

TEXAS CLEAN RIVERS PROGRAM
2019 Basin Highlights Report

A Characterization of Impaired Water Bodies
in the Upper Colorado River Basin





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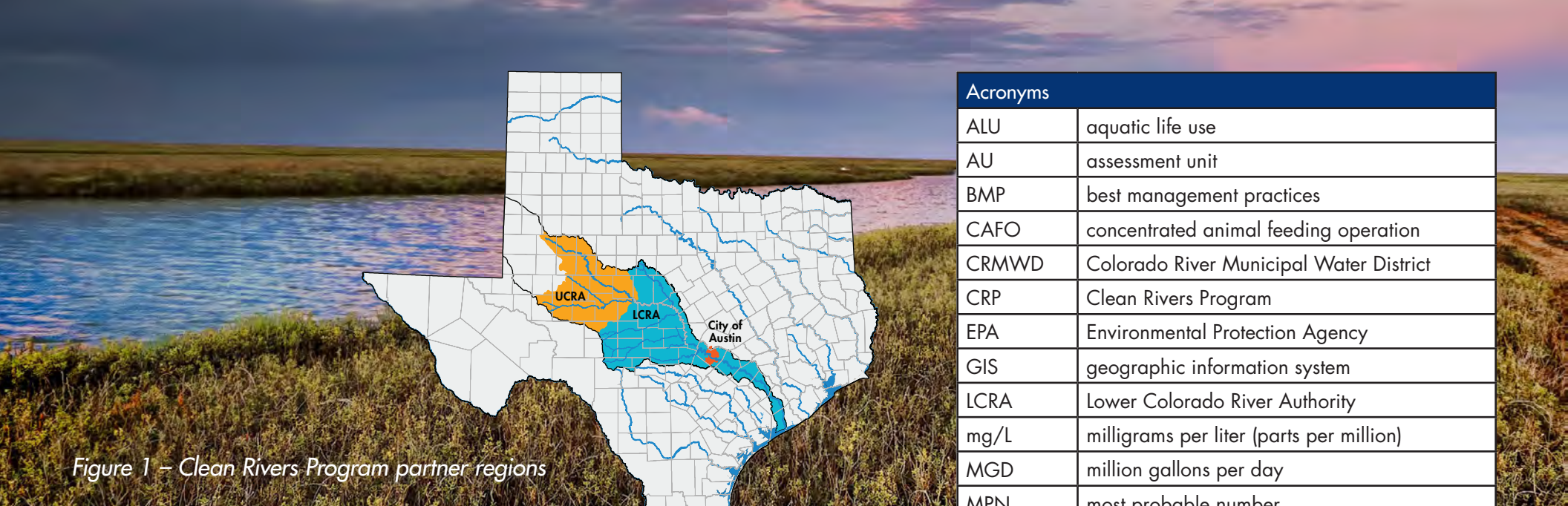


Figure 1 – Clean Rivers Program partner regions

Introduction

About the Clean Rivers Program

The Texas Clean Rivers Program (CRP) provides a foundation for partnerships between the Texas Commission on Environmental Quality (TCEQ), river authorities, local governments, industries and citizens. The program began in 1991 to provide funding for water quality monitoring and comprehensive watershed management on a local level. TCEQ and CRP partners routinely collect water quality data from more than 1,800 sampling locations. TCEQ and others use the data from these sampling locations to establish wastewater permit limits and Texas Surface Water Quality Standards, and to evaluate water quality and establish priorities for corrective actions.

In the Colorado River basin, the Lower Colorado River Authority (LCRA) and Upper Colorado River Authority (UCRA) implement the program in their respective areas (Figure 1). LCRA, UCRA, City of Austin, TCEQ and U.S. Geological Survey (USGS) perform monitoring. Each agency collects and analyzes samples according to a Quality Assurance Protection Plan (QAPP), which ensures comparability.

Acronyms	
ALU	aquatic life use
AU	assessment unit
BMP	best management practices
CAFO	concentrated animal feeding operation
CRMWD	Colorado River Municipal Water District
CRP	Clean Rivers Program
EPA	Environmental Protection Agency
GIS	geographic information system
LCRA	Lower Colorado River Authority
mg/L	milligrams per liter (parts per million)
MGD	million gallons per day
MPN	most probable number
NLCD	National Land Cover Database
NPS	nonpoint-source pollution
QAPP	Quality Assurance Project Plan
RRC	Railroad Commission of Texas
RUAA	Recreational Use Attainability Analysis
SWCD	soil and water conservation district
SWQM	surface water quality monitoring
TCEQ	Texas Commission on Environmental Quality
TDA	Texas Department of Agriculture
TDS	total dissolved solids
TLAP	Texas Land Application Permit
TMDL	Total Maximum Daily Load
UAA	Use Attainability Analysis
UCRA	Upper Colorado River Authority
USDA	United States Department of Agriculture
WPP	watershed protection plan
WWTP	wastewater treatment plant
µg/L	microgram per liter

Rationale for the 2019 Basin Highlights Report

Every two years, TCEQ compares all available quality assured data to the Texas Surface Water Quality Standards and publishes the results in the Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d). On Nov. 19, 2015, the Environmental Protection Agency (EPA) approved the 2014 Integrated Report. The report was based on data collected between Dec. 1, 2005, and Nov. 30, 2012. The Draft 2016 Integrated Report was adopted by TCEQ on Oct. 17, 2018; this report is now pending review and approval by the EPA. The Draft 2016 Integrated Report identifies 22 impaired water bodies in the Colorado River basin (Table 1).

The 2019 Basin Highlights Report characterizes impaired water bodies identified in the Draft 2016 Integrated Report based on data, land use and communication with monitoring personnel and local stakeholders. The watershed characterizations will help prioritize monitoring efforts and restorative measures for impaired water bodies in the basin. This report focuses on water quality impairments upstream of Austin. In 2021, the Basin Highlights Report will focus on impairments downstream of Austin.

Water bodies are organized by segment number. The following headings are included for each water body:

- **Segment description** – Describes the geographic units based on Texas Surface Water Quality Standards and the assessment units (AU) and monitoring sites within each segment.
- **Land use** – A description of the land surrounding the impaired segment based on USGS National Land Cover Database (NLCD) aerial imagery and knowledge of the area.
- **Impairment description** – Identifies the reason the water body is impaired and when it first appeared on the 303(d) List. It includes number of samples, parameter(s) of concern or impairment, assessment results, and the designated state water quality standard for comparison.
- **Potential causes of impairment** – Identifies possible causes of the impairment based on land use, communication with monitors, agency staff and CRP Water Quality Advisory Committee members.
- **Potential stakeholders** – Lists companies, agencies or organizations that have a vested interest in the impairment and that may serve as stakeholders.
- **Actions taken** – Identifies actions taken by TCEQ or CRP partners since the water body was first placed on the 303(d) List.
- **Recommendations** – Proposed next step(s) to help the water body attain Texas Surface Water Quality Standards.
- **Maps** – Maps and aerial imagery that define land uses, segments and other boundaries, monitoring sites, permitted discharges and Texas Land Application Permits (TLAPs).



Table 1. Impaired Water Bodies in the Colorado River Basin (Based on the Draft 2016 Integrated Report)

CRP Agency	Watershed	Segment	Water Body	County	Parameter(s)	Year Listed	Category	Actions Taken
Upper Colorado River Authority	Upper	1411	E.V. Spence Reservoir	Coke	Chloride	2014	5c	Maintain monitoring.
					Sulfate	2000	4a	EPA approved a TMDL in 2003. Implementation is ongoing.
					TDS	2000	4a	
		1412	Colorado River below Lake J.B. Thomas	Coke and Scurry	Bacteria	2008	5b	Maintain monitoring.
		1412B	Beals Creek	Mitchell and Howard	Bacteria	2010	5b	High salinity levels prevent proper analysis of bacteria.
		1413	Lake J.B. Thomas	Borden and Scurry	Chloride	2008	5b	Maintain monitoring.
					Sulfate	2012	5b	
					TDS	2010	5b	
		1426	Colorado River below E.V. Spence Reservoir	Coke	Chloride	2014	4a	The segment was on the 303(d) List as recently as 2010 but met surface water quality standards in the 2012 assessment. The 2014 Integrated Report found it to be impaired again. Because of previous impairments, it was categorized as 4a. It remains categorized as 4a in the Draft 2016 Integrated Report.
					TDS	2000	4a	EPA approved a TMDL in 2007. The UCRA has received a 319h grant for a chloride and sulfate contamination source investigation at monitoring site #18338 located at SH208 near the City of Robert Lee. The investigation will assess groundwater, surface water, and soil quality within an approximately 3 mile radius of the site and attempt to identify the source of the elevated chlorides and sulfates. The project is a recommendation of the updated TMDL I-Plan submitted to TCEQ in 2014.
		Concho River	1421	Concho River	Concho and Tom Green	Dissolved oxygen	2008	5c
1425	O.C. Fisher Lake		Tom Green	Chloride	2014	5c	This is a recurring listing that is attributable to evaporation rates exceeding inflows to the lake during dry periods. Maintain monitoring.	
		TDS		2014	5c			
Lake Buchanan	1416A	Brady Creek	McCullough	Dissolved oxygen	2004	5c	The Brady Creek WPP was accepted by EPA on August 31, 2016. UCRA is implementing the first phase of the multi-year recommendations included in the WPP.	
	1416	San Saba River	San Saba and Mills	Bacteria	2008	5b	Work with stakeholders to determine if WPP is feasible. Candidate for the Watershed Action Planning process.	

Category 4a – A TMDL has been completed and approved by EPA.

Category 5a – A TMDL is underway or being planned.

CRP Agency	Watershed	Segment	Water Body	County	Parameter(s)	Year Listed	Category	Actions Taken
Lower Colorado River Authority	Pecan Bayou	1432	Upper Pecan Bayou	Brown	Bacteria	2014	5c	Work with stakeholders to determine if WPP is feasible. Candidate for the Watershed Action Planning process.
	Lake LBJ	1407A	Clear Creek	Burnet	Zn in water	2014	5c	On-site remediation and monitoring of source pollutants is ongoing.
					Ni in water	2014	5c	
					Al in water	2010	5c	
					Sulfate	2010	5c	
					TDS	2010	5c	
					pH	2010	5c	
	Austin	1428C	Gilleland Creek	Travis and Bastrop	Bacteria	2004	4a	EPA approved a TMDL in 2009. Implementation is ongoing.
	Coastal	1501	Tidal portion of Tres Palacios River	Matagorda	Dissolved oxygen	1999	5b	A use attainability analysis was completed in 2008. A WPP for Tres Palacios was completed by Texas Water Resources Institute and local stakeholders and was approved by the EPA in 2018.
					Bacteria	2006	4a	Approved TMDL.
		1402	Colorado River	Wharton	Bacteria	2014	5c	Additional monitoring sites added.
		1402C	Buckners Creek	Fayette	Dissolved oxygen	2010	5c	LCRA began a Use Attainability Analysis project in 2018 for Buckners Creek.
		1402H	Skull Creek	Colorado	Dissolved oxygen	2008	5b	Aquatic life monitoring was completed in 2010. TCEQ proposed changes to the surface water quality standards as part of the 2014 revisions. Monitoring is ongoing.
City of Austin	Austin	1427	Onion Creek	Hays	Sulfate	2014	5c	Maintain monitoring.
		1427A	Slaughter Creek	Travis	Impaired benthics	2002	5b	Maintain monitoring.
		1403A	Bull Creek	Travis	Dissolved oxygen	2010	5c	Monitoring frequency increased.
		1403J	Spicewood tributary to Shoal Creek	Travis	Bacteria	2002	4a	Approved TMDL.
		1403K	Taylor Slough South	Travis	Bacteria	2002	4a	Approved TMDL.
		1428B	Walnut Creek	Travis	Bacteria	2006	4a	Approved TMDL.
		1429C	Waller Creek	Travis	Impaired benthics	2002	5c	Maintain monitoring.
					Bacteria	2006	4a	Approved TMDL.

Category 5b – A review of surface water quality standards will be conducted before a TMDL is scheduled.

Category 5c – Additional data and information will be collected before a TMDL is scheduled.



Total Maximum Daily Load (TMDL)

Studies focused on point source pollution, which is defined as a single, identifiable source of pollution, such as a pipe or a drain.

Watershed Protection Plans (WPPs)

Non-regulatory and stakeholder driven initiatives that focus primarily on non-point sources of pollution. Non-point pollution refers to those inputs and impacts to water quality that occur over a wide area and are not easily attributed to a single source.

Restoring Impaired Water Bodies

In 2010, TCEQ developed the watershed action planning process to help identify and prioritize watershed restoration projects for impaired water bodies. As part of the watershed action planning process, stakeholders and monitoring agencies provide input about local water quality problems. Information about potential sources of pollution, geographic factors in the watershed and community interest is stored in a database and used to implement water quality protection strategies described below.

Total Maximum Daily Load

The first step toward restoration is to determine the source(s) of pollution. In waterways where there are multiple known sources of pollution from permitted facilities, one way to determine the pollution levels and impairment is to develop a scientific model called a total maximum daily load (TMDL). A TMDL study involves a historical water quality data review, targeted monitoring, detailed water quality analysis and the amount or “load” of a pollutant that a water body can receive and still support its designated uses. Once the load is determined among all potential sources of pollution, an implementation plan outlines strategies to reduce pollutant loads. TMDLs focus on point sources of pollution – which typically refers to permitted facilities.

Watershed Protection Plan

A watershed protection plan (WPP) is another way to restore impaired water bodies. Unlike the TMDL, a WPP is non-regulatory. Stakeholders drive a WPP to address causes of the identified impairments. Similar to a TMDL, a WPP uses monitoring data and local input to outline strategies that reduce pollutant loads.

Use Attainability Analysis

Another option for addressing impaired water bodies is a use attainability analysis (UAA). While a TMDL and WPP are designed to improve water quality by limiting pollutants, a UAA is designed to evaluate Texas Surface Water Quality Standards and if appropriate, establish new standards. Similarly, a Recreational Use Attainability Analysis (RUAA) is a study that confirms the level of recreation that takes place in a waterway.

A scenic view of a waterfall cascading into a pool of water, surrounded by lush greenery and a rocky cliffside. The waterfall is on the left side of the frame, with water falling into a pool of greenish water. The background is a rocky cliffside covered in dense green trees and bushes. The sky is clear and blue.

Water Characterizations by Segment



Shoreline view of Inks Lake. Clear Creek, an impaired waterway, is a tributary to Inks Lake.

Segment 1407A: Clear Creek

Impairment: pH, TDS, sulfate, aluminum, zinc and nickel in water

Segment Description

The Clear Creek watershed, located on the northeast side of Inks Lake in Burnet County, is approximately 13 square miles. The creek is about 4.5 miles long, beginning at the confluence with Inks Lake upstream to FM 2341. LCRA monitors Clear Creek at Site 18710.

Land Use

The Clear Creek watershed is rural and comprised mostly of undeveloped, forested land and brush. A tailings pile from an abandoned graphite mine is the source of impairments. Southwestern Graphite began mining operations at the current Greensmiths Inc. site in 1915. The facility produced and refined graphite ore intermittently between 1915 and 1978. Mining stopped in 1978, but Southwestern Graphite continued to process imported ore at the site until the late 1980s. The process required using water from the Colorado River, and later from Inks Lake. After using the water to float graphite from the ore, Southwestern Graphite treated the water and discharged it into Clear Creek where it flowed back into Inks Lake. The parent material from which the graphite was extracted now sits in a 23-acre tailings pile on the bank of Clear Creek. In 2000, Greensmiths Inc. purchased the facility and began using reclaimed tailings materials as a soil amendment to landscape golf courses.

Impairment Description

TCEQ placed Clear Creek on the 2010 303(d) List for not supporting general and aquatic life uses. Data collected from Site 18710, about 1.5 miles downstream of the tailings pile, exceeded criteria for pH, total dissolved solids (TDS), sulfate and aluminum in water.

In 2014, data indicated high levels of zinc and nickel in water, and those constituents were added to the list of impairments for Clear Creek in the 303(d) List for 2014 (Table 2).

Cause of Impairment

Runoff from the tailings pile creates acidic leachate that drains into the creek. The leachate enhances dissolution of heavy metals.

Actions Taken

- In 2004, LCRA worked with TCEQ and Greensmiths Inc. to help secure a permit that would treat leachate onsite and eliminate discharges to the stream.
- In 2007, LCRA established a water quality monitoring site on Clear Creek. Site 18710 is about 1.5 miles downstream of Greensmiths Inc.
- In 2010, Greensmiths Inc. engineered an industrial disposal plan to allow on-site treatment and eliminate discharges to the stream. LCRA reviewed and commented on the application for an industrial disposal permit from TCEQ.

- TCEQ issued a no-discharge permit in December 2010.
- A TCEQ inspection in July 2012 resulted in an enforcement order for unauthorized discharge.
- Inspections by TCEQ are ongoing.

Potential Stakeholders

- Greensmiths Inc.
- LCRA
- TCEQ

Recommendations

- Continue regular inspections of the Greensmiths Inc. facility.
- Continue monitoring at Site 18710.

Table 2. Parameters causing impairment in Clear Creek

Parameter	Number of samples assessed	Number of times criteria was exceeded	Criteria	Mean results
pH	35	27	6.5	NA
TDS (mg/L)	35	NA	600 (mg/L)	1,158 (mg/L)
Sulfate (mg/L)	33	NA	100 (mg/L)	1,132 (mg/L)
Aluminum in water (acute)	15	8	991 (µg/L)	18,951 (µg/L)
Zinc in water (chronic)	15	NA	194 (µg/L)	225 (µg/L)
Nickel in water (chronic)	21	NA	85 (µg/L)	110 (µg/L)

Segment 1411: E.V. Spence Reservoir

Impairment: Chloride, sulfate, and TDS

Segment Description

Segment 1411 is located in the upper Colorado River watershed immediately west of the city of Robert Lee. The watershed begins at Robert Lee Dam on the Colorado River and continues upstream to the confluence of Little Silver Creek in Coke County. The reservoir encompasses approximately 14,640 acres and has a conservation storage capacity of 512,272 acre-feet. During the reporting period, the reservoir contained less than 10 percent of capacity. TCEQ monitored the reservoir at the following sites during the reporting period:

- 13863: E.V. Spence Reservoir at the dam.
- 12359: E.V. Spence Reservoir approximately 5.3 kilometers west of State Highway 208.
- 12360: E.V. Spence Reservoir at the FM 2059 bridge near Silver, Texas.

Land Use

The majority of land in the contributing drainage area is characterized by pasture land and scrub vegetation. Oil and gas production is prevalent in the watershed.

Impairment Description

E.V. Spence Reservoir was first placed on the 303(d) List in 2000 due to elevated sulfate and TDS levels. The TCEQ predecessor agency, Texas Natural Resource Conservation Commission adopted a TMDL in 2001, and the EPA approved it in 2003. Sulfate and TDS remained high in subsequent assessments. According to the Draft 2016 Integrated Report, sulfate averaged 876.83 mg/L and TDS averaged 3623.28 mg/L for criteria

that are 450 and 1,500 mg/L, respectively. Chloride was listed for the first time in 2014, and the listing remained in the Draft 2016 Integrated Report. A mean of 1,341.53 mg/L was reported, which exceeds the criterion of 950 mg/L.

The reservoir is divided into two assessment units: AU 01 extends from the dam upstream to the Rough Creek arm, and AU 02 extends from the Rough Creek arm of the reservoir upstream to the confluence of Little Silver Creek. The entire segment is impaired because general use constituents are averaged for all assessment units. In addition, harmful algal blooms, most notably golden algae (*Prymnesium parvum*), have caused occasional fish kills in the reservoir.

Potential Causes of Impairments

Point Sources

- The cities of Big Spring and Snyder discharge treated wastewater effluent into tributaries far upstream of E.V. Spence Reservoir. They are not a likely major source of salt constituents into the reservoir.

Nonpoint Pollution Sources

- Leaking oil wells.
- Former brine disposal pits.
- Produced brine injection wells.
- Brine leached in the groundwater from an abandoned magnesium plant.
- Mineral dissolution of naturally occurring shallow geological formations.
- Saltcedar transports salts from groundwater to leaves, which then concentrate salts at the surface of the soil when leaves drop each year.

Actions Taken

- The Texas Railroad Commission (RRC) drilled monitoring wells up-gradient and down-gradient of known seeps in the watershed to investigate the impact on surface water. They have plugged over 180 wells in Runnels and Coke counties, many upstream of E.V Spence Reservoir.
- Since EPA approval in 2003, TCEQ has been carrying out the TMDL Implementation Plan, including water quality modeling.
- Saltcedar eradication programs in the watershed include aerial application of herbicide and biological treatment through the introduction of saltcedar leaf beetles.

Potential Stakeholders

- Agricultural interests
- Colorado River Municipal Water District (CRMWD)
- Oil and gas operators
- RRC
- TCEQ
- Texas State Soil and Water Conservation Board
- UCRA

Recommendations

- Continue to identify and plug abandoned or leaking oil and gas wells.
- Continue the introduction of saltcedar leaf beetles.
- Seek funding mechanisms for further implementation of best management practices (BMPs) identified by the RRC.
- Continue routine surface water quality monitoring.



E.V. Spence Reservoir near Silver, Texas



Segment 1412: Colorado River below Lake J.B. Thomas

Impairment: Bacteria

Segment Description

Segment 1412 is located in the upper Colorado River watershed. It begins from a point immediately upstream of the confluence with Little Silver Creek in Coke County and continues upstream to J.B. Thomas Dam. The segment is about 99 miles long. TCEQ monitored the river at the following sites during the period of record:

- 12362: Colorado River 4.7 miles west of Silverado.
- 17002: Colorado River at Mitchell CR 343.
- 12363: Colorado River at State Highway 163.
- 12364: Colorado River upstream of Interstate Highway 20.
- 12365: Colorado River at FM 1808.
- 17003: Colorado River at FM 2835.
- 12366: Colorado at State Highway 350.

Land Use

The watershed consists mainly of pastures, brush and cultivated land. Colorado City has a population of 4,000 and is located just upstream of monitoring Site 12363, but there are no direct discharges or land application permits immediately upstream of the site.

Impairment Description

The impaired AU, 1412_02, begins at the Colorado River's confluence with Beals Creek and continues upstream to a point above Colorado City. Data responsible for the listing are from Site 12363.

TCEQ placed Segment 1412 on the 2008 303(d) List for not supporting contact recreation due to elevated *E. coli* bacteria levels. As part of the 2010 Texas Surface Water Quality Standards revisions, TCEQ identified *Enterococcus* as more appropriate indicator bacteria for Segment 1412 and other inland saline waters.

In 2014, TCEQ began assessing *Enterococcus* data and assessed three samples. The geometric mean was 114 MPN, exceeding the criteria of 33 MPN. In the Draft 2016 Integrated Report,

one sample with a geomean of 630 MPN was reported. It is unusual to list a water body with only four samples of a specific parameter over a multi-year span, but the *E. coli*-based impairment from previous assessments justified continuing the listing.

In addition to the bacteria impairment, TCEQ again identified low dissolved oxygen levels and high chlorophyll-a levels as a concern in the Draft 2016 Integrated Report. Depressed dissolved oxygen concentrations are often associated with low-flow conditions due to drought.

Potential Causes of Impairments

Point Sources

- There are no permitted discharges. Colorado City, which is located near the monitoring site, land-applies wastewater effluent downstream of Site 12363.

Nonpoint Sources

- Much of the contributing watershed for this segment consists of rangeland used for cattle grazing and may be a source of bacteria.
- In Colorado City, homes and businesses are located along the Colorado River. Failing wastewater lines or inadequate septic systems may be sources of bacteria.
- The western portion of Colorado City drains toward Site 12363. Runoff from precipitation events may be sources of bacteria. However, consistently high *E. coli* levels collected at the site indicate something more than stormwater.
- A superfund site, the former Col-Tex Refinery, is located about 1 mile upstream of the monitoring site. Remediation of organic chemicals at the refinery is ongoing, but it is not a likely source of bacteria.

About 4 miles upstream of the site, CRMWD operates a pump station that diverts water from the river. The diversion into an off-channel reservoir helps maintain downstream water quality. It is located upstream of the superfund site and Colorado City, indicating the bacteria is from local sources.

Actions Taken

Sampling and analysis of *Enterococcus* is problematic in remote areas. Bacteria samples are no longer collected as part of routine monitoring in Segment 1412. This is because no accredited laboratories are located close enough to the monitoring site to meet the holding time limitations, and this prevents a quality-controlled analysis of bacteriological samples. The segment will remain on the 303(d) List for the foreseeable future.

Potential Stakeholders

- City of Colorado City
- CRMWD
- TCEQ
- Texas Agrilife Extension
- Texas State Soil and Water Conservation Board
- UCRA

Recommendations

- Communicate with TCEQ or Texas State Soil and Water Conservation Board to determine if the stream is a candidate for an RUAA.
- Encourage labs in closest proximity to the site to strive to meet quality assurance requirements for *Enterococcus* analysis so bacteria data can be collected for this segment.

Segment 1412B: Beals Creek

Impairment: Bacteria

Segment Description

Segment 1412B begins from the confluence with the Colorado River in Mitchell County and continues upstream to the confluence of Mustang Draw and Sulphur Springs Draw in Howard County. The following sites were monitored during the period of record:

- 12156: Beals Creek at SH 163.
- 12157: Beals Creek at FM 821.
- 12158: Beals Creek at Val Verde Road.
- 12159: Beals Creek at East Midway Road in Big Spring.
- 12160: Beals Creek at FM 700.

Land Use

Cultivated crops dominate the upper portion of the watershed, while most of the lower two-thirds of the watershed are composed of brush and grassland. The city of Big Spring is located near the headwaters of the stream. Treated effluent from a desalination plant and the city's wastewater plant provide perennial flow downstream of the city. Oil and gas production also occur in the watershed.

Impairment Description

The impaired AU, 1412B_03, begins at the confluence with Guthrie Draw and continues upstream to the confluence of Mustang Draw and Sulphur Springs Draw. TCEQ first placed Beals Creek on the 2010 303(d) List for not supporting contact recreation because of elevated levels of *E. coli* bacteria.

Similar to Segment 1412, the bacteria standard for Beals Creek is based on *Enterococcus* as the indicator bacteria due to its high

conductivity levels, which are consistently over 10,000 $\mu\text{S}/\text{cm}$. In the absence of *Enterococcus* data due to lack of accredited labs in the region, the impairment carried forward in the 2014 and Draft 2016 303(d) Lists, which are based on historic *E. coli* values.

The Draft 2016 Integrated Report identified concerns for elevated levels of chlorophyll-*a*, ammonia, nitrate and total phosphorous in the segment.

Potential Causes of Impairments

Point Sources

- The city of Big Spring and CRMWD are permitted to discharge treated effluent into Beals Creek (1412B_03) just upstream of sites 12158 and 12159. The CRMWD discharge is wastewater from a desalination plant and not likely to be a source of bacteria.

Nonpoint Sources

- Big Spring is upstream of the monitoring sites and drains into Beals Creek. Runoff from storm events may be sources of bacteria and nutrients. Failing wastewater lines or inadequate septic systems also may be sources.

Actions Taken

- The 2010 Integrated Report identified Beals Creek as impaired for total selenium levels in water. CRMWD and TCEQ Region 7 monitored extensively at several sites between 2011 and 2013. Samples contained selenium levels within Texas Surface Water Quality Standards and Beals Creek was removed from the 303(d) List for the selenium impairment in 2014.
- Holding time limitations prevent further collection of bacteriological data until a resolution can be found.



Potential Stakeholders

Agriculture interests

City of Big Spring | CRMWD

TCEQ | UCRA

Recommendations

Communicate with TCEQ or Texas State Soil and Water Conservation Board to determine if the stream is a candidate for an RUAA.

Find an accredited lab close enough to receive samples within holding time so bacteria sampling can resume.

Segment 1413: Lake J. B. Thomas

Impairment: Chloride, sulfate, and TDS

Segment Description

Lake J.B. Thomas is the westernmost impoundment on the Colorado River. The reservoir impounds the Colorado River from the dam in Scurry County up to a normal pool elevation of 2,258 feet above mean sea level (feet msl). The reservoir has a surface area of approximately 7,808 acres at conservation pool. The reservoir was only 15 percent of capacity on average during the period of record. It is monitored at Site 21614.

Land Use

The western portion of the watershed is used for farming. Brush and grassland dominate the remainder of the watershed. Oil and gas production are prevalent throughout the watershed.

Impairment Description

Segment 1413 was initially placed on the 2008 303(d) List for elevated levels of chloride. In 2010, the segment was listed for TDS, and in 2012, it was listed for sulfate.

The entire reservoir is one assessment unit, AU 1413_01. Data responsible for the listing are from Site 21614. Ten samples were assessed during the Draft 2016 Integrated Report with one exceedance each for chloride, TDS and sulfate. The mean value for chloride was 282.50 mg/L, with an established criteria of 80 mg/L. The average value for TDS was 1045.25 mg/L, which is much higher than the

500 mg/L criteria. Sulfate values averaged at 218 mg/L, well beyond the 110 mg/L criteria.

Potential Causes of Impairment

Nonpoint Sources

- Elevated concentrations of salt constituents in the lake are likely due to regional geology, prolonged drought during the past decade and historical oil and gas production activities. Soils in the watershed are highly mineralized and dissolution of these minerals into surface water occurs easily.
- During the assessment time period, the reservoir capacity was declining or very low. Evaporation, coupled with low inflows, concentrated minerals in the water.
- The watershed contains oil and gas deposits in production since the 1930s. CRMWD identified seepage from the oil and gas production activities, including abandoned or inadequately plugged wells, in the watershed. These seeps typically produce high-saline water and are known to contaminate surface water.

Actions Taken

- CRMWD routinely monitors flow at two seeps near the banks of Lake J.B. Thomas and notifies the RRC when seeps are active.
- CRMWD previously performed an oil and gas well mapping survey in the upper watershed. The survey, titled Tobacco Creek Water Quality Issues, included sulfate and chloride monitoring. CRMWD provided the results to the RRC to help prioritize regulatory activities.



Potential Stakeholders

CRMWD

Landowners

RRC | TCEQ

Texas State Soil and Water
Conservation Board

UCRA

Recommendations

Continue monitoring efforts
to verify the impairment.

Work with RRC on
identifying additional
well-plugging candidates.



Segment 1416: San Saba River

Impairment: Bacteria

Segment Description

Segment 1416 begins from the San Saba River's confluence with the Colorado River, and continues upstream to the confluence of the north and middle forks of the San Saba River near the Menard County line. The river is approximately 168 miles long and was monitored at the following sites during the period of record:

12392: San Saba River at State Highway 16.

17004: San Saba River immediately downstream of U.S. Highway 87.

20662: San Saba River at County Road 340.

The impaired AU, 1416_01, begins at the confluence with the Colorado River upstream to the river's crossing with U.S. Highway 190. Data responsible for the listing are from Site 12392.

Land Use

Brush is the dominant vegetation in the upper part of the watershed. Cultivated crops and forested land are prevalent in the lower half of the watershed. The land immediately surrounding Site 12392 is used for livestock grazing and pecan production.

Jordan Cattle Auction Barn has a TLAP and is located 4 miles upstream of Site 12392 on U.S. Highway 190. The city of San Saba is half a mile south of Site 12392. About 50 percent of the city's stormwater drains to the site. There are no TCEQ permitted discharges immediately upstream of the monitoring site.

Impairment Description

TCEQ placed Segment 1416 on the 2008 303(d) List for not supporting contact recreation due to elevated levels of *E. coli*. TCEQ assessed 44 samples collected from Site 12392 between 1999 and 2006. The resulting geometric mean for *E. coli* was 197 MPN, exceeding the criteria of 126 MPN.

Elevated levels of *E. coli* continued in subsequent assessments. Geometric means were 196, 155 and 167 MPN for 2010, 2012 and 2014. In the Draft 2016 Integrated Report, the geomean for bacteria was assessed as 201.6 MPN. The impairment remains in Category 5c, meaning more information should be gathered before implementing a TMDL or other water improvement project.

Potential Causes of Impairment

Nonpoint Sources

- Agriculture – The land immediately upstream of the monitoring site is used for hay production and grazing livestock. Three pecan orchards are located immediately upstream of the site. There is very little riparian area. Upstream of the monitoring site, cattle have access to the river and use it as a water source.
- Wildlife – Signs of deer and other wildlife have been found near the site. Feral hogs also have become established in the area. Animal waste or soil disturbance from pig rooting may contribute to the high bacteria levels.
- Urban Runoff – The city of San Saba is less than a mile south of the site. The western portion of the city drains stormwater into the river upstream of the site.

Actions Taken

- In 2012, TCEQ Region 9 began monitoring Site 20662 – 22 miles upstream of the impaired site – to determine if the high bacteria was specific to site 12392. Monitoring at both sites between 2012 and 2014 yielded a geometric means of 29 MPN and 264 MPN at sites 20662 and 12392, respectively, indicating that bacteria sources are local. Monitoring at Site 20662 was discontinued in 2015.

- In 2015, LCRA concluded a special project to monitor bacteria at six sites on the San Saba River, including 12392. Samples were collected monthly for six months. Contrary to what was expected, results indicated there were no clear patterns related to location, time or flow levels throughout the study. At most of the sites monitored during this project, livestock grazing (goats, sheep and cattle) near the river or in the river was documented. Nonpoint source pollution was identified as the primary concern for bacteria loading in the creek.
- Stakeholders were informed of the results of the 2015 special study for the lower San Saba River at the annual Water Quality Advisory Committee meeting. However, the stakeholders present voiced no interest in pursuing a Watershed Protection Plan to address the impairment.

Potential Stakeholders

- City of San Saba
- Jordan Auction Barn
- Local landowners
- Concho County
- Natural Resource Conservation Service
- Pecan growers
- Texas AgriLife Extension
- Texas Department of Agriculture
- Texas Parks and Wildlife Department
- Texas State Soil and Water Conservation Board

Recommendations

- Continue to communicate with local stakeholders, TCEQ and the Texas State Soil and Water Conservation Board to determine the river's suitability as a candidate for a WPP.

Segment 1416A-C: Brady Creek

Impairment: Dissolved oxygen

Segment Description

The Brady Creek watershed is about 784 square miles and is located in Concho, McCullough and San Saba counties. The cities of Brady, Melvin and Eden are located in the middle and upper regions of the watershed. Brady Creek, a tributary of the San Saba River, is approximately 90 miles long. TCEQ divides the stream into three sub-segments:

- 1416A: From the confluence of the San Saba River southwest of San Saba upstream to Brady Lake Dam.
- 1416B: Brady Lake.
- 1416C: Brady Creek upstream of Brady Reservoir.

Brady Creek was monitored at the following sites during the period of record:

- 12179: Brady Creek Reservoir mid-lake near dam.
- 14232: Brady Creek on private road 2 miles downstream of FM 714.
- 17005: Brady Creek at Elm Street in Brady downstream
- 20411: of the low-water crossing.
- 20661: Brady Creek at San Saba County Road 261.
Brady Creek immediately downstream of County Road 3034.

The impaired assessment unit, AU 1416A_03, begins at FM 714 and ends upstream at Brady Lake Dam. Data responsible for the listing are from Site 17005. During drought conditions, the site is frequently dry and no data can be collected; however rain in late 2018 improved flows. Site 14232, 2.2 miles downstream, is

in AU 02 and is routinely monitored by UCRA. Because of flow regimes, AU 02 and 03 are designated as having intermediate aquatic life use with a dissolved oxygen criterion of 4.0 mg/L in Appendix D of the Texas Surface Water Quality Standards. perennial flow downstream of the city. Oil and gas production also occur in the watershed.

Land Use

The Brady Creek watershed is composed primarily of brush land. Land just upstream of Brady Lake is used as farm and pasture lands. Below Brady Lake Dam, at the headwaters of 1416A_03, the creek flows through Brady, a community of about 5,200 people. The city's wastewater treatment plant discharges downstream of Site 17005 and upstream of Site 14232. In town, the creek receives stormwater runoff from commercial, residential and industrial properties.

In-stream flows are reduced by Brady Lake and several low-water dams in the city. During the summer, the dams create stagnant pools where elevated nutrients contribute to algal blooms that result in extreme fluctuations of dissolved oxygen levels.

Impairment Description

TCEQ first placed Segment 1416A on the 2004 303(d) List for not supporting its designated aquatic life use based on low levels of dissolved oxygen. The 2004 listing, which was based on single-grab samples, was confirmed through limited 24-hour monitoring. Four of six 24-hour events failed to meet the average dissolved oxygen criteria of 4 mg/L and five of six events failed to meet the 24-hour minimum dissolved oxygen criteria of 3 mg/L during the 2008 assessment. Without sampling at Site 17005, the impairment was carried forward in the 2014 Integrated Report

and also is carried forward in the Draft 2016 Integrated Report. The Draft 2016 Integrated Report identified concerns for elevated levels of chlorophyll-a, total phosphorous and nitrate based on data collected from 14232.

Potential Causes of Impairment

Nonpoint Sources

- Agricultural influences – Farmland 2 miles upstream of Site 17005 is planted in row crops, providing the potential for nutrient contributions from tilled soil and fertilizer.
- Urban influences – All stormwater runoff from the city flows into AU 03 of Brady Creek. Urban runoff likely contributes nutrients that cause algal blooms and dissolved oxygen fluctuations.

Actions Taken

- The Brady Creek Master Plan, produced in 2004 by UCRA, identified and implemented BMPs to decrease the impact of stormwater on the creek.
- UCRA received Clean Water Act 319(h) grant funding from TCEQ to develop a Brady Creek WPP. UCRA and its primary partner, the Texas Institute of Applied Environmental Research, developed the WPP, which was accepted by EPA on Aug. 31, 2016. The WPP includes a multi-year implementation plan.
- In July 2017, UCRA applied for and received a grant to perform the first phase of the Brady Creek WPP's implementation plan. The project consists of installing a hydrodynamic separator to intercept and treat stormwater runoff in an urban subbasin of Brady Creek. Conjunctive BMP effectiveness monitoring is an integral component of the project. The UCRA also will conduct a significant education and outreach program as part of the project.

Stakeholders from the Brady Creek WPP

City of Brady	McCullough County
City of Eden	Soil and Water Conservation District
City of Melvin	TCEQ
Concho County	Texas Parks and Wildlife Department
Concho County Soil and Water Conservation District	Texas State Soil and Water Conservation Board
LCRA	
McCullough County	UCRA

Recommendations

Because monitoring resources were moved from Site 17005 to Site 14232 in 2007, re-establish Site 17005 or another site in AU 03 to determine if dissolved oxygen conditions improve with implementation of the Brady Creek WPP recommendations.

Continue implementing the recommended activities included in the Brady Creek WPP until water quality monitoring indicates attainment of the water quality standards.

Segment 1421: Concho River

Impairment: Dissolved oxygen

Segment Description

The Concho River watershed is about 6,700 square miles. A series of dams near San Angelo capture water from the river's three forks for municipal water supply for the city. Segment 1421 begins upstream of the confluence of the Concho River and Fuzzy Creek in Concho County. The segment extends upstream to the O.C. Fisher Reservoir outlet works on the North Concho River and to the Lake Nasworthy outlet works on the South Concho River in San Angelo. The segment is approximately 64 miles long. Segment 1421 was routinely monitored at the following sites during the period of record:

- 12254: Lipan Creek about 984 yards upstream of the confluence of the Concho River.
- 12255: Kickapoo Creek at FM 380.
- 12257: Dry Hollow Creek at headwaters of Chandler Lake.
- 12401: Concho River Bridge on U.S. Highway 83 at Paint Rock.
- 12402: Concho River at FM 381.
- 12403: Concho River at FM 1692, south of Miles.
- 12404: Concho River at Mullins Crossing Road, 4.5 miles northeast of Veribest.
- 12405: Concho River at Veribest Park.
- 12707: Concho River at FM 380 near Veribest.
- 12408: Concho River downstream from Loop 306 east of San Angelo.
- 12409: Concho River .4 miles downstream of North Concho and South Concho confluence.

- 12412: North Concho River 22 yards above Irving Street Bridge.
- 12416: South Concho River at U.S. Highway 87 in San Angelo.
- 15886: North Concho River at Caddo Street Bridge in San Angelo.
- 17348: South Concho River upstream of the Lone Wolf pump station.

The impaired AU 1421_08, on the North Concho River, begins at the confluence of the North Concho and South Concho rivers upstream to O.C. Fisher Reservoir Dam. Previously, this portion of the river was impaired for exceeding *E. coli* bacteria standards. But the data assessed and reported in the Draft 2016 Integrated Report meets the water quality standard for contact recreation and this impairment has been removed. However, the North Concho River is still on the 303(d) List in the Draft 2016 Integrated Report for dissolved oxygen. The 24-hour average and minimum assessment values collected during the assessment time period failed to meet the 24-hour 5 mg/L average and 3mg/L minimum water quality criteria.

Land Use

The watershed surrounding 1428_08 is heavily urbanized. Industrial, commercial and residential developments are located on either side of the river in San Angelo (population 97,000). Below San Angelo, land is primarily used for farming, pasture, confined animal feed operations and dairies.

Impairment Description

Aquatic Life

TCEQ first placed 1421_08 on the 303(d) List in 2008 for not supporting a high aquatic life use due to low levels of dissolved

oxygen. Data collected from sites 12412 and 15886 between December 2001 and November 2008 showed 15 of 28 diel events failed to meet the average criteria of 5 mg/L. Thirteen of 28 events also failed the 24-hour minimum criteria of 3 mg/L. Subsequent assessments found the impairments continued throughout the 2016 Integrated Report assessment period (2007-2014). The Draft 2016 Integrated Report identified concerns for high levels of nitrate and chlorophyll-a and low dissolved oxygen throughout much of Segment 1421.

Contact Recreation

TCEQ first placed Site 1421_08 on the 303(d) List in 2008 for not supporting contact recreation due to high *E. coli* levels. The geometric mean of 34 *E. coli* samples was 152, 224, 172 and 135 MPN, in 2008, 2010, 2012 and 2014, respectively. The impairment has been removed in the Draft 2016 Integrated Report because the current assessment meets the 126 MPN standard.

Potential Causes of Impairment at Sites 12412 & 15886

Nonpoint Sources

- Low flow, urban stormwater runoff and lack of suitable habitat contribute to the impairments. Urban stormwater runoff from San Angelo has been a serious problem for many years. Fish kills commonly occurred after rain events until stormwater filters were installed as part of a TCEQ and UCRA nonpoint-source pollution abatement program that began in the mid-1990s.
- Fish kills due to runoff are rare now. However, low dissolved oxygen levels are still prevalent in some sections of the river and it is conceivable the designated aquatic life uses may be inappropriate based on recent aquatic life monitoring.

Actions Taken

The Concho River WPP implementation plan resulted in three BMPs to address urban storm water runoff:

- Municipal stormwater ordinance development for the city of San Angelo.
- Anoxic sludge was dredged from portions of AU 1421_08 in March 2010.
- A bank stabilization project in AU 1421_08 from 2011 and 2013.

Stakeholders from the Concho River WPP

City of San Angelo | CRMWD

Downtown merchants

North Concho River
property owners

Texas Parks and Wildlife
Department

TCEQ | UCRA

Recommendations

Continue monitoring.

Work with TCEQ to
develop an appropriate
aquatic life use designation.

Continue to implement
BMPs outlined in the
Concho River WPP.

Segment 1425: O.C. Fisher Lake

Impairment: Chloride and TDS

Segment Description

O.C. Fisher Lake is located on the west side of the city of San Angelo in the Concho River watershed. It begins at the O.C. Fisher Dam and continues upstream to impound the North Concho River to normal pool elevation of 1908 feet msl. Constructed in 1952, it is operated by the U.S. Army Corp of Engineers (USACE). The conservation pool covers 5,440 surface acres with a storage capacity of 119,200 acre-feet. The lake contained only a fraction of its capacity during the reporting period and went dry in 2011.

Land Use

San Angelo State Park is adjacent to the south side of the lake on about 8,000 acres of land leased from USACE. Adjacent to the lake on the north side is Angelo State University's (ASU) Management, Instruction and Research Center. It consists of about 6,000 acres of land leased from USACE and is operated by the Agriculture Department of ASU.

Over 95 percent of the watershed of the North Concho River consists of primarily mesquite and juniper shrub and scrub-type vegetation. The land is used mainly for livestock grazing and wildlife operations. The watershed also contains some small grain and cotton farm operations that utilize groundwater irrigation.

Oil and gas production are prevalent throughout the watershed and have been since the early 1900s. No other major industries are present within the watershed.

Impairment Description

O.C. Fisher Lake has intermittently exceeded general use criteria since 2002. The impairment first appeared on the 2002 Texas 303(d) List due to chloride and TDS concentrations. It remained on the 303(d) List after the 2004 and 2006 assessments with natural sources noted as the sources of impairment. In 2008, the segment was found to be impaired for chloride, but TDS criteria were met. In 2010 and 2012, it met all dissolved solids criteria. Chloride and TDS impairments were reported in the 2014 Integrated Report and again in the Draft 2016 Integrated Report. The chloride and TDS reported values are 567 mg/L and 1298.96 mg/L exceeding the criteria of 150 mg/L and 700 mg/L, respectively.

TCEQ characterizes the impairments as Category 5c; i.e., more information should be collected before implementing a TMDL or other water protection effort. The Draft 2016 Integrated Report also reports a concern for depressed dissolved oxygen in O.C. Fisher Lake.

Potential Causes of Impairments

Point Sources

- Sterling City and the San Angelo State Supported Living Center located in Carlsbad have permitted wastewater treatment facilities that land-apply treated effluent.

Nonpoint Sources

- Historical oil and gas production and dissolution of naturally occurring chlorides from shallow geologic formation may be sources of chloride in the watershed. The most likely causal agent for elevated chlorides and TDS is the interaction of inflows to the lake, evaporation from the lake and drought conditions. A TCEQ-funded study completed by the Texas

Institute of Applied Environmental Research in 2008 (Review of Water Quality and Watershed Characteristics for Segment 1240 (White River Lake), Segment 1425 (O.C. Fisher Lake), and Segment 2307 (Rio Grande below Riverside Diversion Dam) concluded that chloride and TDS concentrations increased with decreasing lake levels. The study noted that periodic improvements in chloride and TDS concentrations correlated to freshwater inflows.

- The lake was dry or nearly dry throughout most of the assessment period for the 2016 Integrated Report.

Actions Taken

- No action has been taken because the impairment is attributed to the concentration of naturally occurring salts caused by evaporation rates exceeding inflows during intermittent and persistent drought conditions that occurred throughout the assessment period.

Potential Stakeholders

- ASU
- City of San Angelo
- LCRA
- San Angelo State Park
- TCEQ
- Texas Parks and Wildlife Department
- UCRA

Recommendations

- Continue water quality monitoring when lake levels allow.





Colorado River below E.V. Spence

Segment 1426: Colorado River below E.V. Spence Reservoir

Impairment: Chloride and TDS

Segment Description

The Colorado River below E.V. Spence Reservoir is about 66 miles long. The segment begins 2.3 miles below the river's confluence with Mustang Creek in Runnels County (near the upper end of O.H. Ivie Reservoir) and continues upstream to Robert Lee Dam in Coke County. Under non-drought conditions, Segment 1426 receives the majority of its base flow from E.V. Spence Reservoir releases. The segment covers more than 2,000 square miles. Segment 1426 is comprised of four AUs, 1426_01, 1426_02, 1426_03 and 1426_04. It was monitored at the following sites during the period of record:

- 17244: Colorado River at Blair Ranch downstream of confluence with Mustang Creek.
- 12430: Colorado River at bridge on U.S. Highway 83 in Ballinger.
- 13651: Colorado River at FM 2111 upstream from Rocky Creek.
- 16901: Colorado River at FM 3115 south of Maverick.
- 12432: Colorado River at U.S. Highway 277 south of Bronte.
- 16900: Colorado River at Double Barrel Road.
- 18338: Colorado River at downstream of State Highway 208 in Robert Lee.
- 17475: Colorado River downstream of Robert Lee Dam.

Land Use

Brush vegetation with a significant portion used for cultivated crops characterize the majority of the land in the segment's watershed. Oil and gas exploration and production are the dominant industries in the region.

Impairment Description

All four AUs in Segment 1426 are impaired for elevated chloride and TDS. TCEQ first listed the segment for chloride in 2002 and TDS in 1999. A TMDL titled Two Total Maximum Daily Loads for Chloride and Total Dissolved Solids in the Colorado River Below E.V. Spence Reservoir was adopted by TCEQ and approved by the EPA in 2007. TCEQ has been carrying out the TMDL Implementation Plan, which also was approved in

2007. TCEQ revised the TMDL Implementation Plan in 2014 and is awaiting approval. In addition to the chloride and TDS impairments, chlorophyll-a and golden algae are listed as concerns in the Draft 2016 Integrated Report.

Potential Causes of Impairments

Point Sources

- The cities of Robert Lee, Bronte, Winters and Ballinger are permitted to land-apply their treated wastewater effluent.

Nonpoint Sources

- Leaking oil wells.
- Former brine disposal pits.
- Produced brine injection wells.
- Mineral dissolution of naturally occurring, shallow geological formations.
- Saltcedar transports salts from groundwater to leaves, which then concentrate salts at the surface of the soil when leaves drop each year.

Actions Taken

- The RRC has drilled monitoring wells up-gradient and down-gradient of known seeps in the watershed to investigate the impact on surface water. It has plugged more than 180 wells in Runnels and Coke counties, many of them upstream of E.V Spence Reservoir.
- RCC operates an interception recovery trench-abatement system near Ballinger for the recovery of chlorides.
- Since EPA approval in 2003, the TCEQ has been carrying out the TMDL Implementation Plan and water quality modeling.

- Saltcedar eradication programs in the watershed include aerial application of herbicide and biological treatment. The biological treatment includes introducing saltcedar leaf beetles.
- UCRA has received a 319h grant to conduct an investigation to attempt to identify the source of elevated TDS and chloride at Site 18338 located at the SH 208 bridge at Robert Lee. The first phase of the project, a desk review, has been completed in compliance with an approved data acquisition QAPP. Project activities are currently paused awaiting approval of the primary QAPP.

Potential Stakeholders

- Agricultural interests
- City of Ballinger
- City of Big Robert Lee
- City of Bronte
- City of Winters
- CRMWD
- Oil and gas operators
- RRC
- TCEQ
- Texas State Soil and Water Conservation Board
- UCRA
- U.S. Fish and Wildlife Service

Recommendations

- Continue identifying and plugging abandoned oil wells, gas wells and leaking wells.
- Continue saltcedar management strategies.
- Seek funding to implement BMPs identified by RRC.
- Continue E.V. Spence Reservoir management measures.
- Continue activities recommended in the revised TMDL I-Plan.

Segment 1432: Upper Pecan Bayou

Impairment: Bacteria

Segment Description

Pecan Bayou is a tributary of the Colorado River above Lake Buchanan. Pecan Bayou begins at its confluence with the Colorado River and ends upstream in Callahan County. Segment 1432 begins immediately upstream of the confluence with Willis Creek to Lake Brownwood Dam in Brown County. The segment, which is about 15 miles long, is composed of one assessment unit. It is routinely monitored by TCEQ at Site 12508 (Pecan Bayou at U.S. Highway 377 in Brownwood).

Land Use

Much of the Segment 1432 watershed is composed of grassland and brush vegetation with forested riparian areas surrounding the upper portion of the creek. The area immediately surrounding the site is a combination of agriculture and urban development where the bayou flows through the east side of Brownwood. A dam restricts flow just upstream of Site 12508. The lower 4 miles of watershed include agricultural uses, orchards and pastures.

Impairment Description

TCEQ first placed Segment 1432 on the Draft 2014 303(d) List for not supporting contact recreation due to elevated levels of *E. coli*. The 2014 Integrated Report reports the geometric mean for *E. coli* as 225 MPN, exceeding the criterion of 126. The 2014 Integrated Report also identified concerns for low dissolved oxygen levels and high chlorophyll-a. The Draft 2016 Integrated Report confirmed those concerns and reported a bacteria geomean of 323 MPN. Upper Pecan Bayou remains in Category 5c for this reporting period.

Potential Causes of Impairments

Nonpoint Sources

- Livestock – Cattle graze in pastures upstream of the monitoring site. The cattle have access to the stream and may contribute fecal material to the water.
- Wildlife – Deer and feral hogs may be sources of fecal contamination.
- Urban runoff – Site 12508 receives stormwater runoff from Brownwood and nearby Early. This likely contributes to bacteria levels in the stream during rain events.

Actions Taken

- TCEQ Region 3 proposed adding a new monitoring site upstream of Site 12508 during fiscal year 2016 to determine if the bacteria source is local.
- Investigations by TCEQ showed no clear source of pollution from upstream locations and reported seeing many pigeons, ducks and geese in the impounded area near the bridge crossing, as well as several pecan orchards and cattle operations upstream of the sampling location.

Potential Stakeholders

Brown County Soil and Water
Conservation District

CAFO operator

City of Brownwood

TCEQ | LCRA

Local landowners

Natural Resource Conservation District

Texas Department of Agriculture

Texas AgriLife Extension

Texas Parks and Wildlife Department

Recommendations

Continue monitoring to better
characterize the impairment
and gather more data.

Evaluate the feasibility of initiating
a WPP with local stakeholders
to address the impairment.

Potentially consider bacterial
source tracking as an option
to investigate sources of bacteria.



Appendices

Appendix A

Colorado River Basin Segments Delisted in the 2016 Draft Integrated Report

Segment	Description	Use Impaired	Parameter	Reason Delisted
1403_03	Lake Austin	Aquatic life	Dissolved oxygen	Recent data meets criteria
1403A_05	Bull Creek	Aquatic life	Dissolved oxygen	AU 05 meets criteria. AU 04 is still impaired for depressed dissolved oxygen.
1403J_01	Spicewood Tributary to Shoal Creek	Contact recreation	<i>E. coli</i>	Approved TDML
1403K_01	Taylor Slough South	Contact recreation	<i>E. coli</i>	Approved TDML
1421_08	Concho River	Contact recreation	<i>Enterococcus</i>	Recent data meets criteria
1427_03, 1427_04	Onion Creek	General use	Sulfate	Recent data meets criteria
1428B_05	Walnut Creek	Contact recreation	<i>E. coli</i>	Approved TDML
1429C_02, 1429C_03	Waller Creek	Contact recreation	<i>E. coli</i>	Approved TDML
1431_01	Mid Pecan Bayou	Contact recreation	<i>E. coli</i>	Recent data meets criteria
1501	Tres Palacios Creek Tidal	Contact recreation	<i>Enterococcus</i>	Approved TDML

Appendix B

Colorado River Basin Segments Delisted in the 2016 Draft Integrated Report

TCEQ protects water quality by establishing Texas Surface Water Quality Standards for water bodies of the state. The standards are made up of two components: designated uses and criteria. Designated uses are purposes for water, including general use, aquatic life use, contact recreation and public water supply. Criteria are usually numeric (sometimes narrative) limits used to compare water quality data or conditions. Common designated uses and their associated criteria are described as follows:

General Use – The category was created to protect overall water quality. Temperature, pH, chloride, sulfate and TDS criteria are used to gauge support for this use. Numeric criteria for these parameters vary among water bodies in the Colorado River basin.

Aquatic Life Use – TCEQ has established different criteria (Table 1) to determine support for aquatic life in freshwater. For aquatic life use, there are four subcategories: exceptional, high, intermediate and limited. As a general rule, all perennial streams are assumed to have a high aquatic life use designation.

Table 1. Aquatic life use criteria

Aquatic Life Use Sub-Category	Dissolved Oxygen (grab sample of 24-hour average)	Dissolved Oxygen (24-hour minimum)	Fish Community Index Score	Benthic Community Index Score	Habitat Index Score
Exceptional	6.0	4.0	58-60	>36	26-31
High	5.0	3.0	48-52	29-36	20-25
Intermediate	4.0	2.0	40-44	22-28	14-19
Limited	3.0	2.0	<34	<22	<14

Contact Recreation – This use refers to a water body’s existing, designated, presumed and attainable use for physical contact, such as swimming. The standard (Table 2) for contact recreation is a measure of bacteria levels. In freshwater, the indicator is *Escherichia coli* bacteria, though fecal coliform bacteria were used as indicators until the early 2000s. In saltwater and coastal areas, *Enterococci* bacteria are used as the indicator. Units of measure for bacteria test results may be reported in most probable number (MPN).

Table 2. Bacteria Criteria for Primary Contact Recreation based on Texas Surface Water Quality Standards

Bacteria	Geometric Mean Criteria	Single Sample Criteria
Fecal coliform	200	400
<i>E. coli</i>	126	394
<i>Enterococcus</i>	35	89

Public Water Supply – This use is evaluated by assessing finished drinking water and/or surface water conditions. Finished drinking water is assessed for toxic contaminants at the point of entry to distribution systems. Finished drinking water also is assessed for elevated levels of dissolved minerals: chloride, sulfate and TDS, which have criteria of 300, 300 and 1000 mg/L, respectively. These criteria for dissolved solids are applied statewide and were developed to ensure water supply utilities could treat and deliver water free of taste and odor.



