2020 Colorado River Basin Highlights Report

A SUMMARY OF WATER QUALITY
IN THE COLORADO RIVER BASIN

TABLE OF CONTENTS

PREPARED BY THE LOWER COLORADO RIVER AUTHORITY
AND THE UPPER COLORADO RIVER AUTHORITY

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

I. EXECUTIVE SUMMARY

The Texas Clean Rivers Program is a statewide water quality monitoring and assessment program that provides funding and resources for regional watershed protection efforts. The program is administered by the Texas Commission on Environmental Quality (TCEQ) in partnership with river authorities and other regional governments. As Clean Rivers Program partners, the Lower Colorado River Authority (LCRA) and Upper Colorado River Authority (UCRA) monitor over 100 sites throughout the basin, and coordinate with the City of Austin Watershed Protection Department and TCEQ regional offices to ensure efficient use of monitoring resources in the Colorado River basin. In total, there are typically between 150-160 sites monitored throughout the Colorado River basin each year. The data collected by these agencies are used to determine if water bodies in the state meet Texas Surface Water Quality Standards.

In 2019, TCEQ evaluated 95 water bodies in the Colorado River basin. Based on the TCEQ assessment, the overall water quality in the basin is good. However, 16 of the assessed water bodies did not meet surface water quality standards. High bacteria levels, low levels of dissolved oxygen, and high chloride and total dissolved solids were among the causes of the impairments.

TCEQ, the Texas State Soil and Water Conservation Board and the above-mentioned data providers are addressing the impairments through restorative projects. Five watershed protection plans have been completed or are ongoing in the Colorado River basin, and there have been nine Total Maximum Daily Load (TMDL) projects (including Tres Palacios Creek) completed or are ongoing as of 2019. The agencies also carried out non-routine monitoring to verify impairments.

In 2019, LCRA and its Clean Rivers Program partners continued to reach out to the public to educate and help resolve local water quality issues. Three Water Quality Advisory Committee meetings were held in the basin. These meetings provided a venue for local stakeholders to learn about water in their region and provide input on projects in their communities.

II. INTRODUCTION

The Texas Clean Rivers Program is a statewide monitoring and assessment program developed to maintain and improve Texas' surface water. The program is administered by TCEQ and regional partners such as river authorities. In the Colorado River basin, LCRA and UCRA implement the program. The City of Austin contributes data and expertise to help assess water quality in Austin. This report describes water quality in the Colorado River basin during 2019.

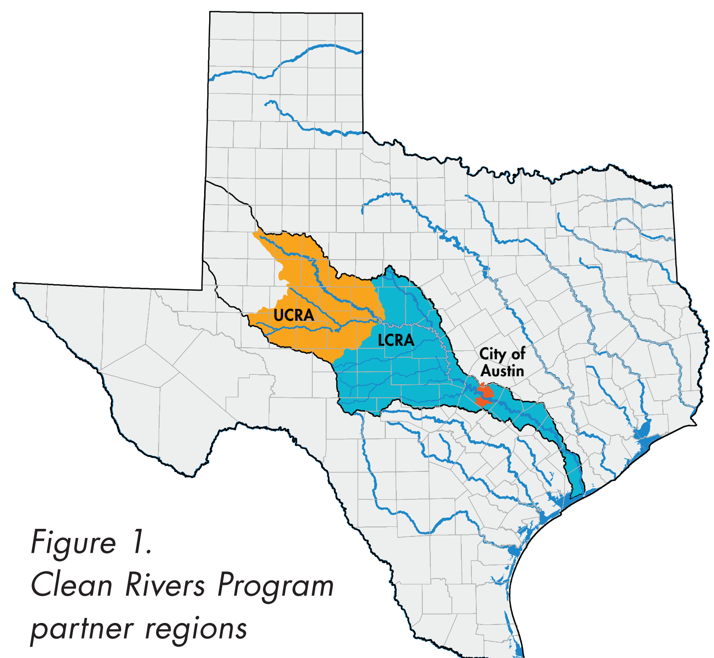


Figure 1. Clean Rivers Program partner regions

III. WATER QUALITY OVERVIEW

The Colorado River basin encompasses about 40,000 square miles from the Texas Panhandle to Matagorda Bay. Geology, soils, climate and human activities influence the river as it traverses the state. Mineralized soils in the upper Colorado and Concho river basins contribute to elevated chloride and sulfate levels in the water. Some reservoirs in the upper basin have salinity levels comparable to Matagorda Bay during drought conditions when evaporation rates are high and minerals in the water are concentrated. Major springs south of San Angelo create stable flows for the South Concho River and provide much needed water for the region.

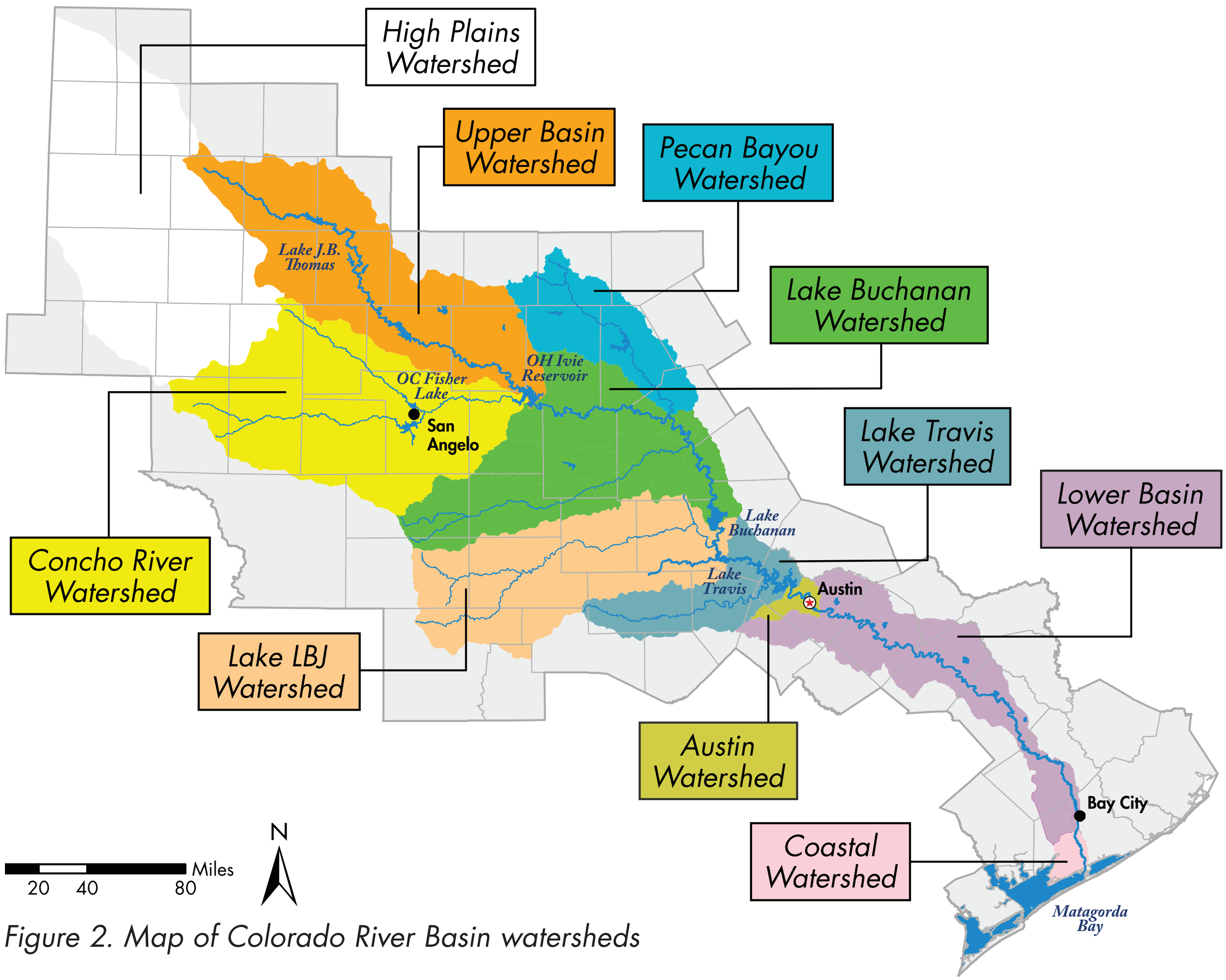
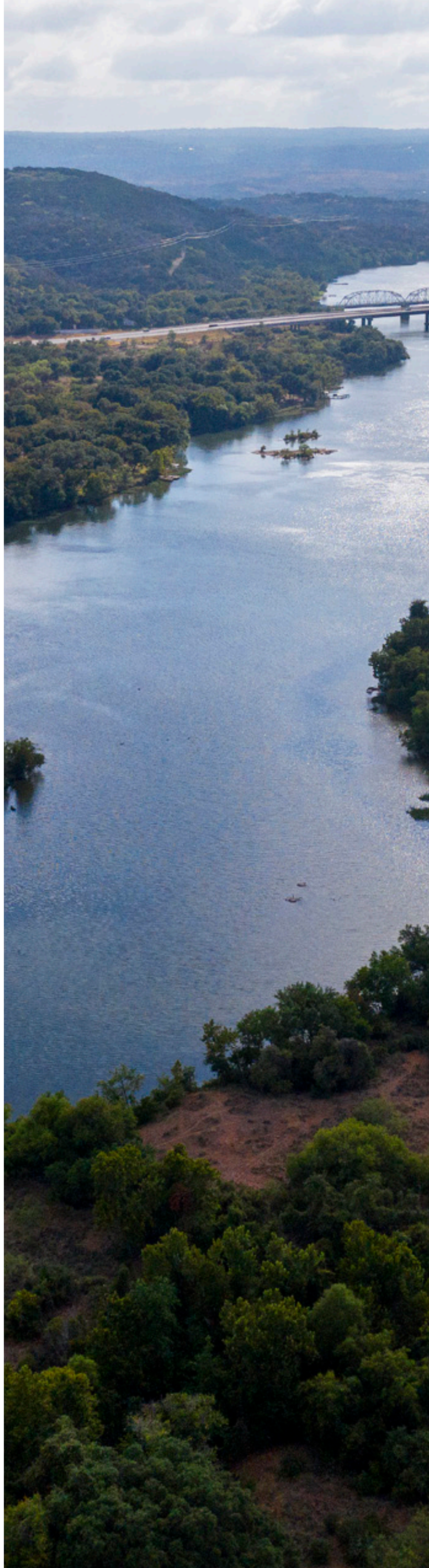
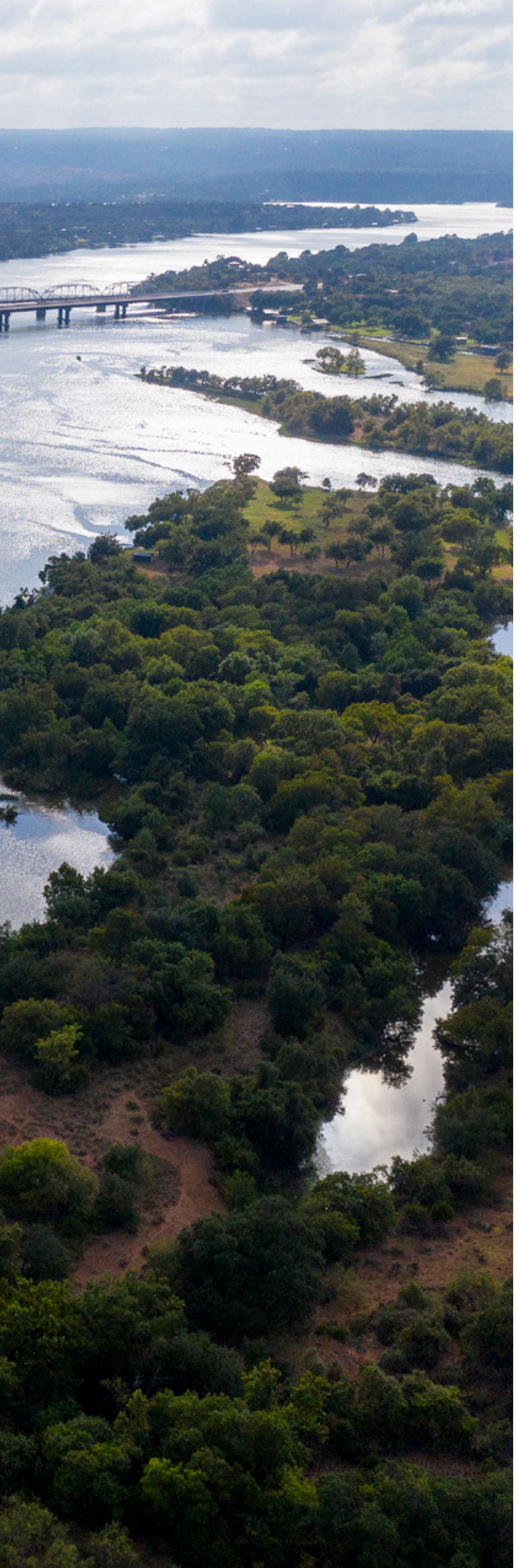
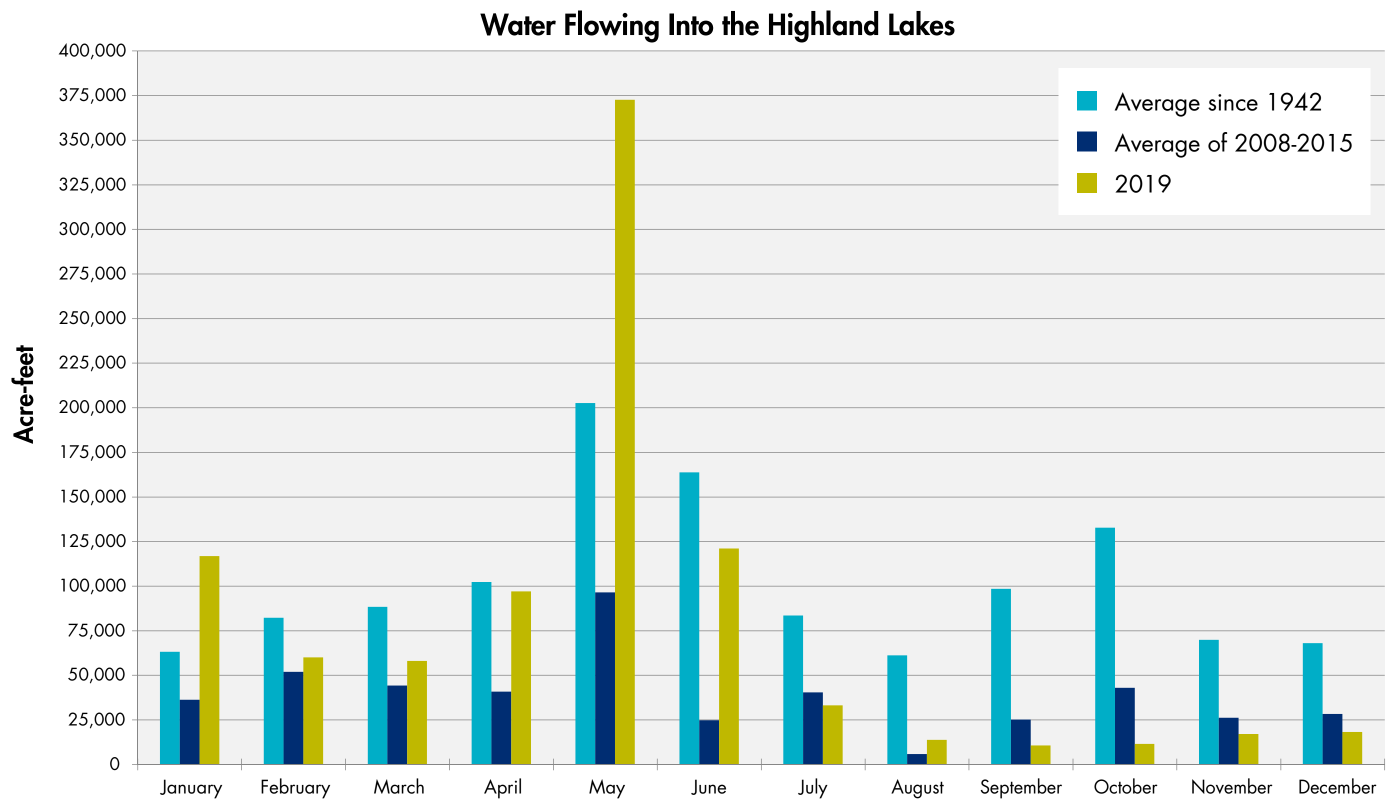


Figure 2. Map of Colorado River Basin watersheds





The middle portion of the basin includes the Highland Lakes: Buchanan, Inks, LBJ, Marble Falls, Travis and Austin, as well as Lady Bird Lake in downtown Austin. The Pedernales, Llano and San Saba rivers are the three major tributaries that flow into the Highland Lakes. The monthly flow of water coming into the Highland Lakes from these tributaries and the Colorado River upstream of Lake Buchanan can be highly variable, but on average, this part of the basin sees the most amount of rainfall and flow during the late spring (Figure 3). The limestone canyons of the Hill Country give way to deep clay soils downstream of Austin. Water in this downstream region tends to be turbid due to high amounts of suspended solids.



*Inflows: the estimated amount of water flowing into the Highland Lakes from rivers and streams

Data for 2018 and 2019 is preliminary and subject to change.

Period: December (acre-feet)

Since 1942 December average: 67,997
2008-2015 December average: 28,338
2019 December: 18,180

Figure 3. Monthly inflows into the Highland Lakes during 2019 compared to historic data

Reservoir	Percent Full	Watershed
Lake J.B. Thomas	24.3	Upper Colorado River
E.V. Spence Reservoir	26.8	Upper Colorado River
O.C. Fisher Lake	9.2	Concho River
Twin Buttes Reservoir	65.2	Concho River
O.H. Ivie Reservoir	69.4	Upper Colorado River
Lake Brownwood	82.2	Pecan Bayou
Lake Buchanan	91.9	Lower Colorado River
Lake Travis	83.1	Lower Colorado River

Table 1. Reservoir Levels on Feb. 13, 2020

IV. WATER QUALITY MONITORING

Water quality monitoring typically includes physical and chemical measurements such as levels of dissolved oxygen, suspended sediments, nutrients, temperature or pesticides in water. It can also include the collection of fish, aquatic insects and habitat data to measure aquatic life and assess the health of streams and reservoirs.

Monitoring data is collected by Clean Rivers Program partners under a TCEQ-approved quality assurance project plan (QAPP) to ensure that it is consistent with regulatory requirements. The data have many uses, including the development of the surface water quality standards, determining if water bodies meet those standards and development of wastewater permit limits. The following entities perform monitoring under an approved QAPP in the Colorado River basin:

- TCEQ
- LCRA
- UCRA
- City of Austin
- U.S. Geological Survey (USGS)

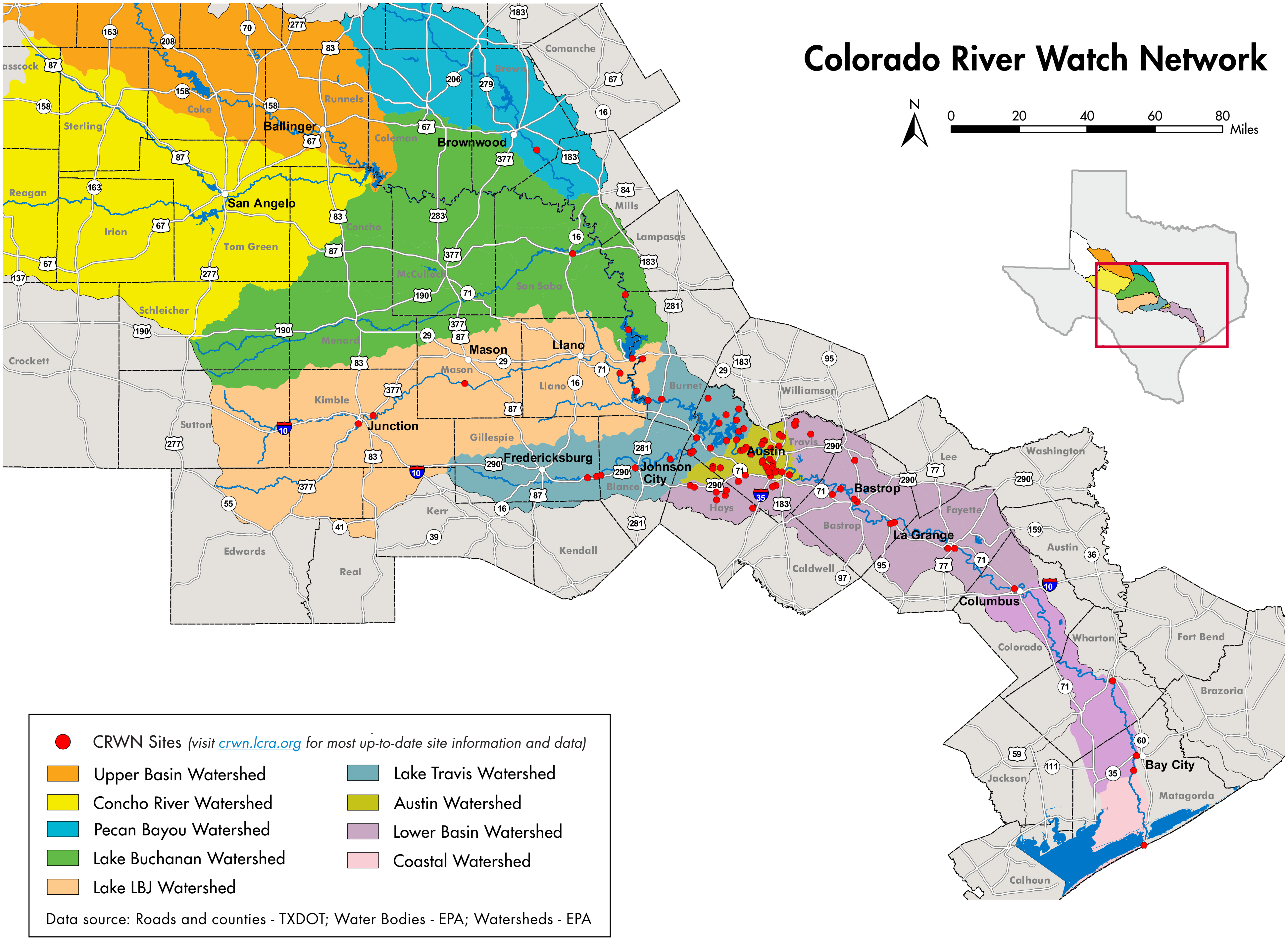


Figure 4. Monitoring sites for the Colorado River Watch Network

In addition to professionally collected data, close to 100 volunteers collect data in the basin through the Colorado River Watch Network, a program administered by LCRA. Volunteers often monitor in areas not routinely sampled by professionals, and their data serves as an important screening tool.

Current and historical water quality monitoring data are available at these websites:

Professional water quality data: http://waterquality.lcra.org

Professional monitoring schedule: http://cms.lcra.org

Volunteer water quality data: http://crwn.lcra.org

V. WATER QUALITY ASSESSMENT

Every two years, TCEQ compares all available quality assured data to the surface water quality standards – or to screening levels when no standards have been established – and publishes the results in the Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d). The Integrated Report defines the status of each water body as one of the following:

1. **Meets or Supports** – Sufficient data are available to assess. The water body meets all applicable surface water quality standards and fully supports its uses.
2. **Concern** – a) Sufficient data are not available to perform a full assessment and the limited data indicate surface water quality standards are not being met, or b) Surface water quality standards have not yet been established. If water quality data indicate a concern, resources are allocated to collect more data and verify the concern.
3. **Impaired** – Sufficient data are available and show that the water body does not meet surface water quality standards. TCEQ publishes a list of impaired water bodies. If monitoring data indicate a water body does not support one or more of its designated uses, then it is said to be impaired. Details of the impairment are published in the TCEQ Integrated Report and 303(d) List.

The Appendix at the end of this report contains a detailed explanation of Texas Surface Water Quality Standards and the TCEQ assessment process. This report focuses on numbers 1 and 3 above, and does not include details of water bodies with a concern status. TCEQ Commissioners approved the Draft 2018 Integrated Report on Sept. 27, 2019. The Environmental Protection Agency approved the 2018 Integrated Report on Dec. 23, 2019. The public comment period for the Draft 2020 Texas Integrated Report ended on Jan. 3, 2020. TCEQ adopted the Texas 303(d) List on March 25, 2020 and and as of this writing it is currently pending approval by the EPA. The 2018 Integrated Report included an evaluation of 90 water body segments in the Colorado River basin. Twenty-two received an impaired designation (Table 2) from TCEQ.

Segment ID	Waterbody	County	Impairment	Assessment Unit	Category
1402C	Buckners Creek	Fayette	Dissolved Oxygen	1402C_01	5c
1402H	Skull Creek	Colorado	Dissolved Oxygen	1402H_01	5b
1403A	Bull Creek	Travis	Dissolved Oxygen	1403A_04	5c
1403J	Spicewood Tributary to Shoal Creek	Travis	Bacteria	1403J_01	4a
1403K	Taylor Slough South	Travis	Bacteria	1403K_01	4a
1407A	Clear Creek	Burnet	Aluminum, Copper, Nickel, Zinc in water; pH; Sulfate; Total Dissolved Solids	1407A_01	5c
1411	E.V. Spence Reservoir	Coke County	Chloride, Sulfate, Total Dissolved Solids	1411_01, 1411_02	5c, 4a
1412	Colorado River Below Lake J.B. Thomas	Coke & Scurry Counties	Bacteria	1412_02	5b
1412B	Beals Creek	Mitchell & Howard Counties	Bacteria	1412B_03	5b
1413	Lake J.B. Thomas	Scurry	Chloride, Sulfate, Total Dissolved Solids	1413_01	5b
1416	San Saba River	Schleicher	Bacteria	1416_01	5c
1416A	Brady Creek	San Saba, McCulloch	Dissolved Oxygen	1416A_03	5c
1421	Concho River	Concho, Tom Green	Dissolved Oxygen	1421_08	5c
1425	O.C. Fisher Lake	Tom Green	Chloride, Total Dissolved Solids	1425_01	5c
1426	Colorado River Below E.V. Spence Reservoir	Runnels, Coke	Total Dissolved Solids	1426_01, 02, 03, 04	4a
1427	Onion Creek	Travis, Blanco	Sulfate	1427_03, 04	5c
1427A	Slaughter Creek	Travis	Macrobenthics	1427A_01	5b
1428B	Walnut Creek	Travis	Bacteria	1428B_05	4a
1428C	Gilleland Creek	Travis	Bacteria	1428C_01, 03, 04	4a
1429C	Waller Creek	Travis	Bacteria, Macrobenthics	1429C_01, 02	5a, 4a, 5c
1432	Upper Pecan Bayou	Brown	Bacteria	1432_01	5c
1501	Tres Palacios Creek Tidal	Matagorda	Bacteria, Dissolved Oxygen	1501_01	4a, 5b

Table 2. Impaired water bodies in the Colorado River basin according to the 2018 Texas Integrated Report

VI. RESTORING IMPAIRED WATER BODIES

TCEQ and the Texas State Soil and Water Conservation Board prioritize impaired water bodies and set goals for improving water quality through the Watershed Action Planning (WAP) process. Clean Rivers Program partners and local stakeholders help identify potential causes for impairments and gage community support of watershed improvement projects. The WAP database, which is managed by TCEQ, tracks progress as work is performed on the prioritized water bodies.

Once a water body is selected through the WAP process, the first step to restoring it is to determine the cause(s) of the impairment. This usually involves verification monitoring or a special study that includes a historical water quality data review, targeted monitoring or a detailed watershed analysis. One of the following projects may be initiated to address the impairment once the cause of the impairment is identified:

- **Total Maximum Daily Load (TMDL)** – A scientific model used to determine the amount or "load" of a pollutant that a water body can receive yet still support its designated uses. Once the load is allocated among all potential sources, an implementation plan outlines strategies to reduce pollutants. Implementation plans are enforceable through regulatory compliance.

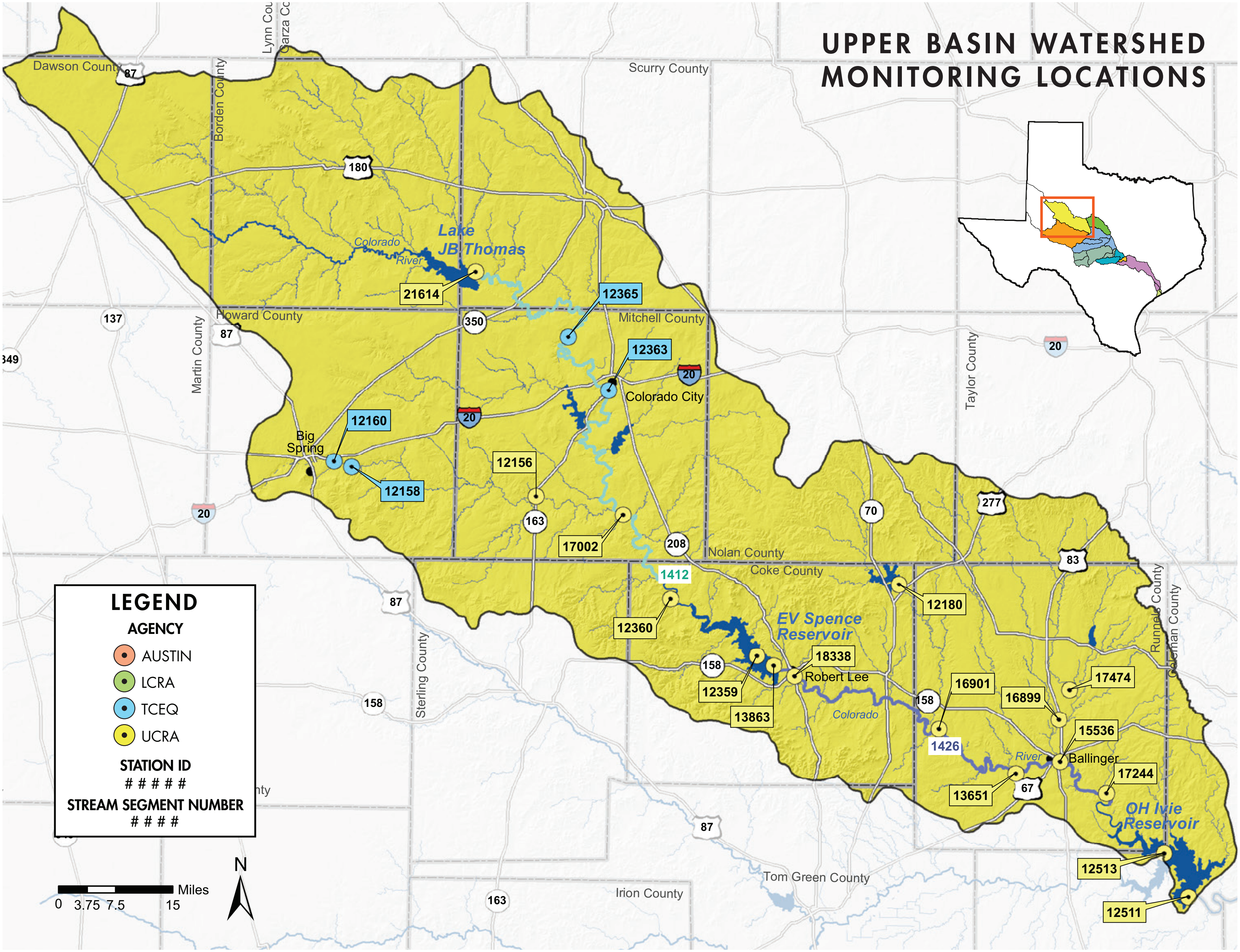
- **Watershed Protection Plan (WPP)** – A stakeholder-driven process to address causes of the identified impairments and develop strategies to reduce pollutant loads. Compliance with WPP strategies is voluntary rather than regulatory.

- **Use Attainability Analysis (UAA)** – Where TMDL and WPP strategies are designed to improve water quality by limiting pollutants, a UAA can help determine whether the level of use originally assigned to the water body is appropriate. For example, in the late 1980s most perennial rivers and streams were assigned a high aquatic life use. Since then, routinely collected data have shown that some water bodies do not meet a high aquatic life use, not because of pollution but because of natural conditions that prevent high aquatic life use from being attained. TCEQ performs UAAs to establish an appropriate level of aquatic life use in the Texas Surface Water Quality Standards.

- **Recreational Use Attainability Analysis (RUAA)** – Similar to a UAA, it confirms the level of recreational use that takes place in a stream. UAAs and RUAAs can result in a revision to the Texas Surface Water Quality Standards.

VII. WATER QUALITY REVIEW BY WATERSHED

This section highlights water quality in the eight major contributing watersheds in the Colorado River basin with emphasis on major water bodies, impairments and efforts to bring water bodies into compliance with Texas Surface Water Quality Standards.


UPPER BASIN WATERSHED MONITORING LOCATIONS
LEGEND
AGENCY
AUSTIN
LCRA
TCEQ
UCRA
STATION ID
# # # # #
STREAM SEGMENT NUMBER
# # # #
Miles
0 3.75 7.5 15
N
Dawson County
Borden County
Scurry County
Howard County
Mitchell County
Martin County
Taylor County
Nolan County
Coke County
Sterling County
Runnels County
Coleman County
Tom Green County
Irion County
Lake JB Thomas
Colorado River
EV Spence Reservoir
OH Ivie Reservoir
Big Spring
Colorado City
Robert Lee
Ballinger
21614
12365
12363
12160
12158
12156
17002
1412
12360
12180
12359
13863
18338
1426
16901
16899
17474
15536
17244
13651
12513
12511

Upper Basin Watershed

The upper Colorado River watershed encompasses about 6,000 square miles. Annual average precipitation ranges from 14 inches in the western portion of the watershed to 21 inches in the eastern portion. Because of the semiarid conditions, many tributaries and drainage features are ephemeral or intermittent, especially in the hot summer months. In 2019, UCRA and TCEQ monitored 22 sites in the following water bodies:

Segment 1411 E.V. Spence Reservoir

Segment 1412 Colorado River below Lake J. B. Thomas including Beals Creek

Segment 1413 Lake J.B. Thomas

Segment 1426 Colorado River below E. V. Spence Reservoir

Segment 1433 O.H. Ivie Reservoir

Segment ID	Water Body	Impairment
1411	E.V. Spence Reservoir	Total dissolved solids, Chloride, Sulfate
1412	Colorado River below Lake J.B. Thomas	Bacteria
1412B	Beals Creek	Bacteria
1413	Lake J.B. Thomas	Total dissolved solids, Chloride, Sulfate
1426	Colorado River below E.V. Spence Reservoir	Total dissolved solids

Table 3. Impairments for the Upper Colorado River Watershed

E.V. Spence Reservoir near Silver, Texas

Colorado River Site 12156

Segment 1411 – E.V. Spence Reservoir

E. V. Spence Reservoir is an impoundment on the Colorado River near the town of Robert Lee. The reservoir has a history of high total dissolved solids (TDS) and sulfate, and in 1998 TCEQ placed it on the 303(d) List for these parameters. In 2014, it was also listed as impaired for chloride as a result of the drought in the seven-year assessment period.

A TMDL was adopted by TCEQ in 2000 and approved by the EPA in 2003. The TMDL implementation plan includes measurements for brush management, management of diversions from the reservoir and plugging leaking oil wells. The management measures continue to be implemented. The reservoir contained 26.8% of its capacity in early 2020. For more information on the E.V. Spence TMDL, visit the TCEQ website at http://www.tceq.texas.gov/waterquality/tmdl.

Segment 1412 – Colorado River below Lake J.B. Thomas, including Beals Creek

This segment of the Colorado River is impaired for contact recreation because of high levels of *E.coli*. Potential sources of bacteria at the monitoring site near Colorado City include urban runoff, leaking wastewater lines and failing septic systems. A portion of the area upstream of the monitoring site consists of farms and rangeland. Runoff from these operations – and wildlife in the area - could be a source of bacteria in the river as well. Routine monitoring is scheduled to continue in 2020.

Beals Creek, a tributary that enters the river downstream of Colorado City, is impaired for bacteria. The creek was also impaired for selenium up until the 2014 Integrated Report assessment found that it met the water quality standards and was removed from the 303(d) List. Potential sources of bacteria include wildlife and failing septic systems located along the creek in Big Spring. Monitoring will continue in 2020.

Segment 1413 – Lake J.B. Thomas

Lake J. B. Thomas is impounded on the Colorado River in Scurry County. The lake is impaired for TDS, sulfate and chloride. The concentrations are due to regional geology, low lake levels caused by drought that occurred during previous assessment periods and historical oil and gas production activities. Soils in the watershed are highly mineralized and dissolution of these minerals into surface water occurs readily. Evaporation coupled with low precipitation during drought conditions and in summer months concentrates minerals in the reservoir. The lake's watershed contains oil and gas deposits in production since the 1930s. Seeps resulting from oil and gas production, including abandoned or inadequately plugged wells, have been identified in the watershed. These seeps typically contain highly saline water, which can contaminate surface water.

Golden Algae

Golden algae (*Prymnesium parvum*) blooms are common in E.V. Spence Reservoir. Fish kills have occurred every year since 2001 and based on sampling by Texas Parks and Wildlife Department (TPWD), golden algae continued to be present in the reservoir in 2019. TPWD will continue to monitor in 2020.

Since 1985, golden algae has caused a number of fish kills in Texas water bodies. While golden algae can occur in stock tanks and reservoirs, it is usually kept in check by competition with other algal species. A bloom of golden algae may be triggered by significant temperature swings, cloudy weather or rising salinity levels. A minor bloom may kill or harm some fish, but serious kills can result when golden algae increases dramatically and produces toxins that impair fish gills, leading to asphyxiation. For more information, visit tpwd.texas.gov/landwater/water/environconcerns/hab/.

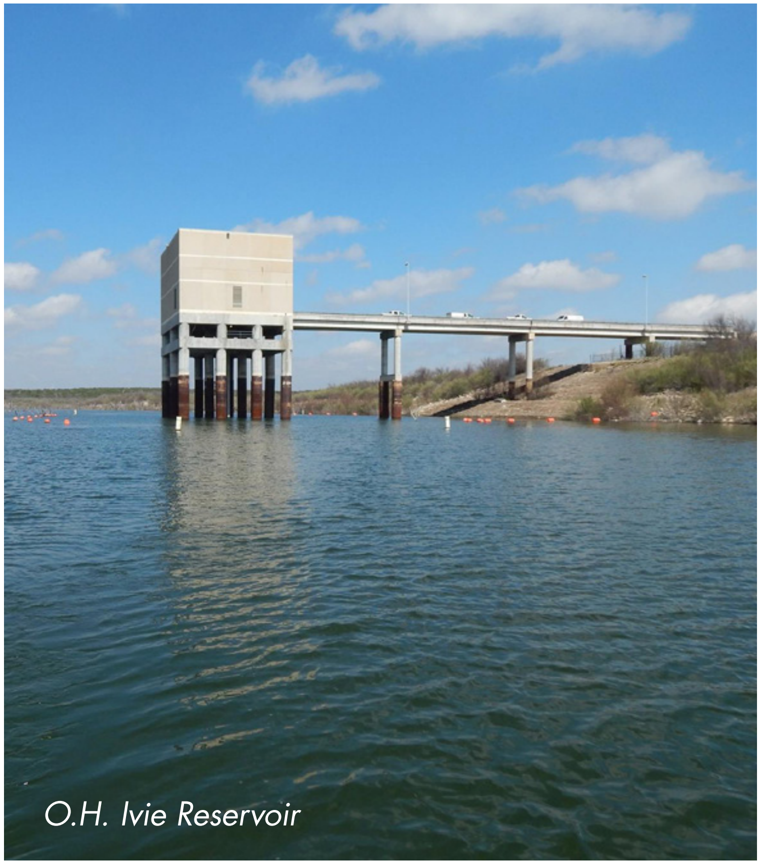
Segment 1426 – Colorado River below E.V. Spence Reservoir

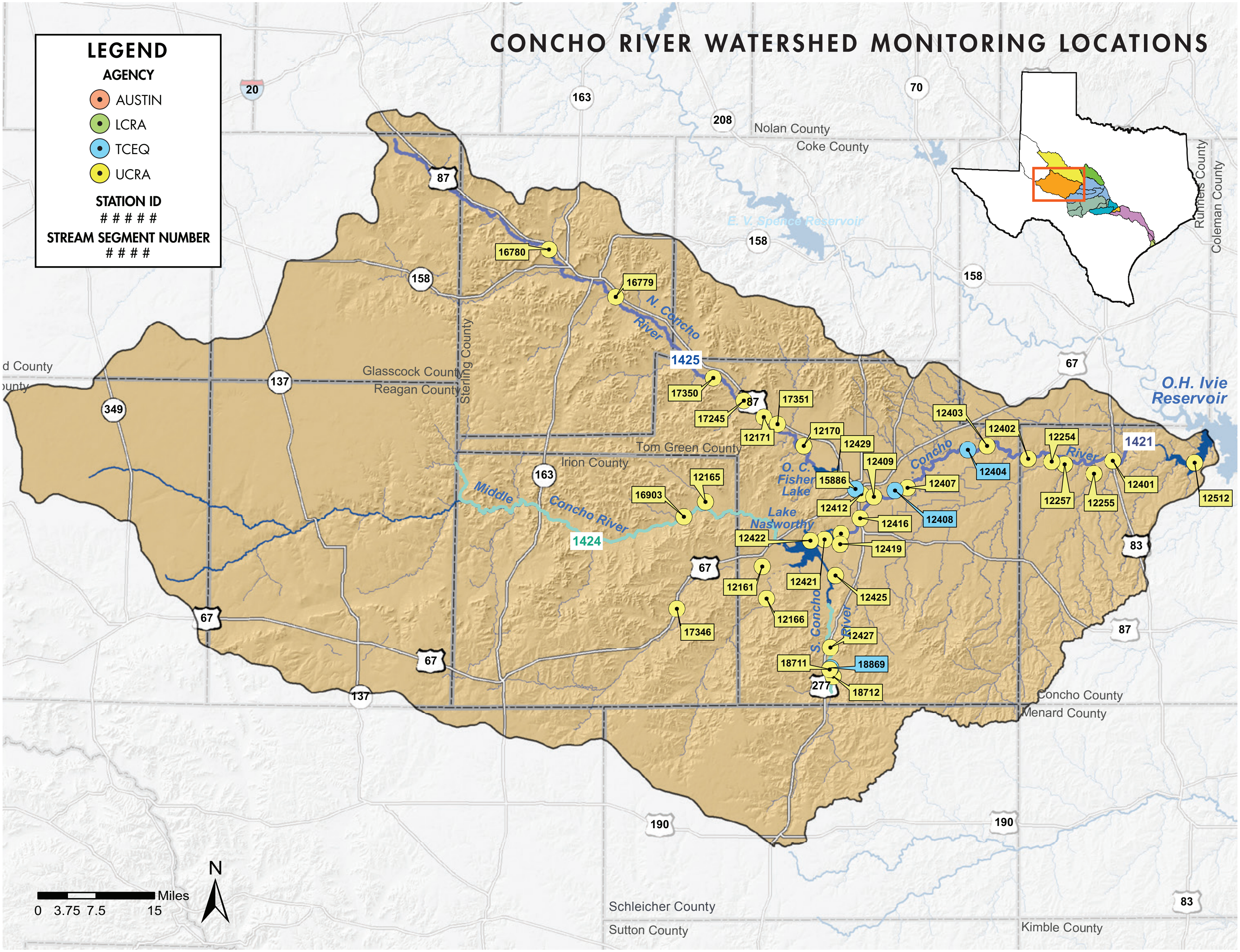
The Colorado River below E.V. Spence Reservoir has a history of high chloride and TDS. In 2000, TCEQ placed it on the 303(d) List. A TMDL was performed to address the problem. It was adopted by TCEQ and approved by the EPA in 2007. A TMDL Implementation Plan was completed in October 2007. The plan uses point source controls, reservoir operations, brush control and oil well plugging to reduce pollutants.

In 2013, UCRA was tasked by TCEQ to update the TMDL Implementation Plan for the Colorado River between E.V. Spence and O.H. Ivie reservoirs. The goal of UCRA has been to support the evaluation and revision (as appropriate) of the TMDL Implementation Plan for TDS and chlorides in the Colorado River below E.V. Spence. UCRA's role has been to facilitate and coordinate public participation in the review and revision process.

Segment 1433 – O.H. Ivie Reservoir

O.H. Ivie Reservoir is an impoundment at the confluence of the Colorado and Concho rivers. When full, the reservoir holds 554,335 acre-feet of water. In early 2020, the reservoir was at 69.4% capacity. Water in O.H. Ivie Reservoir meets all surface water quality standards.


O.H. Ivie Reservoir



CONCHO RIVER WATERSHED MONITORING LOCATIONS
LEGEND
AGENCY
AUSTIN
LCRA
TCEQ
UCRA
STATION ID
# # # # #
STREAM SEGMENT NUMBER
# # # #
N. Concho River
Middle Concho River
S. Concho River
Concho River
O. C. Fisher Lake
Lake Nasworthy
O.H. Ivie Reservoir
E. V. Spence Reservoir
1425
1424
1421
16780
16779
17350
17245
17351
12171
12170
12429
12409
15886
12412
12407
12408
12416
12403
12402
12404
12254
12257
12255
12401
12512
12165
16903
12422
12419
12421
12425
12161
12166
17346
12427
18711
18869
18712
Nolan County
Coke County
Glasscock County
Reagan County
Sterling County
Tom Green County
Irion County
Concho County
Menard County
Schleicher County
Sutton County
Kimble County
Runnels County
Coleman County
Miles
0 3.75 7.5 15
N

Concho River Watershed

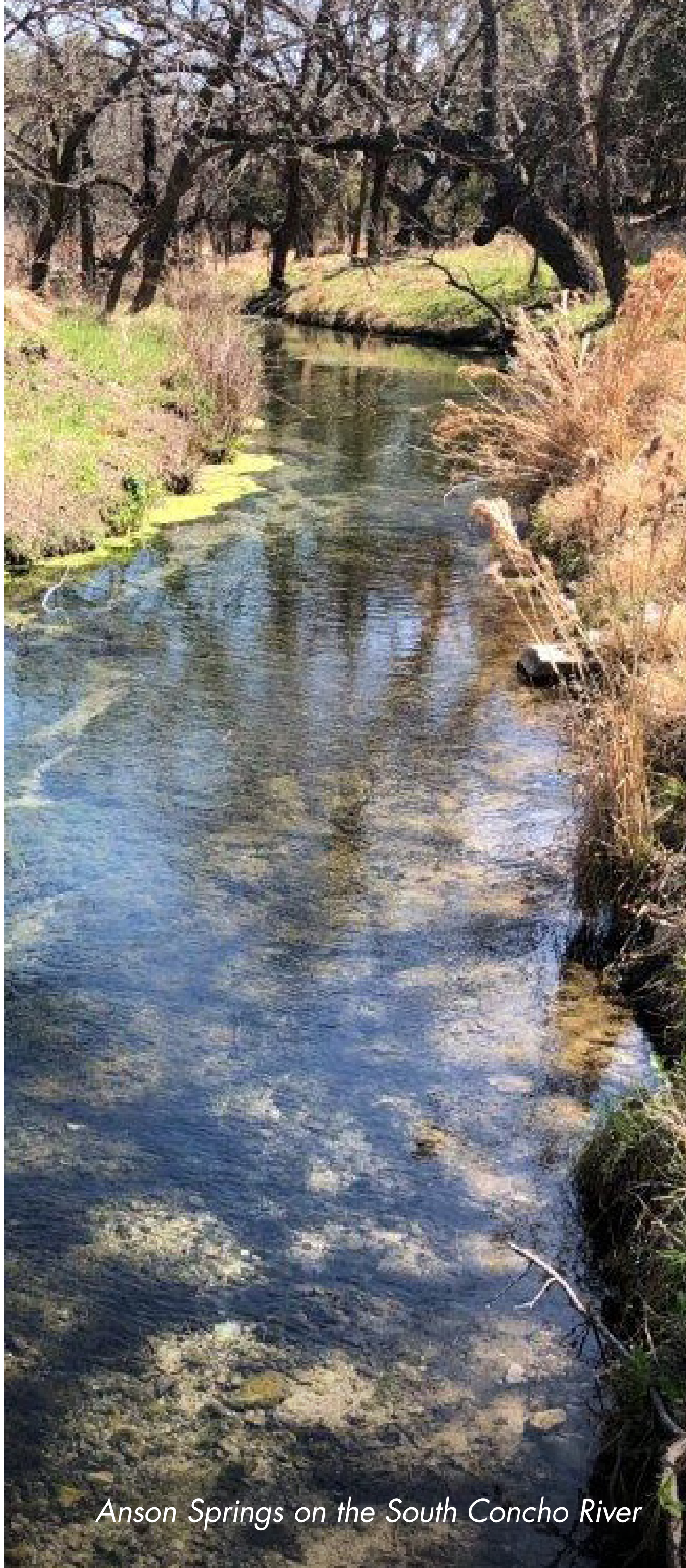
The Concho River watershed is the largest in the Colorado River basin, with an area of approximately 6,700 square miles. Semiarid conditions exist in most of the watershed and many of the tributaries are ephemeral or intermittent.

The principal rivers are the North, Middle and South Concho rivers, and the main Concho River downstream of San Angelo. The rivers are impounded near San Angelo to form O.C. Fisher Reservoir, Twin Buttes Reservoir and Lake Nasworthy.

Below San Angelo, the Concho River flows intermittently past irrigated fields into O.H. Ivie Reservoir, about 60 miles downstream. The North, Middle and main Concho river valleys are characterized by broad floodplains that contain fluvial deposits of gravel, sand and clay and form shallow aquifers. The South Concho River, including Spring and Dove creeks, is characterized by much narrower and steeper valleys. Baseflow for these waterways originates from springs on the northern edge of the Edwards-Trinity Aquifer.

Based on the 2018 TCEQ Integrated Report, the Concho River is impaired for low dissolved oxygen. During the reporting period, 29 sites were routinely monitored on the following water bodies:

Segment 1421	Concho River
Segment 1421A	Dry Hollow
Segment 1421B	Kickapoo Creek
Segment 1421C	Lipan Creek
Segment 1422	Lake Nasworthy
Segment 1423	Twin Buttes Reservoir
Segment 1423A	Spring Creek
Segment 1423B	Dove Creek
Segment 1424	Middle Concho and South Concho rivers
Segment 1424A	West Rocky Creek
Segment 1424B	Cold Creek
Segment 1425	Lake O.C. Fisher
Segment 1425A	North Concho River



Anson Springs on the South Concho River


Concho River


Segment 1423A, Spring Creek

Segment 1421 – Concho River

Segment 1421 includes the Concho River downstream of San Angelo and parts of the north and south forks of the Concho River in San Angelo up to O.C. Fisher Lake and Twin Buttes Reservoir. Below San Angelo, the segment extends downstream approximately 45 river miles to Paint Rock in an area known as the Lipan Flats. The area is comprised of rich farmland and sits atop of the Lipan Aquifer, known for groundwater with high nitrogen concentrations.

Monitoring data collected near San Angelo indicate low levels of dissolved oxygen, and historically also showed elevated bacteria levels. TCEQ placed the river on the 303(d) List in 2008. As presented in the Concho River Basin Watershed Protection Plan submitted to the state Soil and Water Conservation Board in May 2011, the bacteria impairment was likely attributable to avian sources. The Concho River continues to remain impaired for low dissolved oxygen.

Segment 1422 – Lake Nasworthy

Lake Nasworthy is an impoundment on the South Concho River, just below Twin Buttes Reservoir. Water released from Twin Buttes Reservoir is the primary source of water for the lake. The lake holds approximately 14,000 acre-feet of water when it's at conservation pool level. Lake Nasworthy met all applicable surface water quality standards, according to the 2018 Integrated Report.

Segment 1423 – Twin Buttes Reservoir

Twin Buttes Reservoir is an impoundment on the south and middle forks of the Concho River and on Spring and Dove creeks. Monitoring data show that water quality in Twin Buttes Reservoir is good and meets applicable surface water quality standards.

Segment 1425, Site 12171

North Concho River at San Angelo

Segment 1424 – Middle and South Concho Rivers

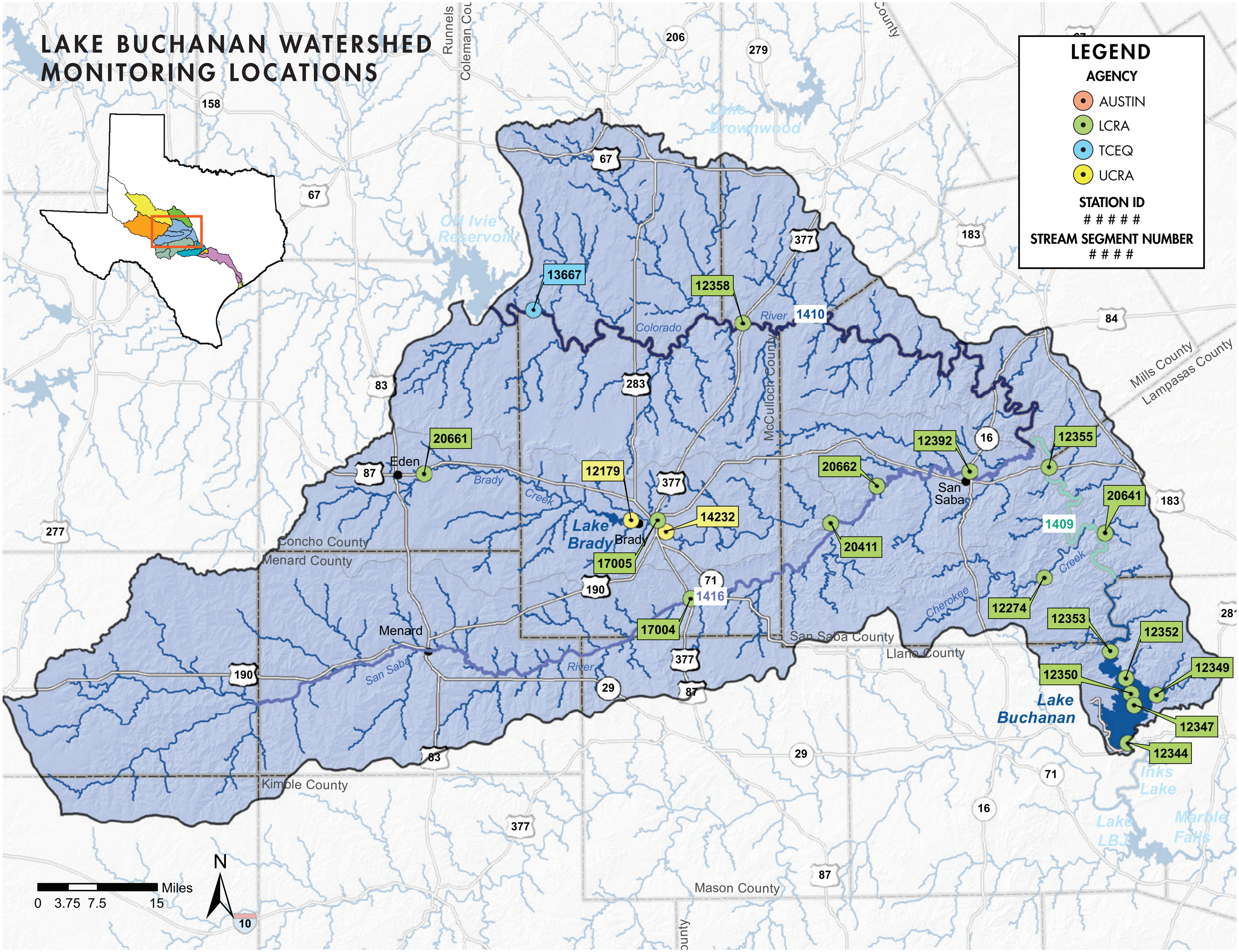
Although the South Concho and Middle Concho rivers are included in the same segment, the two rivers have very different characteristics. The South Concho River is a perennial spring-fed stream created by several large springs that form its headwaters. The Middle Concho River flows intermittently and during the most recent drought became dry for an extended period. No impairments have been identified for either water body.

Segment 1425 – O.C. Fisher Lake

O.C. Fisher Lake is an impoundment on the North Concho River west of San Angelo. Due to long-term drought, the lake completely dried up in 2011. The lake now contains some water due to rains in the last few years, and as of January 2020, the lake was at 9.2% capacity. Due to the low water levels and effects from the drought, O.C. Fisher is now impaired for chloride and total dissolved solids. Monitoring will continue in 2020.

Segment 1425A – North Concho River

The North Concho River is intermittent and typically only flows after recent rainfall events. The river meets all state surface water quality standards according to the 2018 Integrated Report.



LAKE BUCHANAN WATERSHED MONITORING LOCATIONS
LEGEND
AGENCY
AUSTIN
LCRA
TCEQ
UCRA
STATION ID
# # # # #
STREAM SEGMENT NUMBER
# # # #
13667
12358
1410
Colorado River
20661
Eden
Brady Creek
12179
14232
17005
Lake Brady
Brady
20662
20411
12392
San Saba
12355
20641
1409
12274
Cherokee Creek
17004
1416
San Saba River
Menard
12353
12352
12349
12350
12347
12344
Lake Buchanan
Inks Lake
Lake LBJ
Marble Falls
Lake Brownwood
Oh Ivie Reservoir
Concho County
Menard County
McCulloch County
San Saba County
Llano County
Kimble County
Mason County
Mills County
Lampasas County
Runnels
Coleman Cou
Miles
0 3.75 7.5 15
N

Lake Buchanan Watershed

The Lake Buchanan watershed begins where the Colorado River flows from the dam at O.H. Ivie Reservoir. Freshwater from Pecan Bayou, the San Saba River and small perennial streams dilute the dissolved solids common in the upper basin. Water quality in the majority of the watershed meets surface water quality standards. The three exceptions are Upper Pecan Bayou, the San Saba River and Brady Creek. Pecan Bayou and the San Saba River have elevated bacteria levels and Brady Creek contains low levels of dissolved oxygen. In 2019, LCRA and TCEQ routinely monitored 21 sites in the following water bodies:

Segment 1408	Lake Buchanan
Segment 1409	Colorado River above Lake Buchanan
Segment 1410	Colorado River below O.H. Ivie Reservoir
Segment 1416	San Saba River
Segment 1416A	Brady Creek
Segment 1417	Lower Pecan Bayou
Segment 1418	Lake Brownwood
Segment 1419	Lake Coleman
Segment 1420	Pecan Bayou above Lake Brownwood
Segment 1431	Mid Pecan Bayou
Segment 1432	Upper Pecan Bayou


Lake Buchanan and Buchanan Dam

Segment 1408 – Lake Buchanan

Lake Buchanan is an impoundment of the Colorado River in Burnet and Llano counties. At 22,335 surface acres, it is the largest of the Highland Lakes and is one of the two water supply reservoirs in the Highland Lakes reservoir system, with the other being Lake Travis. In 2019, Lake Buchanan remained between 1,010 and 1,020 feet above mean sea level (feet msl), and is predicted to stay above 1,010 feet msl through July 2020 unless extreme dry conditions occur (Figure 4). Monitoring data indicate that the lake meets all applicable surface water quality standards.

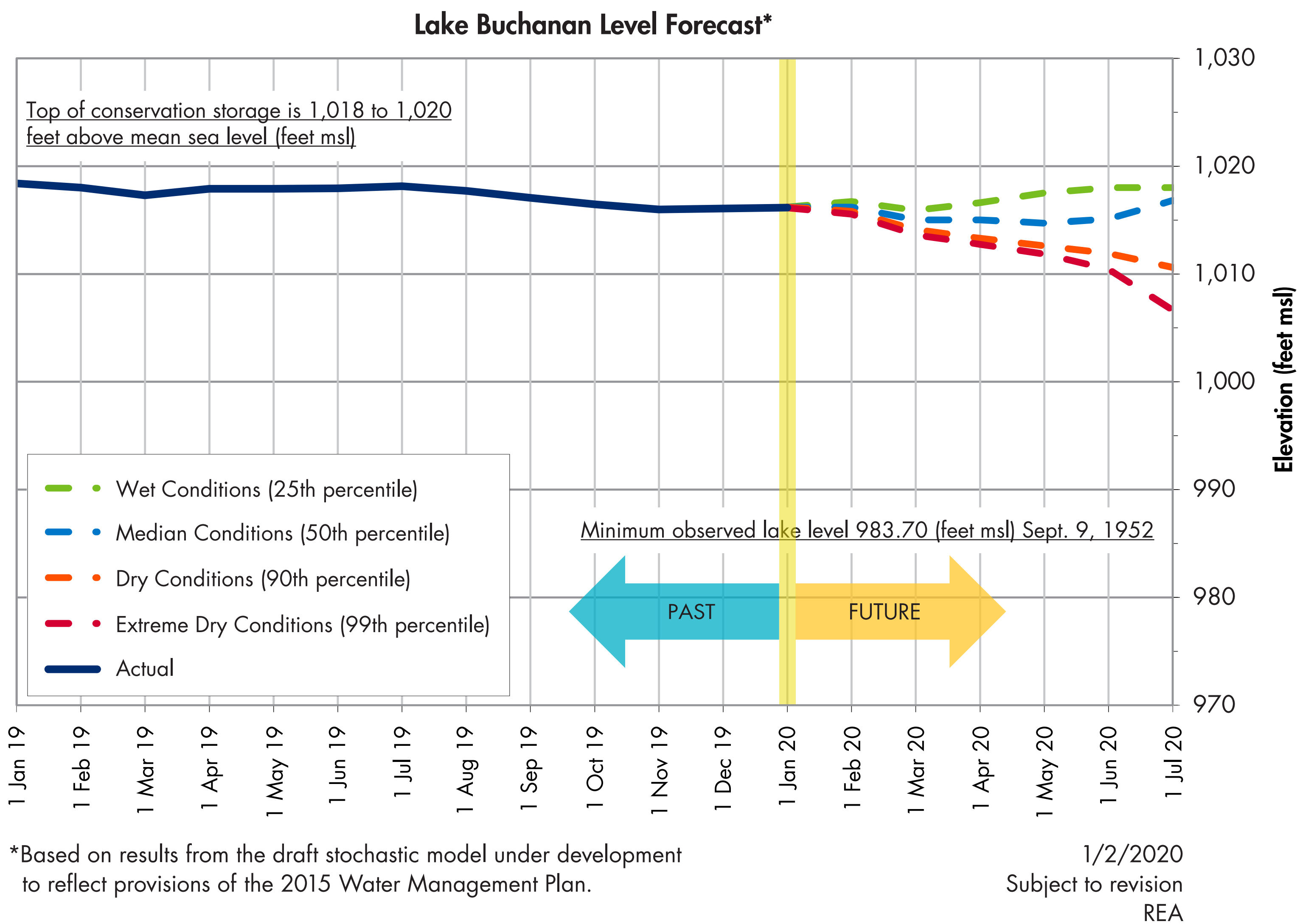


Figure 5. January 2020 water elevation and future water level forecast for Lake Buchanan

On-Site Sewage Facility (OSSF) Ordinance

On-site sewage facilities (OSSF) or septic systems are an integral part of rural America. They can be an efficient way to remove household waste and protect the environment when properly designed and maintained. In 1971, TCEQ delegated regulatory authority of OSSF systems in the Highland Lakes to LCRA. Since then, LCRA has regulated the installation and operation of thousands of OSSF systems in the four-county area. This oversight ensures the best available technology is used to treat septic wastes so pollutants such as bacteria, phosphorus and nitrogen don't leach into surface water. In 2019, LCRA's OSSF program issued 501 permits and conducted over 2,480 inspections.

Highland Lakes Watershed Ordinance

Stormwater runoff carries pollution — pesticides, soil, nutrients, toxics and other residues from everyday human activities. LCRA actively manages stormwater runoff around the Highland Lakes through the Highland Lakes Watershed Ordinance. Through a permitting process, the ordinance requires developers to stabilize land and minimize sediment migration. Water quality is protected by limiting stormwater runoff, creating buffer zones, and installing erosion and sediment controls. New quarries and mines are also covered under the ordinance and must implement measures similar to other development.

Segment 1409 – Colorado River above Lake Buchanan

The Colorado River above Lake Buchanan begins at the confluence with the San Saba River in San Saba County. Chloride and TDS are diluted as the San Saba River and smaller perennial streams supply fresh water into the Colorado River. Bedrock is the dominant substrate and water in this region tends to be clearer than upstream. This stretch of the river met all designated uses, according to the TCEQ 2018 Integrated Report.

Colorado River above Lake Buchanan

Segment 1410 – Colorado River below O.H. Ivie Reservoir

The Colorado River below O.H. Ivie Reservoir is located between the confluence of the Colorado and San Saba rivers and the O.H. Ivie Reservoir Dam. The segment is approximately 138 miles long. Water is released from O.H. Ivie Reservoir to slowly flow through farmland and ranches where it is used to irrigate hay, wheat, cotton and pecan orchards. Segment 1410 met all designated uses, according to the TCEQ 2018 Integrated Report.

Segment 1416 – San Saba River

The San Saba River begins in Schleicher County where the river's North Valley Prong and Middle Valley Prong converge. It flows approximately 168 miles downstream to the confluence with the Colorado River in San Saba County. It does not support contact recreation based on *E.coli* data collected near the town of San Saba.

TCEQ first placed the river on the 303(d) List in 2008 for elevated bacteria levels. Since then, another monitoring site was added upstream of the site where the impairment was found to narrow down the source of the bacteria. The upstream site had bacteria levels that met standards, while the routine monitoring site did not. The main source of bacteria is coming from somewhere near/in the city of San Saba. Potential causes of impairment include a cattle auction barn located four miles upstream of the original monitoring site, stormwater runoff from the town of San Saba, and/or agricultural and wildlife nonpoint sources. LCRA is evaluating funding options for a bacteria source tracking project to better understand the sources of bacteria. Stakeholder engagement and continued monitoring is planned for 2020.

Segment 1416A – Brady Creek

The Brady Creek watershed in Concho, McCulloch and San Saba counties is approximately 784 square miles. Water quality monitoring performed by UCRA in the early 2000s indicated persistently low levels of dissolved oxygen. TCEQ designated the creek as impaired on the 2004 303(d) List.

In 2004, funded by a Clean Water Act 319(h) grant administered by TCEQ, UCRA created the Brady Creek Master Plan. The plan was an urban runoff abatement project that identified stormwater runoff and low flows as causes of the impairment. The project implemented stormwater controls to lessen the impact of runoff into the creek. In March 2009, UCRA received another Clean Water Act 319(h) grant from TCEQ to develop the Brady Creek WPP. Unlike the Brady Creek Master Plan, which included only the area within Brady's city limits, the WPP encompassed the entire watershed. UCRA began monitoring, and a stakeholders group was organized in 2010. From 2010 to 2016, ambient and stormwater monitoring was completed, computer models were used to simulate land use, potential mitigation projects and wastewater discharge scenarios, and stakeholder meetings were held to further develop the plan. The Brady Creek WPP was finalized by UCRA and approved by the EPA in 2016. For more information on the plan, visit https://www.tceq.texas.gov/waterquality/nonpoint-source/projects/brady-creek-watershed-protection-plan.

San Saba River

Brady Creek

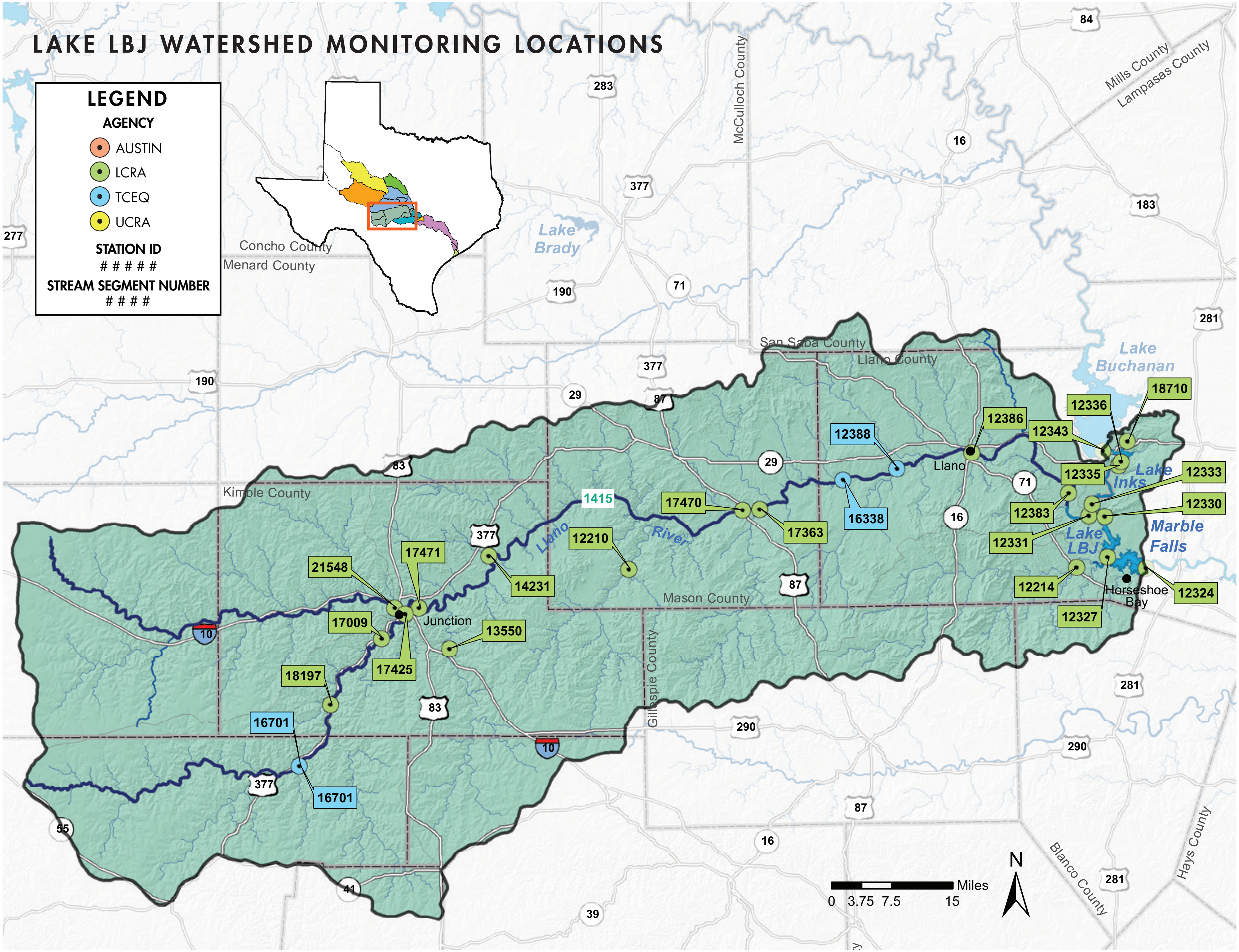
Segments 1417, 1418, 1419, 1420 and 1432

The Pecan Bayou headwaters are southeast of Abilene. The flat terrain in the 2,200-square mile watershed creates sluggish flows. Several small tributaries provide intermittent flows to the bayou. Jim Ned Creek, a major tributary, forms Lake Coleman and merges with Pecan Bayou to form Lake Brownwood, near the City of Brownwood. In the 2014 Integrated Report, Upper Pecan Bayou did not meet the surface water quality standards for contact recreation and continues to be impaired for high bacteria levels in the 2018 Integrated Report.

Segment 1431 – Mid Pecan Bayou

Mid Pecan Bayou begins downstream of Brownwood. The 13-mile segment is surrounded by land used for hay production and row crops and there is a concentrated animal feeding operation in the upper end of the segment. The City of Brownwood wastewater treatment plant historically discharged treated effluent into Willis Creek, about 1.5 miles upstream of the monitoring site. However in recent years, the city constructed a new wastewater treatment plant that reduced the amount of effluent entering the creek by reusing much of the wastewater.

Pecan Bayou at Highway 67 in Brownwood


LAKE LBJ WATERSHED MONITORING LOCATIONS
LEGEND
AGENCY
AUSTIN
LCRA
TCEQ
UCRA
STATION ID
# # # # #
STREAM SEGMENT NUMBER
# # # #
Concho County
Menard County
Kimble County
Mason County
McCulloch County
San Saba County
Llano County
Gillespie County
Mills County
Lampasas County
Blanco County
Hays County
Lake Brady
Lake Buchanan
Lake Inks
Lake LBJ
Marble Falls
Horseshoe Bay
Llano
Junction
Llano River
1415
12388
16338
16701
12386
12336
18710
12343
12335
12333
12383
12330
12331
12214
12327
12324
17470
17363
12210
14231
17471
21548
17009
13550
17425
18197
Miles
0 3.75 7.5 15
N

Lake LBJ Watershed

The Lake LBJ watershed encompasses about 5,000 square miles beginning where the Colorado River is released from Buchanan Dam. Immediately below Buchanan Dam, the river flows into Inks Lake, a pass-through reservoir. Below Inks Dam the river flows about 10 miles to the community of Kingsland, where it merges with the Llano River before flowing into Lake LBJ.

The rock and limestone geology of the Edwards Plateau creates clear-flowing streams like the Llano and James rivers. Many of the spring-fed streams in the watershed are perennial, except during extreme drought conditions. Water quality in the watershed is good with the exception of Clear Creek, a tributary of Inks Lake that does not meet surface water quality standards due to pH, sulfate, TDS, and aluminum, copper, nickel and zinc in the water. In 2013, LCRA routinely monitored 18 sites on the following water bodies:

Segment 1406	Lake LBJ
Segment 1407	Inks Lake
Segment 1407A	Clear Creek
Segment 1415	Llano River (including the north and south forks)

Lake LBJ

Segment 1406 – Lake LBJ

Lake LBJ is impounded where the Colorado and Llano rivers converge in Burnet and Llano counties. The reservoir was completed in 1951 to supply hydroelectric power to the area. Development around the lake is constant and the communities of Granite Shoals, Sunrise Beach, Horseshoe Bay and Kingsland continue to grow. The Highland Lakes Watershed Ordinance and the OSSF Ordinance, which are administered by LCRA, help reduce the impact of development around the lake. Lake LBJ meets all surface water quality standards. Invasive zebra mussels were found in Lake LBJ during 2019.

Segment 1407 – Inks Lake

Inks Lake is a 777-acre impoundment immediately downstream of Buchanan Dam. The lake is home to Inks Lake State Park and is a popular destination for water recreation. Monitoring data indicate the lake met all applicable surface water quality standards based on the 2018 Integrated Report.

Segment 1407A – Clear Creek

Clear Creek is an intermittent tributary of Inks Lake. The creek is about 4.5 miles long and is impaired for pH, sulfate, TDS, and aluminum, zinc, copper and nickel in water. The source of the pollutants is runoff from property that once was a graphite mine. A 23-acre tailings pile – a remnant of the abandoned mine – is located on the banks of the creek. Storm water runoff from the pile has resulted in low pH and heavy metals in the creek. The property is owned by Greensmiths, Inc., which purchased the facility in 2000 and began using reclaimed tailings materials to landscape golf courses. Greensmiths has engineered structures to prevent runoff and has received a zero-discharge permit from TCEQ. The creek has flowed intermittently since 2011. Sampling performed in 2019 showed water quality still did not meet surface water quality standards.

Zebra Mussels

LCRA is continuing to monitor the reproduction and spread of zebra mussels in the Highland Lakes, as well as partnering with Texas Parks and Wildlife Department to share the Clean, Drain, Dry message to help prevent their further spread. Report zebra mussels at https://www.texasinvasives.org/action/report_detail.php.

Inks Lake

Segment 1415 – Llano River (including the north and south forks)

The Llano River begins in Junction, where the North Llano and South Llano rivers converge. With an average annual flow of 40 cubic feet per second, the North Llano River remains perennial, but flow is sluggish during most summers. Flows in the South Llano River have historically been about double those in the North Llano River because of large springs west of Junction.

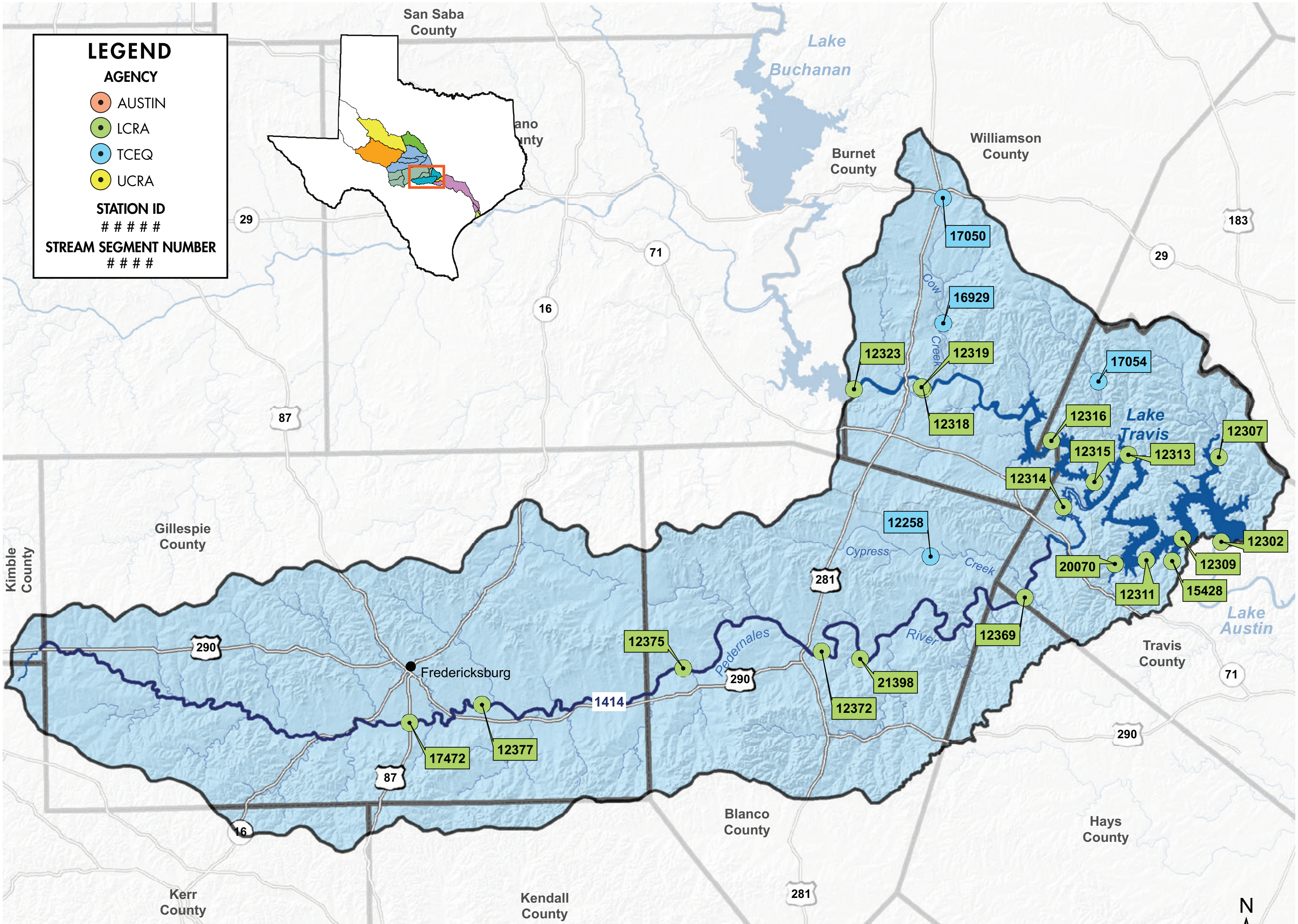
Below Junction, the Llano River flows through the Llano Uplift, an area that contains granite and limestone outcrops that produce clear flowing streams. The Llano River met all applicable surface water quality standards according to the 2018 Integrated Report.

Upper Llano River Watershed Protection Plan

In 2011, the Texas Tech University Llano River Field Station received a Clean Water Act 319(h) grant from the state Soil and Water Conservation Board to develop a WPP for North Llano and South Llano rivers. The Texas Tech field station, Texas Water Resources Institute and the Llano Watershed Alliance (formerly the South Llano Watershed Alliance) developed a plan to identify desired watershed conditions and prioritize management practices to protect the watershed. Chemical and biological monitoring was performed on 14 main stem sites and six spring sites. The monitoring was completed in 2013, and the plan was finalized and approved by the EPA in 2016. For more information on the Llano River WPP, visit https://www.llanoriver.org/watershed-protection-plan.

Llano River under Llano City Bridge

Llano River



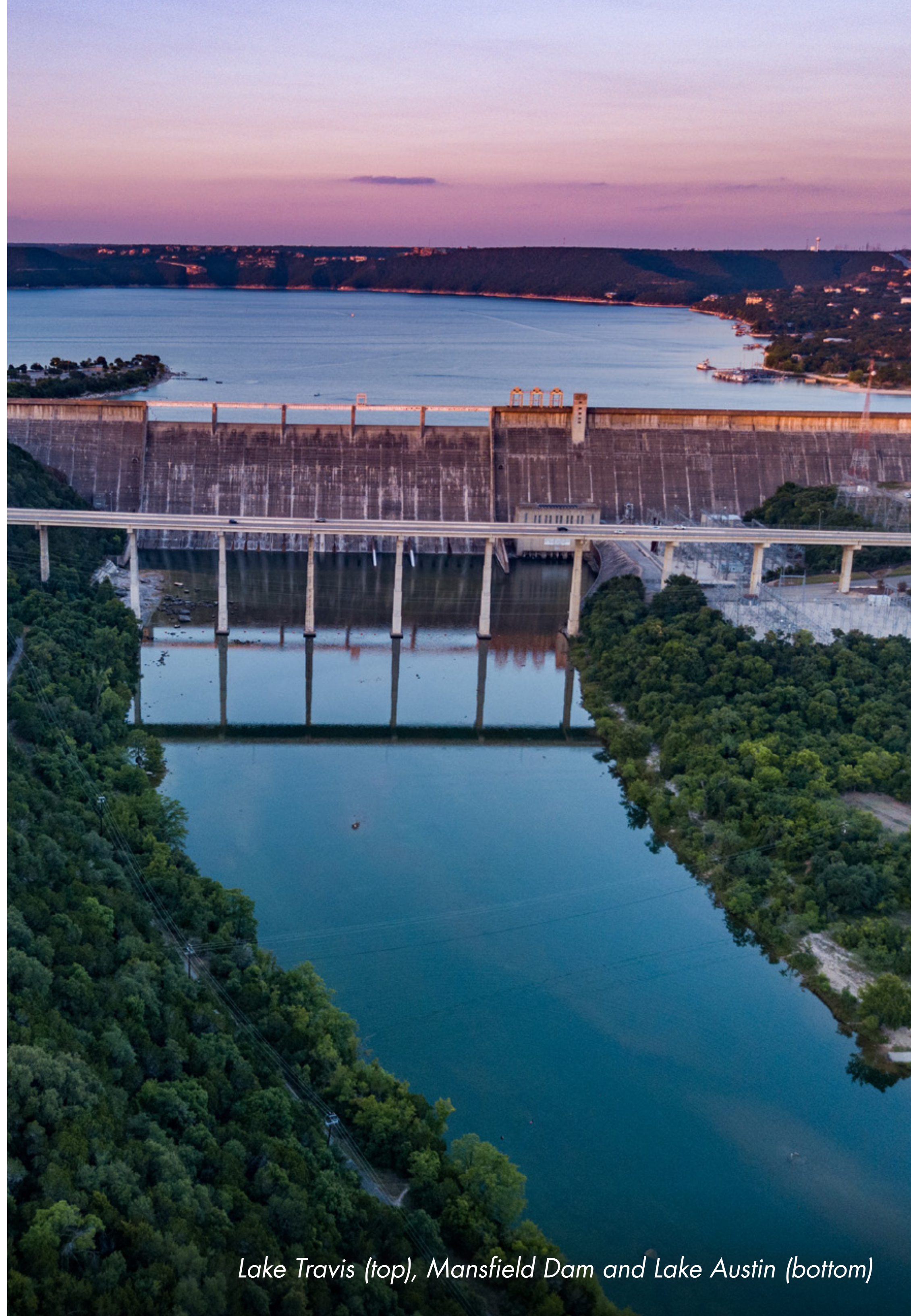
LAKE TRAVIS WATERSHED MONITORING LOCATIONS

Lake Travis Watershed

The Lake Travis watershed in the Texas Hill Country includes the Pedernales River and lakes Travis and Marble Falls. It is approximately 1,830 square miles. The watershed lies within the Edwards Plateau, a region distinguished by rocky terrain and clear perennial streams. Growth and development have dramatically changed the landscape in the region during the last 20 years. Water quality remains good and there are no impairments.

In 2019, LCRA and TCEQ routinely monitored 18 sites on the following segments:

Segment 1404	Lake Travis
Segment 1405	Lake Marble Falls
Segment 1414	Pedernales River
Segment 1414B	Cypress Creek



Lake Travis (top), Mansfield Dam and Lake Austin (bottom)

Segment 1404 – Lake Travis

Mansfield Dam impounds Lake Travis on the Colorado and Pedernales rivers in western Travis County. The reservoir, which is about 18,929 surface acres, was originally designed to contain floodwaters. Historically, it is one of the clearest reservoirs in the state and is a popular recreation destination. In 2017, zebra mussels were first introduced into the Colorado River basin in the lower part of Lake Travis. Since then, zebra mussels have spread downstream into Lake Austin, Lady Bird Lake and the Colorado River below Austin. They can also be found upstream in Lake LBJ and Lake Marble Falls. Lake Travis meets all applicable surface water quality standards. Ongoing LCRA initiatives to protect the lake include the Highland Lakes Watershed and OSSF ordinances and the Colorado River Environmental Models.

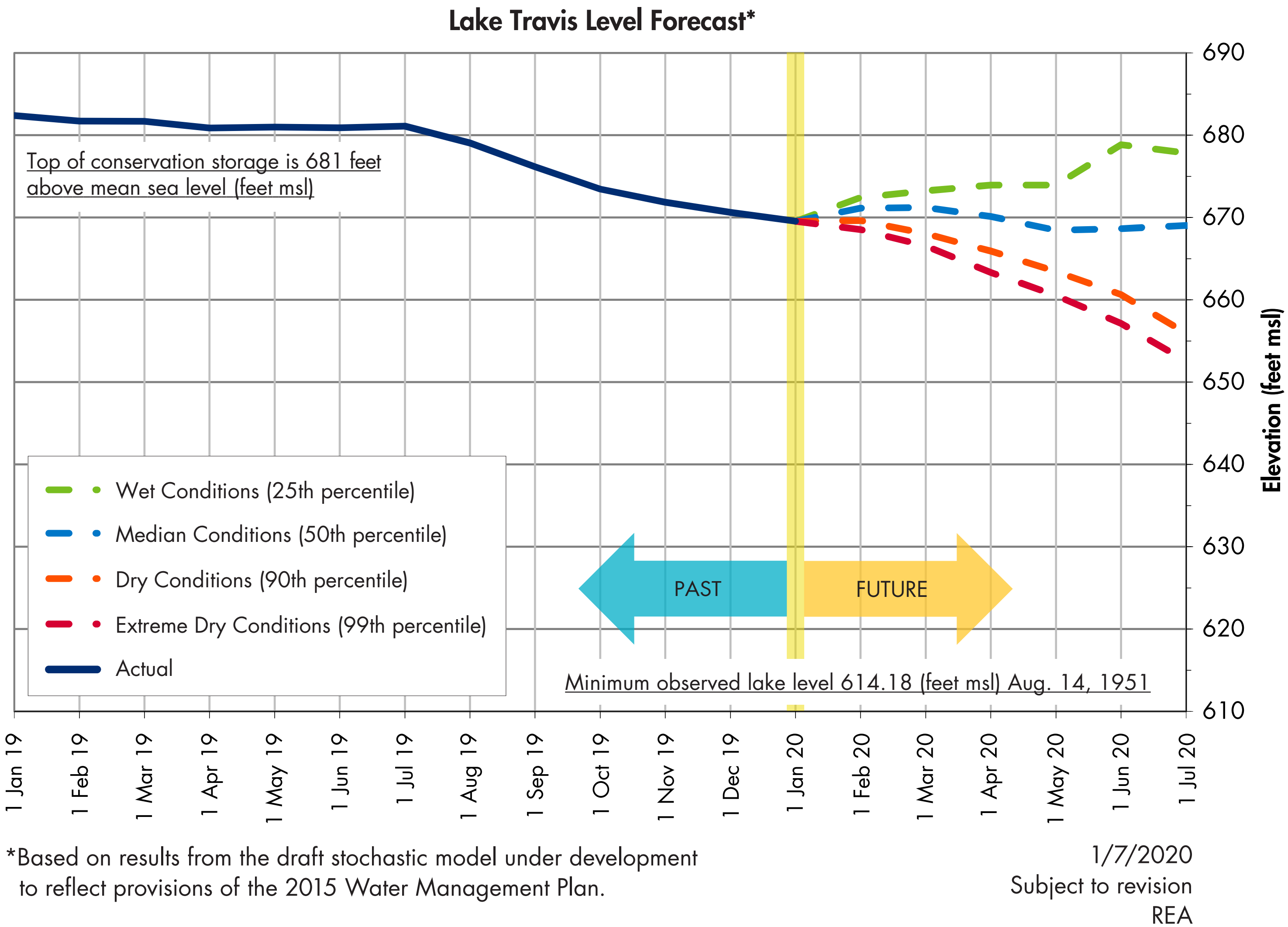


Figure 6. Lake level projections for Lake Travis during the first half of 2020

Colorado River Environmental Models

The Highland Lakes provide water storage, recreational opportunities and a livelihood for many Central Texans. Recognizing their importance to the region, LCRA began developing models to evaluate water quality issues, discern trends and predict the impacts of various decisions, actions and future scenarios on the Highland Lakes. The first model was completed on Lake Travis in 2009 followed by lakes Inks, Marble Falls and LBJ in 2011. The Lake Buchanan model was completed in 2013.

The environmental models have been used to demonstrate the impact of different discharge scenarios and help establish wastewater permit limits in the Highland Lakes watersheds. LCRA worked with the cities of Burnet and Fredericksburg during their TCEQ wastewater permit amendment to develop protective measures based on model output. LCRA will continue to develop the models as lake conditions change and to work with Highland Lakes communities to develop reasonable treatment options that protect water quality. For more information on Colorado River Environmental Models visit http://www.lcra.org/water/quality/water-quality-permit-review-program/Pages/water-quality-models.aspx.

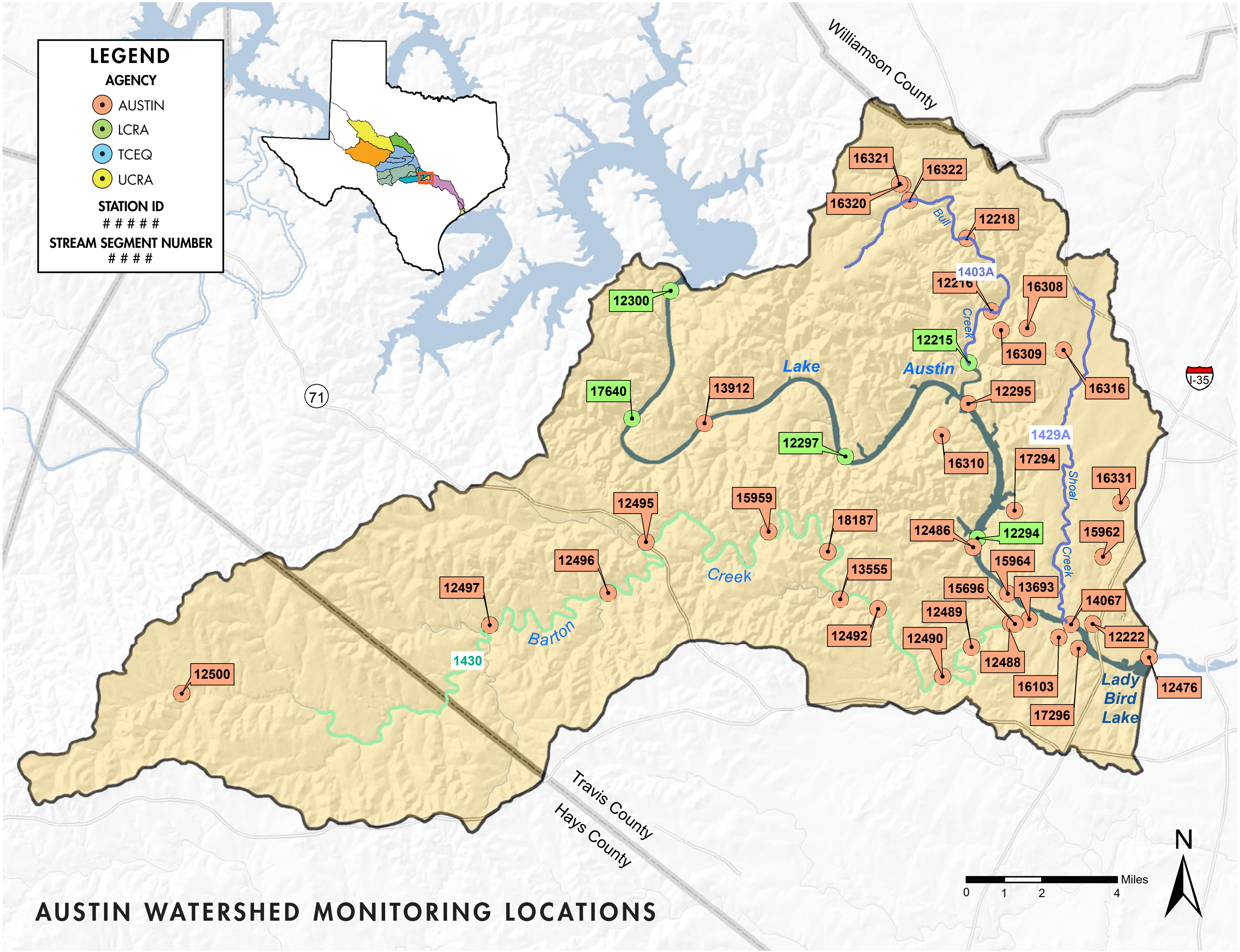
Segment 1405 – Lake Marble Falls

Max Starcke Dam forms Lake Marble Falls on the Colorado River near the City of Marble Falls. With a surface area of 545 acres, it is the smallest reservoir in the chain of Highland Lakes. All surface water quality standards for the lake were attained based on the 2018 Integrated Report.

Segment 1414 – Pedernales River

The headwaters of the Pedernales River are located near Harper in Gillespie County. The river flows 125 miles through Fredericksburg, Stonewall and Johnson City before reaching Lake Travis. Monitoring data collected in 2019 show that the river meets all applicable TSWQS.

Lake Marble Falls and Starcke Dam



AUSTIN WATERSHED MONITORING LOCATIONS

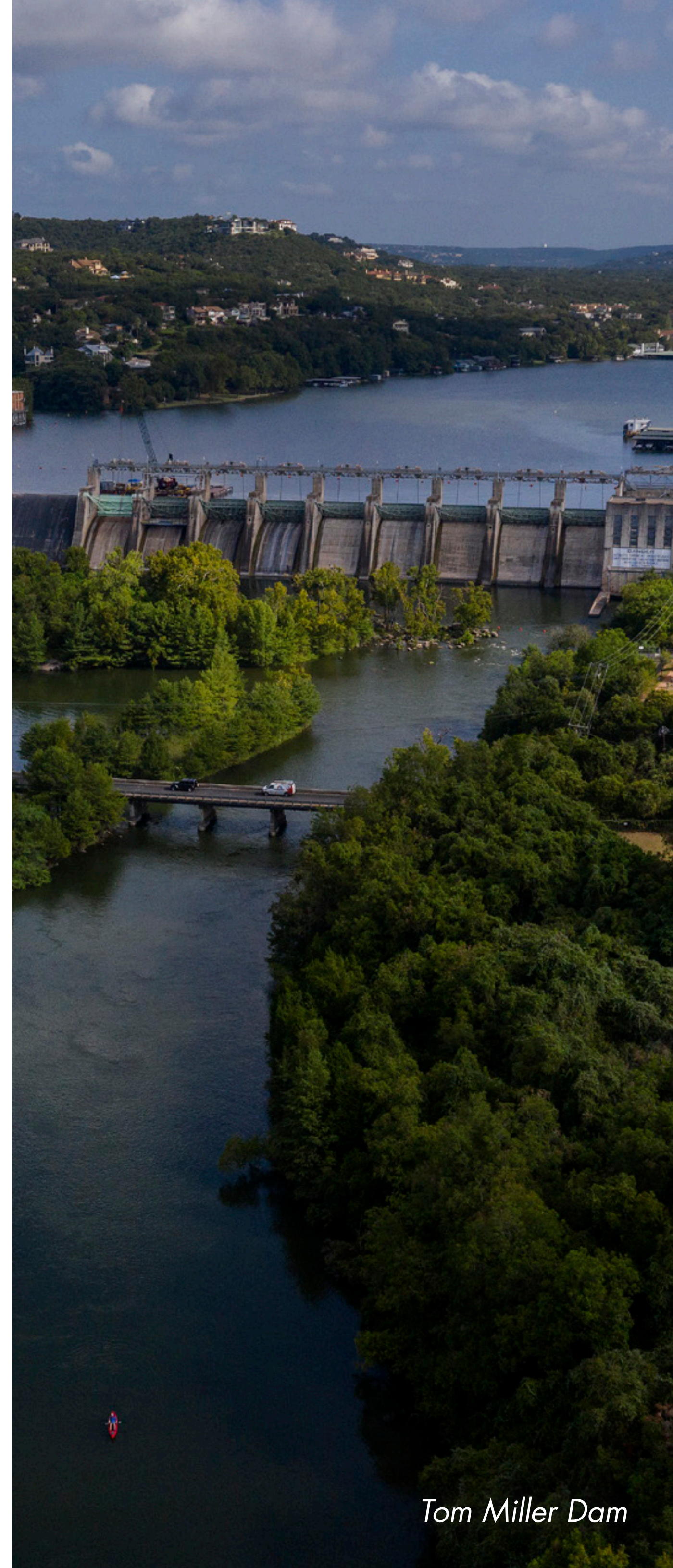
Austin Watershed

The Austin metropolitan watershed encompasses about 700 square miles on the eastern edge of the Edwards Plateau. Austin's population is estimated at close to a million people, making it the most urbanized watershed in the basin. Lake Austin and Lady Bird Lake are narrow and shallow in comparison to the Highland Lakes. They resemble large rivers that cut through Austin and create a natural boundary that bisects and defines the city. The Edwards Aquifer surfaces intermittently in the watershed to form springs, clear streams and groundwater recharge features. Some urban creeks have elevated bacteria levels, especially after rainfall events. In 2019, the City of Austin, TCEQ and LCRA monitored 42 sites on the following water bodies:

Segment 1403 Lake Austin
Segment 1403A Bull Creek
Segment 1427 Onion Creek
Segment 1427A Slaughter Creek
Segment 1427C Bear Creek
Segment 1428 Colorado River below Austin
Segment 1428B Walnut Creek
Segment 1428C Gilleland Creek
Segment 1428K Walter Long Lake
Segment 1429 Lady Bird Lake
Segment 1429A Shoal Creek
Segment 1430 Barton Creek

Segment ID	Water Body	Impairment
1403A	Bull Creek	Dissolved oxygen
1403J	Spicewood Tributary to Shoal Creek	Bacteria
1403K	Taylor Slough South	Bacteria
1427A	Slaughter Creek	Biology
1428B	Walnut Creek	Bacteria
1429C	Waller Creek	Bacteria, Biology

Table 4. Impairments in the Austin Watershed


Tom Miller Dam

Segment 1403 – Lake Austin

Tom Miller Dam impounds the Colorado River to form Lake Austin. It's a narrow and shallow lake that, by size and fluvial properties, is more akin to a river than the upstream Highland Lakes. Water moves through the lake relatively quickly, retained only a few hours in the 20 miles between Mansfield Dam at Lake Travis and Tom Miller Dam. Land around the lake is developed and has little natural riparian corridor. The lake, which is approximately 1,830 surface acres, is used extensively for recreation.

Historical data indicate frequent low dissolved oxygen concentrations near the headwaters at Mansfield Dam. The low dissolved oxygen levels are caused by releases of oxygen-depleted water from deep in Lake Travis. In an effort to increase dissolved oxygen, LCRA installed an aerator in Mansfield Dam to oxygenate the water before release into the upper end of Lake Austin. Verification sampling began in 2013 and showed improvements in dissolved oxygen levels during the most recent assessment period. As a result, the dissolved oxygen impairment has been removed.

Bacteria TMDL for four Austin Creeks

In 2012, TCEQ initiated a bacteria TMDL for Spicewood Tributary of Shoal Creek, Taylor Slough, Waller Creek and Walnut Creek (in the lower Colorado River watershed). TCEQ contracted with the University of Texas Center for Public Policy Dispute Resolution to facilitate public input and develop a TMDL implementation plan. The City of Austin Watershed Protection Department and other stakeholders developed an implementation plan to reduce bacteria in the creeks. Strategies include riparian zone restoration, wastewater infrastructure maintenance, domestic pet waste education, resident outreach and stormwater treatment. The Implementation Plan is available at https://www.tceq.texas.gov/waterquality/tmdl/101-austinbacteria. TCEQ approved the I Plan in 2015, and it continues to be implemented by the City of Austin and stakeholders.

360 Overlook Bridge on Lake Austin

Segment 1403A – Bull Creek

Bull Creek is a perennial, spring-fed tributary of Lake Austin. About 40% of the watershed is developed. The remaining 60% is owned by the City of Austin and is maintained as a preserve protected from further development. Monitoring data show that the upper portion of the stream frequently exhibits low dissolved oxygen levels. It was placed on the 303(d) List in 2010. Water in the upper end of the creek is strongly influenced by groundwater that typically contains low dissolved oxygen. Benthic macroinvertebrate data collected by the City of Austin indicate that Bull Creek maintains high aquatic life use. The City of Austin now monitors dissolved oxygen at a site near the original sampling location that is not directly near a spring. Monitoring will continue in 2020.

Segment 1427 – Onion Creek

The headwaters of Onion Creek are located in Blanco County. The creek flows intermittently about 78 miles to the east to its confluence with the Colorado River in Travis County. The stream interacts with groundwater as it flows over and into limestone fissures in the Edwards Aquifer recharge zone southwest of Austin. High sulfate levels in the upper part of the watershed resulted in the creek not supporting general uses in 2014. Monitoring continues in 2020.

Bull Creek

Onion Creek

Segment 1403J – Spicewood Tributary to Shoal Creek

This small tributary to Shoal Creek, known as Spicewood Springs Tributary, is in the upper portion of the Shoal Creek watershed on the north side of Lady Bird Lake in Austin. It begins near the west side of Loop 1 (MoPac Expressway) in north Austin, where Spicewood Springs discharges. The creek is in an established residential area where wastewater lines traverse the stream's banks. The shallow, spring-fed stream is only about a half mile long, but it is important habitat for a small population of threatened Jollyville Plateau salamanders (*Eurycea nana*).

Water quality data collected near the springs indicate elevated levels of bacteria. TCEQ placed it on the 303(d) List in 2002. At the request of the city, TCEQ initiated a TMDL for bacteria late in 2012. TMDL implementation began in 2013 and continues today. The creek is now in Category 4a, because it contains an approved TMDL and I Plan.

Segment 1403K – Taylor Slough

The Taylor Slough watershed is located on the north side of Lake Austin upstream from Tom Miller Dam. It is in a dense urban landscape composed mostly of single-family residences. Sewer lines cross the creek at several locations in the watershed. Water quality data collected from Reed Park in the downstream portion of the stream indicate elevated levels of bacteria. TCEQ placed it on the 303(d) List in 2002. TCEQ initiated a TMDL for bacteria in 2012. TMDL implementation began in 2013 and continues today. The creek is now in Category 4a, because it contains an approved TMDL and I Plan.

Shoal Creek

Taylor Slough in Reed Park

Segment 1427A – Slaughter Creek

Located in southern Travis County, the Slaughter Creek watershed is approximately 31 square miles and largely urban. The lower watershed consists primarily of densely clustered residential housing. From the headwaters near U.S. 290, the stream flows to the east about 17 miles to the confluence with Onion Creek. A six-mile section of the creek near MoPac Expressway lies over the Edwards Aquifer recharge zone and this mid-reach portion of the creek does not maintain baseflow under normal conditions. The creek was placed on the 2002 303(d) List for not meeting a high aquatic life use based on biological samples.

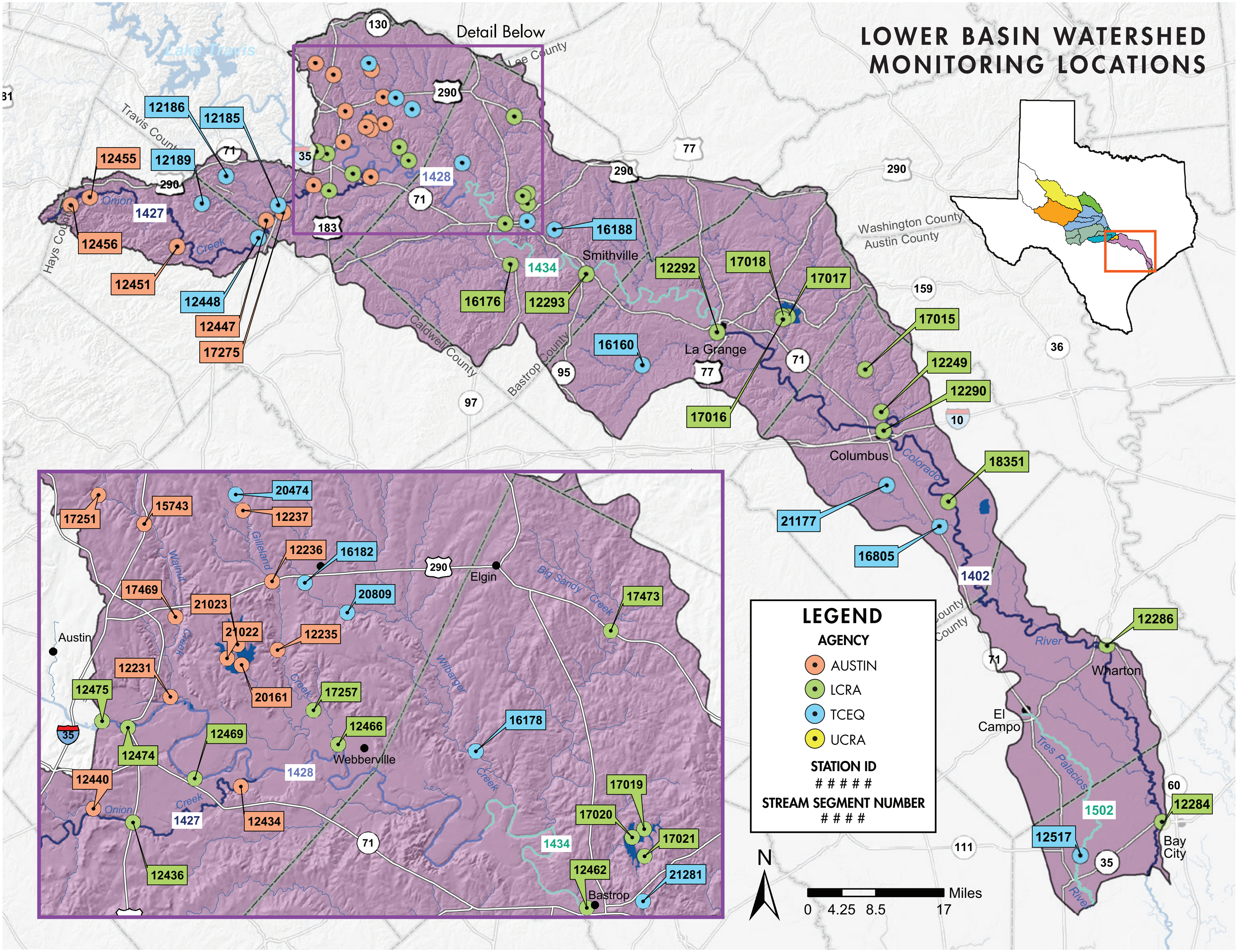
In 2016, the TCEQ proposed new Aquatic Life Use (ALU) standards for the upper portion of the stream, designating it as an intermediate ALU. Monitoring will continue in 2020.

Segment 1429C – Waller Creek

The Waller Creek watershed is on the north side of Lady Bird Lake in downtown Austin. The headwaters begin in north Austin and the stream flows about five miles to its confluence with Lady Bird Lake. Waller Creek is heavily urbanized. Monitoring data collected from several sites on the creek showed elevated levels of bacteria and in 2002, it was placed on the 303(d) List. Potential sources of bacteria include pet and human waste, leaking wastewater infrastructure and urban runoff. Waller Creek subsequently was listed as impaired for macrobenthics.

Construction of the Waller Creek Tunnel, a major channelization project, began in 2011 and filled with water for the first time in 2015. The project has altered the original flow and habitat in the creek, while also reducing flooding in the watershed. The tunnel is used to circulate water from Lady Bird Lake through Waller Creek during non-storm conditions. The tunnel project, in combination with significant redevelopment, will dramatically alter lower Waller Creek in the future. TCEQ initiated a TMDL for bacteria in the upstream portions of the watershed in 2012. TMDL implementation began in 2013. Water quality monitoring is ongoing.

Waller Creek at Waterloo Park


LOWER BASIN WATERSHED MONITORING LOCATIONS
Detail Below
LEGEND
AGENCY
AUSTIN
LCRA
TCEQ
UCRA
STATION ID
# # # # #
STREAM SEGMENT NUMBER
# # # #
Miles
0 4.25 8.5 17
N
Smithville
La Grange
Columbus
Wharton
El Campo
Bay City
Austin
Elgin
Webberville
Bastrop
Lee County
Travis County
Hays County
Caldwell County
Bastrop County
Washington County
Austin County
Colorado River
Onion Creek
Tres Palacios River
Big Sandy Creek
Wilbarger Creek
Gilleland Creek
Walnut Creek
1427
1428
1434
1402
1502
12186
12185
12189
12455
12456
12451
12448
12447
17275
16188
16176
12293
12292
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15743
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12231
12475
20161
17257
12466
12474
12469
12440
12434
12436
17473
16178
17019
17020
17021
12462
21281

Lower Colorado River Watershed

The lower Colorado River watershed below Austin encompasses an area of about 2,195 square miles. Water typically flows more slowly here than in the river above Austin because of the relatively flat terrain. LCRA releases water from the Highland Lakes according to the LCRA Water Management Plan. The releases, which routinely take place in the spring and summer, help flush the river and dilute nutrient loading from wastewater treatment plant effluent downstream of Austin.

In 2019, LCRA, TCEQ and the City of Austin monitored 19 sites on the following water bodies:

Segment 1402	Colorado River below La Grange
Segment 1428	Colorado River below Austin
Segment 1428B	Walnut Creek
Segment 1428C	Gilleland Creek
Segment 1428K	Walter E. Long Lake
Segment 1434	Colorado River between Utley and La Grange
Segment 1434C	Lake Bastrop
Segment 1434D	Wilbarger Creek
Segment 1434	Bastrop State Park Lake


Colorado River in Bastrop

Segment 1428

Walnut Creek

Segment 1428 – Colorado River below Austin

The Colorado River below Lady Bird Lake begins at Longhorn Dam and ends 41 miles downstream near the river's intersection with FM 969 northwest of Bastrop. The upper end of the segment is urban. Over 110 million gallons of treated wastewater effluent flow into the segment each day. The segment meets surface water quality standards according to the 2018 Integrated Report.

Segment 1428B – Walnut Creek

Walnut Creek is a tributary of the Colorado River below Longhorn Dam. Data collected from several sites in the creek indicate elevated levels of bacteria, and as a result, the stream was placed on the 303(d) List in 2002. Potential sources of bacteria include urban runoff and leaking wastewater lines. The City of Austin Watershed Protection Department conducted verification monitoring in 2010 and mapped on-site sewage facilities in an effort to isolate potential sources. A TMDL project began on Walnut Creek and three other Austin creeks in 2012. An I Plan was developed and implementation and monitoring continue in 2020.

Segment 1428C – Gilleland Creek

Gilleland Creek, a tributary of the Colorado River downstream of Austin, was placed on the 303(d) List in 1999 due to elevated bacteria levels. Flow in the creek is predominantly from treated wastewater. LCRA developed the Gilleland Creek TMDL through a contract with TCEQ. It was adopted by TCEQ Commissioners in 2007 and approved by EPA in 2009. The TMDL Implementation Plan – including waste load allocations, stormwater prevention and education – was approved by TCEQ Commissioners in 2011. Monitoring indicates bacteria levels are lower at some sites, but remain above surface water quality standards. Implementation and verification monitoring is ongoing. For more information about the Gilleland Creek TMDL, visit http://www.tceq.texas.gov/waterquality/tmdl/nav/69-gillelandcreekbacteria.

Segments 1434 and 1402 – Colorado River from Utley to Bay City

These two segments of the Colorado River begin at FM 969 near Bastrop and end downstream near Bay City. The water in this section of the river is usually turbid due to sandy loam and clay soils of the region. Based on the 2018 Integrated Report, all surface water quality standards for the segment are met.

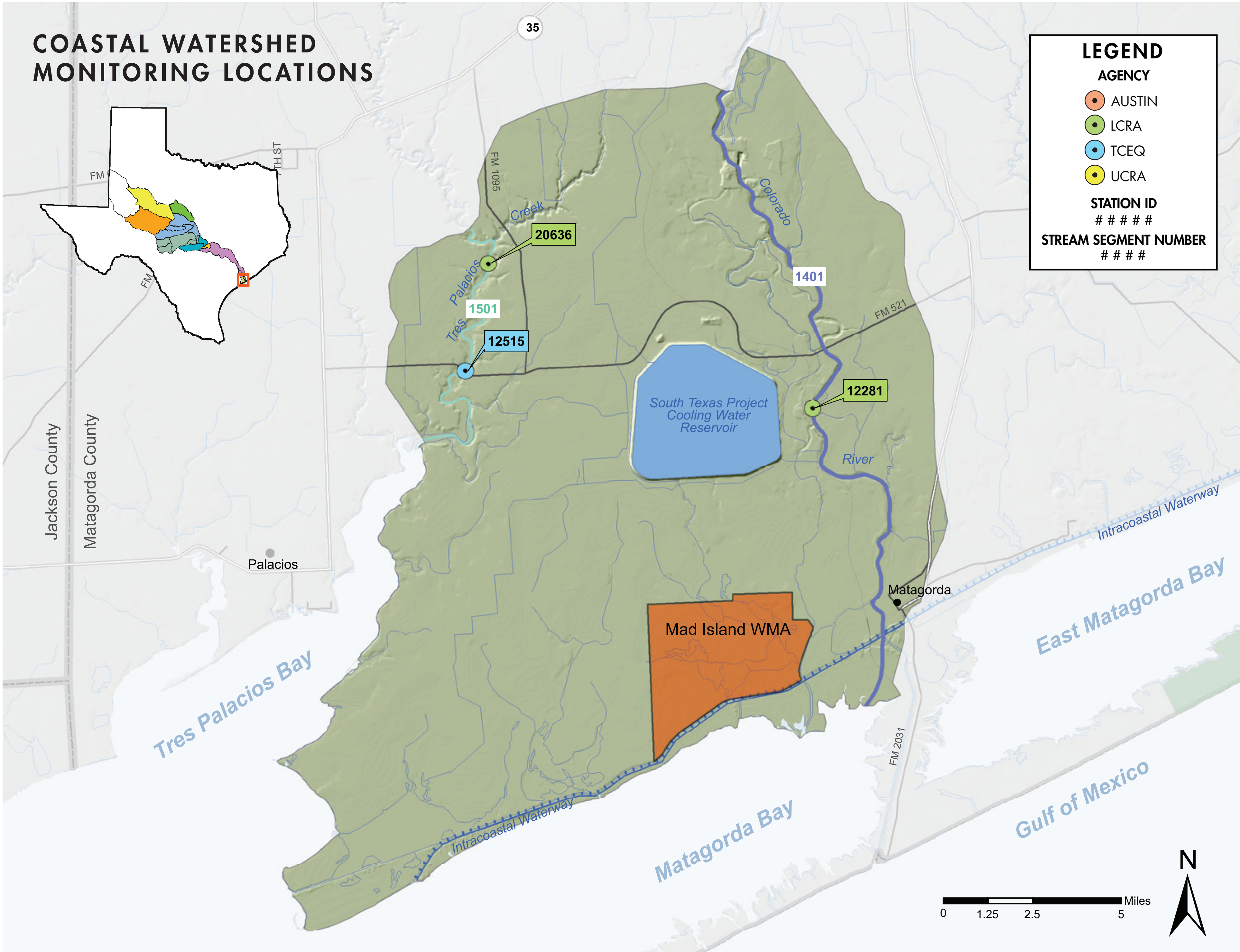
Segment 1402C – Buckners Creek

Located on the south side of the Colorado River near La Grange, the Buckners Creek watershed is about 176 square miles. The stream's headwaters are near the community of Rosanky in Bastrop County. It ends 26 miles downstream at its confluence with the Colorado River. The Buckners Creek watershed is rural. Monitoring data indicated impairment for low levels of dissolved oxygen, and TCEQ placed it on the 2010 303(d) List. Potential causes of low dissolved oxygen include decomposition of organic matter coupled with slow flows and inadequate mixing. LCRA completed a UAA for Buckners Creek in 2019, which is currently being reviewed by TCEQ.


Gilleland Creek


Buckners Creek

COASTAL WATERSHED MONITORING LOCATIONS



Coastal Watershed

The coastal watershed of the Colorado River basin begins downstream of Columbus in Colorado County. From Columbus, the Colorado River flows to the east through Wharton and Bay City before entering Matagorda Bay where brackish waters create a productive spawning ground for estuarine species.

In 2019, LCRA and TCEQ routinely monitored nine sites in the following segments:

Segment 1401	Tidally influenced portion of the Colorado River
Segment 1402H	Skull Creek
Segment 1501	Tidally influenced portion of the Tres Palacios River
Segment 1502	Tres Palacios River downstream of El Campo

Segment ID	Water Body	Impairment
1402H	Skull Creek	Dissolved oxygen
1501	Tres Palacios River (tidal)	Bacteria

Table 5. Impairments for the Colorado Coastal Watershed

Colorado River at Bay City Dam

Segment 1401 – Colorado River (tidal)

The tidal portion of the Colorado River begins downstream of Bay City and ends where it flows into Matagorda Bay. Monitoring data collected about 12 miles upstream of the Intracoastal Waterway indicate elevated levels of bacteria. TCEQ placed the segment on the 303(d) List in 2006. Prior to 2006, fecal coliform was the primary bacterial indicator in tidal water bodies. In 2006, TCEQ began to use *Enterococcus* to measure attainment of contact recreation in the surface water quality standards. The result was an increase in bacteria listings along the Texas Coast, including segments 1401 and 1501. In the 2014 Integrated Report, Segment 1401 was removed from the 303(d) List because data used in the assessment showed that the segment met the standard for contact recreation.

Segment 1402 (Colorado River below La Grange)

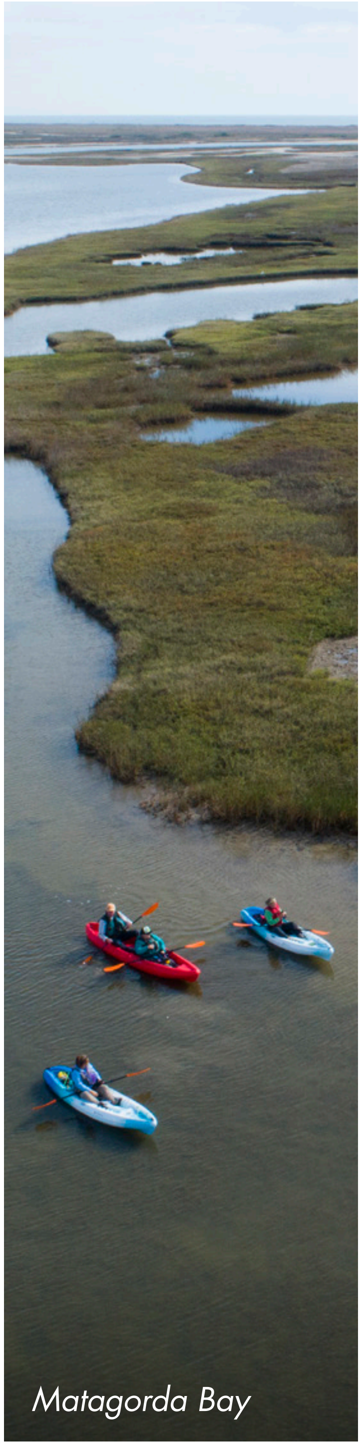
Segment 1402 of the Colorado River begins in La Grange and ends 150 miles downstream near Bay City. The segment traverses two watersheds; the lower Colorado River watershed and the coastal watershed. The upper portion of the segment is discussed above in the Lower Colorado River watershed section.

Segment 1401 of the Colorado River

Matagorda Bay

Matagorda Bay depends on freshwater from the Colorado River to help maintain a productive environment. LCRA is required by the state-approved water management plan to ensure a certain amount of freshwater flows to the bay. The requirements are based on the amount of water flowing into the Highland Lakes and the amount of water flowing into Matagorda Bay. Flow requirements are lower during drought, but critical flows must be maintained to provide a low salinity area near the mouth of the Colorado River for oysters and other important estuarine species.

Wetland Preserve at Matagorda Bay


Matagorda Bay

Segment 1402H – Skull Creek

The Skull Creek watershed is located downstream of Columbus on the south side of the Colorado River. It is approximately 112 square miles. Much of the riparian area in the upper watershed has been cleared and is used for grazing pastures. Several gravel operations are located in the lower part of the watershed.

Skull Creek was first placed on the 303(d) List in 2008 for not supporting its designated aquatic life use at the monitoring site located near the confluence with the Colorado River. Potential causes of the impairment in the data record include decomposition of organic matter and sluggish flow regimes. In 2012, TCEQ completed an aquatic life monitoring project that concluded that, during the time of data collection, the creek supported a diverse aquatic community despite chronic low dissolved oxygen levels. As a result of the aquatic life monitoring, the TCEQ assigned new site-specific standards for dissolved oxygen in the creek. In early 2019, pollutants from a nearby oil and gas waste recycling facility entered Skull Creek, causing the creek to turn black. Investigation by several agencies, water quality monitoring coordination, and legal action continued throughout 2019.

Segment 1501 – Tres Palacios River (tidal)

Segment 1501 is the tidally influenced portion of the Tres Palacios River. It begins below State Highway 35 and ends approximately eight miles downstream where the river flows into Tres Palacios Bay. Monitoring data collected near the confluence of Tres Palacios Bay indicate impairment for bacteria and dissolved oxygen. In an effort to determine if the bacteria was coming from a local source(s), LCRA added a monitoring site upstream of the historical site in 2010. Two years of monitoring showed high bacteria levels were common at both sites, but did not help determine causes.

Potential sources include failing septic systems in a nearby subdivision, stormwater runoff, livestock, wildlife or the application of *Enterococcus* as an indicator organism as discussed in Segment 1401. Dissolved oxygen levels are likely a function of tidal influence (salt water does not retain dissolved oxygen as well as fresh water) and sluggish flows. The Texas Water Resources Institute completed a WPP for Tres Palacios River, which was accepted by the EPA in 2018. For more information visit http://matagordabasin.tamu.edu/tres-palacios/.

Segment 1502 – Tres Palacios River

The headwaters of the Tres Palacios River are located near El Campo. The upper end of Segment 1502 is narrow with steep banks, more reminiscent of a small creek than a river. A narrow riparian area is maintained as the stream winds through cultivated farmland. The segment meets all applicable surface water quality standards.

VIII. PUBLIC PARTICIPATION

Public participation is a cornerstone of the Clean Rivers Program. Since the early 1990s, LCRA and its Clean Rivers Program partners have held annual steering committee meetings in the basin. These meetings provided a venue for local stakeholders to learn about water in their region and provide input on projects in their communities.

LCRA, UCRA and TCEQ now refer to these annual stakeholder meetings in the Colorado River basin as Water Quality Advisory Committees. The meetings are open to the public and are held three times per year at different locations. Each year there are meetings held in San Angelo for upper basin stakeholders and Austin for middle and lower basin stakeholders. In even years, meetings are also held in the lower part of the basin in or near Columbus. In odd years, meetings are hosted in the Hill Country part of the basin. If you or someone you know is interested in getting involved with an advisory committee, we welcome land owners, recreationists, civic leaders and the regulated community. Contact information and minutes from past meetings can be found at http://lcra.org/water/quality/texas-clean-rivers-program.

LCRA Water Quality Advisory Committee 2019 meeting in Austin

Help protect water quality in the lower Colorado River!

The Clean Rivers Program depends on stakeholders like you to identify water quality issues that may otherwise be overlooked. Join the effort to protect water quality by participating in the Clean Rivers Program Water Quality Advisory Committee. Your participation will enable us to have a more comprehensive understanding of the waterways in your area, and will give you a chance to help characterize and improve water quality.

Member Opportunities:

- Attend one committee meeting per year
- Provide occasional feedback via email
- Identify and prioritize water quality issues
- Provide input on the LCRA Clean Rivers Program work plan
- Review water quality reports
- Learn about and share your knowledge about water quality within your community

Email lisa.benton@lcra.org to join an advisory committee or request information about the committee in your region.

IX. APPENDIX

Texas Surface Water Quality: What Is It, and How Is It Measured?

In order to protect water quality, we must define and measure it. The state of Texas has established standards that protect the purposes for which the streams, lakes, and estuaries in the state will be used, and defined measurements that determine whether the water quality is good enough to attain those uses. Based on the standards, the Texas Commission on Environmental Quality (TCEQ), in concert with other federal, regional, and local organizations, carries out a regular program of monitoring and assessment to determine which water bodies are meeting the standards set for their use, and which are not. The state produces a periodic report, the Texas Water Quality Integrated Report for Clean Water Act Sections 305(b) and 303(d), which compares water quality conditions to established standards, as required by the federal Clean Water Act (CWA).

Texas Surface Water Quality Standards

- designate the uses, or purposes, for which the state's waterways should be suitable;
- establish numerical and narrative criteria for water quality throughout the state;
- provide a basis on which TCEQ regulatory programs can establish reasonable methods to implement and attain the state's goals (criteria) for water quality.

Water quality criteria are designed to be protective of uses. Substantial deviations from criteria indicate that related uses might be impaired. For example, the concentration of dissolved oxygen is one criterion for determining the attainment of the aquatic life use. Where oxygen concentrations are low, the use of the water body to support aquatic life might be impaired. However, since other factors affect the health of an aquatic environment, additional data, such as the presence of a high number and variety of species, may show that the use is fully attained, even if oxygen concentrations are lower than the criterion. Four major categories for water use are defined in the Texas Surface Water Quality Standards:

- aquatic life use
- contact recreation (swimming)
- public water supply
- fish and shellfish (oyster) consumption

A variety of other general uses are also considered, such as navigation, water supply for agriculture and industry, seagrass propagation, and wetland functions.

Aquatic Life Use

The standards associated with this use are designed to protect aquatic species, and to protect the propagation of both aquatic and terrestrial species. They establish optimal conditions for the support of aquatic life and define indicators used to measure whether these conditions are met. Some pollutants or conditions that may violate this standard include low levels of dissolved oxygen, or high concentrations of toxics such as metals or pesticides dissolved in water.

Contact Recreation

The standard associated with this use measures the level of certain bacteria in water that indicate the relative risk of swimming or other water sports involving direct contact with the water. It is possible to swim in water that does not meet this standard without becoming ill; however, the probability of becoming ill is higher than it would be if bacteria levels were lower.

Public Water Supply

Standards associated with this use indicate whether water from a lake or river is suitable for use as a source for a public water supply system. Source water is treated before it is delivered to the tap. A separate set of standards governs treated drinking water. Indicators used to measure the safety or usability of surface water bodies as a source for drinking water include the presence or absence of substances such as metals or pesticides. Concentrations of salts, such as sulfate or chloride, are also measured, since treatment to remove high levels of salts from drinking water may be expensive.

Fish Consumption

The standards associated with this use are designed to protect the public from consuming fish or shellfish that may be contaminated by pollutants in the water. The standards identify levels at which there is a significant risk that certain toxic substances dissolved in water may accumulate in the tissue of aquatic species.

Because toxic substances in water may exceed these levels while no accumulation in fish tissue is observable, the state conducts tests on fish and shellfish tissue to determine if there is a risk to the public from consuming fish caught in state waters. The standards also specify bacterial levels in marine waters to assure that oysters or other shellfish subject to commercial harvest and marketing are safe for public sale and consumption.

Indicators of water quality that are not tied to specific uses—such as dissolved solids, nutrients, and toxic substances in sediment—are also described in the standards. Indicators of water quality are discussed in more detail later in this document. A complete copy of the Texas Surface Water Quality Standards is available from the TCEQ Publications Library at 512-239-0028, or on the TCEQ website at www.tceq.texas.gov/permitting/water_quality/wq_assessment/standards/.

Texas Water Quality Integrated Report

The Texas Water Quality Integrated Report for Clean Water Act Sections 305(b) and 303(d) is an overview of the status of surface waters of the state, including concerns for public health, fitness for use by aquatic species and other wildlife, and specific pollutants and their possible sources. More than 700 water bodies are assessed in Texas. The 303(d) List, a subset of the report, identifies:

- water bodies that do not attain one or more of the standards set for their use, or are expected not to meet one or more uses in the near future;
- which pollutants or conditions are responsible for the failure of a water body to attain standards;

Common limitations in water quality include:

- bacteria levels that exceed the criterion established to assure the safety of contact recreation
- dissolved oxygen levels that are lower than the criterion established to assure optimum conditions for aquatic life
- total dissolved solids, sulfate, and chloride that exceed the criteria established to safeguard general water quality uses
- contaminants in fish tissue that pose a risk to consumers

Some water bodies also have:

- toxic substances in water that exceed the criterion to protect aquatic life
- conditions of acidity (measured as pH) and high temperature that exceed the criteria to safeguard general water quality uses

The Integrated Report is available on the TCEQ website at www.tceq.texas.gov/compliance/monitoring/water/quality/data/wqm/305_303.html.

Indicators of Water Quality

Several different parameters are measured to determine whether a water body meets the standards for its use. Some of the most common are listed here, with an explanation of why they are important to the health of a water body.

Bacteria

E. coli and *Enterococci* bacteria are measured to determine the relative risk of swimming (contact recreation), depending on whether the water body is fresh or marine. These bacteria originate from the wastes of warm-blooded animals. The presence of these bacteria indicates that associated pathogens from these wastes may be reaching a body of water. Sources may include inadequately treated sewage, improperly managed animal waste from livestock, pets in urban areas,aquatic birds and mammals, or failing septic systems.

Dissolved Oxygen

The concentration of dissolved oxygen is a single, easy-to-measure characteristic of water that correlates with the occurrence and diversity of aquatic life in a water body. A water body that can support diverse, abundant aquatic life is a good indication of high water quality. A problem frequently related to dissolved oxygen concentrations is an excess of nutrients in water. Large quantities of nutrients in water can cause excessive growth of vegetation. This excessive vegetation, in turn, can cause low dissolved oxygen.

Dissolved Solids

High levels of dissolved solids such as chloride and sulfate can cause water to be unusable, or simply too costly to treat for drinking water uses. Changes in dissolved solids concentrations also affect the quality of habitat for aquatic life.

Metals

High concentrations of metals such as cadmium, mercury, and lead pose a threat to drinking water supplies and human health. Eating fish contaminated with metals can cause these toxic substances to accumulate in human tissue, posing a long-term, but significant health threat. Metals also pose a threat to livestock and aquatic life. Potentially dangerous levels of metals and other toxic substances are identified through chemical analysis of water, sediment, and fish tissue.

Organics

Toxic substances from pesticides and industrial chemicals, called organics, pose the same concerns as metals. Polychlorinated biphenyls (PCBs), for example, are industrial chemicals that are toxic and probably carcinogenic. Although banned in the United States in 1977, PCBs remain in the environment, and they accumulate in fish and human tissues when consumed.

Fish Consumption Advisories and Closures

The Texas Department of State Health Services (DSHS) conducts chemical testing of fish tissue to determine whether there is a risk to human health from consuming fish or shellfish caught in Texas streams, lakes, and bays. Fish seldom contain levels of contaminants high enough to cause an imminent threat to human health, even to someone who eats fish regularly. However, risk increases for people who regularly consume larger fish and predatory fish from the same area of contaminated water over a long period of time. To reduce health risks in areas of contamination, people should eat smaller fish from a variety of water bodies. When a fish consumption advisory is issued, a person may legally take fish or shellfish from the water body under advisory, but it is not recommended. When a fish consumption closure is issued for a water body, the taking of fish or shellfish is legally prohibited.

Fish Consumption Advisories

Fish advisories may warn against the consumption of particular fish or shellfish species from the affected water body, or may recommend the amount of fish that may be consumed over certain periods of time by specific segments of thepopulation. For example, an advisory may read:

"Consumption Advice: The advisory includes all species of fish and recommends limiting consumption to the following:

- Adults should consume no more than one meal, not to exceed 8 ounces of fish per serving, each week.
- Children seven years of age and older should consume no more than one meal, not to exceed 4 ounces of fish per serving, each week.
- Children 6 and under, pregnant women, or women who may soon become pregnant should not consume fish from this reservoir.
- Persons consuming fish from this reservoir should not consume mineral dietary supplements with selenium exceeding 50 micrograms per day."

Fish Consumption Closures

Fish consumption closures identify a specific water body, or portion of a water body, where the taking of fish is prohibited because the human health risk from fish consumption is very high. The closure notice will also identify the contaminant of concern, such as mercury or fecal coliform bacteria, and will list any (or all) species of fish or shellfish which people are prohibited from taking from the area of closure.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