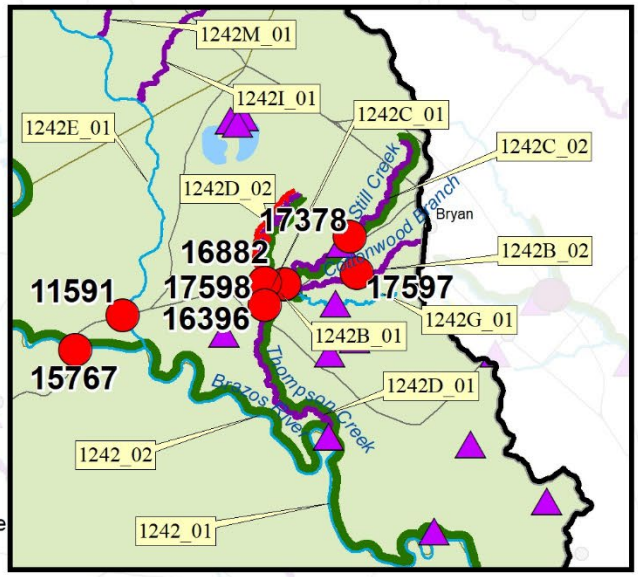
Unclassified waterbody: **1242Q**: Bull Hide Creek
Assessment Units (Stations): 1242Q_01 (11604, 20128), 1242Q_02 (None)

Unclassified waterbody: **1242R**: Cow Bayou
Assessment Units (Stations): 1242R_01 (11717, 11718, 11719, 11720)

1256: Brazos River/Lake Brazos – From the low water dam forming Lake Brazos in McLennan County to a point immediately upstream of the confluence of Aquilla Creek in McLennan County (includes the Bosque River Arm to the Waco Lake Dam). The portions of 1256 in the Central Watershed are the Brazos River and the Lake Brazos portion of the segment.

Segment Portion Length in Central Watershed: 14.5 Miles
*Assessment Units (Stations): 1256_01 (12043), 1256_02 (12041, **14226**)*

Central Watershed of the Brazos River FY22 Water Quality Monitoring and 2020 IR Status



Abbott
1242N_02
West
Leroy
Tehuacana Creek
1242N_01
Elm Mott
Axtell
84
1256_01
Lacy-Lakeview
Tradinghouse Creek Reservoir
LIMESTONE
Bellmead
1242H_01
1256_02
14226
18457
18457
Waco
Hallsburg
Mart
1242P_02
MCLENNAN
Beverly Hills
11609
Woodway
12037
Riesel
Big Creek
Hewitt
Robinson
Big Sandy Creek
6
1242_06
35
1242_05
Bullhide Creek
1242A_01
1242Q_02
Golinda
Lorena
Satin
Marlin City Lake
16781
1242Q_01
7
Little Brazos River
Kosse
Moody
Eddy
Cow Bayou
Marlin
18644
Chilton
11723
Bruceville-Eddy
1242P_01
14
Deer Creek
1242J_01
1242E_03
Lott
Bremond
1242O_01
Belfalls
1242J_01
FALLS
12032
1242F_02
320
1242_04
1242E_02
Walnut Creek
22204
Rosebud
ROBERTSON
Pond Creek
77
16403
1242K_01
16406
Calvert
Mud Creek
1242F_01
20562
1242L_01
Brazos River
1242_03
Pin Oak Creek
20563
Hearne
1242M_01
1242E_01
Spring Creek
20564
1242I_01
MILAM
Campbells Creek
20561
1242_02
190
See Inset Map
Milano
BRAZOS
Cedar Creek
21
BURLESON
6
Old River
Snook
1242_01
105

Bacteria Impairment
Dissolved Oxygen Impairment
Chlorophyll a and/or Nutrient Concern
BRA Routine Monitoring Station
TCEQ Routine Monitoring Station
TWRI Routine Monitoring Station
Wastewater Outfall
Watershed Boundary

Brazos River Authority

0 10 20 Miles

N

GRIM

Table 3.3.9.1 Segment Specific Water Quality Standards with Indications of Impairment and/or Concern from the 2020 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) and Significant Long-term Trends[1]

Central Watershed of the Brazos River		Uses		Surface Water Quality Standards								Nutrient Screening Levels			
Segment	Name	Recreation[2]	Aquatic Life[3]	Cl (mg/L)	SO4 (mg/L)	TDS (mg/L)	Dissolved Oxygen Average/ Minimum (mg/L)	pH	Bacteria[4] (MPN/100ml)	Temperature (°F)	Chlorophyll *a* (µg/l)	Ammonia - N (mg/l)	Nitrate - N (mg/l)	Total Phosphorus (mg/l)	Chlorophyll *a* (µg/l)
1242	**Brazos River above Navasota River**	**PCR**	H	**350**	**200↑**	**1000**	**5.0/3.0**	**6.5-9.0**	**126**	**95**		**0.33**	**1.95**	**0.69**	**14.1**
1242A	Marlin City Lake System	PCR	H	350	200	1000	5.0/3.0	6.5-9.0↓	126↑	95		0.11	0.37	0.2↑	26.7
1242B	Cottonwood Branch	SCR1	L	350↑	200	1000↑	2.0/1.5	6.5-9.0↑	630↑	95		0.33	1.95	0.69	14.1
1242C	Still Creek	PCR	H	350	200	1000	5.0/3.0	6.5-9.0↑	126	95		0.33	1.95↑	0.69	14.1
1242D	Thompsons Creek	PCR	H I	350	200	1000	5.0/3.0 4.0/3.0	6.5-9.0	126↑	95		0.33	1.95↑	0.69↑	14.1↑
1242E	Little Brazos River	PCR	H	350	200↑	1000	5.0/3.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1242F	Pond Creek	PCR	L	350	200	1000	3.0/2.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1242G	Unnamed Tributary of Cottonwood Branch	PCR	I	350	200	1000	4.0/3.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1242H	Tradinghouse Reservoir	PCR	H	350↓	200↓	1000↓	5.0/3.0	6.5-9.0	126	95		0.11	0.37	0.2	26.7
1242I	Campbells Creek	SCR1	L	350	200	1000	2.0/1.5	6.5-9.0	630	95		0.33	1.95	0.69	14.1
1242J	Deer Creek	PCR	H	350	200	1000	5.0/3.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1242K	Mud Creek	PCR	L	350	200	1000	3.0/2.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1242L	Pin Oak Creek	PCR	L	350	200	1000	3.0/2.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1242M	Spring Creek	PCR	L	350	200	1000	3.0/2.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1242N	Tehuacana Creek	PCR	H	350	200	1000	5.0/3.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1

1242O	Walnut Creek	PCR	H	350	200	1000	5.0/3.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1242P	Big Creek	PCR	M	350	200	1000	2.0/1.5	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1242Q	Bull Hide Creek	PCR	H	350	200	1000	5.0/3.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1242R	Cow Bayou	PCR	H	350	200	1000	5.0/3.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1256	Lake Brazos	PCR	H	400	200	↓1150	5.0/3.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1

[1]Long-term trends described in this report are based on analysis of all data collected from Fiscal year 1990 through 2021 with a minimum 10-year data set and at least 20 samples unless otherwise specified. A trend was considered statistically significant at p≤0.05 with an R-value of 0.2 to 1.
[2]PCR-Primary Contact Recreation
[3]E-Exceptional, H-High, I-Intermediate, L-Limited, M-Minimal
[4] The criteria numbers represent the geometric mean for *E. coli*

Segment or portion of segment impaired

Segment or portion of segment has a concern for the standard or screening level

↑ Statistically significant increasing trend

↓ Statistically significant decreasing trend

Central Watershed of the Brazos River

The Central Watershed of the Brazos River extends from Lake Brazos Dam in Waco to the mouth of the Navasota River southeast of College Station and drains approximately 2,706 square miles. Land usage is primarily agricultural, with two sizeable and rapidly growing urban areas, Waco in the upstream portion of the watershed and western portion Bryan/College Station in the downstream area of the watershed. Two classified waterbodies, the Brazos River above Navasota River (**1242**), Lake Brazos (**1256**) and 18 unclassified waterbodies are within the Central Watershed of the Brazos River.

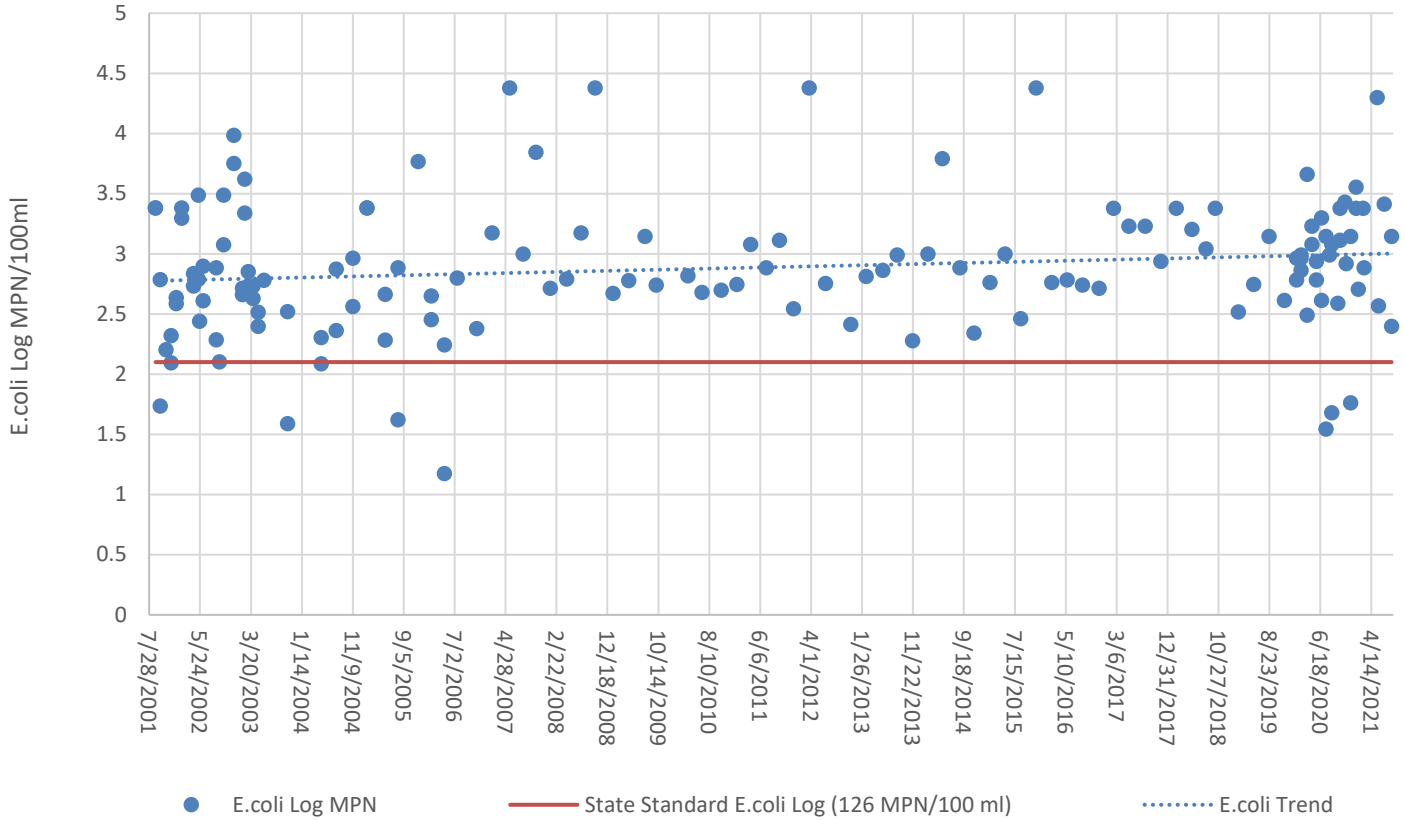
In the 2020 assessment, segment **1242** has no impairments, but AUs **1242**_01,_02, _04 _05 and _06 have concerns for chlorophyll *a* while AU_05 has a concern for nitrate. The upstream portion of **1242** (AU_05) is downstream of a heavily urbanized area while the middle and downstream portions of **1242** (_04, _02 and _01) are adjacent to planted/cultivated land use. Urban point sources and agricultural activity are likely sources of nutrients and resultant elevated chlorophyll *a* concentrations.

Eleven tributaries to the Brazos above Navasota possess bacterial impairments, including: Cottonwood Branch (**1242B**), Still Creek (**1242C**), Thompson Creek (**1242D**) (also an impairment for suppressed DO), Pond Creek (**1242F**), Campbell's Creek (**1242I**), Deer Creek (**1242J**), Mud Creek (**1242K**), Pin Oak Creek (**1242L**), Spring Creek (**1242M**), Walnut Creek (**1242O**) and Big Creek (**1242P**).

Cottonwood Branch (**1242B**), Still Creek (**1242C**), Thompson Creek (**1242D**) are all impaired for bacteria. Cottonwood Branch and Thompsons Creek both have statistically significant increasing trends for bacteria. **1242D**_02 also has an impairment for depressed dissolved oxygen. Nutrient enrichment is a concern for these segments as well. **1242D**_01 has a concern for impaired fish community and **1242D**_02 has a concern for impaired macrobenthic community and chlorophyll *a*.

Thompsons Creek is impaired for bacteria and shows a statistically significant increasing trend in bacterial concentrations (Figure 3.3.9.1). **1242D** is currently assessed on PCR standards, but the proposed recreational use change to SCR 1 is currently pending EPA approval. AU **1242D**_02 is predominantly rural with Hay/Pasture covering most of the subwatershed (60%). Any bacterial or nutrient contributions is likely nonpoint sources including leaking OSSFs, agricultural runoff, wildlife and livestock. Regarding the dissolved oxygen impairment, indications are that low DO is a natural condition in the AU according to a Use Attainability

Figure 3.3.9.1 **1242D** (Station 16396) - Bacteria



Assessment (UAA) performed by BRA in 2013. BRA has conducted six 24-hour dissolved oxygen diel monitoring events on Thompson Creek (Figure 3.3.9.2) with one more event scheduled for the spring of 2022. This will help to complete data collection

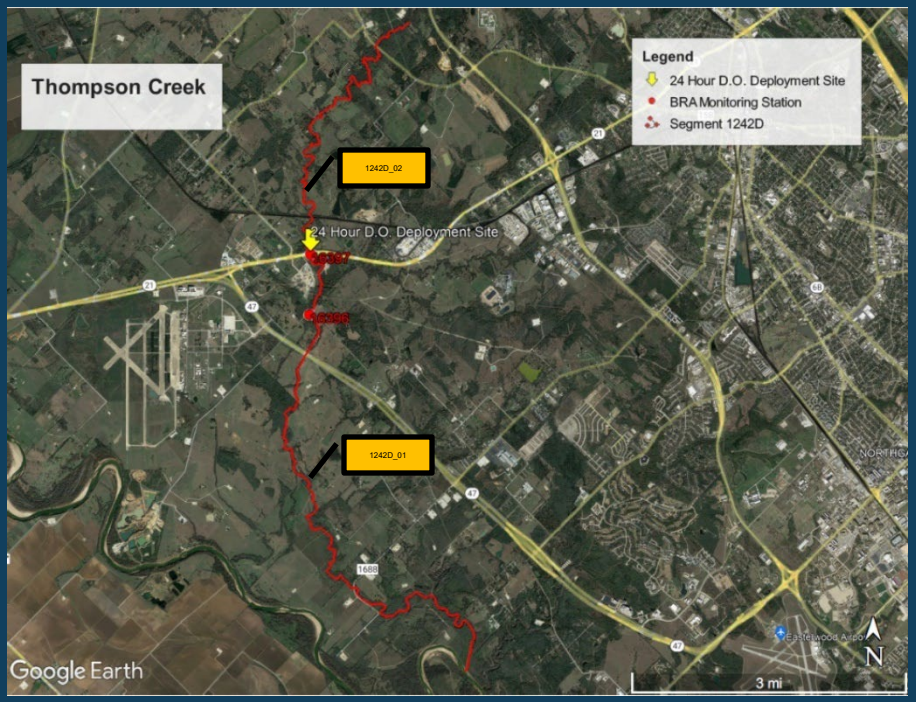


Figure 3.3.9.2 24-hr DO deployment site at BRA monitoring station 16397

efforts needed to assess state standards for this segment. High chlorophyll *a* concentrations are likely typical during no-flow periods due to lack of flushing which would allow planktonic algae to proliferate in isolated pools. Chlorophyll a, nitrate and total phosphorus all have increasing statistically significant trends. Ammonia, nitrate and total phosphorus sources are unknown but likely originate from nonpoint sources. Water quality sources for impairments and concerns in **1242D**_01 should be similar to AU_02 with the addition of compounding effects from any impairment or concern sources due to the confluence with Still Creek and Cottonwood Branch. Still Creek transports wastewater effluent from one WWTF and creates perennial flow in Thompsons Creek AU_01.

Still Creek (**1242C**) is impaired for bacteria and has concerns for nitrate, total phosphorus and dissolved oxygen. AU **1242C**_02 land use is primarily developed (43.39%) especially near the headwaters of Still Creek and adjacent to the left bank, followed by hay/pasture (34%) which is adjacent to the right bank of Still Creek. Bacterial or nutrient contributions are likely a mix of point sources including industrial discharges, municipal separate storm sewer systems (MS4s), wastewater treatment facilities (WWTFs) and nonpoint sources including failing OSSFs, agricultural runoff, wildlife, livestock and pets.

Cottonwood Branch AU **1242B**_01 land use is predominantly hay/pasture (54%); however, it is downstream of an industrial discharge that discharges into an Unnamed Tributary of Cottonwood Branch **1242G** which may contribute to the bacteria impairment and nitrate and total phosphorus concerns. AU **1242B**_02 is predominantly an urban subwatershed with 65% categorized as developed. Additional bacterial data was collected in FY21 and will continue through FY22, with preliminary data analysis suggesting **1242B**_02 will be delisted in the 2022 IR.

Pond Creek (**1242F**) is impaired for bacteria and has a concern for nitrate. There are no known sources in the Pond Creek subwatershed. The Pond Creek Watershed Monitoring and Assessment project was initiated in December 2021. Through this project, supplemental water quality monitoring will be conducted with a focus on collecting paired flow rate and *E. coli* concentration data. Data will be collected at up to two sites monthly including station 16406 and 22204 in FY23. Monthly sampling will allow data gaps to be filled and will improve watershed analysis. Such data is crucial in understanding bacterial loads throughout the watershed.

Campbell's Creek (**1242I**), Deer Creek (**1242J**), Mud Creek (**1242K**), Pin Oak Creek (**1242L**), Spring Creek (**1242M**), Walnut Creek (**1242O**) and Big Creek (**1242P**) all are impaired for bacteria. RUAAs have also been completed for 1242I_01, 1242K_01, 1242L_01, 1242M_01 and 1242O_01. Results have led to the recommendation by TCEQ that the recreational use of these segments be revised to SCR 1 and are awaiting approval by EPA in all but **1242I** which has been approved by EPA. More data collection has been initiated for the four segments with new approved bacterial criteria. As in the case of the unclassified tributary streams in the Bosque and Leon Watersheds, many of the impaired or concern sub-segments in **1242** are small, rural streams with little to no flow for most of the year whose water is primarily generated by storm events and the associated runoff contributing to bacterial impairments and concerns.

Along with the bacterial impairment, Deer Creek (**1242J**) also has a concern for nitrate and an impaired macrobenthic community. Deer Creek is a part of the Characterization of Middle Yegua, Davidson, and Deer Creeks project to address bacterial impairments in each subwatershed. The project was completed in 2020. Through this project, existing data such as water quality data, flow, wildlife and livestock estimates, number of septic systems, etc. was collected and evaluated to assist in identifying causes and sources of parameters impairing water quality. As a result of this characterization effort, it was determined that more water quality and flow data was necessary. To supplement collected data and attempt to fill data gaps and improve analysis, additional water quality and flow data is being collected at two sites monthly in the Deer Creek watershed. Such data is crucial in estimating load reductions.

The 2020 IR indicates that Tehuacana Creek (**1242N**) has concerns for nitrate, total phosphorus, chlorophyll *a*, and having had a fish kill. Tehuacana Creek is a shallow rural stream with typically low to no flow in the upper portion of the watershed. One permit holder discharges directly into Tehuacana Creek. Downstream of the discharge near US Hwy 84/SH 31, flow in Tehuacana Creek is more consistent. Land Use in the Tehuacana Creek watershed was determined to be comprised of approximately 75% agricultural land, 18% rangeland, 5% urban or built-up land and 2% water. Bacterial and nutrient contributions are likely industrial discharge point source and nonpoint sources including agricultural runoff and wildlife.

Bull Hide Creek (**1242Q**) has a concern for nitrate. There is one permit holder discharges directly into Bull Hide Creek. Tradinghouse Reservoir (**1242H**) also has a concern for general use after having a fish kill report. The Brazos River/Lake Brazos segment **1256** has a concern for chlorophyll *a* in AU **1256**_02 – the Lake Brazos portion of the segment that runs adjacent through downtown Waco.

Special Studies:

Characterization of Middle Yegua, Davidson, and Deer Creeks:
In April 2018, TWRI began the Characterization of Middle Yegua, Davidson, and Deer Creeks project. The watershed characterization was completed in 2020. Through this project, existing data such as water quality data, flow, wildlife and livestock estimates, number of septic systems, etc. was collected and evaluated to assist in identifying causes and sources of parameters

impairing water quality. As a result of this characterization effort, it was determined that more water quality and flow data was necessary. To supplement collected data and attempt to fill data gaps and improve analysis, additional water quality and flow data is being collected at two sites monthly in the Deer Creek watershed. The data from this characterization can be used in future watershed-based plans.

Watershed Characterization of the Thompsons Creek Watershed
This watershed characterization study focused on three segments in the Thompson Creek Watershed. Portions of Cottonwood Branch (1242B_01 and 1242B_02) first listed in 2006, Still Creek (1242C_02), first listed in 2006 and Thompsons Creek (1242D_01 and 1242D_02), first listed in 2002, are all listed as impaired for recreational use due to elevated bacteria in the 2020 IR. The portion of Thompsons Creek from the confluence of Still Creek upstream to the confluence of Thompson's Branch (1242D_02) is also listed as impaired in the 2020 IR for depressed dissolved oxygen and has been since 2006.

This characterization addresses the bacterial impairments in the in the noted segments with water quality monitoring and a review of demographic, climatic, physical, and hydrological conditions of the Thompson's Creek watershed. Existing data for water quality parameters, flow, livestock, wildlife, stormwater permits, and a number of on-site sewage facilities were analyzed to develop a better understanding of potential causes and sources of bacteria pollution. As is the goal with these watershed characteristic studies data collected will help stakeholders with future watershed planning efforts. A final report Watershed Characterization of the Thompsons Creek Watershed.

TPWD Tehuacana Creek Water Quality Reports
Texas Parks and Wildlife has produced a series of reports documenting water quality on Tehuacana Creek with a historical water quality review and review of current data with additional biological data collected throughout the study. For more information please see Historical Data Review for Tehuacana Creek Segment 1242N in the Brazos River Basin, Interim Data Report for Tehuacana Creek Segment 1242N in the Brazos River Basin. A Final Report for Tehuacana Creek Segment 1242N in the Brazos River Basin will be published in 2022.

Table 3.3.9.2 Water Quality Issues Summary

Water Quality Issue	Affected Area	Possible Influences/Concerns	Possible Actions Taken/to be Taken
Impairments			
Bacteria	1242B Cottonwood Branch 1242C Still Creek 1242DThompsons Creek 1242F Pond Creek 1242I Campbells Creek 1242J Deer Creek 1242K Mud Creek 1242L Pin Oak Creek 1242M Spring Creek 1242O Walnut Creek 1242P Big Creek	• Small rural tributaries, highly influenced by nonpoint sources and very little flow. • Runoff from agriculture and ranchland could provide contributions. • Herbaceous/shrubland could provide contributions from wildlife. • Storm water runoff • WWTFs • Industrial discharges	• Await EPA review and approval of revised recreational uses • More current data should be collected in segments where new criteria have been approved and there is a lack of current data. • Review results of the Watershed Characterization of the Thompsons Creek Watershed • Review results of the Characterization of Middle Yegua, Davidson, and Deer Creeks project

			• Add a monitoring station on 1242G to help determine sources on 1242B_01
Dissolved Oxygen	1242D Thompsons Creek	• Natural sources • Non-point sources	• 24-hr DO is being collected
Concerns			
Bacteria	1242N Tehuacana Creek	• Industrial discharge point source • Nonpoint sources including agricultural runoff and wildlife	• Continue routine water quality monitoring
Dissolved Oxygen	1242C Still Creek 1242I Campbells Creek 1242M Spring Creek	• Natural sources • Non-point sources	• Conduct 24-hr DO study
Chlorophyll *a*/ Nutrients	1242 Brazos River above Navasota River 1242B Cottonwood Branch 1242C Still Creek 1242D Thompsons Creek 1242F Pond Creek 1242J Deer Creek 1242N Tehuacana Creek 1242Q Bullhide Creek 1256 Lake Brazos	• Industrial and municipal permitted discharges • Agricultural runoff • Storm water runoff • Other non-point sources	• Review results of the Watershed Characterization of the Thompsons Creek Watershed • Review results of the Characterization of Middle Yegua, Davidson, and Deer Creeks project • Continue routine water quality monitoring
Impaired Macrobenthic community	1242D Thompsons Creek 1242J Deer Creek	• Natural sources	• Continue routine water quality monitoring
Impaired Fish Community	1242D Thompsons Creek	• Natural sources	• Continue routine water quality monitoring
Fish Kill	1242H Tradinghouse Reservoir 1242N Tehuacana Creek	• Industrial and municipal permitted discharges • Agricultural runoff • Storm water runoff • Other non-point sources	• Continue routine water quality monitoring

3.3.10 Navasota Watershed

Watershed Area	Active Surface Water Monitoring Stations	Monitoring Agencies	Permitted Discharges	Potential Stakeholders	Classified Segments
2235 sq. m	18	BRA, TCEQ	53	Cities of Bryan, College Station, Thornton, Groesbeck, Teague, Mexia; Atofina Chemicals, Sanderson Farms, US Silica Company, NRG Texas	1209, 1210, 1252, 1253

Description of Segments:

1209: **Navasota River Below Lake Limestone** – From the confluence with the Brazos River in Grimes County to Sterling C. Robertson Dam in Leon/Robertson County.

Segment Length: 120 miles
*Assessment Units (Stations): 1209 _01 (11872, **11873**), 1209_02 (**11875**, 20528), 1209_03 (**16398**), 1209_04 (**18341**), 1209_05 (**11877**), 1209_06 (None)*

Unclassified waterbody: **1209A**: Country Club Lake
Assessment Units (Stations)*: 1209A_01 (11792, 11793, 11794, 20262, 20264, 20265, 20266, 20267, 20268, 20270)*

Unclassified waterbody: **1209B**: Fin Feather Lake
Assessment Units (Stations)*: 1209B_01 (11798, 11799, 11800, 20253, 20254, 20255, 20256, 20257, 20258, 20259, 20260, 20261)*

Unclassified waterbody: **1209C**: Carter's Creek
Assessment Units (Stations)*: 1209C_01 (11784, **11785**, 21259)*

Unclassified waterbody: **1209D:** Country Club Branch
Assessment Units (Stations)*: 1209D_01 (11795)*

Unclassified waterbody: **1209E**: Wickson Creek
Assessment Units (Stations)*: 1209E_01 (11789, 15033)*

Unclassified waterbody: **1209F**: Wolfpen Creek
Assessment Units (Stations)*: 1209F_01 (None)*

Unclassified waterbody: **1209G**: Cedar Creek
Assessment Units (Stations)*: 1209G_01 (11787, 20529)*

Unclassified waterbody: **1209H**: Duck Creek
Assessment Units (Stations)*: 1209H_01 (**16389**, **21742**), 1209H_02 (16390)*

Unclassified waterbody: **1209I**: Gibbon's Creek
Assessment Units (Stations)*: 1209I_01 (11756), 1209I_02 (17904, **18800**, 20719), 1209I_03 (None)*

Unclassified waterbody: **1209J**: Shepherd Creek
Assessment Units (Stations)*: 1209J_01 (**11790**)*

Unclassified waterbody: **1209K**: Steele Creek
Assessment Units (Stations)*: 1209K_01 (None), 1209K_02 (16384)*

Unclassified waterbody: **1209L**: Burton Creek
Assessment Units (Stations)*: 1209L_01 (11783), 1209L_02 (None)*

Unclassified waterbody: **1209N**: Gibbon's Creek Reservoir
Assessment Units (Stations)*: 1209N_01 (11749), 1209N_02 (11747, 11750, 11752, 11753), 1209N_03 (11746), 1209N_04 (11751)*

Unclassified waterbody: **1209O**: Normangee Lake
Assessment Units (Stations)*: 1209O_01 (20271, 20272, 20273, 20274, 20275, 20276, 20277, 20278, 20279)*

Unclassified waterbody: **1209P**: Clear Creek
Assessment Units (Stations)*: 1209P_01 (20019)*

1210: **Lake Mexia** – From Bistone Dam in Limestone County up to the normal pool elevation of 448.3 feet (impounds Navasota River).

Segment Area: 1001.19 acres
*Assessment Units (Stations): 1210_01 (11878, 14238, **17586**, 17587), 1210_02 (17588, 18444)*

Unclassified waterbody: **1210A**: Navasota River above Lake Mexia
*Assessment Units (Stations): 1210A_01 (**16391**)*

1252: **Lake Limestone** – From Sterling C. Robertson Dam in Leon/Robertson County to a point 2.3 km (1.4 miles) downstream of SH 164 in Limestone County, up to normal pool elevation of 363 feet (impounds Navasota River).

Segment Area: 15960.74 acres

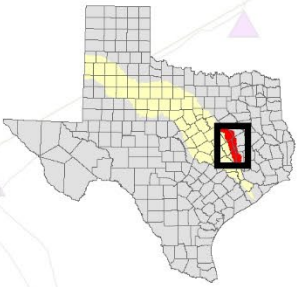
*Assessment Units (Stations): 1252_01 (**12123**), 1252_02 (**12125**), 1252_03 (**12124**), 1252_04 (13971), 1252_05 (**13970**)*

1253: Navasota River Below Lake Mexia – From a point 2.3 km (1.4 miles) downstream of SH 164 in Limestone County to Bistone Dam in Limestone County.

Segment Length: 19 miles
*Assessment Units (Stations): 1253_01 (**12126**), 1253_02 (13650, 16393), 1253_03 (17039)*

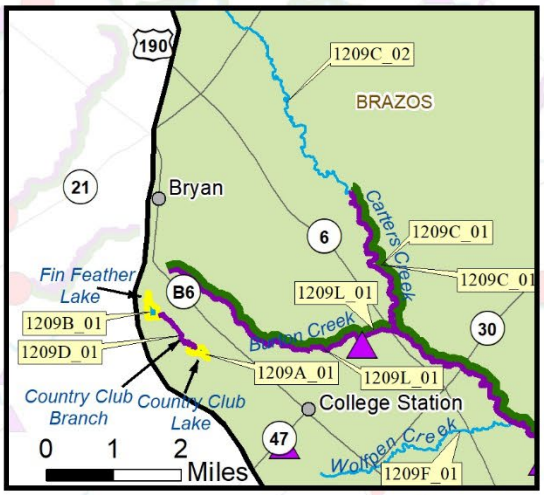
Unclassified waterbody: **1253A**: Springfield Lake
*Assessment Units (Stations): 1253A_01 (**16247**, 18799)*

Navasota River Watershed
FY22 Water Quality Monitoring and 2020 IR Status



- Bacteria Impairment
- Dissolved Oxygen Impairment
- pH Impairment
- Toxicity in Sediment Impairment
- Chlorophyll a and/or Nutrient Concern
- BRA Routine Monitoring Station
- TCEQ Routine Monitoring Station
- BRA - Instream Flow Station
- Wastewater Outfall
- Watershed Boundary

HILL
Coolidge
Mount Calm
Navasota River
1210A_01
1210_01
Lake Mexia
1210_02
Mexia
16391
17586
1253A_01
FREESTONE
84
Teague
Christmas Creek
MCLENNAN
1253_03
Springfield Lake
16247
Holman Creek
1253_02
Groesbeck
Navasota River
1252_04
1253_01
12126
LIMESTONE
1252_05
13970
12125
Thornton
1252_02
1252_03
Jewett
Lake Limestone
12124
14
1209K_02
1252_01
12123
79
FALLS
Kosse
Steele Creek
LEON
1209_05
7
Marquez
Twin Oaks Reservoir
1209K_01
11877
Duck Creek
1209H_02
1209_05
1209H_01
Camp Creek Lake
1209O_01
Franklin
ROBERTSON
Normangee
Normangee Lake
Navasota River
18341
1209_04
MADISON
1209J_01
Cedar Creek
North Zulch
Shepard Creek
1209G_01
Seg 1209J
BRAZOS
1209E_01
Wixon Valley
Navasota River
16398
1209I_03
Wickson Creek
Gibbons Creek Reservoir
90
See Inset Map
1209N_01
1209_03
30
1209N_04
1209N_03
1209N_02
11875
11785
18800
1209I_02
Carters Creek
Gibbons Creek
1209C_01
1209I_01
Wellborn
GRIMES
Anderson
BURLESON
1209_02
6
Millican
1209_01
11873
105
Navasota



Brazos River Authority

0 10 20 Miles

Table 3.3.10.1 Segment Specific Water Quality Standards with Indications of Impairment and/or Concern from the 2020 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) and Significant Long-term Trends[1]

Navasota River Watershed		Uses		Surface Water Quality Standards								Nutrient Screening Levels			
Segment	Name	Recreation[2]	Aquatic Life[3]	Cl (mg/L)	SO4 (mg/L)	TDS (mg/L)	Dissolved Oxygen Average/ Minimum (mg/L)	pH	Bacteria[4] (MPN/100ml)	Temperature (°F)	Chlorophyll *a* (µg/l)	Ammonia - N (mg/l)	Nitrate - N (mg/l)	Total Phosphorus (mg/l)	Chlorophyll *a* (µg/l)
1209	**Navasota River below Lake Limestone**	**PCR**	**H**	**140**	**100**	**600**	**5.0/3.0**	**6.5-9.0 ↑**	**126**	**93**		**0.33**	**1.95 ↑**	**0.69**	**14.1**
1209A	Country Club Lake	PCR	H	140	100	600	5.0/3.0	6.5-9.0	126	93		0.11	0.37	0.20	26.7
1209B	Fin Feather Lake	PCR	H	140	100	600	5.0/3.0	6.5-9.0	126	93		0.11	0.37	0.20	26.7
1209C	Carter's Creek	PCR	I	140	100 ↓	600	4.0/3.0 ↑	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1209D	Country Club Branch	PCR	L	140	100	600	3.0/2.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1209E	Wickson Creek	PCR	L	140	100	600	3.0/2.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1209F	Wolfpen Creek	PCR	L	140	100	600	3.0/2.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1209G	Cedar Creek	PCR	H	140	100	600	5.0/3.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1209H	Duck Creek	SCR1	H	140	100	600	5.0/3.0	6.5-9.0	630	93		0.33	1.95	0.69	14.1
1209I	Gibbon's Creek	PCR	L	140	100	600	3.0/2.0	6.5-9.0 ↑	126	93		0.33	1.95	0.69	14.1
1209J	Shepherd Creek	SCR 1	M	140	100	600	2.0/1.5	6.5-9.0	630	93		0.33	1.95	0.69	14.1
1209K	Steele Creek	PCR	M	140	100	600	2.0/1.5	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1209L	Burton Creek	PCR	L	140	100	600	3.0/2.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1209N	Gibbon's Creek Reservoir	PCR	H	140	100	600	5.0/3.0	6.5-9.0	126	93		0.11	0.37	0.20	26.7
1209O	Normangee Lake	PCR	H	140	100	600	5.0/3.0	6.5-9.0	126	93		0.11	0.37	0.20	26.7
1209P	Clear Creek	PCR	H	140	100	600	5.0/3.0	6.5-9.0	126	93		0.33	1.95	0.69	14.1
1210	**Lake Mexia**	**PCR**	**H**	**100**	**50**	**400**	**5.0/3.0**	**6.5-9.0**	**126**	**90**		**0.11**	**0.37**	**0.20**	**26.7**
1210A	Navasota River above Lake Mexia	SCR1	M	100	50	400	2.0/1.5	6.5-9.0	630	90		0.33	1.95	0.69	14.1
1252	**Lake Limestone**	**PCR**	**H**	**50 ↓**	**50**	**300 ↓**	**5.0/3.0**	**6.5-9.0 ↑**	**126**	**90**		0.11	0.37	0.20	26.7 ↑

1253	**Navasota River below Lake Mexia**	**PCR**	**H**	**440 ↓**	**150 ↓**	**1350 ↓**	**5.0/3.0**	**6.5-9.0 ↑**	**126**	**93**		**0.33**	**1.95**	**0.69**	**14.1**
1253A	Springfield Lake	PCR	H	440 ↓	150	1350 ↓	5.0/3.0	6.5-9.0	126	93		0.11	0.37	0.20	26.7 ↑

[1]Long-term trends described in this report are based on analysis of all data collected from Fiscal year 1990 through 2021 with a minimum 10-year data set and at least 20 samples unless otherwise specified. A trend was considered statistically significant at p≤0.05 with an R-value of 0.2 to 1.
[2]PCR-Primary Contact Recreation, SCR-Secondary Contact Recreation
[3]E-Exceptional, H-High, I-Intermediate, L-Limited, M-Minimal
[4] The criteria numbers represent the geometric mean for *E. coli*

Segment or portion of segment impaired

Segment or portion of segment impaired, but TMDLs have been completed and approved by EPA

↑ Statistically significant increasing trend

Segment or portion of segment has a concern for the standard or screening level

↓ Statistically significant decreasing trend

Navasota River Watershed

The Navasota River Watershed drains approximately 2,235 square miles, originating in southeast Hill County and flows 125 miles south to its confluence with the Brazos River. The main stem of the river is impounded in three places in Limestone County creating Lake Mexia, Lake Springfield and Lake Limestone. Land use in this watershed is primarily agricultural land with one growing urban area, Bryan/College Station. The Navasota River runs through two eco-regions: the Texas Blackland Prairies in the northern portion and the East Central Texas Plains in the southern portion of the watershed. Urbanization is not widespread but is primarily in the Bryan and College Station area in Brazos County. In most of the area water quality is good, though there are segments within the watershed that exceed the state standards for *E. coli* and dissolved oxygen. This is not an unexpected result for waterbodies in this area due to sluggish flow, warm temperatures and an abundance of organic matter.

Segment **1209** consists of the Navasota River below Lake Limestone downstream to its confluence with the Brazos River. This segment contains several small tributary creeks and two off-channel city lakes in Bryan/College Station, Country Club Lake and Fin Feather Lake. Segment **1209** is impaired for recreational use due to high concentrations of *E. coli* bacteria. Using station 11877 (Figure 3.3.10.1) as a representative station for segment 1209, there are increasing trends in nitrate (Figure 3.3.10.2) and pH (3.3.10.3). There are concerns for increased nitrate and total phosphorus in AU 1209_01.

Figure 3.3.10.2 **1209** (Station 11877) - Nitrate

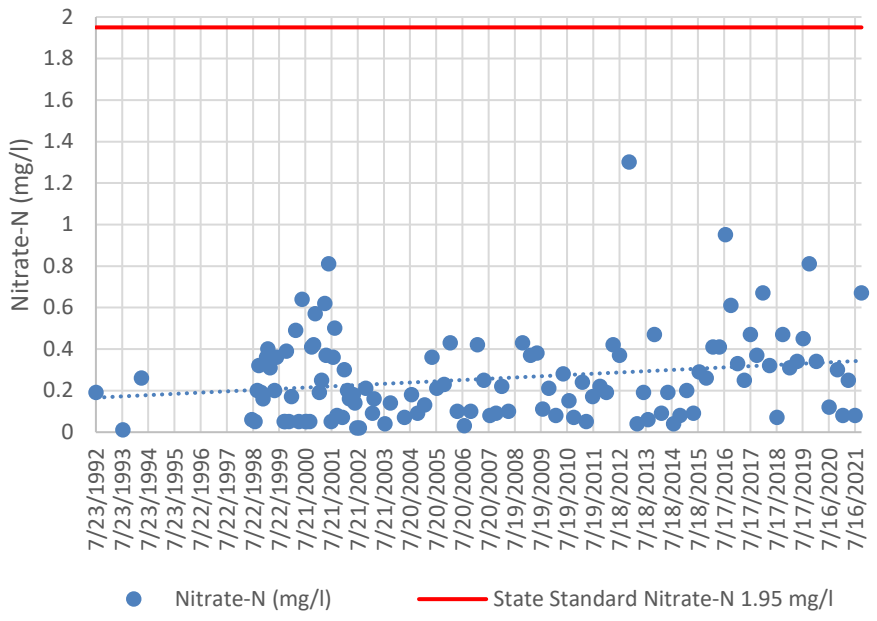
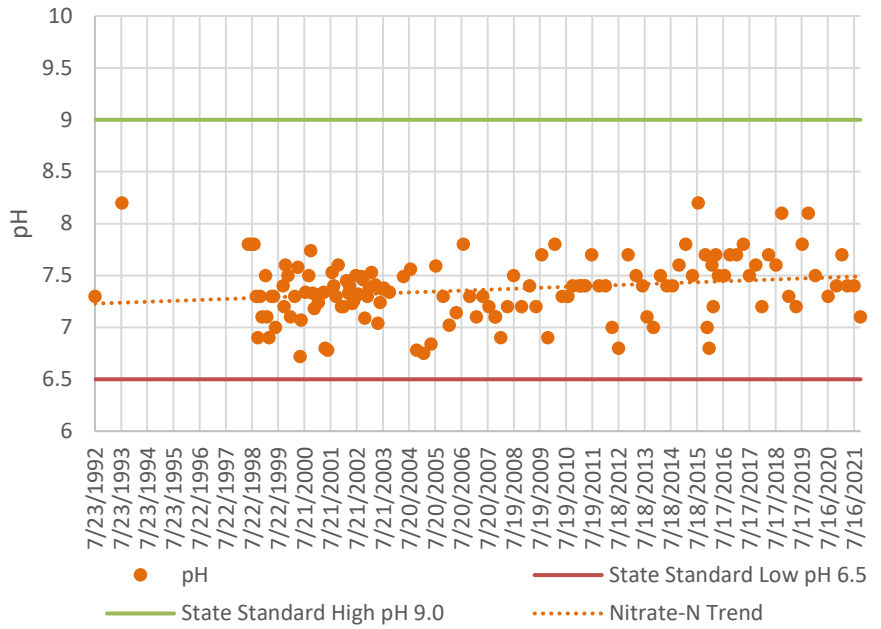


Figure 3.3.10.3 **1209** (Station 11877) - pH



To address water quality issues in **1209**, in 2015, watershed stakeholders organized to develop the Navasota River Below Lake Limestone Watershed Protection Plan. The WPP was approved in 2017 and is currently being implemented. Point sources contributing *E. coli* to the impaired AUs identified include domestic wastewater and regulated stormwater. Nonpoint source pollution sources identified in the watershed include domestic animals, failing on-site sewage facilities (OSSFs), feral animals, agricultural activities, nonregulated stormwater runoff, and wildlife. Recommended management measures focus on reducing *E. coli* loading to waterbodies by retaining it on the landscape or removing the source in the case of feral hogs. Management recommendations focus on sources that are feasibly managed including feral hogs, livestock, OSSFs, pets, and wastewater. All management recommended is voluntary and when implemented, will reduce *E. coli* loading to the Navasota River and its tributaries. Navasota River watershed stakeholders also decided to pursue development of a total maximum daily load (TMDL) and a TMDL Implementation Plan in addition to the WPP. The TMDL and Implementation Plan include the same management measures as in the WPP. The TMDL was adopted by TCEQ in August 2019 and approved by the EPA in October 2019. The Implementation plan was approved by TCEQ in August 2019.

Figure 3.3.10.1 Station 11877 Navasota River at US 79

Country Club Lake (**1209A**) and Fin Feather Lake (**1209B**) are two small municipal lakes located in the cities of Bryan/College Station. From 1988 to 1990 a study conducted by the Texas Parks and Wildlife Department found that sediment from both lakes is toxic to aquatic organisms. Researchers found arsenic, copper and zinc, among other metals in sediment samples from both lakes. These pollutants have been attributed to long-term discharge from an old nearby pesticide formulating facility. Periodic monitoring of sediment toxicity and eventual development of a more extensive long-term monitoring plan, a legacy TMDL, and the possibility of future remediation recommendations for copper and zinc are needed to restore aquatic life use in these two lakes.

Carters Creek (**1209C**), Country Club Branch (**1209D**) and Burton Creek (**1209L**) are listed as impaired due to elevated concentrations of bacteria. Carters Creek also has a concern for nitrate, total phosphorus and chlorophyll *a*, while Burton Creek has a concern for nitrate. TMDLs have been developed and approved for these waterbodies to address bacterial impairments. There is a TMDL Implementation Plan (I-Plan) approved for these streams. The TMDL determined that the most probable sources of bacteria within the watersheds of these impaired segments are stormwater runoff from permitted municipal separate storm sewer system (MS4) sources, dry weather discharges (illicit discharges) from storm sewers, sanitary sewer overflows, and unregulated sources such as wildlife, unmanaged feral animals, livestock, and pets. These same sources can contribute to nutrient and chlorophyll *a* concerns. Other unclassified segments of **1209** that are impaired for bacteria include Wickson Creek (**1209E**), Duck Creek (**1209H**), Gibbons Creek (**1209I**), Shepard Creek (**1209J**), and Steele Creek (**1209K**) along with a concern for bacteria and dissolved oxygen on Cedar Creek (**1209G**). Duck Creek (**1209H**) and Gibbon's Creek (**1209I**) also have a depressed dissolved oxygen impairment. These are typically small or stagnant creeks in lowland areas and have little flow

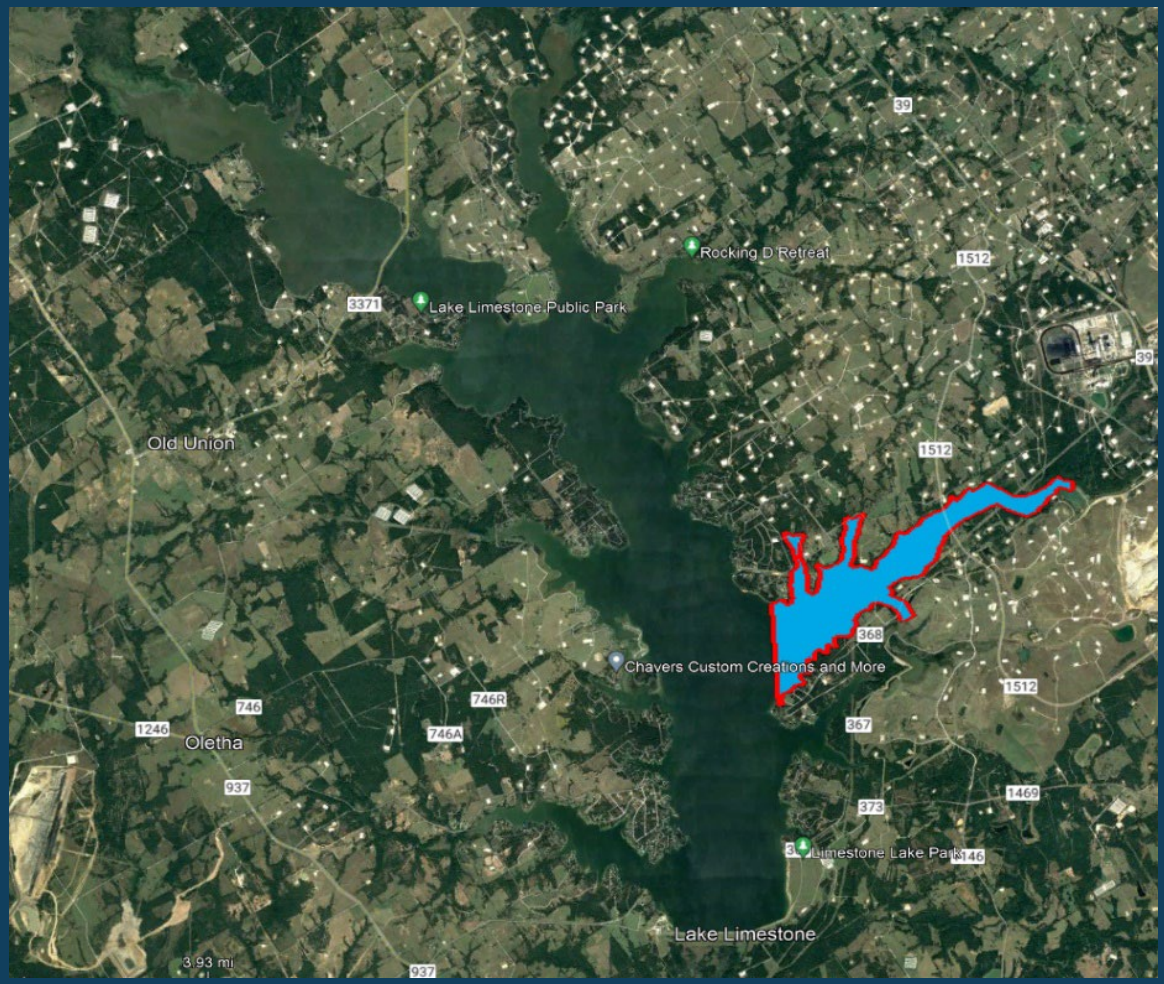


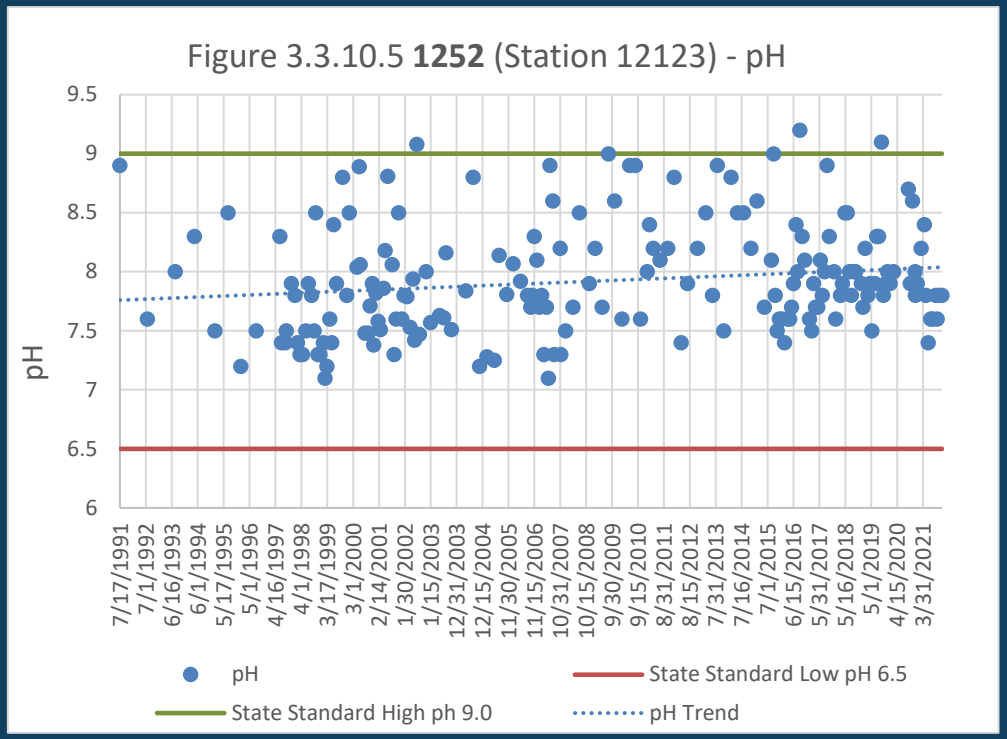
Figure 3.3.10.4 Lambs Creek (1252_03) portion of Lake Limestone

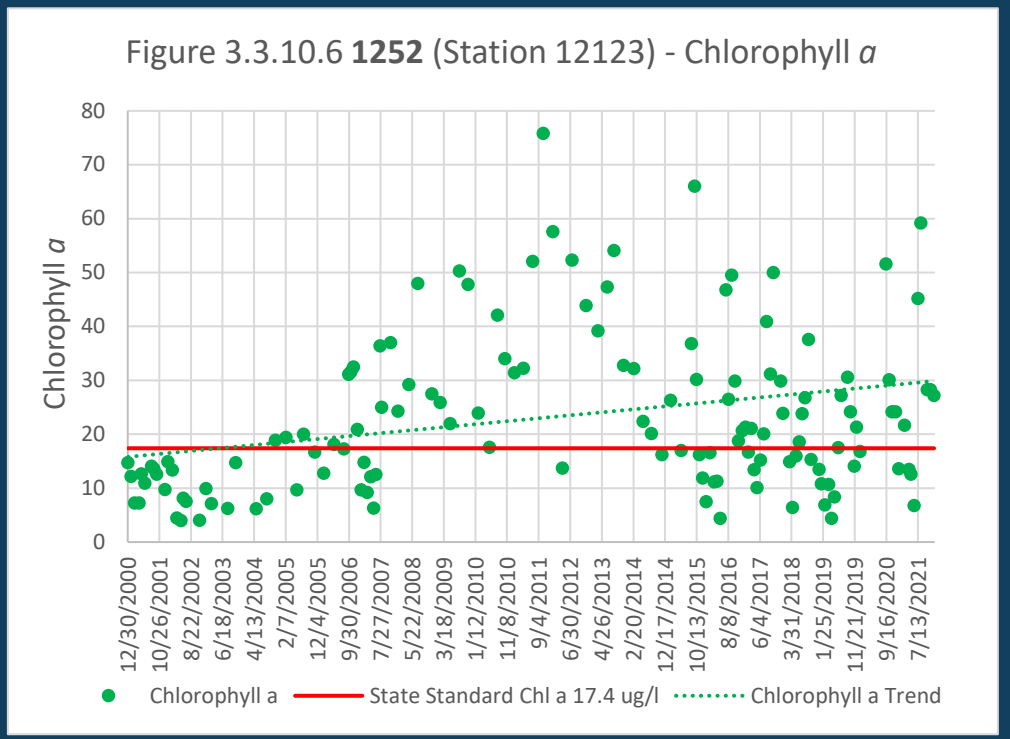
or mixing of water often resulting in water quality that is not suitable for supporting general uses.

Additionally, municipal discharges, stormwater runoff from agricultural lands and livestock and wildlife waste may be contributing to the bacterial and impairments.

Lake Mexia **1210** showed a carryforward concern for dissolved oxygen from grab samples, but no concerns were showed when 24-hr dissolved oxygen was assessed. Segment **1210A** includes the Navasota River above Lake Mexia and it is impaired for elevated levels of bacteria. There is a concern for chlorophyll *a* in **1210A**.

Segment **1252**, Lake Limestone is impaired for pH within the Lambs Creek arm (1252_03) on the east side of the lake. When using station 12123 near the dam to represent Lake Limestone, there is a statically significant increasing level of pH (Figure 3.3.10.5) and chlorophyll *a* (3.3.10.6). Increased chlorophyll *a* can also increase pH in an aquatic system. Sources and causes for pollution in this segment are currently unknown.





Segments **1253** - Navasota River below Lake Mexia has a concern for dissolved oxygen and chlorophyll *a* with an increasing trend in pH. **1253A** - Lake Springfield has a concern for dissolved oxygen and an increasing trend for chlorophyll *a*. Sources and causes for pollution in these segments are currently unknown.

Special Studies:

Navasota River Below Lake Limestone Watershed Protection Plan

The Navasota River Below Lake Limestone Watershed Protection Plan began in 2015 to address the recreational use impairment in segment **1209**. The WPP was completed and accepted by EPA in early 2017. Recommended management measures focus on reducing *E. coli* loading to waterbodies by retaining it on the landscape or removing the source in the case of feral hogs. Management recommendations focus on sources that are feasibly managed including feral hogs, livestock, on-site sewage facilities (OSSFs), pets, and wastewater. All management recommended is voluntary and when implemented, will reduce *E. coli* loading to the Navasota River and its tributaries. Navasota River watershed stakeholders also decided to pursue development of a total maximum daily load (TMDL) and a TMDL Implementation Plan in addition to the WPP. The TMDL and Implementation Plan include

the same management measures as in the WPP. The TMDL was adopted by TCEQ in August 2019 and approved by the EPA in October 2019. The Implementation plan was approved by TCEQ in August 2019. For more information visit the web site at http://navasota.tamu.edu/.

Three Total Maximum Daily Loads for Indicator Bacteria in the Carters Creek Watershed
TMDLs have been developed and approved for segments 1209C, 1209D, 1209L to address bacterial impairments. There is a TMDL Implementation Plan approved for these streams. The TMDL identified regulated and unregulated sources of bacteria in the watershed that could contribute to water quality impairment. Regulated sources identified include permitted dischargers, such as industrial discharges, municipal separate storm sewer systems (MS4s), and wastewater treatment facilities (WWTFs). Sanitary sewer overflows, dry weather discharges, and illicit discharges are a subset of these regulated sources. Unregulated sources that could contribute to the bacterial load in the Carters Creek watershed include domestic animals, neglected and failing on-site sewage facilities (OSSFs), and wildlife. The I-Plan includes six management measures and two control actions. Management measures include coordinating and expanding existing water quality monitoring in the watershed and conducting a watershed bacteria source survey; determining feasibility of modifying tax valuation requirements for agricultural lands and quantifying expected water quality impacts of modifications and impacts of transitioning from agriculture to wildlife valuations; working to improve OSSF identification, inspection, pre-installation planning, education, operation, maintenance and tracking to ensure proper system functioning; implementing sanitary sewer overflow (SSO) initiatives as appropriate across the watershed; implementing voluntary Best Management Practice (BMPs) on agricultural or undeveloped properties; continuing existing efforts and work to establish new mechanisms that encourage and promote future development and redevelopment that will mitigate adverse water quality impacts in the watershed. Control actions include implementing entity-specific MS4 Phase II Stormwater Management Programs (SWMPs) throughout the watershed and monitoring WWTF effluent *E. coli* concentrations according to individual permit requirements. For more information visit the web site at http://cartersandburton.tamu.edu/.

Brazos Basin Instream Flow Monitoring Program to Inform on Environmental Flow Standards.

The Navasota River near Easterly is part of the Brazos Basin Instream Flow Monitoring Program to Inform on Environmental Flow Standards. Extensive habitat and biological data collection efforts have and will occur at various flow regimes to better assess the impact that varying water levels have on aquatic communities. Assessments were conducted at Navasota River 1209_04 in September 2017, May 2018, July 2018, August 2019, September 2019.

Reservoir Fisheries Habitat Improvement Project
Beginning in 2016, the BRA and TPWD Inland Fisheries Staff entered into a partnership to perform habitat improvement projects on Possum Kingdom Lake, Lake Granbury, Lake Proctor, Lake Aquilla, Lake Whitney, Lake Belton, Stillhouse Hollow Lake, Lake Georgetown, Lake Granger, Lake Limestone and Lake Somerville.

The goal is to improve fishery habitat, and thus resiliency, and to proactively mitigate the negative effects that future reduced water levels may have on reservoir fisheries. Due to differences in fisheries, native habitat, and lake usage, a different plan will be developed and implemented for each lake.

Five freshwater fish reefs were deployed into the lower end of Lake Limestone during December 2019. Each reef was comprised of 5 Georgia Structures, constructed similarly to original Georgia DNR specifications. Holes were drilled in the PVC to negate buoyancy and then weighted-down further with cinder blocks. The locations of the freshwater fish reefs were selected to provide easy access for anglers and accommodate moderate water elevation changes. A total of 25 fish habitat structures were deployed adjacent to the boat ramp and park on the East side of the reservoir closest to the dam. The original plan was to deploy them near the fishing piers at the park, but extremely shallow water prevented that plan from working. Instead, the reefs were placed further offshore, on or near
areas of rapid depth changes in the vicinity of points. Depth at reef locations will range from 15ft to 19ft when the reservoir is at conservation pool. The reservoir was about 3 ft below conservation pool depth at the time of placement.

Figure 3.3.10.7 Constructed freshwater reefs being placed in Lake Limestone

Candidate Conservation Agreement with Assurances for the Balcones Spike and Texas Fawnsfoot in the Brazos River Basin (CCAA)
The Brazos River Authority CCAA requires mussel population monitoring in the Lower portion of the Navasota River.

Biological Assessments:

To address the dissolved oxygen impairment, an aquatic life assessment (ALU) was conducted in 2015-2017 on Duck Creek (**1209H**) to investigate past indications of use nonsupport, and to generate data for identifying an appropriate ALU and dissolved oxygen criteria. Benthic macroinvertebrate assemblages attained a high ALU in 1209H_01, and an intermediate ALU in 1209H_02, while fish assemblages attained a high ALU in both 1209H_01 and 1209H_02.

Table 3.3.10.2 Water Quality Issues Summary

Water Quality Issue	Affected Area	Possible Influences/Concerns	Possible Actions Taken/to be Taken
Impairments			
Bacteria	• Navasota below Lake Limestone • Carters Creek • Country Club Branch • Wickson Creek • Duck Creek • Gibbons Creek • Shepherd Creek • Steele Creek • Burton Creek • Navasota River above Lake Mexia	• Stormwater runoff from permitted municipal separate storm sewer system sources. • Dry weather discharges (illicit discharges) from storm sewers, sanitary sewer overflows. • Unregulated sources such as wildlife, unmanaged feral animals, livestock and pets.	• Continue to follow implementation management measures and control actions outlined in the Two Total Maximum Daily Loads for Indicator Bacteria in the Navasota River below Lake Limestone and monitor for water quality improvements. • Implement management measures and control actions outlined in the Navasota below Lake LimestoneTMDL/I-Plan in neighboring watersheds. • An RUAA was completed for 1209I. Results have led to the recommendation that the recreational use of this segment be revised to SCR 1 in this segment. Await EPA review and approval of revised recreational use for 1209I before a management strategy is selected. • An RUAA was completed for 1209K. Results have led to the recommendation that the recreational use of this segment be revised to SCR 1 in this segment. Await EPA review and approval of revised recreational use for 1209K before a management strategy is selected. • An RUAA was completed for 1209E. Results have led to the recommendation that the recreational use of this segment be revised to SCR 1 in this segment. Await EPA review and approval of revised recreational use for 1209E before a management strategy is selected.

Dissolved Oxygen	• Duck Creek • Gibbons Creek	• Flat topography/low streambed slope, and low base flows, resulting in minimal flow velocities • Heavy tree canopy cover which blocks sunlight and minimizes primary production, then contributes an abundance of oxygen-demanding leaf litter during late fall and winter	• To address the dissolved oxygen impairment, an ALU was conducted in 2015-2017 on Duck Creek to investigate past indications of use nonsupport, and to generate data for identifying an appropriate ALU and dissolved oxygen criteria. Texas Water Quality Standards (WQS) review of the 1209H ALU. • Perform a UAA to determine if the existing ALU and DO criteria are appropriate, and if not, provide data for establishing new standards.
pH	• Lake Limestone	• Sources are unknown	• Continue routine monitoring
Concerns			
Chlorophyll *a*/Nutrients	• Navasota below Lake Limestone • Carters Creek • Burton Creek • Navasota River above Lake Mexia • Navasota River below Lake Mexia	• There are no known point sources	• Continue routine monitoring
Dissolved Oxygen	• Cedar Creek • Lake Mexia • Navasota River below Lake Mexia • Springfield lake	• Springfield Lake is a shallow lake with very little inflow • heavy tree canopy cover which blocks sunlight and minimizes primary production, then contributes an abundance of oxygen-demanding leaf litter during late fall and winter	• Conduct additional 24-hr DO studies
Bacteria	• Cedar Creek	• Small rural tributary, highly influenced by nonpoint sources and very little flow	• Continue routine monitoring
Toxic Substances in Sediment	• Country Club Lake • Fin Feather Lake • Normangee Lake	• Legacy pollution	• No recommendations

3.3.11 Yegua Creek Watershed

Watershed Area	Active Surface Water Monitoring Stations	Monitoring Agencies	Permitted Discharges	Potential Stakeholders	Classified Segments
1318 sq. m	12	BRA, TCEQ, TWRI	19	Cities of Brenham, Somerville, Giddings, Lexington, Caldwell, Rockdale, Dime Box; Lee County Water Supply, Aqua WSC, Luminant Mining, Alcoa, Inc., Southwest Milam Water Supply Corp., Manville Water Supply Company, South Central Water Company, Camp For All Foundation	1211, 1212

Description of Segments:

1211: Yegua Creek – From the confluence with the Brazos River in Burleson/Washington County to Somerville Dam in Burleson/Washington County

Segment Length: 20.5 miles
*Assessment Units (Stations): 1211_01 (**11880**)*

Unclassified waterbody: **1211A**: Davidson Creek 58.5 miles
*Assessment Units (Stations): 1211A_01 (**11729**), 1211A_02 (**18349**, 20388, **21420**)*

1212: Somerville Lake – From Somerville Dam in Burleson/Washington County up to normal pool elevation of 238 feet

Segment Area: 11968 acres
*Assessment Units (Stations): 1212_01 (**11881**), 1212_02 (**22060**), 1212_03 (**16879**, 20532), 1212_04 (11882, **22059**)*

Unclassified waterbody: ***1212A***: Middle Yegua Creek
*Assessment Units (Stations): 1212A_01 (**11838**), 1212A_02 (**11840**, **18750**)*

Unclassified waterbody: ***1212B***: East Yegua Creek
*Assessment Units (Stations): 1212B_01 (**11594**), 1212B_02 (No stations)*

Unclassified waterbody: **1212C**: Nail Creek

Assessment Units (Stations)*: 1212C_01 (20674)*

Unclassified waterbody: **1212D:** Cedar Creek
Assessment Units (Stations)*: 1212D_01 (20675)*

Unclassified waterbody: **1212E**: McCain Creek
Assessment Units (Stations)*: 1212E_01 (20676)*

Unclassified waterbody: **1212F**: Burns Creek
Assessment Units (Stations)*: 1212F_01 (20677)*

Unclassified waterbody: **1212G**: Jerdelle Creek
Assessment Units (Stations)*: 1212G_01 (20678)*

Unclassified waterbody: **1212H**: Sandy Branch
Assessment Units (Stations)*: 1212H_01 (20679)*

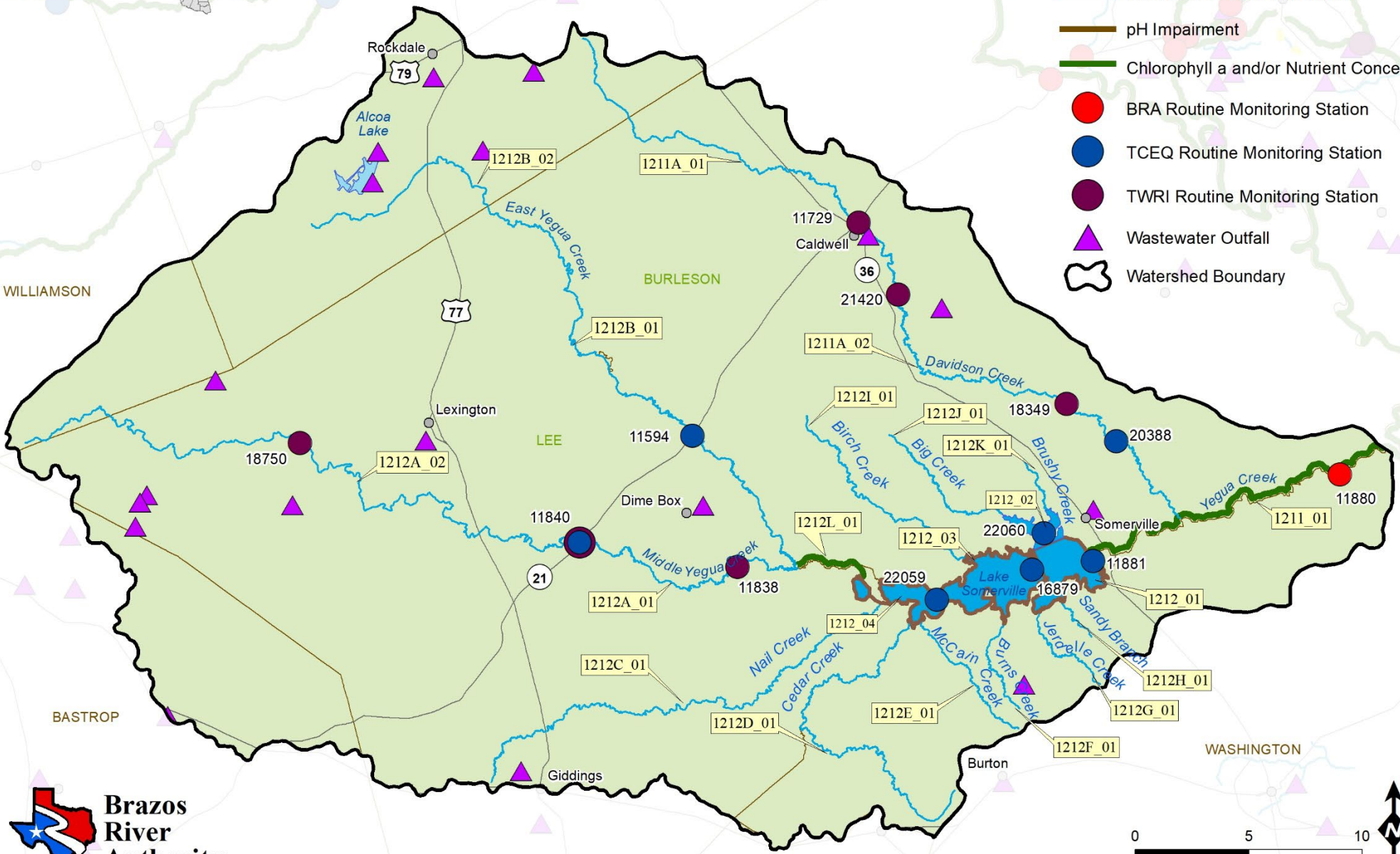
Unclassified waterbody: **1212I**: Birch Branch
Assessment Units (Stations)*: 1212I_01 (20680)*

Unclassified waterbody: **1212J**: Big Creek
Assessment Units (Stations)*: 1212J_01 (20681)*

Unclassified waterbody: **1221K:** Brushy Creek
Assessment Units (Stations)*: 1212K_01 (20682)*

Unclassified waterbody: **1212L**: Yegua Creek
Assessment Units (Stations)*: 1212L_01 (20683, 20834)*

Yegua Creek Watershed
FY22 Water Quality Monitoring and 2020 IR Status



Brazos River Authority

Table 3.3.11.1 Segment Specific Water Quality Standards with Indications of Impairment and/or Concern from the 2020 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) and Significant Long-term Trends[1]

Yegua Creek Watershed		Uses		Surface Water Quality Standards								Nutrient Screening Levels			
Segment	Name	Recreation[2]	Aquatic Life[3]	Cl (mg/L)	SO4 (mg/L)	TDS (mg/L)	Dissolved Oxygen Average/ Minimum (mg/L)	pH	Bacteria[4] (MPN/100ml)	Temperature (°F)	Chlorophyll *a* (µg/l)	Ammonia - N (mg/l)	Nitrate - N (mg/l)	Total Phosphorus (mg/l)	Chlorophyll *a* (µg/l)
1211	**Yegua Creek**	**PCR**	**H**	**140**	**130**	**640**	**5.0/3.0**	**6.5-9.0**	**126**	**91**		**0.33**	**1.95**	**0.69**	**14.1** ↑
1211A	Davidson Creek	PCR	I	140	130	640	4.0/3.0	6.5-9.0 ↑	126	91		0.33	1.95	0.69	14.1
1212	**Somerville Lake**	**PCR**	**H**	**100** ↓	**100** ↓	**400** ↓	**5.0/3.0**	**6.5-9.0**	**126**	**93**		0.11	0.37	0.20	26.7
1212A	Middle Yegua	PCR	H	100	100	400	5.0/3.0	**6.5-9.0**	126	93		0.33	1.95	0.69	14.1
1212B	East Yegua	SCR1	H	100	100	400	5.0/3.0 ↓	**6.5-9.0** ↓	630	93		0.33	1.95	0.69	14.1
1212C	Nail Creek	PCR	L	100	100	400	3.0/2.0	**6.5-9.0**	126	93		0.33	1.95	0.69	14.1
1212D	Cedar Creek	PCR	L	100	100	400	3.0/2.0	**6.5-9.0**	126	93		0.33	1.95	0.69	14.1
1212E	McCain Creek	PCR	M	100	100	400	2.0/1.5	**6.5-9.0**	126	93		0.33	1.95	0.69	14.1
1212F	Burns Creek	PCR	L	100	100	400	3.0/2.0	**6.5-9.0**	126	93		0.33	1.95	0.69	14.1
1212G	Jerdelle Creek	PCR	L	100	100	400	3.0/2.0	**6.5-9.0**	126	93		0.33	1.95	0.69	14.1
1212H	Sandy Branch	PCR	M	100	100	400	2.0/1.5	**6.5-9.0**	126	93		0.33	1.95	0.69	14.1
1212I	Birch Creek	PCR	L	100	100	400	3.0/2.0	**6.5-9.0**	126	93		0.33	1.95	0.69	14.1
1212J	Big Creek	PCR	L	100	100	400	3.0/2.0	**6.5-9.0**	126	93		0.33	1.95	0.69	14.1
1212K	Brushy Creek	PCR	M	100	100	400	2.0/1.5	**6.5-9.0**	126	93		0.33	1.95	0.69	14.1
1212L	Yegua Creek	PCR	L	100	100	400	3.0/2.0	**6.5-9.0**	126	93		0.33	1.95	0.69	14.1

[1]Long-term trends described in this report are based on analysis of all data collected from Fiscal year 1990 through 2021 with a minimum 10-year data set and at least 20 samples unless otherwise specified. A trend was considered statistically significant at p≤0.05 with an R-value of 0.2 to 1.
[2]PCR- Primary Contact Recreation, SCR-Secondary Contact Recreation
[3]E-Exceptional, H-High, I-Intermediate, L-Limited, M-Minimal
[4] The criteria numbers represent the geometric mean for *E. coli*

Segment or portion of segment impaired

↑ Statistically significant increasing trend

Segment or portion of segment has a concern for the standard or screening level

↓ Statistically significant decreasing trend

Yegua Creek Watershed

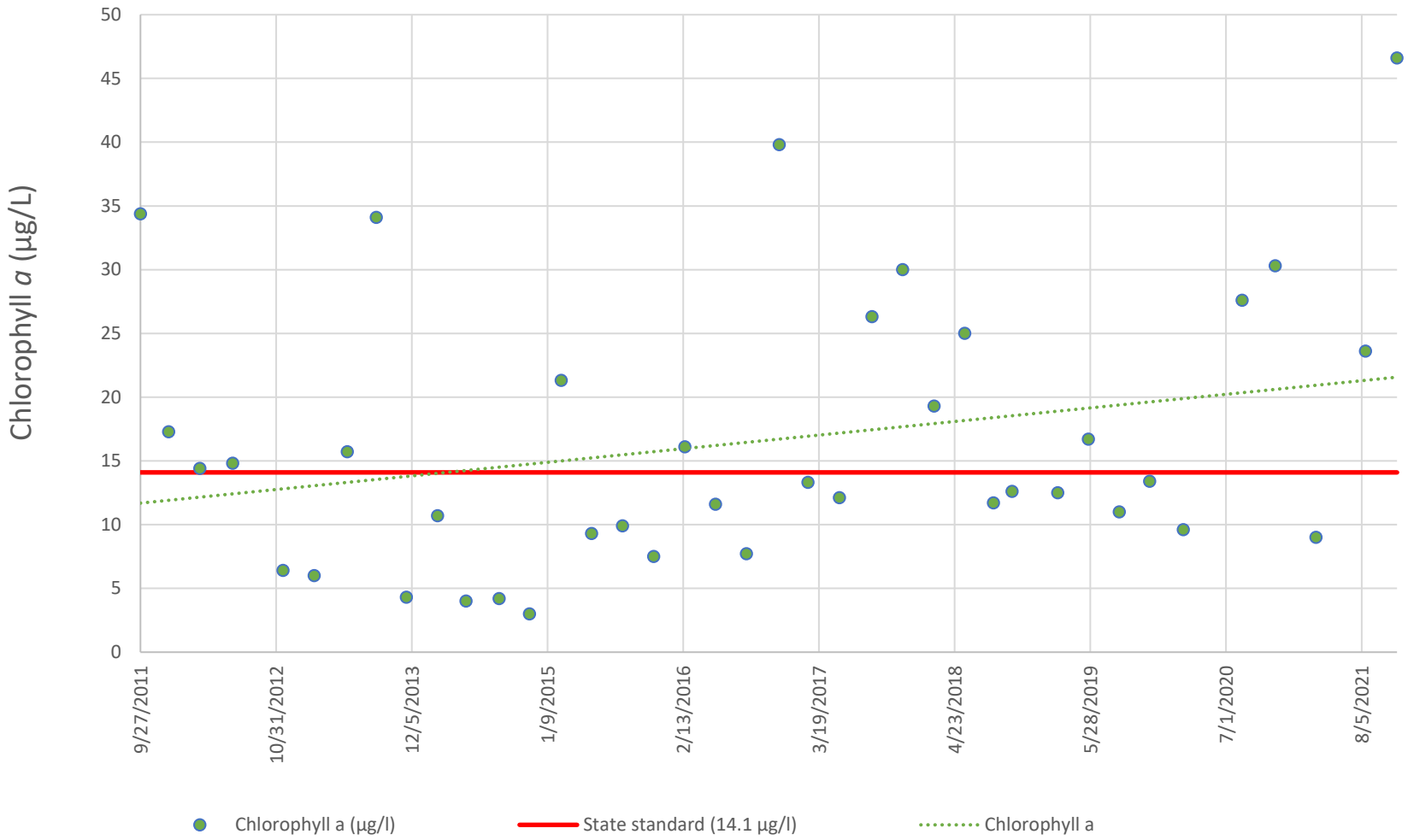
Land use in the Yegua Creek watershed is mainly rural and cattle production intensive with small urban areas and limited crop production areas. The main channel is impounded for flood control, municipal water supply and recreation to create Lake Somerville. Lake Somerville's holdings are the main water supply for The City of Brenham. Land use in the upstream portion of the watershed, bisected by highway 21, primarily consists of pockets of mixed forest interspersed with cleared pasture land. The downstream portion includes most of the city of Caldwell, and cleared pasture land with small riparian corridors

Davidson Creek (**1211A**) is on the 2020 303(d) List for both bacteria and dissolved oxygen impairments. Middle Yegua Creek (**1212A**) is on the 2020 303(d) List for bacteria exceeding standards and has a concern for depressed dissolved oxygen and aquatic life use. East Yegua (**1212B**) had a change to its designated use (from PCR to SCR1) when the segment was assessed in 2016, and the previous bacteria impairment was removed when assessed based on 2018 Texas Surface Water Quality Standards criteria. To address impairments in **1211A** and **1212A**, a Characterization of Middle Yegua, Davidson, and Deer Creeks project was completed in 2020. Through this project, existing data such as water quality data, flow, wildlife and livestock estimates, number of septic systems, etc. was collected and evaluated to assist in identifying causes and sources of parameters impairing water quality. As a result of this characterization effort, it was determined that more water quality and flow data was necessary. To supplement collected data and attempt to fill data gaps and improve analysis, additional water quality and flow data is being collected at six sites monthly (three sites in each of the Middle Yegua Creek and Davidson Creek watersheds). Such data is crucial in estimating load reductions. Load reductions needed to accomplish water quality standards and goals will be calculated using Load Duration Curves.

Lake Somerville is currently on the 303(d) list for pH (**1212**_01, _03, and _04). Lake Somerville is classified in the 2020 Texas Integrated Report as eutrophic. Over production by planktonic algae produces diel swings in dissolved oxygen causing super-saturation during the day while respiration can cause nighttime oxygen levels to crash. As photosynthesis ramps up in the daylight hours, CO_2 is removed from the water causing more alkaline conditions. Additional data collection including routine monitoring of ten tributaries to Somerville Lake (1212); algae identification, low-level nutrient, silica sampling and algal assays in 1212; and stormwater monitoring in selected subwatersheds were conducted through the Two Data Collection Initiatives project administered by BRA, ending in 2013. No point sources were identified as contributing to the impairment. Internal nutrient cycling within the lake appeared to be the most likely cause of the elevated pH in the reservoir. Segment **1212L** has a concern for chlorophyll *a*. The source is unknown.

Yegua Creek below the dam to the confluence with the Brazos (**1211**) is currently not listed for any parameters, but there is a concern for bacteria and chlorophyll *a* with a statistically significant increasing trend for chlorophyll *a* (Table 3.3.11.1 and Figure 3.3.11.1). Internal nutrient cycling within the Somerville Lake likely impacts the downstream segment of 1211.

Figure 3.3.11.1 **1211** Yegua Creek (Station 11880) - Chlorophyll *a*



Special Studies:

Characterization of Middle Yegua, Davidson, and Deer Creeks:

In April 2018, TWRI began the Characterization of Middle Yegua, Davidson, and Deer Creeks project. The watershed characterization was completed in 2020. Through this project, existing data such as water quality data, flow, wildlife and livestock estimates, number of septic systems, etc. was collected and evaluated to assist in identifying causes and sources of parameters impairing water quality. As a result of this characterization effort, it was determined that more water quality and flow data was necessary. To supplement collected data and attempt to fill data gaps and improve analysis, additional water quality and flow data is

being collected at six sites monthly (three sites in each of the Middle Yegua Creek and Davidson Creek watersheds). The data from this characterization can be used in future watershed-based plans.

Reservoir Fisheries Habitat Improvement

Beginning in 2016, the BRA and TPWD Inland Fisheries Staff entered into a partnership to perform habitat improvement projects on Possum Kingdom Lake, Lake Granbury, Lake Proctor, Lake Aquilla, Lake Whitney, Lake Belton, Stillhouse Hollow Lake, Lake Georgetown, Lake Granger, Lake Limestone and Lake Somerville. The goal is to improve fishery habitat, and thus resiliency, and to proactively mitigate the negative effects that future reduced water levels may have on reservoir fisheries. Due to differences in fisheries, native habitat, and lake usage, a different plan will be developed and implemented for each lake.

From October 9 to November 8, 2018, a total of 85 Mossback structures were assembled and placed in clusters at total of 17 locations in Lake Somerville. Each location has 4-6 structures total with proportions of tall vs. short varying by location. The locations for the Mossback clusters (Figure 3.3.11.2) were selected to provide easy access for bank anglers as well as boating anglers and to prevent them from becoming boating hazards during normal pool. Mossback structures stand approximately 30 inches (Root Wad) and 55 inches (Safe Haven) once assembled and set in concrete cinder blocks.

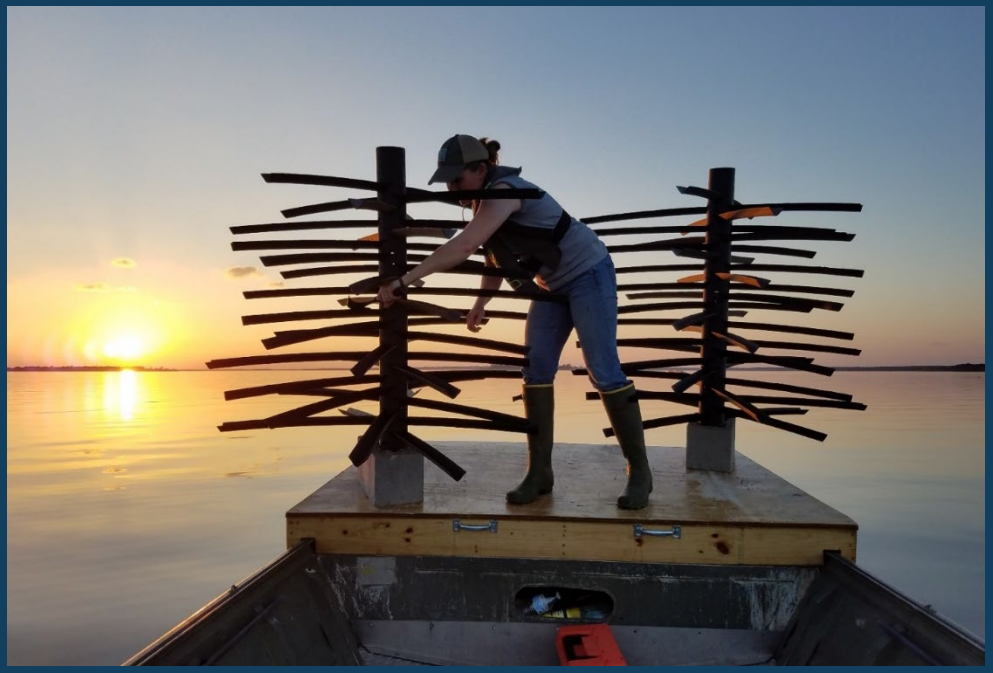


Figure 3.3.11.2 Mossback cluster being set on Lake Limestone

Table 3.3.11.2 Water Quality Issues Summary

Water Quality Issue	Affected Area	Possible Influences/Concerns	Possible Actions Taken/to be Taken
Impairments			
Bacteria	• Davidson Creek • Middle Yegua Creek	• Domestic livestock • Wildlife and Feral Hogs • Domestic Pets • OSSFs • Permitted discharges • SSOs	• Review results of the Characterization of Middle Yegua, Davidson, and Deer Creeks project • Continue data collection effort
Depressed DO	• Davidson Creek	• Primary productivity enhanced by same possible influences/concerns as for bacterial impairment	• UAA to determine appropriateness of DO Standard or conduct 24-hr DO study

		• Natural features of the stream	
pH	• Somerville Lake	• No point sources have been identified as contributing to the impairment. • Internal nutrient cycling within the lake appeared to be the most likely cause of the elevated pH in the reservoir	• Continue to monitor long-tern station in segment 1212
Concerns			
Bacteria	• Yegua Creek	From Davidson Creek upstream: • Domestic livestock • Wildlife and Feral Hogs • Domestic Pets • OSSFs • Permitted discharges • SSOs	• Apply any management measures that may result from the Middle Yegua, Davidson, and Deer Creeks project to adjacent watersheds.
Chlorophyll *a*	• Yegua Creek	• Nutrient enriched waters from upstream lake discharging into segment • Previously conducted special study identified no point sources as contributing to the impairment	• Continue to monitor long-tern station in segment 1211
Dissolved Oxygen	• Middle Yegua Creek	• Unknown	• Review results of the Characterization of Middle Yegua, Davidson, and Deer Creeks project • Continue data collection effort • UAA to determine appropriateness of DO Standard or conduct 24-hour DO study

3.3.12 Lower Watershed of the Brazos River

Watershed Area	Active Surface Water Monitoring Stations	Monitoring Agencies	Permitted Discharges	Potential Stakeholders	Classified Segments
2,091	9	BRA, TCEQ	98	Cities of Richmond, Rosenberg, Freeport, Lake Jackson, Fulshear, Orchard, West Columbia, Needville, Missouri City, Industry, Sugar Land, Sealy, Hempstead, Brenham, Bellville, Burton, Wallis, West Columbia; Various other permit holders*	1201, 1202, 1245 (partial)

Description of Segments:

1201: Brazos River Tidal – From the confluence with the Gulf of Mexico in Brazoria County to a point 100 meters (110 miles) upstream of SH 332 in Brazoria County

Segment Area: 25 miles

*Assessment Units (Stations): 1201_01 (**11843**, 16878)*

1202: Brazos River Below Navasota River – From a point 100 meters (110 yards) upstream of SH 332 in Brazoria County to the confluence of the Navasota River in Grimes County

Segment Length: 199 miles

*Assessment Units (Stations): 1202_01 (**16355**), 1202_02 (11845,**11846**, 11847), 1202_03 (**11848**,11849 16387, **21816**), 1202_04 (16386), 1202_05 (**11850**)*

Unclassified waterbody: **1202A**: Beason Creek

Assessment Units (Stations): 1202A_01 (None)

Unclassified waterbody: **1202B**: Rabbs Bayou

Assessment Units (Stations): 1202B_01 (None)

Unclassified waterbody: **1202C**: Hog Branch

Assessment Units (Stations): 1202C_01 (20651)

Unclassified waterbody: **1202D**: New Year Creek
Assessment Units (Stations): 1202D_01 (None)

Unclassified waterbody: **1202E**: Little Sandy Creek
Assessment Units (Stations): 1202E_01 (15131,15132), 1202E_02(15129, 15130)

Unclassified waterbody: **1202G**: Brookshire Creek
Assessment Units (Stations): 1202G_01 (None)

Unclassified waterbody: **1202H**: Allen's Creek
*Assessment Units (Stations): 1202H_01 (**11577**, 21621, 21753)*

Unclassified waterbody: **1202I**: Bessie's Creek
*Assessment Units (Stations): 1202I_01 (11580, **21814**), 1202I _02 (18589), 1202I _02 (None)*

Unclassified waterbody: **1202J**: Big Creek
*Assessment Units (Stations): 1202J_01 (**16353**, 17932), 1202J _02 (17551)*

Unclassified waterbody: **1202K**: Mill Creek,
*Assessment Units (Stations): 1202K_01 (**11576**, 21577, 21579)*

Unclassified waterbody: **1202P**: Pond Creek
Assessment Units (Stations): 1202P_01 (11579)

Unclassified waterbody: **1202Q**: Clear Creek,
Assessment Units (Stations): 1202Q_01 (11578)

1245: Upper Oyster Creek – the approximately 3-mile portion of Upper Oyster Creek from Steep Bank Creek/Brazos River confluence in Fort Bend County to near State Highway 6 in Fort Bend County.

Segment Length: 48 miles
Assessment Units (Stations): a portion of 1245_01 (None)
Unclassified waterbody: **1245B**: Brown's Bayou
Assessment Units (Stations): 1245B_01 (17380)

Unclassified waterbody: **1245C**: Bullhead Bayou

*Assessment Units (Stations): 1245C_01 (11508, **17371**, 17372)*

Unclassified waterbody: **1245D**: Unnamed tributary of Bullhead Bayou
*Assessment Units (Stations): 1245D_01 (**17382**)*

Unclassified waterbody: **1245F**: Alcorn Bayou
*Assessment Units (Stations): 1245F_01 (**17381**)*

Unclassified waterbody: **1245I**: Steep Bank Creek
Assessment Units (Stations):1245I_01 (11507, 17689)

* Wastewater permit holders in the Lower Watershed: JTI Constructors, Land Tejas Companies Ltd., Twimwood Inc, Frito-Lay Inc., Fort Bend County Municipal Utility District, Wood Road & I 10 Investments Inc., Sienna Plantation Municipal Utility District, Dry Creek (Houston) ASLI VII LLC, Brazosport Water Authority, Bhakti Vishram Kuteer LLC, US Steel Tubular Products Inc,, Brazoria County Water Supply District, Chevron Phillips Chemical Company LP, Beacon Estates Water Supply Company, Royal Valley Utilities Inc., Royal Wailea Investment LP, Plantation Municipal Utility District, BASF Corporation, The Dow Chemical Company, Pecan Grove Municipal Utility District, Greatwood Hospitality Inc, Brookshire Municipal Water District Royal Valley Utilities Inc., NRG Texas Power LLC, Hammond Mound Utilities, Inc., Aqua Development Company, Austin County Water Supply Company, Phillips 66 Company, Vulcan Construction Materials LP, Ellwood Texas Forge Navasota LLC, Ventana Development McCrary Ltd., Brazos Valley Energy LP and Calpine Operating Services Company Inc., Positive Feed Ltd., ACME Brick Company, B & B Investments Inc., Fulshear Lakes Ltd., Petra Nova CCS I LLC, Chappell Hill Service Company LLC

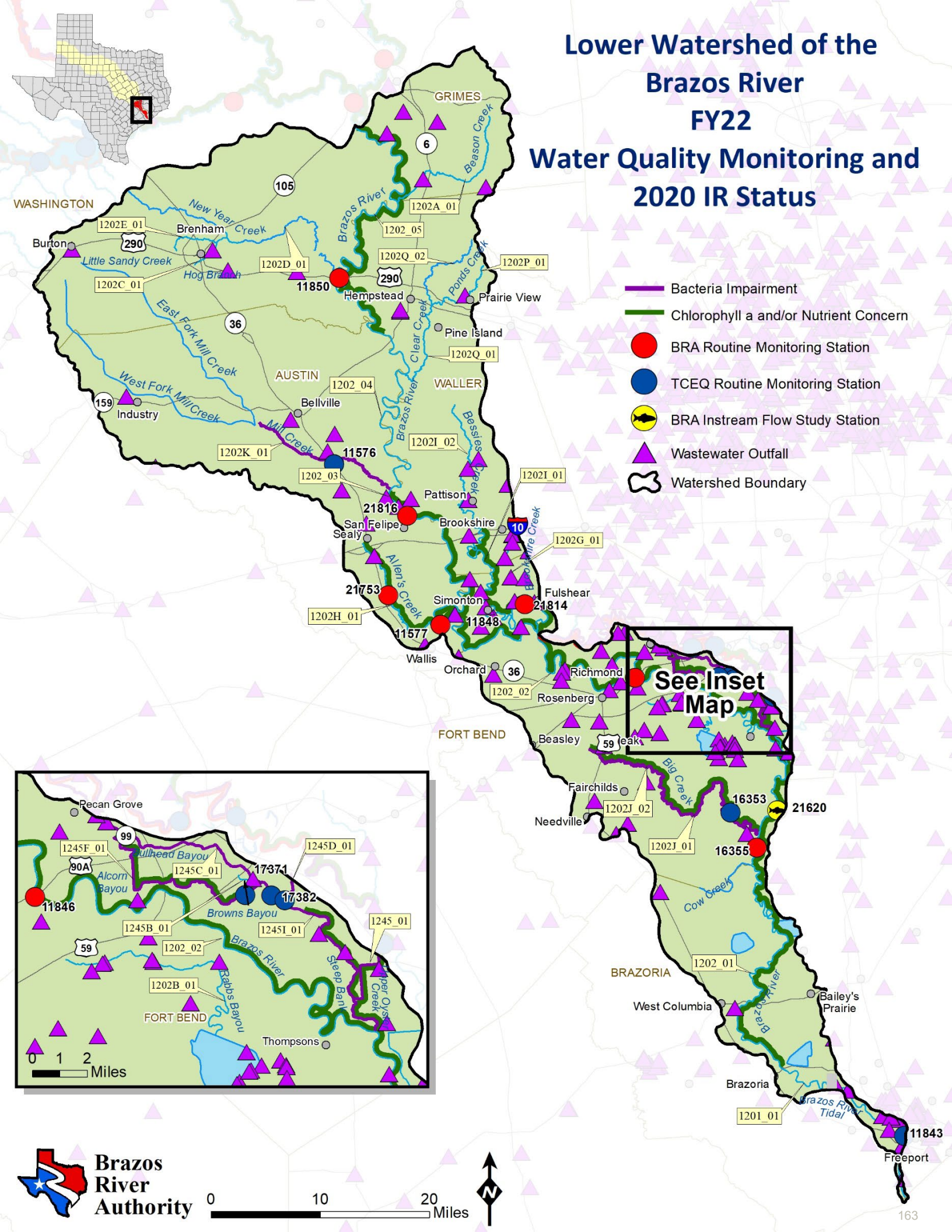

Lower Watershed of the Brazos River
FY22
Water Quality Monitoring and 2020 IR Status
Bacteria Impairment
Chlorophyll a and/or Nutrient Concern
BRA Routine Monitoring Station
TCEQ Routine Monitoring Station
BRA Instream Flow Study Station
Wastewater Outfall
Watershed Boundary
See Inset Map
GRIMES
WASHINGTON
AUSTIN
WALLER
FORT BEND
BRAZORIA
Brazos River
New Year Creek
Little Sandy Creek
Hog Branch
East Fork Mill Creek
West Fork Mill Creek
Mill Creek
Clear Creek
Ponds Creek
Bessies Creek
Allen's Creek
Big Creek
Cow Creek
Bullhead Bayou
Alcorn Bayou
Browns Bayou
Rabbs Bayou
Steep Bank
Oyster Creek
Brazos River Tidal
Burton
Brenham
Hempstead
Prairie View
Pine Island
Industry
Bellville
Pattison
San Felipe
Sealy
Brookshire
Fulshear
Simonton
Wallis
Orchard
Richmond
Rosenberg
Beasley
Fairchilds
Needville
West Columbia
Bailey's Prairie
Brazoria
Freeport
Pecan Grove
Thompsons
1202E_01
1202A_01
1202_05
1202Q_02
1202P_01
1202D_01
1202C_01
11850
1202Q_01
1202_04
1202K_01
11576
1202_03
1202I_02
1202I_01
21816
1202G_01
21753
1202H_01
11577
11848
21814
1202_02
1202J_02
16353
21620
1202J_01
16355
1202_01
1201_01
11843
1245F_01
1245D_01
1245C_01
17371
17382
1245I_01
1245_01
11846
1245B_01
1202_02
1202B_01
0 1 2 Miles
0 10 20 Miles
Brazos River Authority
N

Table 3.3.12.1 Segment Specific Water Quality Standards with Indications of Impairment and/or Concern from the 2020 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) and Significant Long-term Trends[1]

Lower Watershed		Uses		Surface Water Quality Standards								Nutrient Screening Levels			
Segment	Name	Recreation[2]	Aquatic Life[3]	Cl (mg/L)	SO4 (mg/L)	TDS (mg/L)	Dissolved Oxygen Average/ Minimum (mg/L)	pH	Bacteria[4] (MPN/100ml)	Temperature (°F)	Chlorophyll *a* (µg/l)	Ammonia - N (mg/l)	Nitrate - N (mg/l)	Total Phosphorus (mg/l)	Chlorophyll *a* (µg/l)
1201	**Brazos River Tidal**	**PCR**	**H**				**4.0/3.0**	**6.5-9.0**	**35**	**95**		**0.46**	**1.10**	**0.66**	**21.0**
1202	**Brazos River Below Navasota River**	**PCR**	**H**	**300** ↓	**200** ↓	**750**	**5.0/3.0**	**6.5-9.0** ↑	**126**	**95**		**0.33**	**1.95**	**0.69** ↑	**14.1** ↑
1202A	Beason Creek	PCR	I	300	200	750	4.0/3.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1202B	Rabbs Bayou	PCR	L	300	200	750	3.0/2.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1202C	Hog Branch	PCR	I	300	200	750	4.0/3.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1202D	New Year Creek	PCR	I	300	200	750	4.0/3.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1202E	Little Sandy Creek	PCR	I	300	200	750	4.0/3.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1202G	Brookshire Creek	PCR	L	300	200	750	3.0/2.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1202H	Allen's Creek	SCR1	H	300 ↑	200	750 ↑	3.0/2.0	6.5-9.0 ↑	630	95		0.33	1.95 ↑	0.69	14.1
1202I	Bessie's Creek	PCR	I	300	200	750	4.0/3.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1202J	Big Creek	PCR	I	300 ↓	200 ↓	750 ↓	4.0/3.0 ↓	6.5-9.0	126 ↑	95		0.33	1.95 ↑	0.69 ↑	14.1 ↓
1202K	Mill Creek	PCR	H	300	200 ↑	750	5.0/3.0	6.5-9.0	126	95 ↓		0.33	1.95 ↑	0.69	14.1
1202P	Pond Creek	PCR	H	300	200	750	3.0/2.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1202Q	Clear Creek	PCR	H	300	200	750	5.0/3.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1245	**Upper Oyster Creek**	**PCR**	**I**	**140**	**75**	**1070**	**4.0/3.0[5]**	**6.5-9.0**	**126**	**95**		**0.33**	**1.95**	**0.69**	**14.1**
1245B	Brown's Bayou	PCR	L	140	75	1070	3.0/2.0	6.5/9.0	126	95		0.33	1.95	0.69	14.1
1245C	Bullhead Bayou	SCR 1	L	140	75	1070	3.0/2.0	6.5/9.0	630	95		0.33	1.95	0.69	14.1

1245D	Unnamed Tributary of Bullhead Bayou	SCR 1	L	140	75	1070	3.0/2.0	6.5/9.0	630	95		0.33	1.95	0.69	14.1
1245F	Alcorn Bayou	PCR	L	140	75	1070	3.0/2.0	6.5/9.0	126	95		0.33	1.95	0.69	14.1
1245I	Steep Bank Creek	PCR	L	140	75	1070	3.0/2.0	6.5/9.0	126	95		0.33↓	1.95	0.69	14.1↓

[1]Long-term trends described in this report are based on analysis of all data collected from Fiscal year 1990 through 2021 with a minimum 10-year data set and at least 20 samples unless otherwise specified. A trend was considered statistically significant at p≤0.05 with an R-value of 0.2 to 1.
[2]PCR- Primary Contact Recreation, SCR-Secondary Contact Recreation
[3]E-Exceptional, H-High, I-Intermediate, L-Limited
[4] The criteria numbers represent the geometric mean for *E. coli*
[5]A 24-hour minimum dissolved oxygen criterion of 1.0 mg/L applies from the confluence with Steep Bank Creek/Brazos River upstream to Dam #3

Segment or portion of segment impaired

Segment or portion of segment impaired, but TMDLs have been completed and approved by EPA

↑ Statistically significant increasing trend

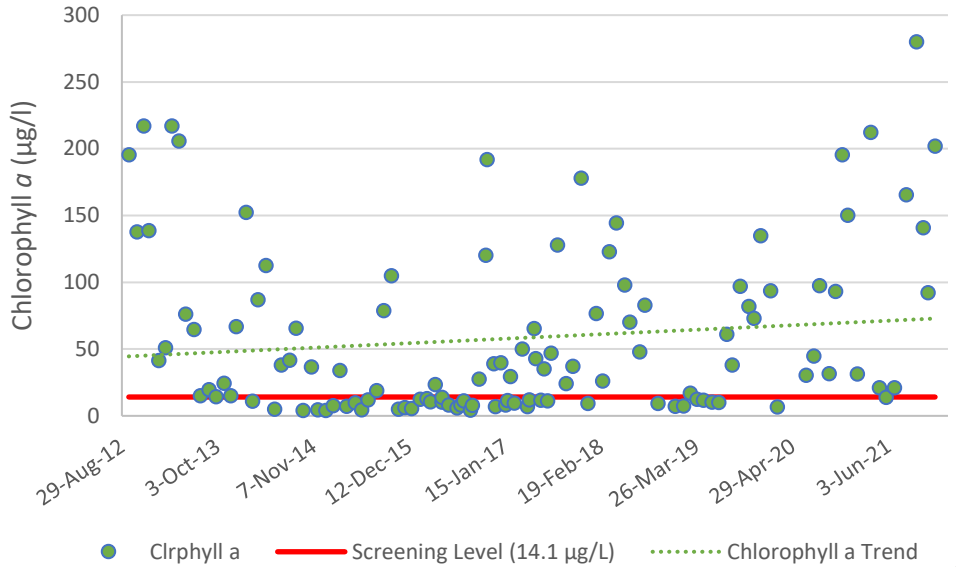
Segment or portion of segment has a concern for the standard or screening level

↓ Statistically significant decreasing trend

Lower Watershed of the Brazos River

The Lower Brazos watershed begins at the confluence of the Navasota River and the Brazos River and continues downstream where the Brazos River empties into the Gulf of Mexico. Encompassing 2,077 mi2, the Lower Watershed is a combination of two classified water bodies, segment **1202**, a freshwater portion of the Brazos River, and segment **1201**, the tidal portion of the Brazos River. Land use in this area of the Brazos River varies greatly from upstream to downstream. The Lower Watershed traverses land that includes agriculture, mining facilities, small municipalities, as well as the far southern portion of the Greater Houston area. Agriculture in this area ranges from livestock to row crops of sorghum, rice, corn, and cotton. Fort Bend County has experienced significant growth, which has led to sedimentation and runoff effects in the Brazos River. This runoff includes fertilizers, pesticides, sewage treatment effluent and even animal waste. All of these contribute to an increase in nutrients, bacteria and organic matter build-up.

Figure 3.3.12.1 1202 Brazos River below Navasota River (11850)



The 2020 IR reports chlorophyll *a* remains a concern for segment **1202** (Brazos River below confluence of Navasota River) and an increasing trend is indicated (Figure 3.3.12.1). Urban and suburban expansion, upstream agricultural uses, and ill equipped or outdated waste water treatment plants could be contributing to nutrient levels below screening levels but elevated to enough to contribute to algal blooms leading to increased Chlorophyll *a* levels.

Allen's Creek (**1202H**) was impaired for not supporting contact recreation use due to elevated bacteria in the 2016 IR. New bacteria criteria has been accepted by the EPA for this segment. Applying the new criteria, the bacterial impairment has been removed in the 2020 Integrated Report. Concerns persist for nitrate and total phosphorus with an increasing trend in nitrate indicated (Figure 3.3.12.2). The monitoring location – station 21753 on this unclassified waterbody is just upstream of the confluence of the mainstem, and Sealy, TX. At this location there is an abundance of agricultural land, which could lead to increased nutrients and livestock contributions to the water.

Bessie's Creek (**1202I**) added concerns for bacteria (near non-attainment), depressed dissolved oxygen and total phosphorus. It is not surprising to see dissolved oxygen level decrease with an increase in total phosphorus, as phosphorus is a driver of increased algal growth. Robust suburban development has occurred nearby Bessie's creek in the last 15 years and could be contributing to the trend of higher bacteria and total phosphorus. Effects of development on water quality parameters are well documented. Contributors to bacteria include displacement of wildlife to undisturbed habitats close to stream, new WWTPs and increased pet density. Contributors to total phosphorus include WWTPs discharging more but within permit limits and poor yard management practices such as over fertilizing.

Figure 3.3.12.2 1202H Allens Creek (21753) - Nitrate

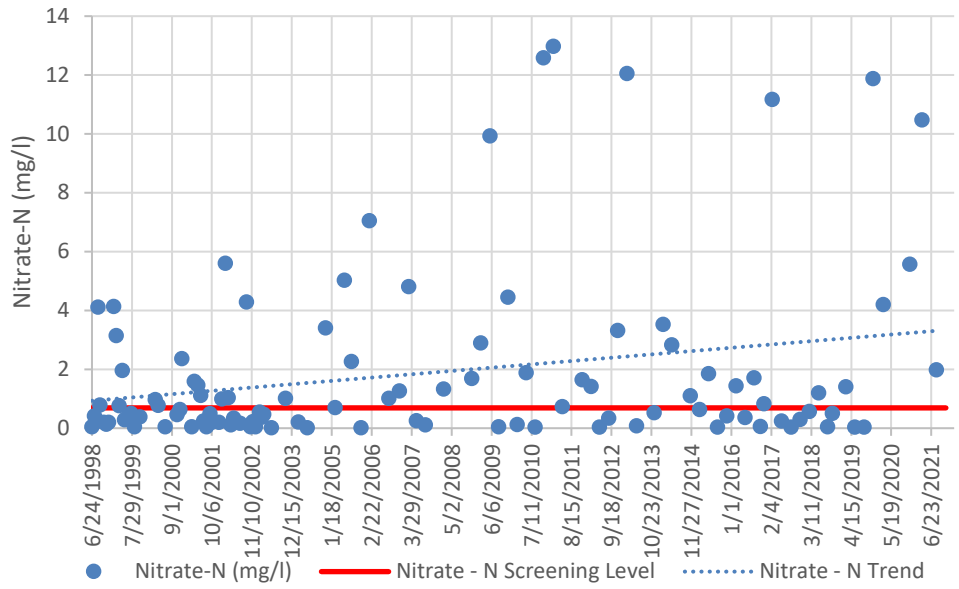
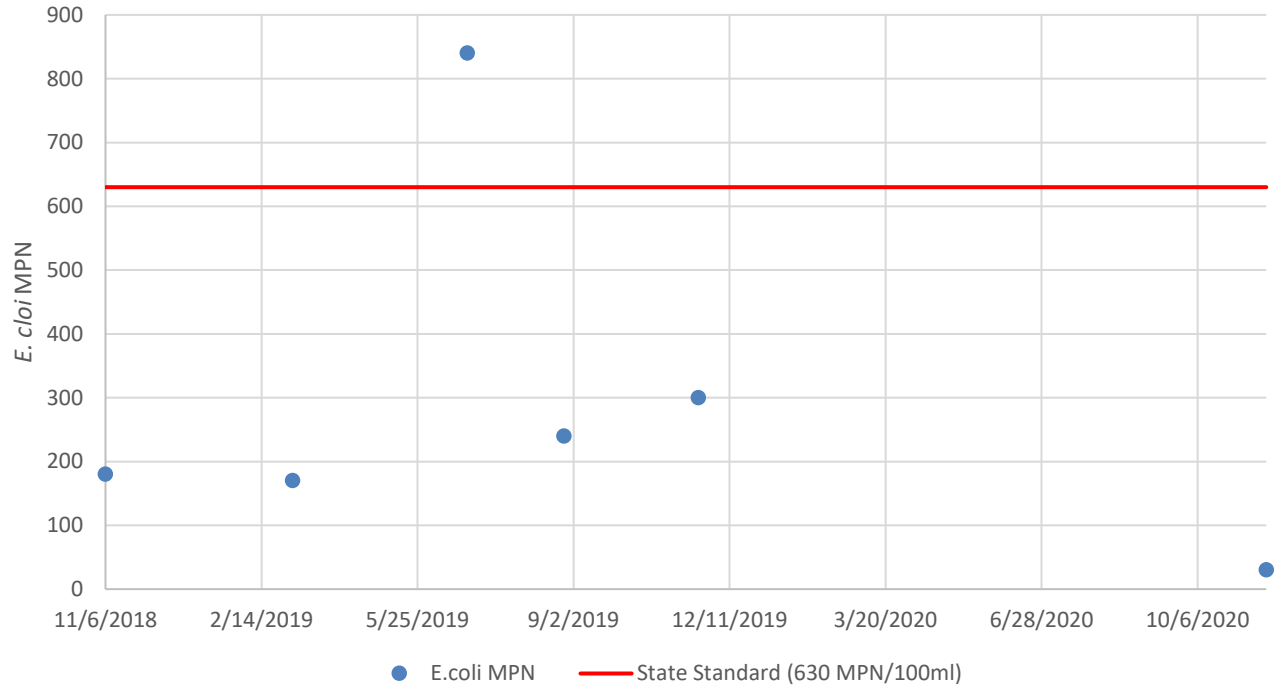


Figure 3.3.12.3 1202J_02 Big Creek at State Highway 36

Big Creek (**1202J**) has a concern for aquatic life use due to impaired fish community and impaired habitat. The portion of Big Creek from the confluence of the Brazos River upstream to the confluence of an unnamed tributary 2.1 km downstream of FM 2977 south of Rosenberg (**1202J**_01) is impaired for not supporting contact recreation use due to elevated bacteria in the draft 2020 IR. There are also concerns for the fish community and habitat in **1202J**_01, however these are carried forward concerns and not assessed in the 2020 IR. There are concerns for dissolved oxygen, nitrate, and total phosphorus in **1202J**_02, the portion of Big Creek from the confluence with an unnamed tributary 2.1 km downstream of FM 2977 upstream to the confluence of Cottonwood Creek and Coon Creek. Bacteria issues and nutrient concerns in Big Creek are most likely a result of agricultural and wildlife runoff. Like Allen's Creek, this section of the creek is shallow, with muddy bottoms and low sloping banks. There is little habitat variety in this portion of the creek which leads to low diversity in the fish community. The two assessment units of Big Creek are surrounded by row crop land. When nutrient levels such as these are increased it is often a result of nonpoint source pollution, such as rangeland and agricultural runoff. A Use Attainability Analysis (UAA) may be appropriate for this unclassified waterbody. These areas of concern in the waterbody may be associated with the lack of riparian buffer in the sub-watershed (Figure 3.3.12.3). Big Creek also has an increasing trend for bacteria, nitrate and total phosphorus. (Table 3.3.12.1).

Bullhead Bayou (**1245C**) and Unnamed Tributary to Bullhead Bayou (**1245D**) retained bacterial impairments. Due to lack of data, these waterbodies were not assessed, and the impairment is carried forward**.** It is likely that these two streams would come off the list of impairments with collection of more bacteria data and the SCR1 criteria being applied. In 2018 TCEQ restarted data collection efforts. The limited amount of data collected since 2018 show bacteria levels are below the criteria (Figure 3.3.12.4). The geometric mean of the available samples is 195 (n=6), well below the 630 secondary contact recreation criteria.

Figure 3.3.12.4 1245C Bullhead Bayou (Station 17371) - Bacteria



Mill Creek (**1202K**) is on the 303(d) List for a bacterial impairment. Although there are no concerns, there is an increasing trend in nitrate and sulfate concentrations in this unclassified

waterbody. There is a concern for impaired habitat in Mill Creek. It has similar riparian land use as the other streams. There is very little riparian buffer between the stream and the row crop and pasture that surrounds the sub-watershed. To address water quality issues, the Mill Creek Watershed Partnership was formed to guide development of the Mill Creek Watershed Protection Plan. See "Special Studies" below for more details.

Alcorn Bayou (**1245F**) and Steep Bank Creek (**1245I**) both have impairments for not supporting contact recreation use due to bacteria as well as concerns for nitrate. Both of these segments flow through urbanized residential areas where both pet waste and fertilizer runoff are likely sources of bacteria and nutrients. Education may be impactful for water quality improvement.

Special Studies:

Mill Creek Watershed Protection Plan
In March 2016 the EPA approved the Mill Creek Watershed Protection Plan. It is in the implementation phase. The WPP helps focus restoration efforts and enables financial and technical assistance to facilitate improvements in Mill Creek. Potential sources identified in the WPP are: urban runoff, dogs, cattle, goats, sheep, horses, domestic hogs, poultry, deer, feral hogs, and wastewater. Contributing to other concerns, pollutants such as nutrients, sediment, pesticides and hydrocarbons (fuel, motor oil and grease) may also be present in runoff. Urban management measures focus on addressing potential sources of bacteria in existing urbanized areas. Dog waste and urban stormwater runoff are the two primary sources for which management measures were recommended. City ordinances and pet waste collection facilities are proposed to address dog waste. To address stormwater management, the WPP and created Partnership will support cities in the watershed in seeking funding to conduct detailed engineering analyses to properly locate and design practices specific to each city. In order to reduce the occurrence of illicit sanitary sewer system discharges, it was recommended that cities participate in TCEQ's Sanitary System Sewer Overflow Initiative program and cities will work to extend sanitary sewer service to peripheral areas not currently served. Education programs for homeowners on septic systems and seeking funding to provide assistance to those who are unable to repair failing systems due to financial constraints were also components of the WPP management measures. Agricultural management measures identified included voluntary site-specific Water Quality Management Plans for individual operations. Enhanced planning and financial assistance are provided to farmers and ranchers for development of management plans that reduce bacteria and nutrient losses. Activities including filter strips, nutrient management, and conservation easements are recommended as pollutant controls in the Mill Creek watershed. To address concerns over feral hogs in the lower portion of the watershed, the expertise and resources of the Texas Wildlife Services will be utilized for technical assistance, education, and direct control of feral hogs. In addition, continued employment of a full-time, regional feral hog management position to provide direct technical assistance in the Mill Creek watershed is supported.

Brazos Basin Instream Flow Monitoring Program to Inform on Environmental Flow Standards.
The Brazos River at Richmond and the Brazos River near Rosharon are part of the Brazos Basin Instream Flow Monitoring Program to Inform on Environmental Flow Standards. Extensive habitat and biological data collection efforts have and will occur at various flow regimes to better assess the impact that varying water levels have on aquatic communities.

Biological Assessments:
In FY19 BRA conducted an aquatic life monitoring and habitat assessment event at stations 21620 - Brazos River 8.4 km upstream of FM 1462 west of Rosharon in September of 2019 following the Brazos Basin Instream Flow Monitoring Program to Inform on Environmental Flow Standards protocol. The Brazos River at 21620 achieved a high fish community index score and an intermediate benthic macroinvertebrate community index score.

Table 3.3.12.2 Water Quality Issues Summary

Water Quality Issue	Affected Area	Possible Influences/Concerns	Possible Actions Taken/to be Taken
Impairments			
Bacteria	• Allens Creek • Big Creek • Mill Creek • Bullhead Bayou • Unnamed tributary of Bullhead Bayou • Steep Bank Creek • Alcorn Bayou	• Urban runoff, dogs, cattle, goats, sheep, horses, domestic hogs, poultry, deer, feral hogs, and wastewater	• Implementation of new EPA SCR1 Standards on stream that are impaired at the PCR standard. • Continue to follow and implement recommended best management practices outlined in the Mill Creek WPP and monitor for water quality improvements. • Implement BMPs outlined in the Mill Creek WPP in neighboring watersheds.
Concerns			
Chlorophyll *a*/Nutrients	• Brazos River below Navasota River • Allens Creek • Bessie's Creek • Big Creek • Alcorn Bayou • Steep bank Creek	• Urban runoff, dogs, cattle, goats, sheep, horses, domestic hogs, poultry, deer, feral hogs, and wastewater • Rapid development	• Continue to follow and implement recommended best management practices outlined in the Mill Creek WPP and monitor for water quality improvements. • Implement BMPs outlined in the Mill Creek WPP in neighboring watersheds.
Dissolved Oxygen	• Bessie's Creek • Big Creek	• Increased nutrient input leading to increased primary productivity depleting dissolved oxygen	• Implement BMPs outlined in the Mill Creek WPP in neighboring watersheds.
Fish Community/Habitat	• Big Creek • Mill Creek	• Little habitat variety in portions of these segments with shallow, muddy bottom and low sloping banks leading to low diversity in the fish community	• Continue to follow and implement recommended best management practices outlined in the Mill Creek WPP and monitor for water quality improvements.

			• Implement BMPs outlined in the Mill Creek WPP in neighboring watersheds. • Education
Bacteria	• Bessie's Creek	• Urban runoff, dogs, and wastewater	• Implement BMPs outlined in the Mill Creek WPP in neighboring watersheds. • Education

3.3.13 Upper Oyster Creek Watershed

Watershed Area	Active Surface Water Monitoring Stations	Monitoring Agencies	Permitted Discharges	Potential Stakeholders	Classified Segments
120 mi^2	3	TCEQ	33	Fulshear, Sugar Land, Stafford, Missouri City, Fort Bend County	1208 (partial), 1245, 1258

Description of Segments:

Unclassified waterbody: **1202F**: Unnamed Oxbow Slough
Assessment Units (Stations): 1202F_01 (None)

1245: Upper Oyster Creek – From Steep Bank Creek/Brazos River confluence in Fort Bend County to pumping station on Jones Creek at Brazos River in Fort Bend County (includes portions of Steep bank Creek, Flat Bank Creek Diversion Channel, and Jones Creek).

Segment Length: 48 miles
*Assessment Units (Stations): 1245_01 (11506, 12072,**12074** -12078, 17690, 18211), 1245_02 (12079-**12083**, 17373, 21187), 1245_03 (12084 -**12087**,12088 -12092, 17685, 21748)*

Unclassified waterbody: **1245A**: Red Gully
Assessment Units (Stations): 1245A_01 (11516), 1245A_02 (18212)

Unclassified waterbody: **1245C**: Headwater portion of Bullhead Bayou
Assessment Units (Stations): 1245C_01 (No stations in this portion of 1245C in this watershed)

Unclassified waterbody: **1245E**: Flewellen Creek
Assessment Units (Stations): 1245E_01 (11512-11515, 17686)

Unclassified waterbody: **1245G**: Brooks Lake
Assessment Units (Stations): 1245G_01 (11510-11511)

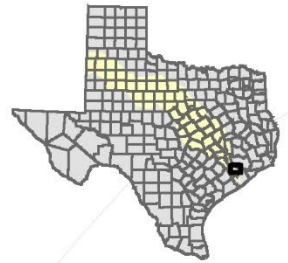
Unclassified waterbody: **1245H**: Alkire Lake
Assessment Units (Stations): 1245H_01 (17687)

Unclassified waterbody: **1245J**: Stafford Run.
Assessment Units (Stations): 1245J_01 (17688, 18209)

1258: Middle Oyster Creek – From the confluence with the Brazos River to the Flat Bank diversion channel in Fort Bend County

Segment Length: 15 miles
Assessment Units (Stations): 1258_01(None)

Upper and Middle Oyster Creek Watershed
FY22 Water Quality Monitoring and 2020 IR Status



1245E_01
Fulshear
Flewellen Creek
1245_03
1245A_02
99
Upper Oyster Creek
1245A_01
Red Gully
Bullhead Bayou
1245C_01
12087
Sugar Land
12083
90A
Alkire Lake
1245H_01
Stafford
59
Brooks Lake
1202F_01
1245G_01
1245_02
Upper Oyster Creek
Stafford Run
1245J_01
1245_01
12074
1258_01
Middle Oyster Creek
6
HARRIS
FORT BEND
BRAZORIA

Bacteria Impairment
Depressed Dissolved Oxygen Impairment
Chlorophyll a and/or Nutrient Concern
TCEQ - Routine Monitoring Station
Wastewater Outfall
Watershed Boundary

Brazos River Authority

N

0 5 10 Miles

Table 3.3.13.1 Segment Specific Water Quality Standards with Indications of Impairment and/or Concern from the 2020 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) and Significant Long-term Trends1

Upper Oyster Creek Watershed		Uses		Surface Water Quality Standards								Nutrient Screening Levels			
Segment	Name	Recreation[2]	Aquatic Life[3]	Cl (mg/L)	SO4 (mg/L)	TDS (mg/L)	Dissolved Oxygen Average/ Minimum (mg/L)	pH	Bacteria[4] (MPN/100ml)	Temperature (°F)	Chlorophyll *a* (µg/l)	Ammonia - N (mg/l)	Nitrate - N (mg/l)	Total Phosphorus (mg/l)	Chlorophyll *a* (µg/l)
1202F	Unnamed Oxbow Slough	PCR	L	300	200	750	3.0/2.0	6.5-9.0	126	95		0.33	1.95	0.69	14.1
1245	**Upper Oyster Creek**	**PCR**	**I**	**140**	**75**	**1070**	**4.0/3.0[5]** ↑	**6.5-9.0** ↑	**126**	**95**		**0.33**	**1.95** ↑	**0.69**	**14.1**
1245A	Red Gully	PCR	I	140	75	1070	4.0/3.0	6.5/9.0	126	95		0.33	1.95	0.69	14.1
1245C	Bullhead Bayou	SCR 1	L	140	75	1070	3.0/2.0	6.5/9.0	630	95		0.33	1.95	0.69	14.1
1245E	Flewellen Creek	PCR	M	140	75	1070	2.0/1.5	6.5/9.0	126	95		0.33	1.95	0.69	14.1
1245G	Brooks Lake	PCR	H	140	75	1070	5.0/3.0	6.5/9.0	126	95		0.11	0.37	0.20	26.7
1245H	Alkire Lake	PCR	H	140	75	1070	5.0/3.0	6.5/9.0	126	95		0.11	0.37	0.20	26.7
1245J	Stafford Run	PCR	H	140	75	1070	5.0/3.0	6.5/9.0	126	93		0.33	1.95	0.69	14.1
1258	**Middle Oyster Creek**	PCR	H	300	150	750	5.0/3.0	6.5/9.0	126	90		0.33	1.95	0.69	14.1

[1]Long-term trends described in this report are based on analysis of all data collected from Fiscal year 1990 through 2021 with a minimum 10-year data set and at least 20 samples unless otherwise specified. A trend was considered statistically significant at p≤0.05 with an R-value of 0.2 to 1.
[2]PCR-Primary Contact Recreation
[3]E-Exceptional, H-High, I-Intermediate, L-Limited, M-Minimal
[4] The criteria numbers represent the geometric mean for *E. coli*
[5] A 24-hour minimum dissolved oxygen criterion of 1.0 mg/L applies from the confluence with Steep Bank Creek/Brazos River upstream to Dam #3

Segment or portion of segment impaired

Segment or portion of segment impaired, but TMDLs have been completed and approved by EPA

Segment or portion of segment has a concern for the standard or screening level

↑ Statistically significant increasing trend

↓ Statistically significant decreasing trend

Upper Oyster Creek (**1245**) is located within the Brazos River Basin, southwest of Houston in northern Fort Bend County and varies from a natural stream course to a highly modified system of canals and dams which create impoundments that maintain nearly constant water levels for industrial, residential, recreational and drinking water supply. The canal system was dredged to serve as a conveyance for water pumped from the Brazos River into Jones Creek to be diverted into Upper Oyster Creek. It originates at the Gulf Coast Water Authority's (GCWA) Shannon Pumping Station on the Brazos River south of the City of Fulshear and terminates at the confluence of Steep Bank Creek and the Brazos River, located southeast of the City of Sugar Land. Three small dams on Upper Oyster Creek are located on the watercourse around the City of Sugar Land. The dams form impoundments to maintain nearly constant water levels for industrial and recreational uses. The land within the watershed of Segment 1245 has undergone rapid changes. The area has been characterized by high rates of land development and conversion from rural and agricultural uses to urban residential and industrial use. This watershed is heavily suburbanized. Segment **1245** is impaired for depressed dissolved oxygen and bacteria and has concerns for nitrate, total phosphate and chlorophyll *a* in the 2020 IR. These impairments led to a bacteria TMDL that was approved by the EPA in 2007. Bacterial sources identified were onsite sewage facilities (OSSFs), wastewater treatment facilities (WWTFs), sanitary sewer collection systems, agricultural and wildlife sources and urban nonpoint sources including pet waste and stormwater runoff. Two TMDLs for DO were also approved by the EPA in September 2010. The pollutants considered of greatest concern regarding depressed dissolved oxygen concentration were carbonaceous biochemical oxygen demand (CBOD) and ammonia nitrogen (NH3-N). The Implementation Plan (I-Plan)for the three TMDLs was approved by the TCEQ in 2014.

Alkaire Lake (**1245H**) is an amenity lake and Brooks Lake (**1245G**) is an off-channel impoundment of Upper Oyster Creek. Red Gully (**1245A**), Flewellen Creek (**1245E**), and Stafford Run (**1245J**) are freshwater streams that are all tributaries to Upper Oyster Creek. As all of the segments traverse through urbanized residential areas where both pet waste and fertilizer runoff are likely sources of bacteria and nutrients, education may be impactful for water quality improvement as well as any implementation action or strategies outlined in the Upper Oyster Creek TMDL/I-Plan.

Special Studies:

Upper Oyster Creel Bacteria and Dissolved Oxygen TMDLs

The TMDL for bacteria was adopted on August 8, 2007, and the TMDLs for dissolved oxygen on July 28, 2010. On January 15, 2014, the TCEQ approved the I-Plan, which addressed both the bacteria and dissolved oxygen TMDLs. Stakeholders meet each spring in the watershed to discuss the status of efforts to improve water quality in Upper Oyster Creek. The bacterial TMDL identified OSSFs, WWTFs, sanitary sewer collection systems, agricultural and wildlife sources andurban nonpoint sources including pet waste and stormwater runoff as likely sources of bacteria. Nonpoint sources with compounding factors such as changes in flow due to surface water conversion and pumping, dredging activities, and herbicidal applications to combat invasive plant species contributed to the dissolved oxygen impairment. Implementation strategies and actions overlap to help improve both the bacterial and the

dissolved oxygen impairments. These strategies and actions should also help to address chlorophyll *a* and nutrient concerns. There are 12 Implementation Strategies (IS) and 55 Implementation Actions (IA) described in the I-Plan. ISs are general approaches to addressing the causes and sources of impairments. IAs are specific components of each IS. ISs include: monitoring for bacteria and dissolved oxygen, research evaluating data collected, continue and expand existing education and outreach, implement new education and outreach efforts, general nonpoint source management, urban MS4 stormwater management, agricultural/livestock management, feral hog management, avian wildlife management , and strategies for WWTFs, sanitary sewer collection systems and OSSFs.

Table 3.3.13.2 Water Quality Issues Summary

Water Quality Issue	Affected Area	Possible Influences/Concerns	Possible Actions Taken/to be Taken
Impairments			
Bacteria	• Upper Oyster Creek • Bullhead Bayou	• OSSFs, WWTFs, sanitary sewer collection systems, agricultural and wildlife sources • urban nonpoint sources including pet waste and stormwater runoff	• Continue to follow implementation actions and strategies outlined in the Upper Oyster Creek TMDL/I-Plan and monitor for water quality improvements. • Implement actions and strategies outlined in the Upper Oyster Creek TMDL/I-Plan in neighboring watersheds.
Dissolved Oxygen	• Upper Oyster Creek	• Nonpoint sources including WWTFs, regulated and unregulated nonpoint sources, and water pumped into the segment from the Brazos River.	• Continue to follow implementation actions and strategies outlined in the Upper Oyster Creek TMDL/I-Plan and monitor for water quality improvements. • Implement actions and strategies outlined in the Upper Oyster Creek TMDL/I-Plan in neighboring watersheds.
Concerns			
Chlorophyll *a*/Nutrients	• Upper Oyster Creek • Red Gully • Bullhead Bayou	• Urban runoff, dogs, cattle, goats, sheep, horses, domestic hogs, poultry, deer, feral hogs, and wastewater • Rapid development	• Continue to implementation actions and strategies outlined in the Upper Oyster Creek TMDL/I-Plan and monitor for water quality improvements. • Implement actions and strategies outlined in the Upper Oyster Creek TMDL/I-Plan in neighboring watersheds. • Education

Bacteria	• Red Gully • Flewellen Creek • Stafford Run	• OSSFs, WWTFs, sanitary sewer collection systems, agricultural and wildlife sources • urban nonpoint sources including pet waste and stormwater runoff	• RUAAs suggested for Flewellen Creek and Stafford Run • Implement actions and strategies outlined in the Upper Oyster Creek TMDL/I-Plan in neighboring watersheds. • Education

4.0 FINDINGS, RECOMMENDATIONS AND CONCLUSIONS

4.1 Findings and Recommendations

GENERAL

Findings

- 69 waterbodies (97 AUs) in the Brazos River basin are listed as impaired on the 2020 303(d) List.
- Most of the rapidly developing regions in the basin could benefit from additional monitoring to document baseline conditions and monitor changes as development increases.
- There is a lack of flow and precipitation data to correlate with other parameters.
- There is limited biological data available to assess aquatic life conditions throughout the basin.

Recommendations

- Focus monitoring activities according to the unique characteristics of each subwatershed.
- Conduct special studies in sub-watersheds where development is occurring.
- Continue performing biological assessments to better characterize status of aquatic life in the basin.
- Attempt to build a larger flow dataset to correlate with other parameters and verify flow classifications.
- Continue to leverage federal and state funds for the benefit of water quality and tax and fee payers.

BACTERIA

Findings

- 62 waterbodies (73 AUs) in the Brazos River basin are listed on the 2020 303(d) List for bacterial impairments.
- Impairment and concern listings appear appropriate when compared against current data analysis methodologies.
- Most of the unclassified waterbodies that are listed on the 2020 303(d) list for bacterial contamination are small, rural streams with low to intermittent flow.

Recommendations

- Reduce monitoring of small, rural unclassified waterbodies with low to intermittent flow where a baseline data set has been established.
- Conduct watershed characterization studies, consisting of a set of water and habitat assessments compiling hydrology, geology, wildlife, LULC, and water quality data to inform on the best way to improve water quality where RUAA's have resulted in no change to the recreational use.
- Attempt to collect more flow data with which to correlate other data

DISSOLVED OXYGEN

Findings

- 9 waterbodies (10 AUs) in the Brazos River basin are listed on the 303(d) List for dissolved oxygen impairments.
- Several streams have 24-hr DO monitoring be conducted currently

Recommendations

- Work with TCEQ regarding the appropriateness of assuming high aquatic life use standards for small streams with low to intermittent flow where meeting the high aquatic life use standard is hindered by the stream's inability to buffer against high ambient air temperatures during summer months.
- Work with TCEQ to perform Use Attainability Analyses on impaired stream segments to determine the most appropriate dissolved oxygen standard for each segment.

NUTRIENTS AND CHLOROPHYLL *a*

Findings

- 78 waterbodies (110 AUs) in the Brazos River basin have concerns for nutrients and/or chlorophyll *a*
- There is limited low-level nutrient data in the basin.

Recommendations

- Attempt low-level nutrient collection at strategic locations in the basin.
- Continue to support on-going and planned special studies addressing nutrient concerns in the basin.
- Continue to follow and support the TCEQ Nutrient Criteria Development process.

NATURAL SALT

Findings

- Salt in the mainstem of the Brazos River basin comes from natural brine springs in Stonewall, Kent and Garza counties that deposit highly concentrated groundwater into the watershed of the Salt Fork and Double Mountain Fork of the Brazos. Rainfall then flushes this residual salt into the rivers.
- The natural salt produced in the uppermost portion of the Brazos River basin affects the mainstem throughout its entire reach and is subject to drought and flood.

Recommendations

- Continue to support any special studies regarding natural salt in the basin

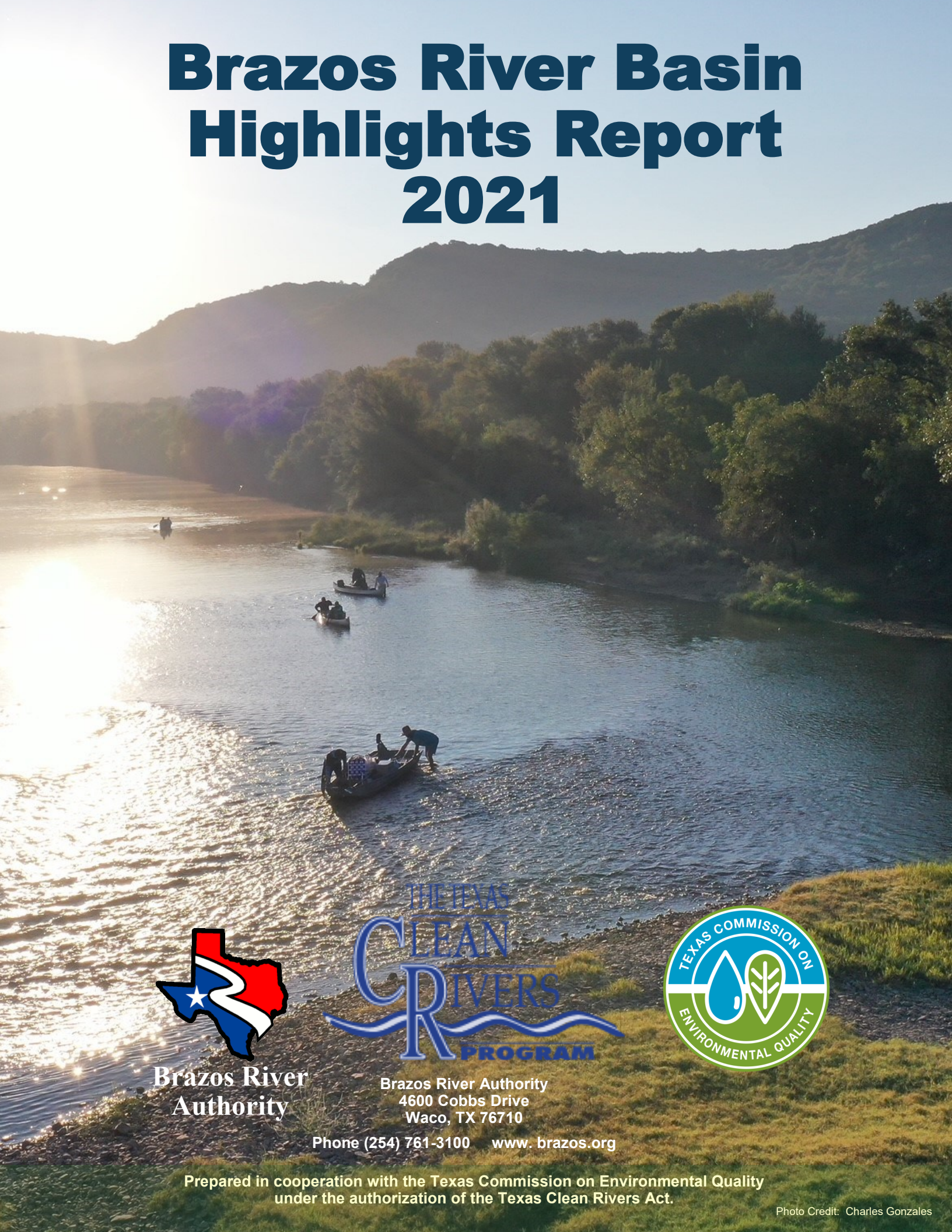
4.2 Conclusions

The Brazos River Basin Clean Rivers Program's watersheds are spread over a wide variety of land uses and ecoregions. Water travels from the undeveloped regions through increasingly urbanized areas, through arid West Texas to wet Gulf Coastal Plains and finally into the Gulf of Mexico. The largest water quality management issue facing the Brazos River basin is the intrusion of natural salt into the mainstem of the Brazos River from brine springs in the northern portion of the basin and from the Gulf of Mexico in the south. Elevated chlorides and total dissolved solids affect water usability along the entire mainstem. Bacteria and nutrients are a problem in over a quarter of the basin's segments. Great strides have been made through the use of RUAAs to better classify recreational use of many impaired streams in the basin and the Authority will continue to support this effort as well as Watershed Protection Plans in the basin.

Throughout this report, the Authority has outlined areas that need more detailed analysis or more information to better assess water quality conditions. The Authority will continue to coordinate with the Technical Advisory Committee, local entities and stakeholders to gather this data. As the Authority gains understanding of the dynamics within each of the watersheds, we are able to better inform and educate the public on water quality in their community.

To address all the problems identified in this report will require continued participation by local stakeholders in addition to federal, state and regional entities. The most important factor determining the success of activities to improve the waters of the Brazos basin will be the commitment and understanding of individuals in the basin to water quality.

Brazos River Basin Highlights Report 2021



Brazos River Authority

THE TEXAS CLEAN RIVERS PROGRAM

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Brazos River Authority
4600 Cobbs Drive
Waco, TX 76710

Phone (254) 761-3100 www. brazos.org

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

Photo Credit: Charles Gonzales