2025 San Antonio River Basin Highlights Report

Watershed Characterization for Cibolo Creek Watershed

THE TEXAS CLEAN RIVERS PROGRAM

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

SAN ANTONIO RIVER AUTHORITY

Prepared by the San Antonio River Authority

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- *Texas Clean Rivers Program Staff who provided guidance, comments and support for this program and report.*

Cover Picture: Station 12802: Lower Cibolo Creek at FM 541 West of Kosciusko (Assessment Unit 1902_03)

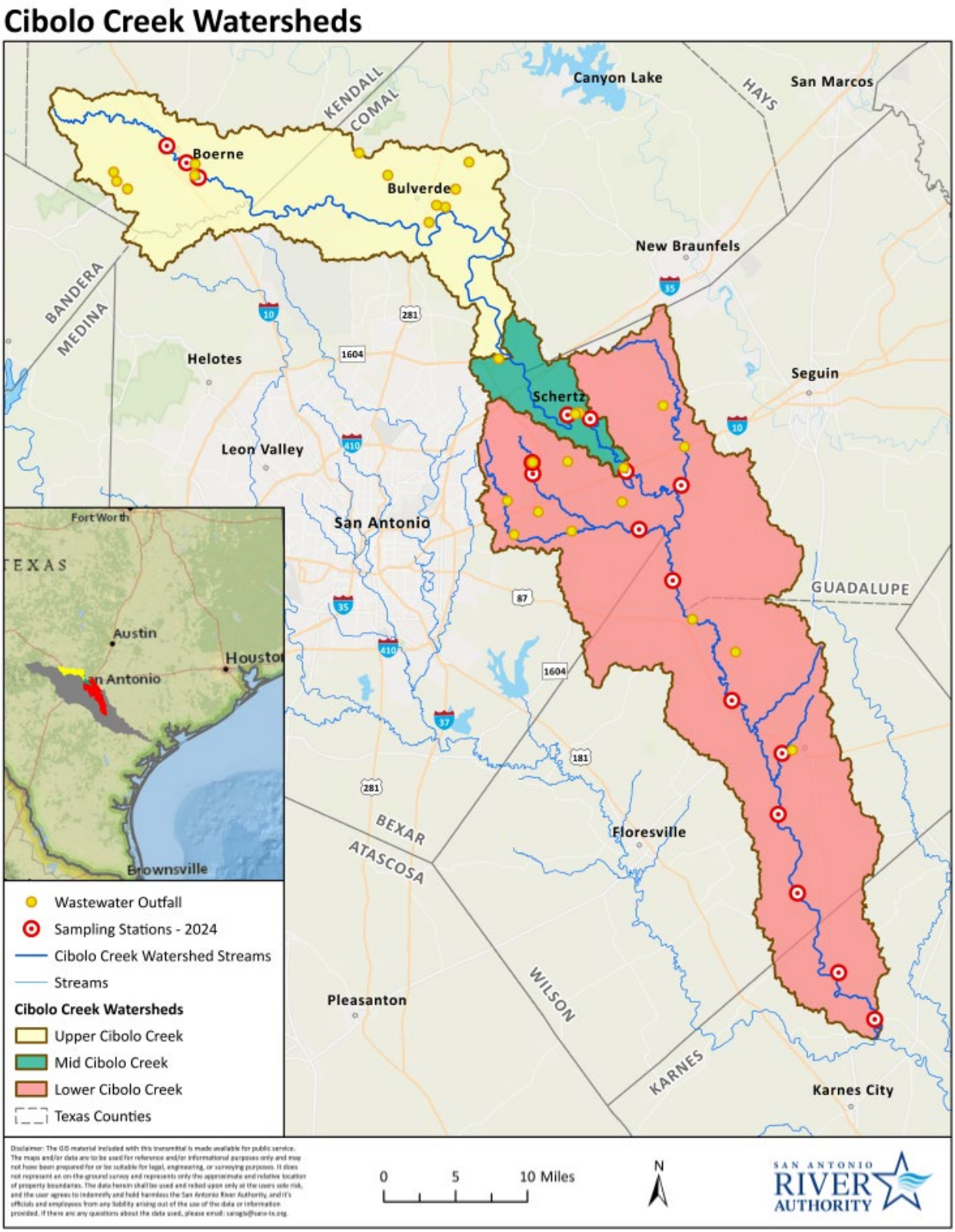

Figure 1-1: Cibolo Creek Watershed

Cibolo Creek:
Cibolo Creek's headwaters are in southwest Kendall County about a mile upstream from the confluence with Champee Springs. The creek traverses in a general southeast direction for approximately 157 miles where it confluences into the San Antonio River in northern Karnes County. As the creek moves south, it crosses the Edwards Plateau, Texas Blackland Prairie and the East Central Texas Plains ecoregions.

The creek recharges the Trinity and the Edwards Aquifer and becomes intermittent south of the City of Boerne and becomes perennial again south of FM 78 near the City of Schertz.

Currently, according to the Texas Commission on Environmental Quality (TCEQ) 2024 Integrated Report (24 IR), the only impairment on Cibolo Creek is for recreation use (*E. coli* bacteria in water). There are concerns for macrobenthic communities (aquatic bugs), aquatic habitat, and nutrients in water (nitrate nitrogen and total phosphorus). There are tributaries of Cibolo Creek that have impairments for recreation use and depressed dissolved oxygen. There are also concerns for recreation use (*E. coli* bacteria in water), depressed dissolved oxygen, and nutrients in water (nitrate nitrogen, ammonia nitrogen and total phosphorus).

Water Quality Graphs:
For the 24 IR, the TCEQ evaluates data for the previous seven years. The period of record for the 24 IR was from 12/1/2015 to 11/30/2022. Graphs for this report were drawn from this same period. By evaluating seven years of data, a robust data set can be evaluated that characterizes the water quality.

Maps disclaimer:
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Figure 2-1: Map of Upper Cibolo Creek Watershed. Segment 1908 with current sampling stations and permitted wastewater treatment plants identified.

Segment Description:
Cibolo Creek from the Missouri-Pacific Railroad bridge west of Bracken in Comal County to a point 1.5 km (0.9 mi) upstream of the confluence of Champee Springs in Kendall County. Upper Cibolo Creek is approximately 67 miles long with a drainage area of 264 sq mi. Sampling stations that have been historically monitored in the Upper Cibolo Watershed are listed below (bolded sites are currently being monitored this year):

- 12853: Cibolo Creek SE of Boerne
- 12855: Cibolo Creek at Boerne City Park
- 12857: Cibolo Creek at IH10 in Boerne
- **15126: Cibolo Creek below Menger Creek**
- 16702: Cibolo Creek 1.6km SH46
- 20649: Cibolo Creek at low water crossing on Linde Ranch
- **20821: Upper Cibolo Creek at Northrup Park**
- 20822: Frederick Creek upstream of West Graham Street Bridge
- 20823: Upper Cibolo Creek at River Road Park
- 20830: Upper Cibolo Creek at Sparkling Springs Drive
- 21494: Frederick Creek 30m downstream of IH10 and 1.45km upstream of the confluence with Upper Cibolo Creek
- 21495: Frederick Creek 30m upstream of IH10 and 1.56km upstream of the confluence with Upper Cibolo Creek

There is only one impairment listed in the 2024 TCEQ Integrated Report (24 IR) in assessment unit (AU) 1908_01 for recreation use. AU1908_01 is Cibolo Creek from the confluence of Balcones Creek upstream to N. School Street in Boerne. Stations 12853, 12855,15126,16702,20649, and 20823 are located in AU 1908_01. The TCEQ is currently monitoring station 15126 in this AU. This AU also has concerns identified for nutrients (nitrate nitrogen and total phosphorus in water). There are no other concerns identified for the Upper Cibolo Watershed.

Hydrologic Characteristics:

A review of USGS automated stream flow stations for the last ten years on this segment indicate that there are three USGS gages on Upper Cibolo Creek. Summary statistics are provided in Tables 2-1, 2-2, and 2-3.

Table 2-1:Flow statistics from USGS gage 08183900.

Cibolo Creek near Boerne (9/1/2014 to 8/31/2024) Daily Average Data			
Season	Median (cfs)	Maximum (cfs)	Minimum (cfs)
Fall	3.1	1,900.0	0.6

Winter	5.5	289.0	1.1
Spring	6.7	6,110.0	1.6
Summer	3.7	797.0	0.6
Total	4.59	6110	0.6

Table 2-2: Flow statistics from USGS gage 08183978.

Cibolo Creek at Specht Rd. near Bulverde (9/3/2014 to 8/31/2024) Daily Average Data			
Season	Median (cfs)	Maximum (cfs)	Minimum (cfs)
Fall	0.0	1780.0	0.0
Winter	0.0	77.1	0.0
Spring	0.0	1300.0	0.0
Summer	0.0	300.0	0.0
Total	0.0	1780.0	0.0

Table 2-3: Flow statistics from USGS gage 08184050.

Cibolo Creek at Smithson Valley Rd near Bulverde (9/1/2014 to 8/31/2024) Daily Average Data			
Season	Median (cfs)	Maximum (cfs)	Minimum (cfs)
Fall	0.0	5,800.0	0.0
Winter	0.0	11.9	0.0
Spring	0.0	1,700.0	0.0
Summer	0.0	354.0	0.0
Total	0.0	5800.0	0.0

The most upstream gage's location, Cibolo Creek near Boerne, is perennial. Downstream from Boerne the creek becomes intermittent as it recharges the Edwards and Trinity aquifers. The two lower stations (near Bulverde) are dry most of the time and typically flow only after rainfall.

This region is characterized by limestone hills with shallow soils and sparse vegetation which creates natural rapid stormwater runoff. This area is also rapidly developing creating additional impervious cover that generates rapid stormwater runoff. This along with intense rainfall create an area that is prone to flash floods.

The median daily average flow for the Boerne station is 4.59 cubic feet per second (cfs) with a range of flows from 0.6 cfs to 6,110 cfs. The highest flows occurred during the spring, while the lowest daily average flows occurred in the fall.

The median daily average flow for both stations near Bulverde was 0.00 cfs with a range of flows from 0.0 to 1,780.0 cfs at Specht Rd. and 0.0 to 5,800.0 cfs at Smithson Valley Rd. The maximum flows for both stations occurred during the fall, while the lowest daily average flows occurred during the winter.

Land Use and Natural Characteristics:

While all of Upper Cibolo Creek is identified as perennial in the 24 IR, only the portion of the creek in and around the City of Boerne is perennial. Downstream of the Cibolo Nature Center in South Boerne, Cibolo Creek recharges into the Trinity Aquifers and its flow becomes intermittent. Further downstream, Cibolo Creek becomes a major contributor to recharge of the Edwards Aquifer.

There are numerous towns and communities in the Upper Cibolo Creek Watershed, including the City of Boerne, Fair Oaks Ranch, Bracken, Garden Ridge, Timberwood Park along with numerous small subdivisions throughout the watershed.

Upper Cibolo Creek flows along the northern edge of Camp Bullis, a military training reservation.

Many of the rural homes in the Upper Cibolo Creek Watershed are serviced by septic systems. There are also numerous small wastewater systems servicing communities in the area. There are two major wastewater treatment facilities, both are located in the City of Boerne. The Esser Road plant is permitted to discharge 1.2 million gallons per day (MGD) into Currey Creek and the Old San Antonio Road wastewater treatment and recycling center is permitted to discharge 1.4 MGD into Menger Creek. Both creeks are tributaries of Cibolo Creek.

Land use in Upper Cibolo Creek spans the Edwards Plateau ecoregions, and is mostly rural, though suburban neighborhoods and local municipalities have seen consistent growth over the years. Most of the watershed remains undeveloped, with areas of high

development concentrated along major traffic corridors such as IH-10 and US-281. Approximately 43.1% of the watershed area is covered by evergreen forests, which are dominated by species such as Ashe juniper (*Juniperus ashei*), cedar elm (*Ulmus crassifolia*), and live oak (*Quercus virginiana*), typical of the Texas Hill Country. Shrubland, comprising 37.6% of the watershed, supports a variety of plants like Texas sagebrush (*Leucophyllum frutescens*), yucca (*Yucca filamentosa*), prickly pear cactus (*Opuntia basilaris*) and mesquite (*Prosopis glandulosa*), providing vital habitat for local wildlife. Grasslands, making up 5.1% of the area, are home to species like little bluestem (*Schizachyrium scoparium*), side-oats grama (*Bouteloua curtipendula*), and Indian grass (*Sorghastrum nutans*). Open development, also accounting for 5.1%, includes suburban neighborhoods and commercial areas where species like red oak (*Quercus rubra*), boxelder (*Acer negundo*), and non-native ornamentals may be found. Deciduous forests, covering 3.6% of the watershed, are typically found along riparian

Figure 2-2: Upper Cibolo Creek Watershed land use.

zones, with trees like pecan (*Carya illinoinensis*), sycamore (*Platanus occidentalis*), cottonwood (*Populus deltoides*) and Texas black walnut (*Juglans macrocarpa*). Developed low-intensity areas, comprising 3.2% of the watershed, include areas with limited development where native plants like huisache (*Vachellia farnesiana*) and agarita (*Mahonia trifoliolata*) might persist among scattered homes and rural structures. Finally, developed medium-intensity accounts for 1.1% of the watershed, while high intensity development makes up only 0.3% of the entire watershed area. These areas are more urbanized, with limited vegetation and high impervious cover.

Figure 2-3: Upper Cibolo Creek downstream of Northrup Park (near station 20821) at Johns Rd. in the City of Boerne

Water Quality Issues:

A review of the 24 IR indicated that assessment unit (AU) 1908_01:Cibolo Creek from the confluence of Balcones Creek upstream to North School Street in Boerne is not supporting the contact recreation, *E. coli* bacteria, standard and has concerns for nutrients.

The impairment for *E. coli* bacteria was first identified in 2006. The 24 IR indicated that 41 samples of *E. coli* that had a geometric mean of 259.45 most probable number (MPN), exceeding the criteria of 126.

The 24 IR indicated that nutrients were also identified as a concern in AU 1908_01 . Nitrate nitrogen did not meet the screening level (1.95 mg/L) for 21 out of 41 samples (51 percent). Total phosphorus did not meet the screening level (0.69 mg/L) for 15 out of 41 samples (36 percent).

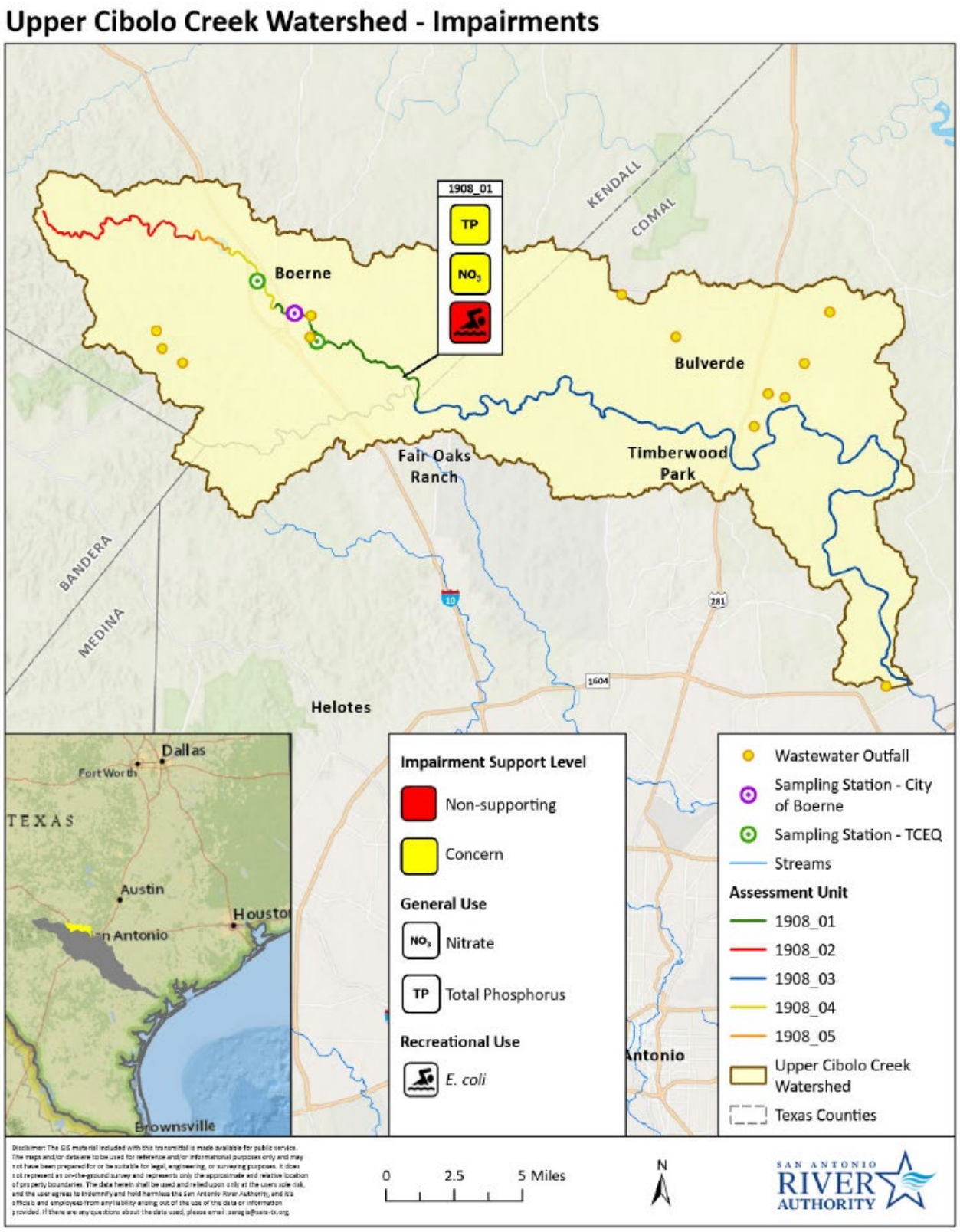

Figure 2-4: Upper Cibolo Creek Watershed impairments and concerns.

Potential Causes of Water Quality Issues:

There are two large wastewater treatment plants. Both plants are downstream of station 20823 but upstream of 15126.The Esser Road Plant is permitted to discharge 1.2 MGD into Currey Creek, which flows into Cibolo Creek south of Highway 46. The wastewater treatment plant on Old San Antonio Road is permitted to discharge 1.4 MGD into Menger Creek. Figure 2-4 shows that much of the *E. coli* bacteria is entering the creek upstream of the wastewater treatment plants.

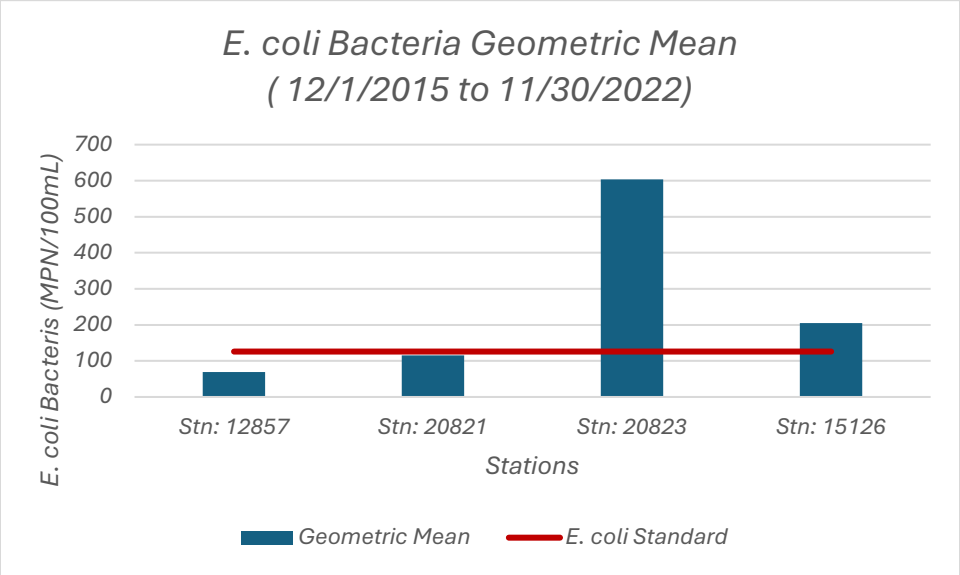

Figure 2-5: E.coli bacteria geometric mean by stations with at least ten data points, listed from upstream to downstream. Stations 20823 and 15126 are in AU 1908_01.

Station 20823, Upper Cibolo Creek at River Road Park is located approximately 100 ft. upstream of Dietert Mill Dam. This is the Boerne River Road Park and an area that is heavily used by residents and wildlife.

Figure 2-6: Upper Cibolo Creek at River Road Park in Boerne, looking downstream at Dietert Mill Dam (Station 20823).

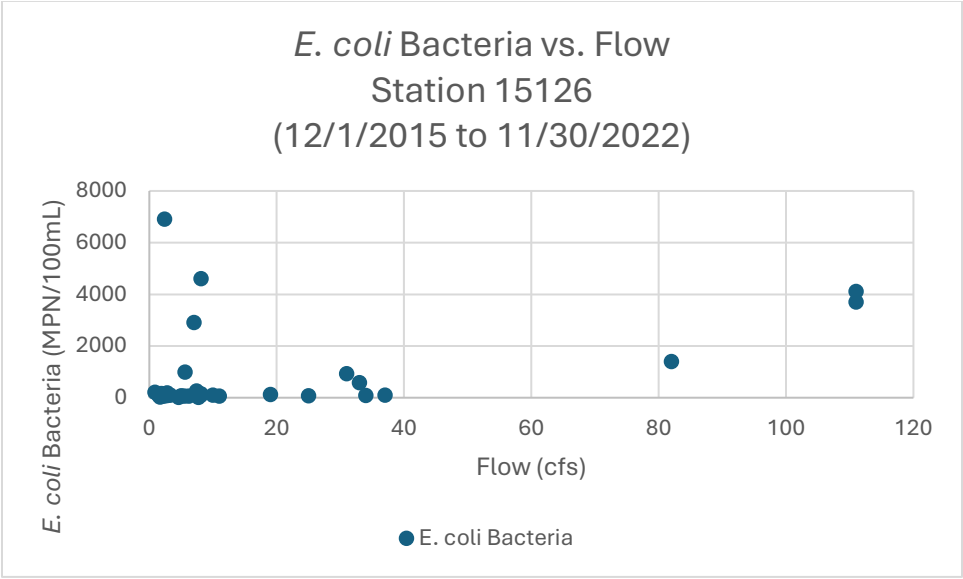

Figure 2-7: E. coli bacteria versus flow values at station 15126: Cibolo Creek below Menger Creek confluence.

Flow data is unavailable at Station 20823, since it is a small reservoir. However, an examination of *E. coli* data for station 15126, shows that elevated *E. coli* values are occurring under both low flow and high flow conditions indicating that both point source pollution (likely wildlife) and non-point source pollution due to urban storm water runoff are both influencing the elevated *E. coli* levels in AU 1908_01.

The City of Boerne has worked to reduce the excessive wildlife in their park, but it is hard to change people's attitude towards feeding wildlife at its parks. Cibolo Creek and its tributaries also have extensive riparian areas that naturally attract wildlife.

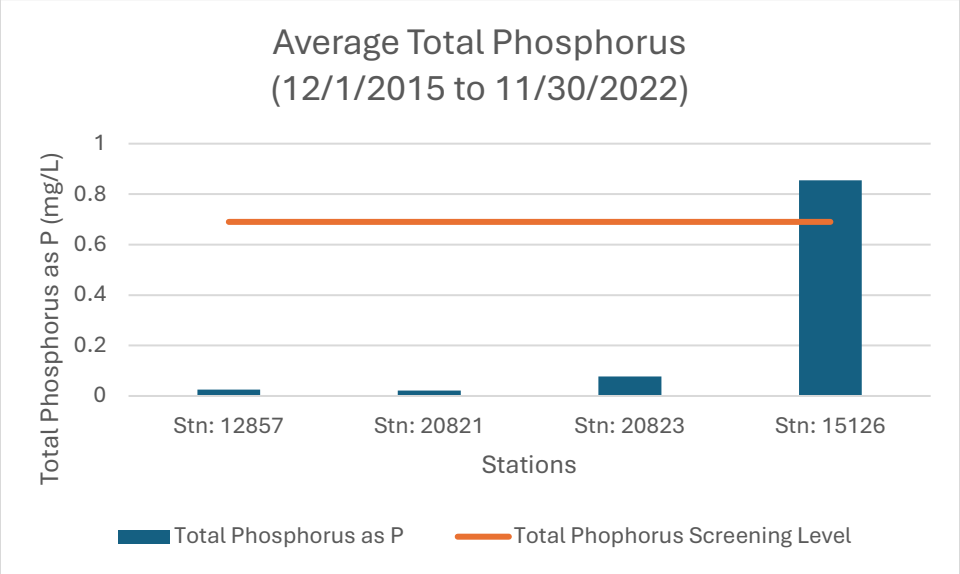

Figure 2-8: Average total phosphorus by stations with at least ten data points, listed from upstream to downstream. Stations 20823 and 15126 are in AU 1908_01.

In the Upper Cibolo Creek segment, station 15126 was the only station that had values greater than the nutrient screening levels.

A review of station 15126 indicates that elevated nutrients occurred during low flows, indicating a point source. The two wastewater treatment plants upstream of 15126 and downstream of 20823 are the most likely source of the elevated phosphorus and nitrate.

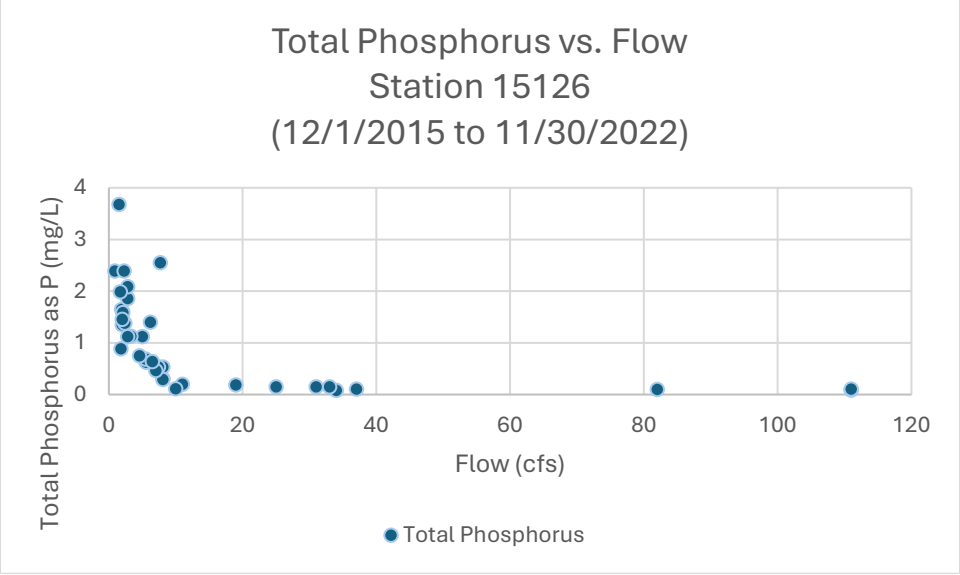

Figure 2-9: Total phosphorus versus flow. Indicating the pollutant is due to a point source, not storm water runoff

No other parameters were identified as impairments or concerns in the Upper Cibolo Creek watershed.

Potential Stakeholders:

In 2013, the City of Boerne, the Texas Commission on Environmental Quality and local stakeholders developed a comprehensive watershed protection plan (WPP). As part of the WPP they worked with the following stakeholders:

- AgriLife Extension County Agents-Kendall County
- Alamo Soil and Water Conservation District
- Bexar Audubon
- Boerne Independent School District
- Cibolo Nature Center
- Cibolo Preserve
- City of Fair Oaks Ranch
- Concerned citizens
- Cow Creek Groundwater Conservation District
- Guadalupe Blanco River Authority
- Kendall County
- Kendall County Farm Bureau
- Kendall Soil and Water Conservation District
- Natural Resource Conservation Service
- San Antonio River Authority
- San Antonio River Environmental Advisory Committee
- Texas AgriLife Extension
- Texas Commission on Environmental Quality
- Texas Department of Agriculture
- Texas Department of Transportation
- Texas Master Naturalist – Alamo Area Chapter
- Texas Master Naturalist – Hill Country Chapter
- Texas Master Naturalist – Lindheimer Chapter (Comal County)
- Texas Parks and Wildlife Department
- Texas State Soil and Water Conservation Board
- Texas Stream Team with the Meadows Center for Water and the Environment at Texas State University
- Texas Water Resources Institute
- The Nature Conservancy
- Trinity Glen Rose Groundwater Conservation District
- University of Texas at San Antonio
- Upper Cibolo Creek Landowners Association
- US Fish and Wildlife Service
- USDA Natural Resources Conservation Service

Recommended Actions:

SARA recommends that TCEQ continue monitoring in the Upper Cibolo Creek.

No biological sampling is currently being done in the Upper Cibolo Creek Watershed. SARA plans to monitor one site on the Upper Cibolo Creek for habitat and fish community in FY26.

The community in and around the City of Boerne worked together to form the Upper Cibolo Creek Watershed Partnership. The partnership worked together to develop a watershed protection plan for Upper Cibolo Creek.
The Upper Cibolo Creek Partnership needs to continue to implement the recommendations in the Upper Cibolo Creek Watershed Protection Plan particularly those associated with avian wildlife.

Ongoing Projects:

- The Texas Commission on Environmental Quality is currently monitoring two sites on Upper Cibolo Creek.

- Watershed Protection Plan:

  <u>City of Boerne WPP Implementation Overview:</u>
  Upon EPA approval of the Upper Cibolo Creek Watershed Protection Plan (UCC WPP) in 2013, the City made a long-term commitment to support efforts to improve surface water quality throughout the watershed. As a result, the City has maintained a full-time position with watershed coordination responsibilities as part of their annual work plan. In addition to significant WPP management strategy implementation projects that occurred between 2013 and 2017, the City has continued to conduct watershed-based water quality improvement initiatives for over a decade in the areas of outreach and education, domestic waterfowl management, water quality monitoring, annual creek clean-up events, riparian protection, and low impact development (LID). Lasting outcomes from the UCC WPP is the incorporation of watershed protections into the City of Boerne Unified Development Code (UDC). Within Section 8.2. Watershed Protection of the UDC are requirements for 1) the establishment of drainageway protection zones (DPZ) to ensure riparian vegetation is protected along stream corridors and simultaneously help improve in-stream water quality conditions and 2) the installation of low impact development facilities for development or re-development projects where > 200 sq.ft of new impervious surface is created. LID facilities are selected and designed according to the Boerne Edition of the San Antonio River Basin Low Impact Development Technical Guidance Manual.

WPP Timeline:

- 2009–2013 WPP Development funded through TCEQ by 319 Clean Water Act (CWA) grant
- 2013–2017 WPP Implementation work funded through TCEQ by 319 CWA grant
- 2017–2025 WPP Implementation work funded by the City of Boerne

BMP Overview

- Outreach and Education
    - The City of Boerne maintains a webpage dedicated to watershed protection with links to the Upper Cibolo Creek Watershed Protection Plan.
    - City of Boerne Communication Department use of social media video content to promote water quality and water conservation initiatives.
    - Boerne City Council and Planning and Zoning Commission Presentations.
    - TX AgriLife Healthy Lawns / Healthy Waters Workshops
    - Low Impact Development Workshop
    - Developers and Engineers workshops for local ordinance requirements to include tree preservation, stormwater management and LID.
    - Homeowner Septic System Maintenance Workshop
    - Boerne Independent School District 7th Grade In-class Watershed Protection Program
    - Free Conservation Event: Water Conservation / Watershed Protection / Green Living Fair
    - Installation of permanent “Do Not Feed Waterfowl” signage
    - Installation of permanent educational signage at River Road Park and the Patrick Heath Public Library dedicated to the topics of “What is a Watershed” and “What is Riparian”
    - Newsletters

Figure 1-10: Photo of Do Not Feed any Wildlife sign at Boerne River Road Park.

    - Ryan Bass, Environmental Program Manager for the City of Boerne joined Brian Davenport on the Creekside at the Cibolo podcast to discuss the Watershed Protection Plan. He has also become a regular guest: https://www.audacy.com/podcast/creekside-at-the-cibolo-with-brian-davenport-20423.

- Creek / Lake Clean Up Events
    - Boerne City Lake Tire Removal Project resulting in 200 tires being removed from the lake.
    - Annual creek clean up events focused on urban streams

Figure 2-11: Photo of pet waste station.

- Pet Waste Station Installations
- Domestic Waterfowl Management Program: Egg Oiling and Trap/Relocate Events
- River Road Park Stream Bank Stabilization Project completed in 2024
- Riparian Enhancement Projects, Long-term projects plantings trees along shorelines at Boerne City Lake and along UCC at Northrup Park and Boerne City Park
- Staff training field days for engineers, planners and construction inspectors related to NPS and surface water groundwater interactions
- Boerne City Lake Water Quality Monitoring Program
- UDC Update
    - LID manual adoption with sediment and contaminant targets
    - DPZ 1 and DPZ 2 establishment
    - Improved flood plain development requirements
    - Land study requirements for development to include habitat and geologic assessments.

- San Antonio River Authority's Cibolo Creek Holistic Watershed Master Plan: this masterplan is a phased project at SARA designed to provide communities with sustainable solutions that address concerns with flooding, water quality, stream health and recreation. The Plan covers Upper, Mid and Lower Cibolo Creek Watersheds.

Water quality data from the TCEQ's Surface Water Quality Monitoring Database (which includes CRP data) along with other relevant databases is used to support water quality modeling efforts in the Cibolo Creek Watershed. The project objective is to identify locations and develop strategies for improvement of water quality in the watershed. Specifically, to determine the location of best management practices to reduce *E coli* bacteria and nutrients in the watershed. The current Cibolo Creek Watershed Holistic Master Plan can be found at: https://www.sariverauthority.org/wp-content/uploads/2024/02/Cibolo-Creek-Watershed-Holistic-Master-Plan-All-Phases_web.pdf.

The water quality models and the plan are currently being updated.

Major Watershed Events:

Development:
The City of Boerne and the entire hill country is developing rapidly. According to the Census Bureau, the population went from 10,471 in 2010 to 17,800 in 2020 with an estimated population of 21,774 as of July 1, 2023. Land development is rapidly occurring in this area. The rapid population growth has put stress on resources in the hill country.
Increased development means increased demand for drinking water. Increased urbanization can lead to increased stormwater runoff due to increased impervious cover from roofs, streets and parking lots.

Fish Kills:
A review of data provided by the Texas Parks and Wildlife's Kills and Spills Team (TPWD KAST) from 2015 to the present, indicate that there have been two fish kills in the Upper Cibolo Creek Watershed:

- On December 1, 2018, a contractor accidently released bentonite into Frederick Creek. A plan was put into place to remove the bentonite. In order to remove the bentonite, coffer dams were placed in the creek, and the area was dewatered. In the process of successfully relocating 528 fish and three Paper Pondshell mussels, a total of 98 fish died due to the stress of relocation.
- August 24, 2022, the City of Boerne notified TPWD KAST that in Cibolo Creek (area commonly known as Boerne City Lake) that there were hundreds of dead fish and other fish were gasping for air at the surface. There had been rain the previous day, but the lake was still stagnant. It is believed that low dissolved oxygen levels were the cause of the fish kill. The City of Boerne placed three pumps into the impoundment to help circulate the water and save the remaining fish.

Drought:
Since 2022, most of the Upper Cibolo Watershed has been under drought conditions.

Figure 2-12: Upper Cibolo Creek downstream of Dietert Mill Dam.

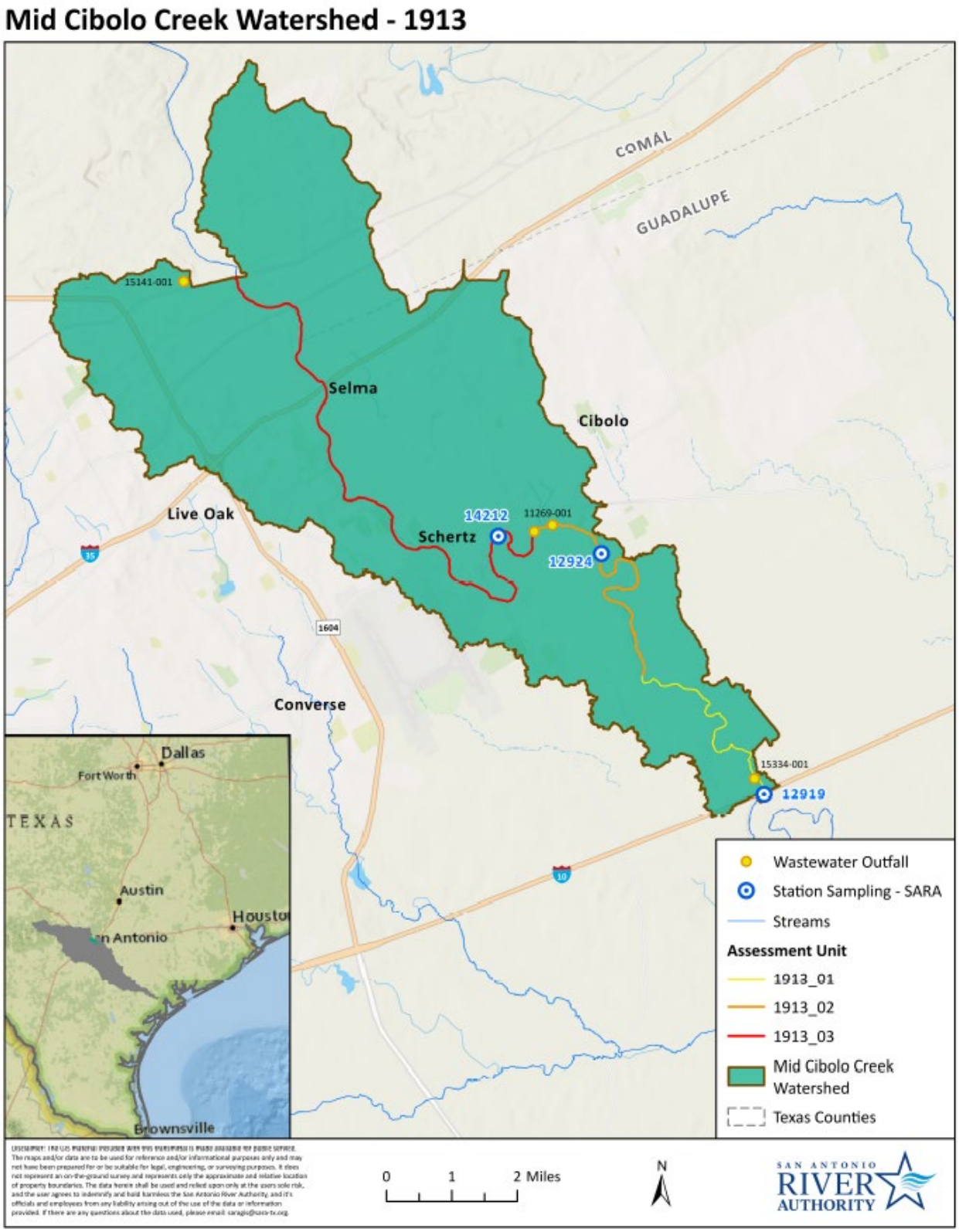

Figure 3-1: Map of Mid Cibolo Creek Watershed. Segment 1913 with current sampling stations and permitted wastewater treatment plants identified.

Segment Description:

Cibolo Creek from a point 100 meters (110 yards) downstream of IH 10 in Bexar/Guadalupe County to the Missouri-Pacific Railroad bridge west of Bracken in Comal County. The Mid Cibolo is approximately 19 miles long with a drainage area of 43 square miles. Sampling stations that have been historically monitored in the Upper Cibolo Watershed are listed below (bolded sites are currently being monitored this year):

- 12921: Cibolo Creek at Weir Road
- **12919: Cibolo Creek at IH 10/US90 on East Bank**
- **12924: Cibolo Creek at Schaeffer Road 3 miles East of Randolph Air Force Base**
- **14212: Cibolo Creek Upstream of Municipal Wastewater Treatment Plant Off River Road.**

There are no impairments listed in the 2024 TCEQ Integrated Report in segment 1913. The San Antonio River Authority is currently monitoring the current three sites bolded above. This segment is divided into three assessment units (AU) with 1913_01 being the most downstream AU, and 1913_03 being the most upstream AU. There are concerns for nitrate nitrogen and total phosphorus for AU 1913_01 (12919) and 1913_02 (12924). AU 1913_03 (14212) has no concerns identified.

Hydrologic Characteristics:

Figure 3-2: Mid Cibolo Creek upstream of Nacogdoches Road West of Bracken. Pooled water can be seen at the bottom of the picture, upstream is dry. Note the railroad bridge in the distance is the segment divider between the Upper and Mid Cibolo Creek.

Table 3-1:Flow statistics from USGS gage 08185000.

Cibolo Creek at Selma (9/1/2014 to 8/31/2024) Daily Average Data			
Season	Median (cfs)	Maximum (cfs)	Minimum (cfs)
Fall	0.0	10,600	0.0
Winter	0.0	99.8	0.0
Spring	0.0	8,830.0	0.0
Summer	0.0	603.0	0.0
Total	0.0	10,600	0.0

Table 3-2:Flow statistics from USGS gage 08185065.

Cibolo Creek near Saint Hedwig (9/1/2014 to 8/31/2024) Daily Average Data			
Season	Median (cfs)	Maximum (cfs)	Minimum (cfs)
Fall	10.6	3230.0	0.2
Winter	13.2	728.0	0.7
Spring	12.5	4220.0	0.3
Summer	7.9	1010.0	0.2
Total	11.5	4220.0	0.2

The most upstream gage in segment 1913, Cibolo Creek at Selma TX, is intermittent. Much of the lower portion of Upper Cibolo Creek which is upstream of the Selma gage flows over the Edwards Aquifer Recharge and Transition Zone. Due to the recharge, this gage is dry most of the time and typically flow only occurs after rainfall.

The Mid Cibolo Watershed is also rapidly developing, creating additional impervious cover that generates rapid stormwater runoff. This, along with intense rainfall, create an area that is prone to flash floods.

The median daily average flow for the Selma station was 0.0 cfs with a range of flows from 0.0 cfs to 10,600.0 cfs. The highest flows occurred during the Fall, while the lowest daily average flow was 0.0 cfs during all seasons.

The median daily average flow for the station near Saint Hedwig was 11.5 cfs with a range of flows from 0.2 to 4,220.0 cfs. The maximum flows for the gage near Saint

Hedwig was 4,220.0 cfs and occurred during the spring, while the lowest flows occurred during the summer and fall.

Land Use and Natural Characteristics:

Much of the upper portion of AU 1913_03 is not monitored. This is because this portion of the Mid Cibolo Creek is intermittent. A small portion (1.2 mi.) of the upper portion of the Mid Cibolo is on the Edwards Aquifer transition zone. Mid Cibolo Creek becomes perennial downstream of FM 78 in Schertz Texas.

There are numerous towns in the upper portion of this segment, particularly along the IH 35 corridor. Communities in this watershed include part of Garden Ridge, Bracken, Selma, Schertz, Universal City, Cibolo and Live Oak.

Cibolo Creek runs near the northeast border of Joint Base San Antonio-Randolph (Randolph Air Force Base).

Most of the population in the Mid Cibolo is serviced by Cibolo Creek Municipal Authority's wastewater treatment plant. This plant is permitted to discharge 10 MGD.

Land use in the Middle Cibolo Watershed spans the Texas Blackland Prairie ecoregion and reflects a mix of natural habitats, agricultural land, and varying levels of urban development, characteristic of San Antonio suburbs. Scrubland, covering 29.9% supports a variety of plants like Texas sagebrush (*Leucophyllum frutescens*), yucca (*Yucca filamentosa*), prickly pear cactus (*Opuntia basilaris*) and mesquite (*Prosopis glandulosa*), providing vital habitat for local wildlife. Developed open spaces, comprising 12.5%, include parks and recreational areas with grasses, shrubs, and trees like live oak (*Quercus virginiana*) and Ashe juniper (*Juniperus ashei*). Cultivated crop areas (12.4%) are primarily used for farming, where crops like cotton, sorghum, and corn are grown, with some native plants and wildflowers occasionally found near edge habitats. Developed low-intensity areas (11.2%) consist of sparsely developed land, such as rural residential areas with native plants like huisache (*Vachellia farnesiana*) and agarita (*Mahonia trifoliolata*) mixed in with planted vegetation. Developed medium-intensity areas (10.8%) feature suburban neighborhoods with trees like cedar elm (*Ulmus crassifolia*), red oak (*Quercus rubra*), and non-native ornamentals. Evergreen forests, making up 8.7%, are dominated by species like Ashe juniper (*Juniperus ashei*), live oak

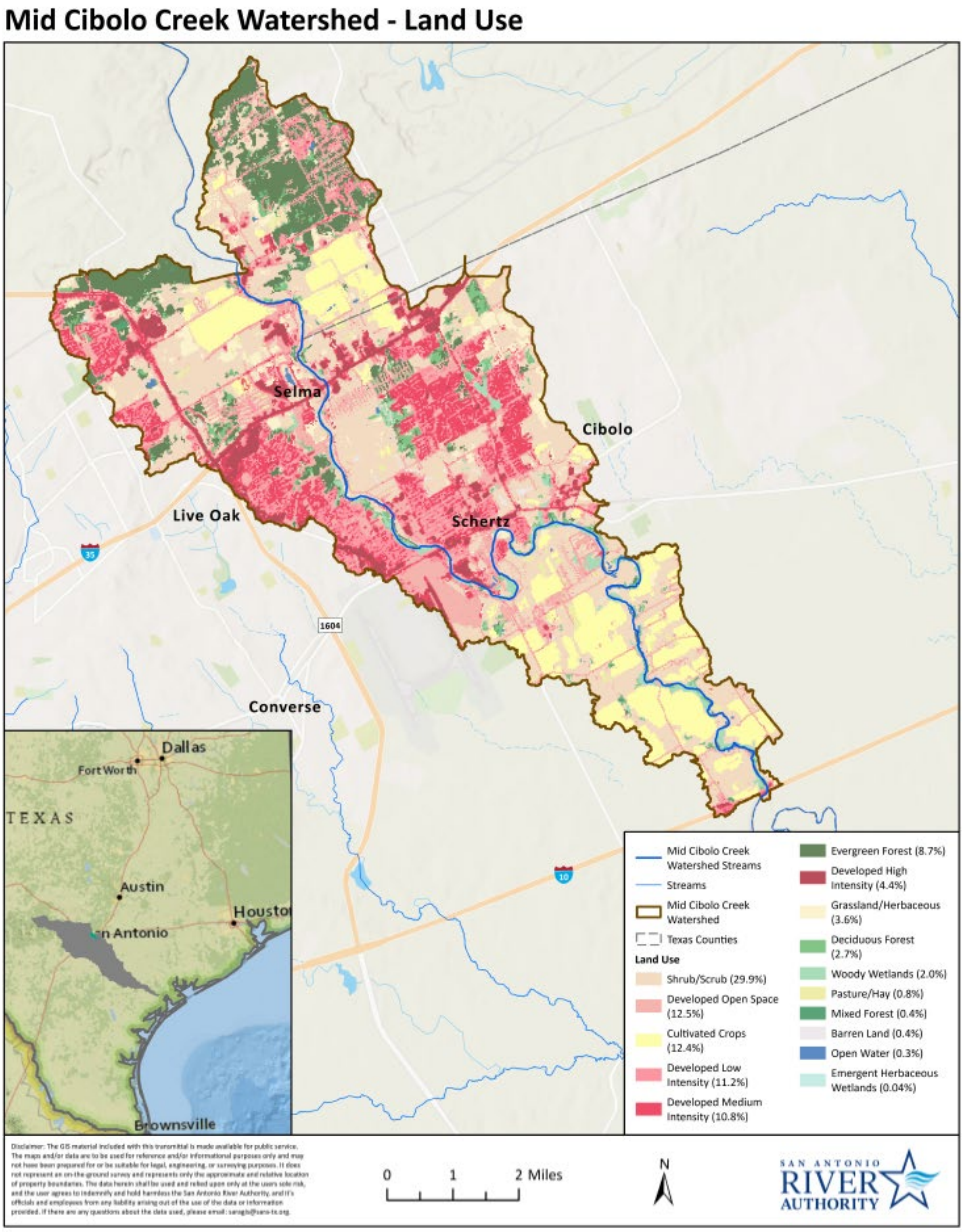

Figure 3-3: Mid Cibolo Creek Watershed land use.

(*Quercus virginiana*), and cedar elm (*Ulmus crassifolia*), typical of the region's upland areas. Developed high-intensity zones (4.4%) are urbanized with limited vegetation, although species like yaupon holly (*Ilex vomitoria*) and mesquite (*Prosopis glandulosa*) can sometimes be found in pockets of green space. Grasslands and herbaceous areas (3.6%) are home to species like little bluestem (*Schizachyrium scoparium*), side-oats grama (*Bouteloua curtipendula*), and Indian grass (*Sorghastrum nutans)*, while deciduous forests (2.7%) along riparian zones consist of trees like pecan (*Carya illinoinensis*), sycamore (*Platanus occidentalis*), cottonwood (*Populus deltoides*) and Texas black walnut (*Juglans macrocarpa*). Lastly, woody wetlands, covering 2.0%, are found in floodplain areas and support species like willows (*Salix spp.*), buttonbush (*Cephalanthus occidentalis*), and bald cypress (*Taxodium distichum*).

Figure 3-4: Station 14212 Mid Cibolo Creek upstream of CCMA Wastewater Treatment Plant off River Road.

Water Quality Issues:

There are no impairments listed in the 24 IR for segment 1913. There are concerns for nitrate nitrogen and total phosphorus for AU 1913_01 (Stn.12919). Nitrate nitrogen did not meet the screening level (1.95 mg/L) for 36 out of 36 samples (100 percent). Total phosphorus did not meet the screening level (0.69 mg/L) for 21 of 37 samples (57 percent).
There are also concerns for nitrate nitrogen and total phosphorus for AU 1913_02 (Stn. 12924). Nitrate nitrogen did not meet the screening level (1.95 mg/L) for 38 out of 39 samples (97 percent). Total phosphorus did not meet the screening level (0.69 mg/L) for 23 of 40 samples (58 percent).

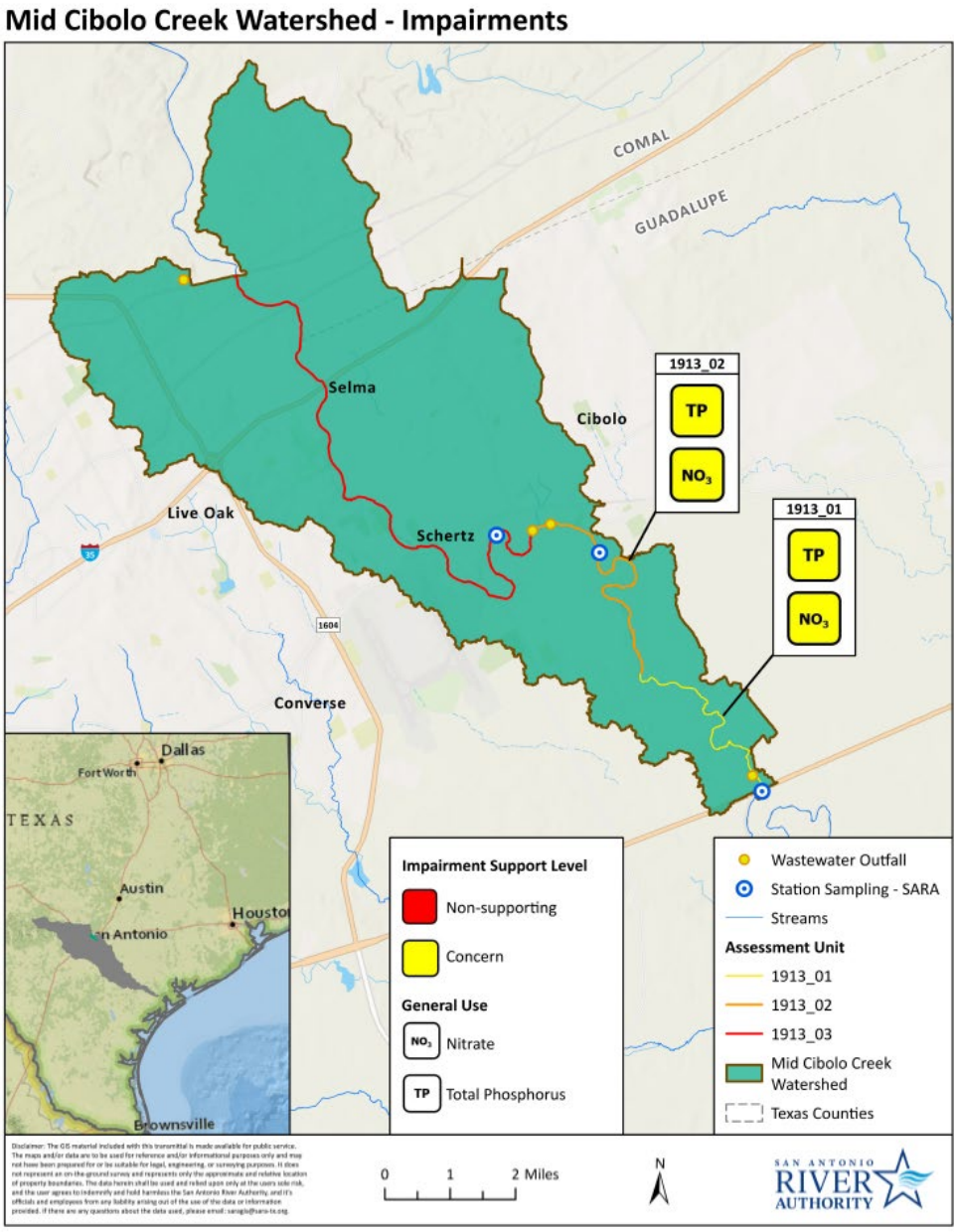

Figure 3-5: Mid Cibolo Creek Watershed concerns.

Potential Causes of Water Quality Issues:

As mentioned earlier, much of the upper portion of this segment is intermittent. There are no current monitoring stations in the intermittent portion of the Mid Cibolo. Station 14212 is in AU 1913_03 which is fully supporting all parameters evaluated. Immediately downstream of station 14212 is a major wastewater treatment plant, ODO J. Riedel WWTP which is operated by Cibolo Creek Municipal Authority (CCMA). Downstream of the WWTP is station 12924, which is in AU 1913_02. This AU is identified as a concern for both nitrate nitrogen and total phosphorus. A review of both nitrate nitrogen and total

phosphorus data indicate that the excessive nutrient levels are due to a point source. (see figure 3-6).

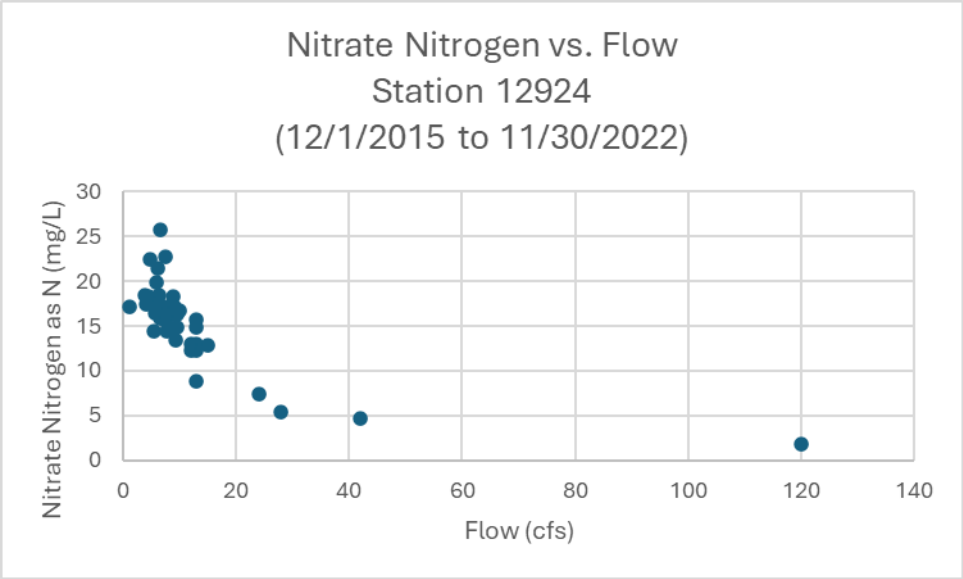

Figure 3-6: Graph compares nitrate nitrogen levels to flow. Nitrate nitrogen levels are elevated under low flow and ambient conditions and lower under high flow conditions indicating that the source of nitrate nitrogen is due to point source and not stormwater runoff.

The likely cause is the wastewater treatment plant discharge. However, a review of the data indicates that since 2021, sampling downstream of the WWTP is meeting the TCEQ screening level for total phosphorus. It is estimated that if this trend continues, the TCEQ 2028 integrated report will no longer have a concern for total phosphorus in AU 1913_02. (see figure 3-7)

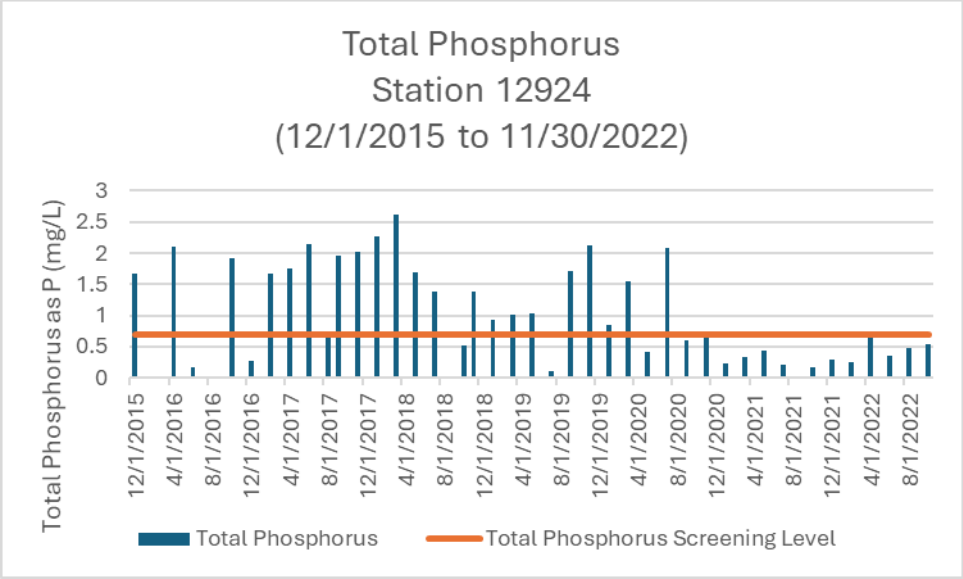

Figure 3-7: Total phosphorus values collected at station 12924 over time along with TCEQ screening level for total phosphorus. Graph shows that recent values are meeting the TCEQ screening level.

Figure 3-8: Station 12924 at Schaeffer Road downstream of CCMA Wastewater Treatment Plant Discharge.

Station 12919 is in AU 1913_01 and is the farthest downstream station on Mid Cibolo Creek. This AU is identified as a concern for both nitrate nitrogen and total phosphorus. A review of both nitrate nitrogen and total phosphorus data indicate that the elevated nutrient levels are mostly due to point source. (see figure 3-9). The point source is likely from wastewater discharge.

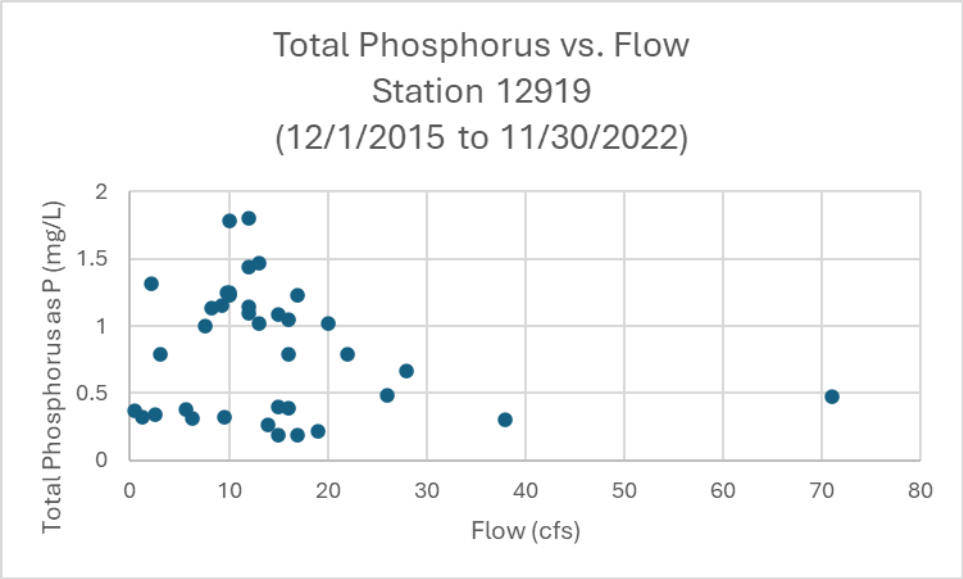

Figure 3-9: Graph compares total phosphorus levels to flow. Total phosphorus levels are elevated under low flow and ambient conditions indicating that the source of total phosphorus is due to point source discharge.

However, like station 12924, recent total phosphorus levels are below the TCEQ screening level (see figure 3-10). It is estimated that if this trend continues, the TCEQ 2028 integrated report will no longer have a concern for total phosphorus in AU 1913_03.

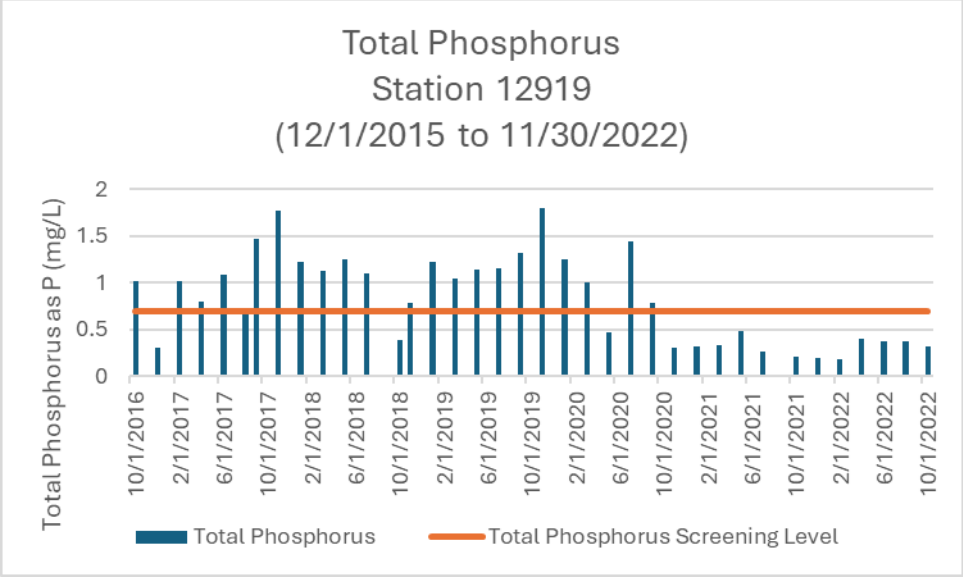

Figure 3-10: Total phosphorus values at station 12919 collected over time along with TCEQ screening level for total phosphorus. Graph shows that recent values are meeting the TCEQ screening level.

Potential Stakeholders:

Below is a list of organizations who have a vested interest in water quality and ecological health of the Mid Cibolo Watershed and who may have representatives willing to serve as stakeholders for future implementation plans or watershed protection plans.

- Alamo Soil and Water Conservation District
- Bexar Audubon
- Cibolo Creek Municipal Authority
- City of Cibolo
- City of Garden Ridge
- City of Schertz
- City of Selma
- Comal Trinity Groundwater District
- Concerned citizens
- Guadalupe Blanco River Authority
- Guadalupe County
- Guadalupe County Farm Bureau
- Guadalupe County Groundwater District
- Natural Resource Conservation Service
- Randolph Air Force Base
- San Antonio River Authority
- San Antonio River Environmental Advisory Committee
- Texas AgriLife - Texas Water Resources Institute, and County Extension Agents
- Texas Commission on Environmental Quality
- Texas Department of Agriculture
- Texas Master Naturalist – Alamo Area Chapter
- Texas Master Naturalist – Guadalupe Chapter
- Texas Master Naturalist – Lindheimer Chapter (Comal County)
- Texas Parks and Wildlife Department
- Texas State Soil and Water Conservation Board
- Texas Stream Team with the Meadows Center for Water and the Environment at Texas State University
- Texas Water Resources Institute
- The Nature Conservancy
- Universal City
- US Fish and Wildlife Service
- USDA Natural Resources Conservation Service

Recommended Actions:

Stakeholders from the Mid and Lower Cibolo Creek initiated a Watershed Protection Plan (WPP) in 2017. This WPP was accepted by EPA in 2019. The purpose of this

document is to address water quality in Mid Cibolo Creek, Lower Cibolo Creek and Martinez Creek, Salitrillo Creek and Clifton Branch. Martinez Creek, Salitrillo Creek and Clifton Branch are tributaries of the Lower Cibolo Creek.

While there are no impairments for Mid Cibolo Creek, there are concerns for nitrate nitrogen and total phosphorus in AU 1913_01 and 1913_02. There are no concerns for AU 1913_03 which is upstream of the CCMA wastewater treatment plant. The likely cause of the nutrient impairments are elevated nitrate nitrogen and total phosphorus in the WWTP discharge. Elevated nutrients can lead to low dissolved oxygen levels and elevated chlorophyll-a levels. Elevated levels of chlorophyll-a is an indication of excessive algae. While algae is an important component of a healthy aquatic system, generating oxygen and food for aquatic organisms, an overabundance of algae can produce low levels of dissolved oxygen that can kill aquatic organisms. In AU 1913_01 (Stn. 12919) there were no values of dissolved oxygen or chlorophyl-a that did not meet the stream standard or screening criteria. In AU 1913_02 (Stn. 12924) there was one value that did not meet the 24-hour dissolved oxygen minimum criteria and one value out of 40 values that did not meet the dissolved oxygen grab screening level.

It is common for wastewater treatment plants to discharge elevated levels of nutrients into streams. At this time, nutrients do not appear to be causing low dissolved oxygen levels or excessive algae growth.

Ongoing Projects:

- The San Antonio River Authority will continue to monitor water quality through the Texas Clean Rivers Program.

- Cibolo Creek Holistic Watershed Master Plan: this masterplan is a phased project at SARA designed to provide communities with sustainable solutions that address concerns with flooding, water quality, stream health and recreation. The Plan covers Upper, Mid and Lower Cibolo Creek Watershed.

  Water quality data from the TCEQ's Surface Water Quality Monitoring Database (which includes CRP data) along with other relevant databases is used to support water quality modeling efforts in the Cibolo Creek Watershed. The project objective is to identify locations and develop strategies for improvement of water quality in the watershed. Specifically, to determine the location of best management practices to reduce *E. coli* bacteria and nutrients in the watershed. The current Cibolo Creek Watershed Holistic Master Plan can be found at: https://www.sariverauthority.org/wp-content/uploads/2024/02/Cibolo-Creek-Watershed-Holistic-Master-Plan-All-Phases_web.pdf.

  The water quality models, and the plan are currently being updated.

- Texas Water Resources Institute (TWRI) continues to provide online and in person training for such subjects as: Texas Watershed Stewards, Introduction to Septic Systems for Homeowners, Texas Riparian and Stream Ecosystem Education, and Lone Star Healthy Streams.

Major Watershed Events:

Development:
The population continues to increase in the Mid Cibolo Watershed particularly around the IH 35 corridor.

Fish Kills:
A review of data provided by TPWD KAST from 2015 to the present, indicate that there was only one fish kill event on the Mid Cibolo. On December 27, 2016 a fish kill occurred likely due to runoff from putting out a mulch fire by the Selma Fire Department. It was estimated that 138 fish were killed. Species killed included sunfish, Yellow Bullhead Catfish and Largemouth Bass.

Drought:
Like much of Texas, this area suffered from drought. Due mainly to wastewater discharge from CCMA, the creek was perennial downstream of the discharge outfall.

Figure 3-11: Mid Cibolo Creek at IH 10 looking downstream.

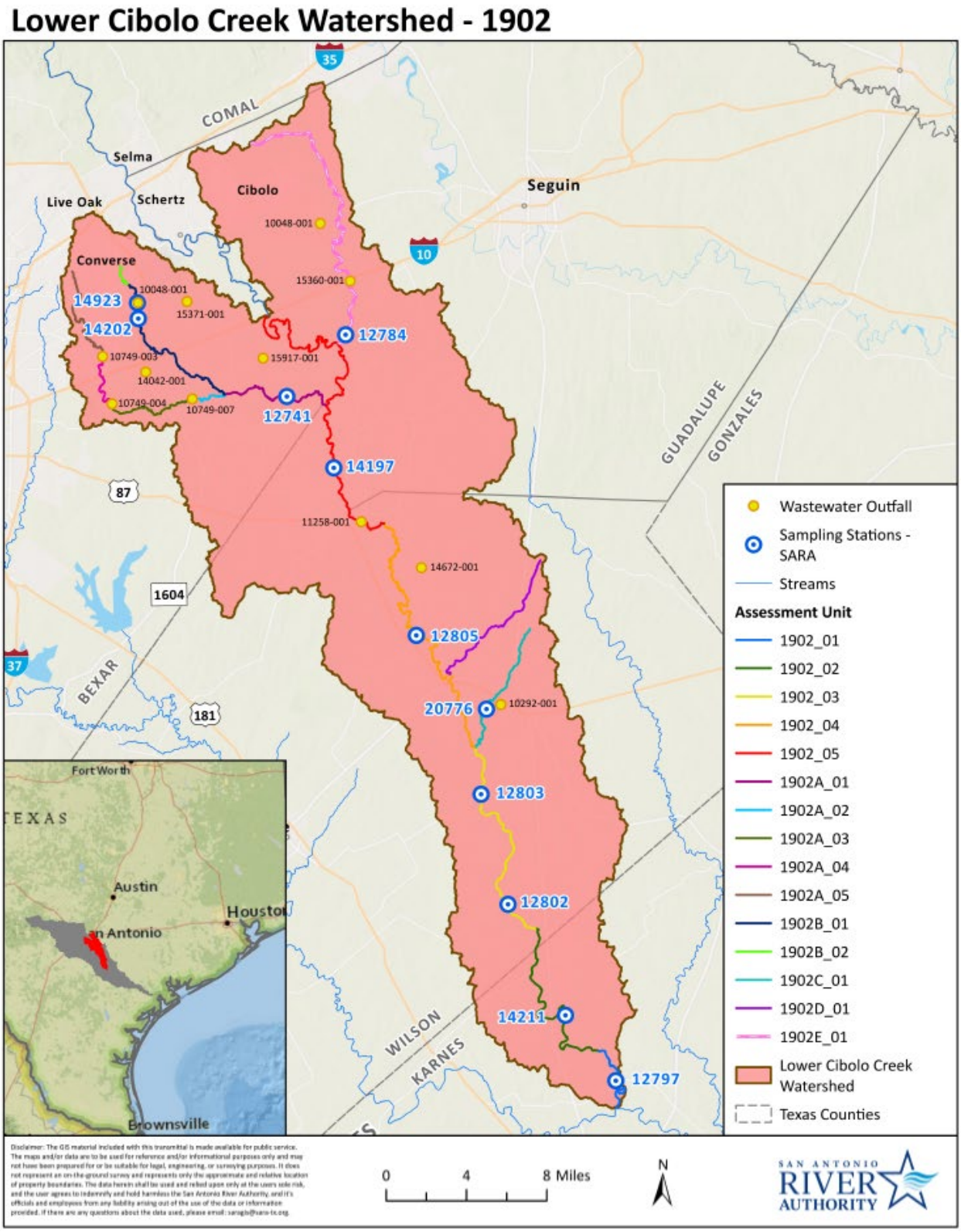

Figure 4-1: Map of Lower Cibolo Creek Watershed. Segment 1902 with current sampling stations and permitted wastewater treatment plants identified.

Segment Description:

Lower Cibolo Creek - from the confluence with the San Antonio River in Karnes County to a point 100 meters (110 yards) downstream of IH 10 in Bexar/Guadalupe County. Lower Cibolo Creek is approximately 71 miles long with a drainage area of 546 square miles. Sampling Stations that have been historically monitored in the Lower Cibolo Watershed are listed below (bolded sites are currently being monitored this year):

- **12797: Cibolo Creek at FM 81 East of Panna Maria**
- **12802: Cibolo Creek at FM 541 West of Kosciusko**
- **12803: Cibolo Creek at FM 537 on West bank 4 miles West of SH 123 South of Stockdale**
- **12805: Cibolo Creek at FM 539**
- 12806: Cibolo Creek SE of La Vernia
- **14197: Cibolo Creek at Scull Crossing**
- **14211: Cibolo Creek at CR 389 near Cestohowa Texas**
- 20777: Cibolo Creek at FM 2724
- 21755: Cibolo Creek Approx 2.25 km upstream of FM 537
- 12784: Santa Clara Creek NW of New Berlin
- **12741: Martinez Creek on N. Gable Rd**
- **14202: Salitrillo Creek at Autumn Run**
- **14923: SARA Salitrillo WWTP 249 meters downstream from Schaefer Road**
- 20775: Clifton Branch at State Highway 97/US Highway
- **20776: Clifton Branch at Old Floresville Road/Wilson County Road 401**

Figure 4-2: Aquatic biologists and student intern electrofishing underneath fallen tree at station 14197, Cibolo Creek at Scull Crossing. (Electrofishing shocks the fish, they are stunned, caught, identified, measured and allowed to recover prior to release).

Hydrologic Characteristics:

Table 4-1: Flow statistics from USGS gage 08185500.

Cibolo Creek at Sutherland Springs (9/1/2014 to 8/31/2024) Daily Average Data			
Season	Median (cfs)	Maximum (cfs)	Minimum (cfs)
Fall	25.3	6,860.0	9.7
Winter	35.0	5,290.0	22.3
Spring	35.0	9,000.0	15.0
Summer	21.8	7,140.0	8.8
Total	30.4	9,000.0	8.8

Table 4-2: Flow statistics from USGS gage 08186000

Cibolo Creek near Falls City (9/1/2014 to 8/31/2024) Daily Average Data			
Season	Median (cfs)	Maximum (cfs)	Minimum (cfs)
Fall	29.5	7,420.0	2.9
Winter	39.7	5,190.0	25.7
Spring	41.5	8,410.0	0.0
Summer	27.2	11,000.0	3.0
Total	35.4	11,000.0	0.0

Table 4-3: Flow statistics from USGS gage 08185100

Martinez Creek near Saint Hedwig (9/1/2014 to 8/31/2024) Daily Average Data			
Season	Median (cfs)	Maximum (cfs)	Minimum (cfs)
Fall	10.7	2,260.0	5.4
Winter	13.1	1,700.0	7.2
Spring	9.5	2,120.0	6.0
Summer	9.5	3,950.0	5.3
Total	12.0	3,950.0	5.3

Land Use and Natural Characteristics:

Lower Cibolo Creek is perennial, due in large part to wastewater discharges into the Mid Cibolo and the large treatment plants that discharge into Salitrillo Creek and Martinez Creek.

Communities that are all or part of the Lower Cibolo Creek Watershed include: Universal City, Converse, Schertz, Live Oak, Adkins, St. Hedwig, Marion, Cibolo, New Berlin, La Vernia, Sutherland Springs, Stockdale, Kosciusko, and Panna Maria.

There are numerous communities that discharge wastewater into wastewater treatment plants owned and operated by the San Antonio River Authority, that are not necessarily in the watershed. This includes parts of eastern/northeast Bexar County and the City of San Antonio. Other communities such as Marion, La Vernia, and Stockdale have their own smaller wastewater treatment plants that discharge into the Lower Cibolo Watershed. Smaller communities and rural areas rely on individual septic systems.

Land use in the Lower Cibolo Watershed spans the East Central Texas Plains ecoregion, and reflects a blend of agricultural land, natural vegetation, and various stages of development. Pasture and hay fields dominate the landscape, covering 36.3% of the area, with species such as buffalograss (*Bouteloua actyloides*), blue grama (*Bouteloua gracilis*), and side-oats grama (*Bouteloua curtipendula*) being common in the pastures. Shrubland, comprising 30.9% of the watershed, supports a variety of plants like Texas sagebrush (*Leucophyllum frutescens*), yucca (*Yucca filamentosa*), prickly pear cactus (*Opuntia basilaris*) and mesquite (*Prosopis glandulosa*), providing vital habitat for local wildlife. Cultivated crops (10.5%) are typically fields of cotton, corn, or sorghum, with some native plants and wildflowers occasionally found near edge habitats. Deciduous forests, covering 7.7%, are typically found along riparian areas and include trees like pecan (*Carya illinoinensis*), sycamore (*Platanus occidentalis*), cottonwood

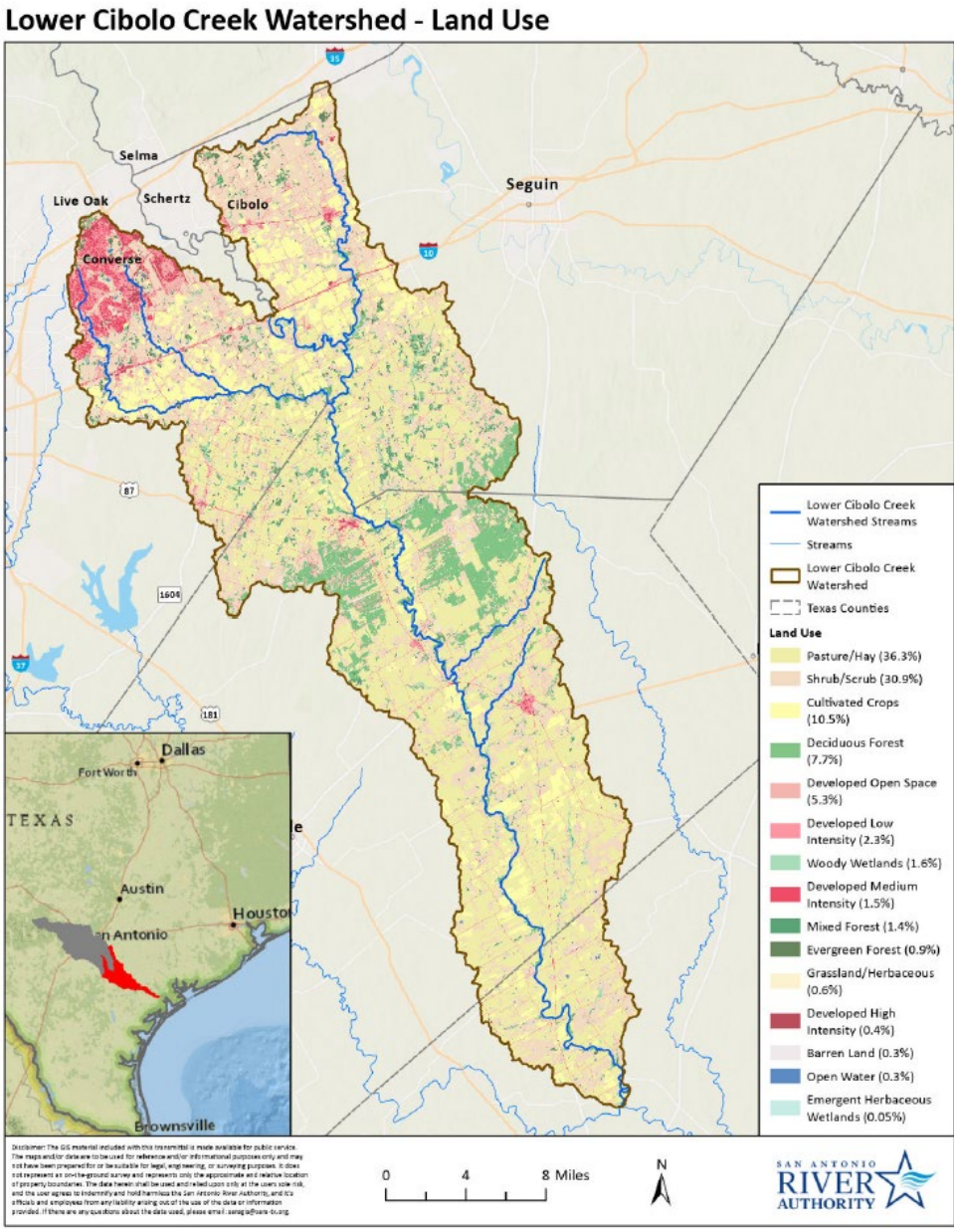

Figure 4-3: Lower Cibolo Creek Watershed land use.

(*Populus deltoides*) and Texas black walnut (*Juglans macrocarpa*). Developed open spaces (5.3%) such as parks and recreational areas are home to grasses, live oaks (*Quercus virginiana*), and native shrubs like agarita (*Mahonia trifoliolata*). Developed low-intensity areas (2.3%) consist of rural residential properties, where native species such as huisache (*Vachellia farnesiana*) and blackbrush (*Coleogyne ramosissima*) intermingle with cultivated plants. Woody wetlands (1.6%) in floodplain areas support species like willows (*Salix*), bald cypress (*Taxodium distichum)*, and buttonbush (*Cephalanthus occidentalis*). Developed medium-intensity zones (1.5%) include suburban developments with a mix of ornamental plants and native species like cedar elm (*Ulmus crassifolia*) and live oak (*Quercus virginiana*). Mixed forests (1.4%) are characterized by a blend of hardwoods like oak and mesquite. Evergreen forests,

though limited to 0.9%, are found in the higher elevations with trees such as Ashe juniper (*Juniperus ashei*), cedar elm (*Ulmus crassifolia*), and live oak (*Quercus virginiana*). Grassland and herbaceous areas (0.6%) host native grasses like little bluestem (*Schizachyrium scoparium*), side-oats grama (*Bouteloua curtipendula*), and Indian grass (*Sorghastrum nutans*), while developed high-intensity areas (0.4%) are urbanized with little natural vegetation.

Agriculture is an important economic and cultural driver in the Lower Cibolo Creek Watershed. Cattle ranching and farming are common. However there are no cattle concentrated animal feeding operations (CAFO) currently in the Lower Cibolo Creek Watershed. There is a CAFO in Guadalupe County that is in the Lower Cibolo Creek Watershed. This CAFO is a poultry operation.

Prior to 2010, there were few well pads and infrastructure associated with oil production near Cibolo Creek in Wilson and Karnes County. By 2015, Oil production increased dramatically with well pads, traffic, and substantially more people in this area.

Currently there is still substantial oil production, but little increase in the number of pads since 2015. There is also less traffic and less people servicing the oil production industry today than in 2015. See Google Earth screen shots from 2010, and 2020 (see figure 4-4 and 4-5).

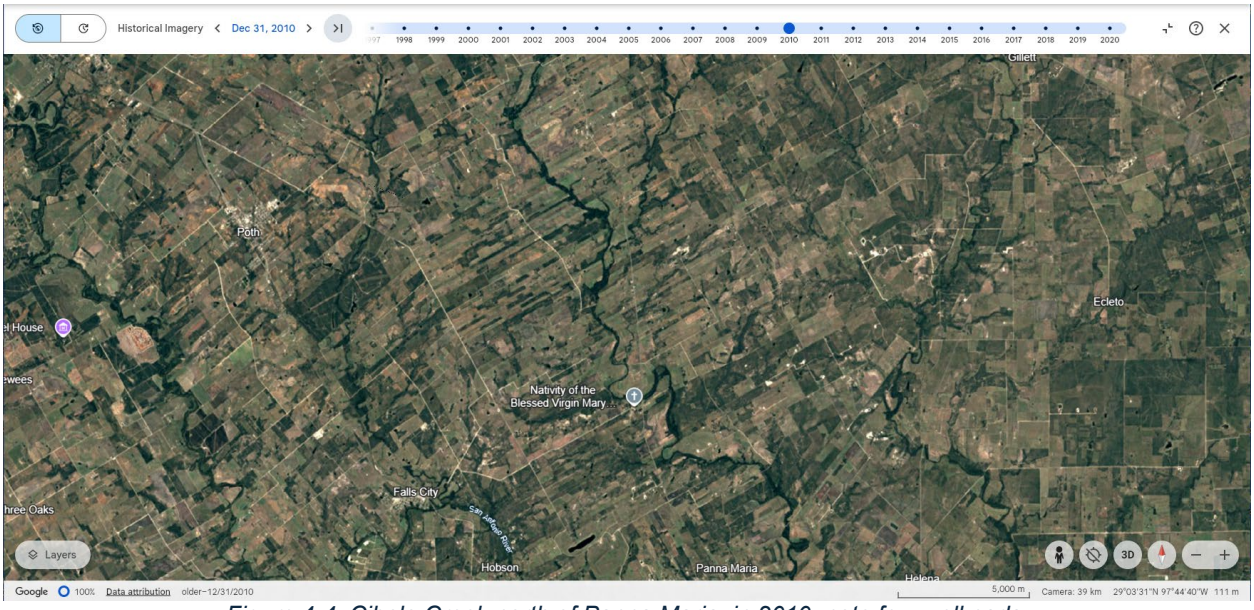

Figure 4-4: Cibolo Creek north of Panna Maria, in 2010, note few well pads.

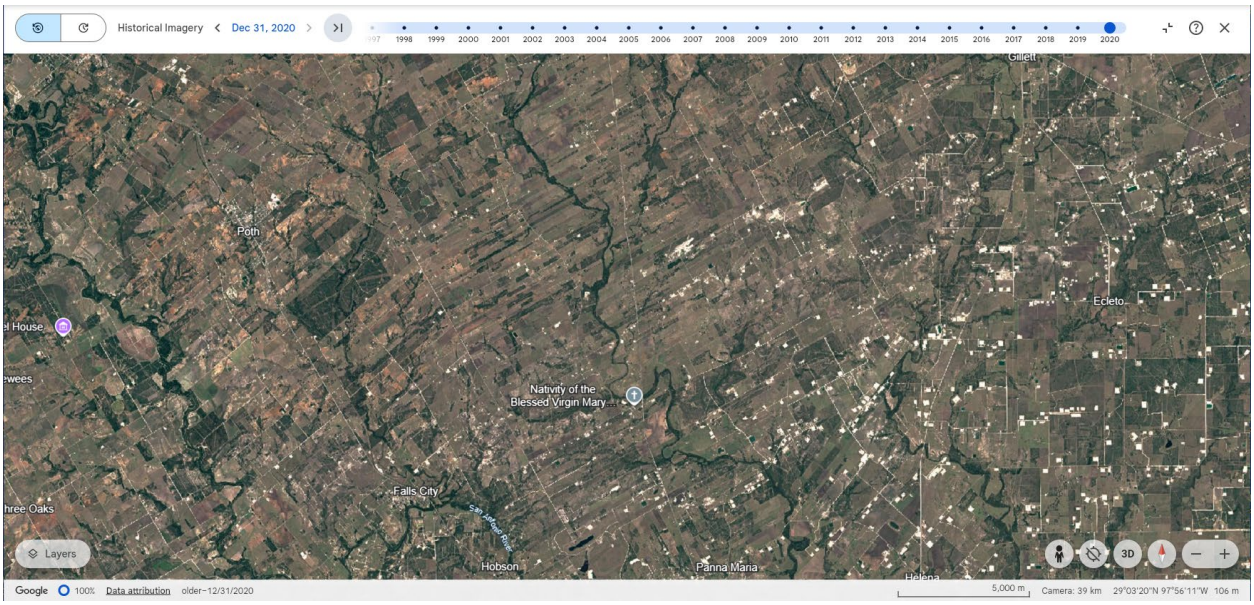

Figure 4-5: Cibolo Creek north of Panna Maria, in 2020

Figure 4-6: SARA staff conducting a habitat assessment at station 12802, Cibolo Creek at FM 541 west of Kosciusko

Water Quality Issues:

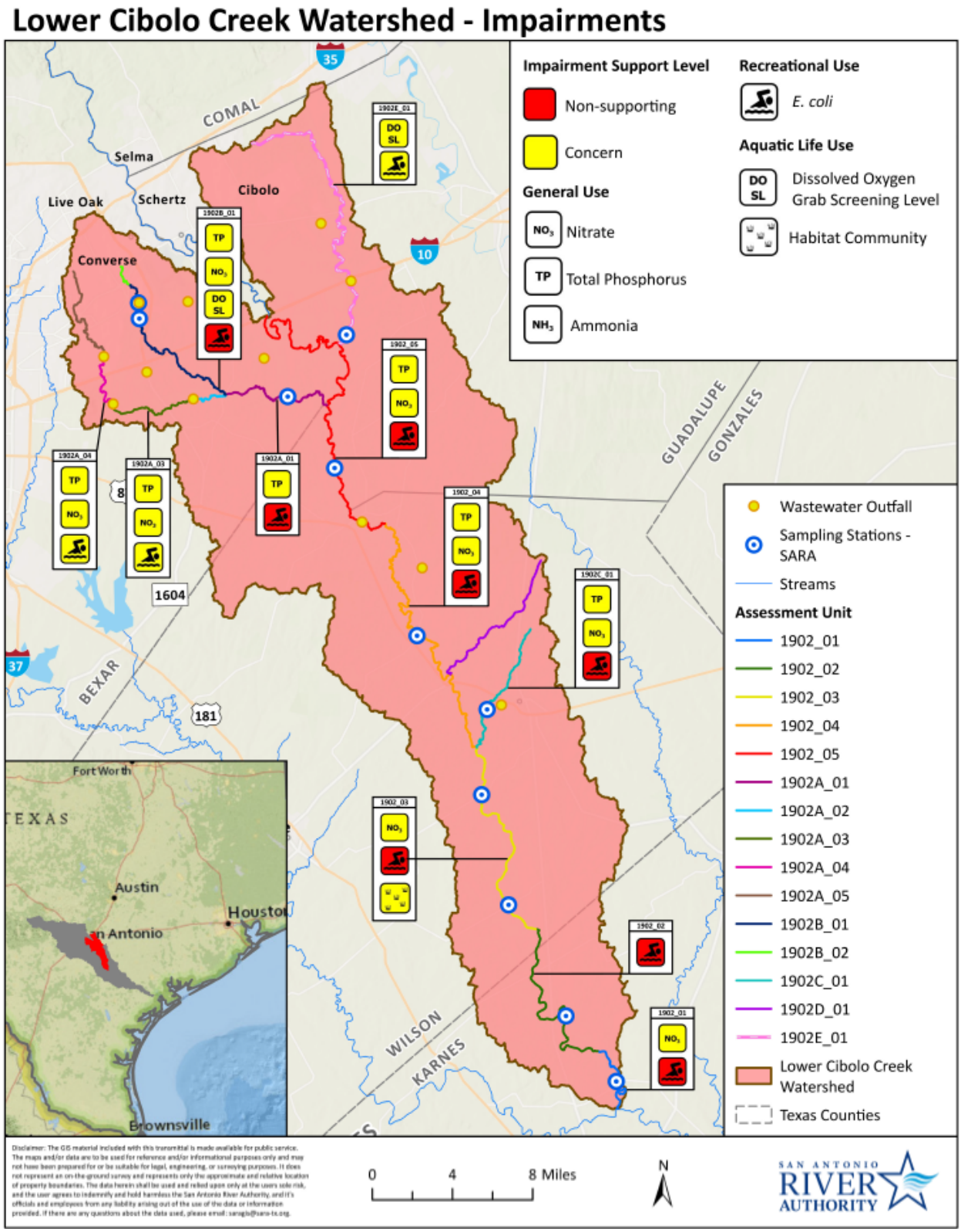

Figure 4-7: Lower Cibolo Creek Watershed impairments and concerns.

A review of the 2024 IR indicated that several AUs for Lower Cibolo Creek and its tributaries are not supporting the stream standard for *E. coli* bacteria. In addition, in 2014, Clifton Branch was placed on the EPA's 303(d) list of impaired waterbodies for 24 hour dissolved oxygen readings for both the average and minimum standard. There are also concerns for *E. coli*, nutrients, dissolved oxygen, macrobenthic (aquatic bugs) communities and habitat.

See tables 4-4 to 4-8 for a listing of specific AU impairments and concerns.

Table 4-4: Lower Cibolo Creek contact recreation E. coli bacteria impairments.

Lower Cibolo Creek						
Parameter	AU	Year First on 303(d) list of impaired Waterbodies	Number of Samples Assessed	Geometric Mean	TCEQ Water Quality Standard	Integrated Level of Support
E. coli Bacteria	Cibolo Creek 1902_01	2004	77	177.3	126	Not supporting
E. coli Bacteria	Cibolo Creek 1902_02	2004	353	256.42	126	Not supporting
E. coli Bacteria	Cibolo Creek 1902_03	2004	21	183.05	126	Not supporting
E. coli Bacteria	Cibolo Creek 1902_04	2004	68	163.43	126	Not supporting
E. coli Bacteria	Cibolo Creek 1902_05	2004	42	155.69	126	Not supporting

Table 4-5: Lower Cibolo Creek Watershed tributaries contact recreation E. coli bacteria impairments and concerns for near non-attainment. AUs with concerns are not listed on the EPA 303(d) list of impaired AUs.. AUs 1902A_03 & 04 were carried forward from previous integrated reports, since sufficient data was not available during the 24 IR period of record.

Lower Cibolo Creek Watershed Tributaries						
Parameter	AU	Year First on 303(d) list of impaired Waterbodies	Number of Samples Assessed	Geometric Mean	TCEQ Water Quality Standard	Integrated Level of Support
E. coli Bacteria	Martinez Creek 1902A_01	2016	42	549.6	126	Not supporting
E. coli Bacteria	Martinez Creek 1902A_03	--	--	--	126	Concern

Lower Cibolo Creek Watershed Tributaries						
Parameter	AU	Year First on 303(d) list of impaired Waterbodies	Number of Samples Assessed	Geometric Mean	TCEQ Water Quality Standard	Integrated Level of Support
E. coli Bacteria	Martinez Creek 1902A_04	--	--	--	126	Concern
E. coli Bacteria	Salitrillo Creek 1902B_01	2010	41	242.1	126	Not supporting
E. coli Bacteria	Clifton Branch 1902C_01	2014	64	344.58	126	Not supporting
E. coli Bacteria	Santa Clara Creek 1902E_01	--	29	138.18	126	Concern

Table 4-6: Lower Cibolo Creek nutrient screening concerns. AUs 1902A_03 & 04 were carried forward from previous integrated reports, since sufficient data was not available during the 24 IR period of record.

Lower Cibolo Creek Nutrients						
Parameter	AU	Number of Samples Assessed	Number of Exceedances	Percent Exceeded Screening Level	TCEQ Screening Level	Integrated Level of Support
Nitrate Nitrogen	Lower Cibolo Creek 1902_01	73	24	32.9	1.95 mg/L	Concern
Nitrate Nitrogen	Lower Cibolo Creek 1902_03	21	10	47.6	1.95 mg/L	Concern
Nitrate Nitrogen	Lower Cibolo Creek 1902_04	64	44	68.8	1.95 mg/L	Concern
Nitrate Nitrogen	Lower Cibolo Creek 1902_05	40	34	85.0	1.95 mg/L	Concern
Total Phosphorus	Lower Cibolo Creek 1902_04	68	45	66.2	0.69 mg/L	Concern
Total Phosphorus	Lower Cibolo Creek 1902_05	42	27	64.3	0.69 mg/L	Concern

Table 4-7: Lower Cibolo Creek Tributaries nutrient and dissolved oxygen screening concerns and impairments. AUs 1902A_03 & 04 were carried forward from previous integrated reports, since sufficient data was not available during the 24 IR period of record.

Lower Cibolo Creek Tributaries Nutrients and Dissolved Oxygen						
Parameter	AU	Number of Samples Assessed	Number of Exceedances	Percent Exceeded Screening Level	TCEQ Screening Level	Integrated Level of Support
Nitrate Nitrogen	Martinez Creek 1902A_03	--	--	--	1.95 mg/L	Concern
Nitrate Nitrogen	Martinez Creek 1902A_04	--	--	--	1.95 mg/L	Concern
Nitrate Nitrogen	Salitrillo Creek 1902B_01	40	16	40.0	1.95 mg/L	Concern
Ammonia Nitrogen	Clifton Branch 1902C_01	62	20	32.2	0.33 mg/L	Concern
Total Phosphorus	Martinez Creek 1902A_01	42	39	92.8	0.69 mg/L	Concern
Total Phosphorus	Martinez Creek 1902A_03	--	--	--	0.69 mg/L	Concern
Total Phosphorus	Martinez Creek 1902A_04	--	--	--	0.69 mg/L	Concern
Total Phosphorus	Salitrillo Creek 1902B_01	41	41	100.0	0.69 mg/L	Concern
Total Phosphorus	Clifton Branch 1902C_01	64	24	37.5	0.69 mg/L	Concern
Dissolved Oxygen Grab Average	Salitrillo Creek 1902B_01	41	9	22.0	5 mg/L	Concern
Dissolved Oxygen Grab Average	Santa Clara Creek 1902E_01	29	7	24.1	3 mg/L	Concern
Dissolved Oxygen 24 Hour Average	Clifton Branch 1902C_01	16	10	62.5	3 mg/L	Not Supporting
Dissolved Oxygen 24 Hour Minimum	Clifton Branch 1902C_01	16	15	93.8	2 mg/L	Not Supporting

Table 4-8: Lower Cibolo Creek macrobenthic community near non-attainment concerns and habitat screening concerns.

Lower Cibolo Creek Biological Communities and Habitat					
Parameter	AU	Number of Samples Assessed	Data Mean	TCEQ Screening Level	Integrated Level of Support
Impaired Macrobenthic Community	Lower Cibolo Creek 1902_02	4	30.64	30	Concern
Habitat	Lower Cibolo Creek 1902_03	14	18.57	14	Concern

Potential Causes of Water Quality Issues:

The two main water quality issues are elevated *E. coli* bacteria levels and nutrients.

E. coli bacteria:

Cibolo Creek and it's tributaries are designated for primary contact recreation 1 (PCR1). PCR1 activities involve a significant risk of ingestion of water with activities such as swimming , diving, tubing and hand fishing. *E. coli* bacteria is measured to determine if a waterbody is meeting the PCR1 standard. We measure *E. coli* bacteria because it is an indication of recent fecal contamination. A waterbody is considered fully supporting the PCR1 if the geometric mean is at or below 126 MPN per 100 mL.

None of the AUs of Mid Cibolo Creek are identified as impaired. The lower portion of the Mid-Cibolo (AU 1913_03) that flows into the Lower Cibolo is currently meeting the *E. coli* standard. Unfortunately, all AUs for the Lower Cibolo are identified as impaired for *E. coli* bacteria and listed on the EPA 303(d) list of impaired water bodies.

Limited bacteria source tracking data collected from 2014 to 2015 at Cibolo Creek at CR 389 (Stn.14211) indicate that 59% of the bacteria are from wildlife, 18% are from livestock, 6% are from human, 2% are from pets and 15% are from unknown sources.

Limited bacteria source tracking data collected from 2013 to 2015 at Cibolo Creek at FM 81 (Stn. 12797) indicate that 58% of the bacteria are from wildlife, 27% are from livestock, 10% are from human, 5% are from unknown sources.

E. coli levels from the Mid Cibolo (segment 1913) are fully supporting the stream standard for *E. coli* bacteria. However, the water coming from Santa Clara Creek (1902E) is identified as a concern with an *E. coli* geometric mean of 138.18. Santa Clara Creek is likely not causing a large impact on Cibolo Creek since it has little flow (median flow was 0.2 cfs with over 40% of the time flows were less than 0.01 cfs when sampling).

E. coli geometric mean from the 24 IR for Martinez Creek was 549.6 MPN per 100 mL. The median flow from when samples were taken was 12 cfs. It is impacting Cibolo Creek considerably more than Santa Clara Creek.

The San Antonio River Authority has three wastewater treatment plants on Martinez Creek (Martinez I: 2.21 MGD permitted flow, Martinez II: 3.5 MGD permitted flow, Martinez IV: 2.0 MGD permitted flow) and one wastewater treatment plant on Salitrillo Creek with a 7.33 MGD permitted flow. Salitrillo Creek is a tributary of Martinez Creek.

The *E. coli* geometric mean for Salitrillo Creek in the 24 IR was 242.1 MPN per 100 mL. SARA's Environmental Sciences Department monitors the discharge from the Salitrillo Wastewater Treatment Plant. The geometric mean was 18.5 MPN per 100 mL, so this is in line with the bacteria source tracking data, that the majority of the *E. coli* values are not from the wastewater treatment plants.

Clifton Branch also has an elevated *E. coli* level 344.58 MPN per 100 mL from the integrated report, but like Santa Clara Creek, this creek has very low flows with a median flow rate of 0.3 cfs.

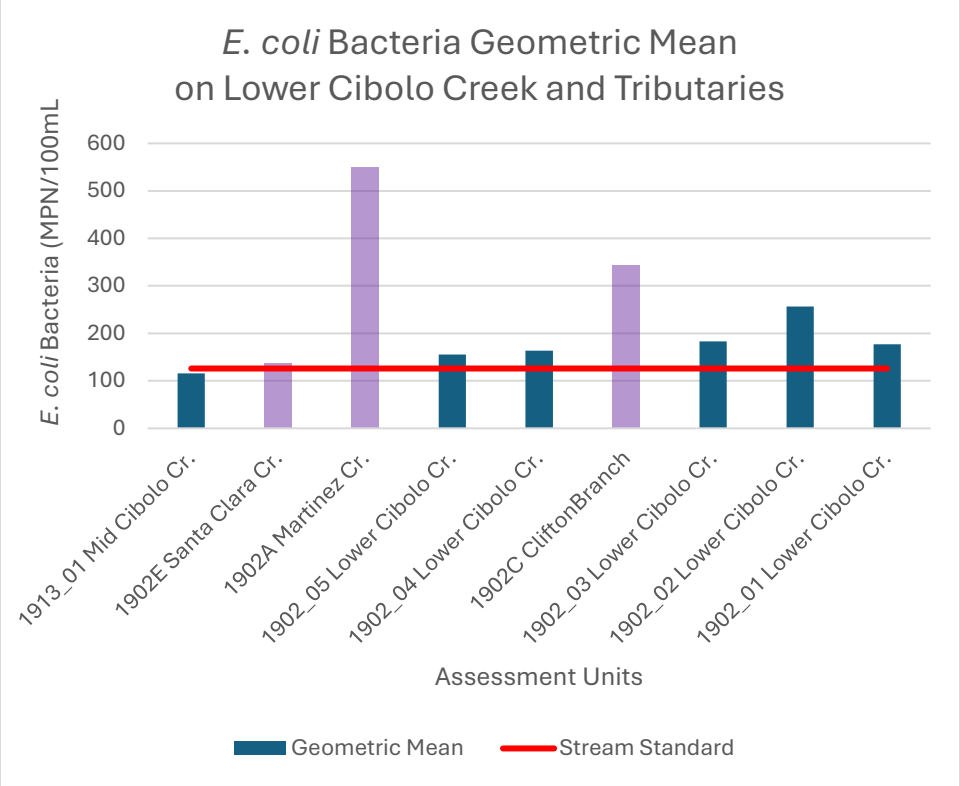

Figure 4-8: Graph shows the geometric mean for each AU in the Lower Cibolo Creek Watershed as listed in the 24 IR. The lower AU for Mid Cibolo was also listed since it flows into Lower Cibolo Creek. The blue columns are Cibolo Creek, while the purple columns are tributaries. Values above the red line are not meeting the TCEQ standard. The values go from upstream (left) to downstream (right).

While the upper portion of Salitrillo Creek and Martinez Creek are urban, the downstream portions of these creeks are more rural. Numerous small hobby farms exit. As you move downstream on Cibolo Creek the farms and ranches get larger. There are more row crops and ranch land. Wildlife is common, and livestock are also common in this area. During stormwater events, fecal matter washes into the creeks. In addition, *E. coli* bacteria in the stream bed gets resuspended. *E. coli* levels are higher during stormwater runoff conditions.

Nutrients:

Nutrients are needed for the development of aquatic plants and algae. These are the bases for the food web that support the aquatic ecosystems. However, elevated levels of nutrients can cause algae blooms and overgrowth of aquatic plants. It can increase the diurnal amplitude of dissolved oxygen levels in a creek. When the sun is out, photosynthesis occurs and dissolved oxygen levels are high, but when photosynthesis is not occurring at night, or excessive algae or plants are decaying, dissolved oxygen levels can get very low, causing stress and even death to aquatic organisms.

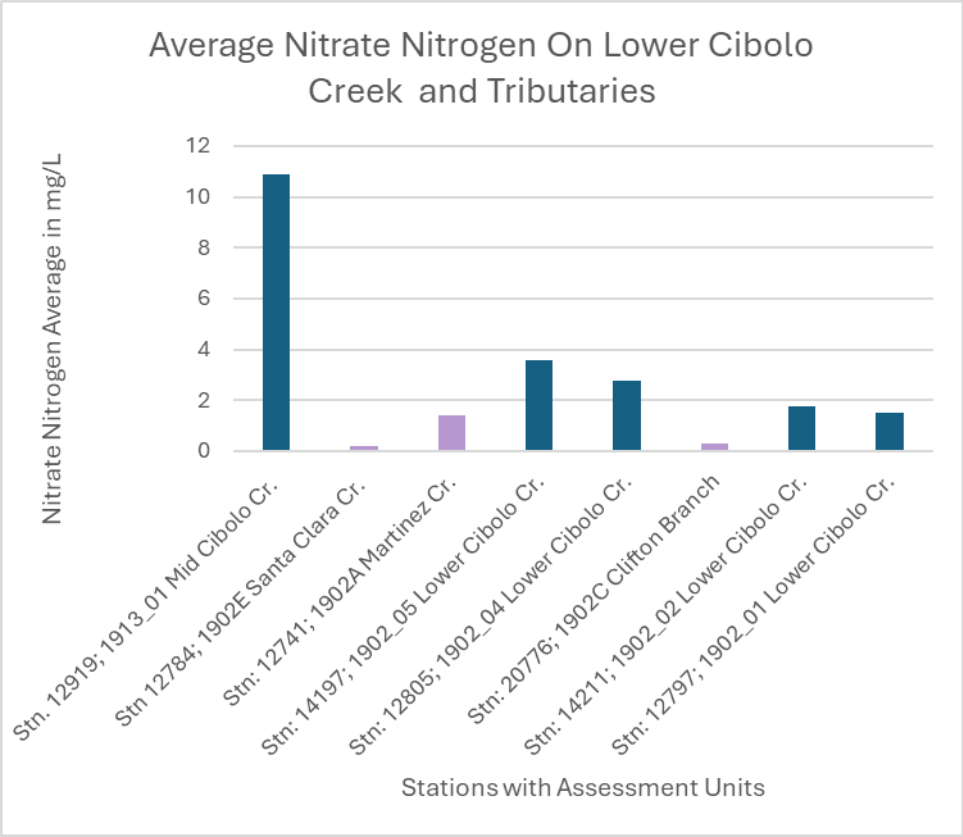

Figure 4-9: Graph shows the average nitrate nitrogen level for monitoring station locations on Cibolo Creek and its tributaries. The lower AU for Mid Cibolo was also listed since it flows into Lower Cibolo Creek. The blue columns are Cibolo Creek, while the purple columns are tributaries. The values go from upstream (left) to downstream (right).

Determining the appropriate level of nutrients in an aquatic system is a delicate balancing act. If the values are too high, you can create low dissolved oxygen levels which can cause fish kills and dead zones. If the nutrient level is too low, you can starve the aquatic ecosystem and harm fisheries in our rivers, creeks, bays and estuaries. Currently, the screening level for nitrate nitrogen is at or below 1.95 mg/L. Total phosphorus screening level is at or below 0.69 mg/L. Nitrate nitrogen is identified as a concern on all AUs on the Lower Cibolo Creek, except AU 1902_02 which is the lower portion of the segment. AU 1902_02 had 11 values out of 42 samples exceed the screening level, however if 12 values had exceeded the screening level, the AU would have been identified as a concern.

A review of data shows that most of the elevated nitrate nitrogen levels are under low or ambient flow conditions. However, the upper two AUs (1902_05 and 1902_04) are also negatively influenced by stormwater runoff events. This is likely due to the impact of stormwater runoff events in the highly urbanized area of Bexar County flowing into Wilson County and the increasing urbanization and growth of hobby farms in northern Wilson County. Wilson County has cattle production along with row crops like grain sorghum, peanuts, corn and hay. All of these have the potential for causing elevated nitrate levels during stormwater events.

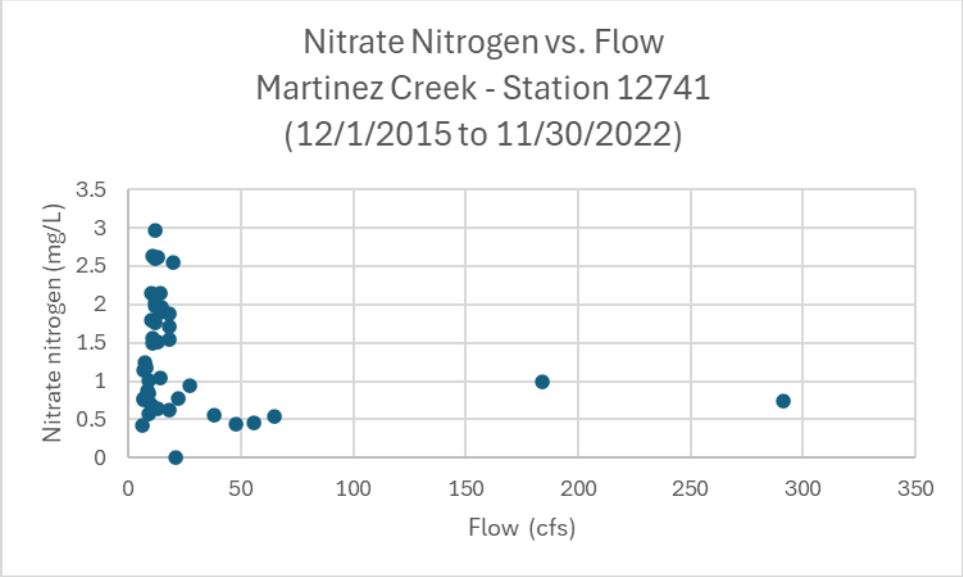

Figure 4-10: Graph compares nitrate nitrogen levels to flow. While nitrate nitrogen is not identified as a concern in the 24 IR, this graph shows that the levels are higher under low and ambient conditions indicating that the source of the nitrate nitrogen is due to point source discharge. Values greater than 1.95 mg/L are not meeting the TCEQ screening level for nitrate nitrogen.

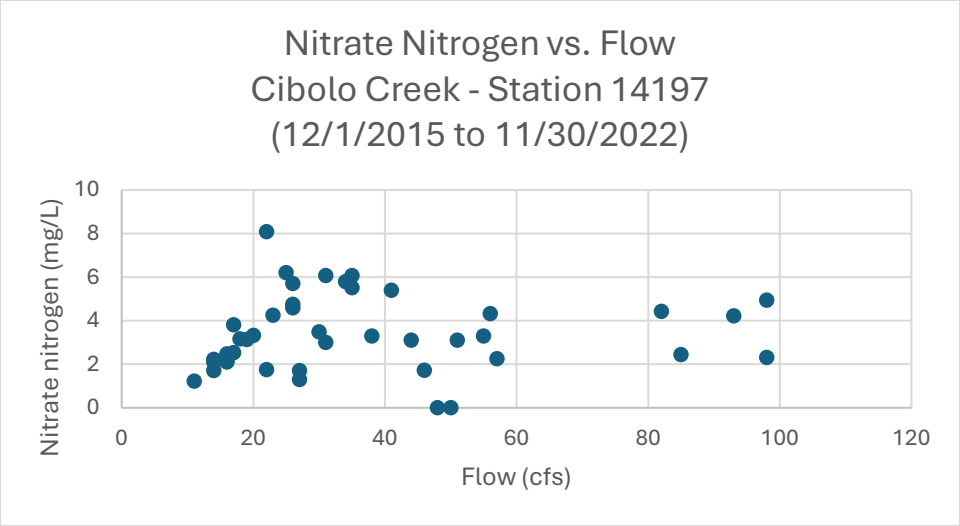

Figure 4-11: Graph compares nitrate nitrogen levels to flow. Nitrate nitrogen levels are elevated under ambient and high flow conditions indicating that the source of the nitrate nitrogen is due to both point source and non-point source discharge such as storm water runoff.

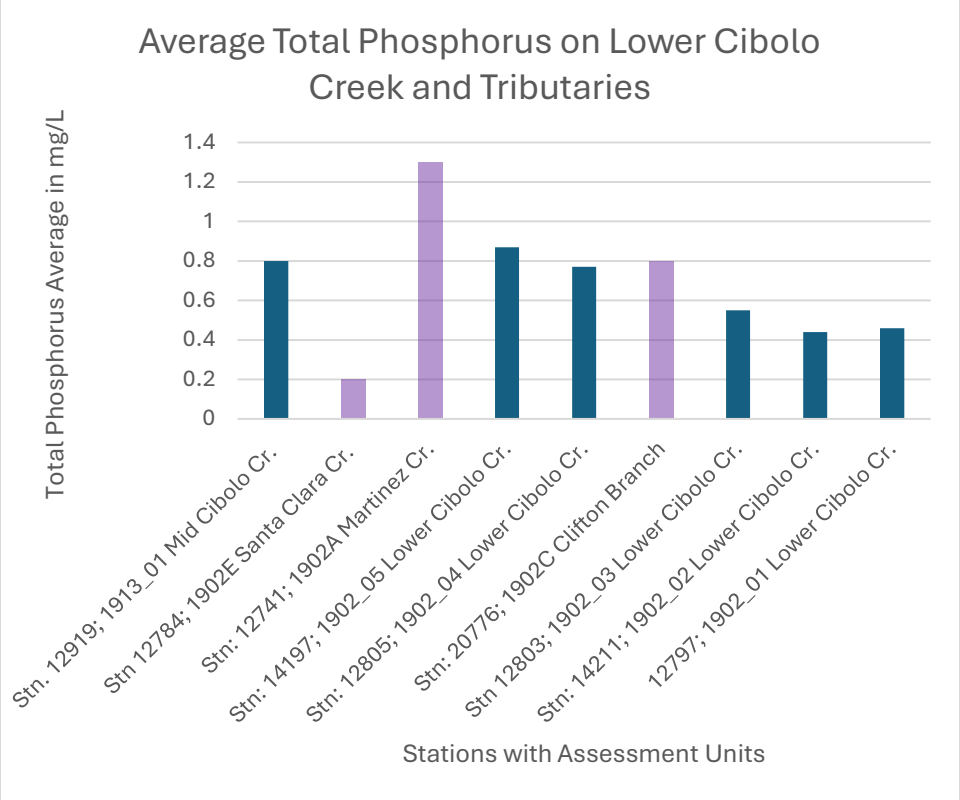

Figure 4-12: Graph shows the average total phosphorus level for monitoring station locations on Cibolo Creek and its tributaries. The lower AU for Mid Cibolo is also listed since it flows into Lower Cibolo Creek. The blue columns are Cibolo Creek, while the purple columns are tributaries. The stations go from upstream (left) to downstream (right).

Currently Mid Cibolo Creek which feeds into Lower Cibolo Creek (AU 1902_05) has a concern for total phosphorus. In addition, Martinez Creek which is a tributary of Lower

Cibolo Creek and confluences with Lower Cibolo Creek in AU 1902_05 also has a concern for total phosphorus identified in the TCEQ 24 IR. The main source is from wastewater treatment plant discharges. AU1902_05 flows into AU 1902_04 which also has a concern identified for total phosphorus. As Cibolo Creek flows downstream, with no major wastewater treatment plants discharging into the creek, phosphorus is removed through sedimentation and biological uptake by algae, aquatic plants, and microbes.

The City of Stockdale has a wastewater treatment plant that discharges to an unnamed tributary of Clifton Branch which flows into Cibolo Creek. Clifton Branch is identified in the TCEQ 24 IR as a concern for phosphorus, but this wastewater treatment plant is only permitted to discharge a daily average flow of 0.3 MGD. Clifton Branch naturally has little flow. The flows ranged from <0.01 to 2.7 cfs when sampling. Even though it has a concern for phosphorus, it contributes little phosphorus to Lower Cibolo Creek due to the low flow.

Clifton Branch is also identified as a concern for ammonia nitrogen. During the period of record, there are two stations that were monitored, station 20775 which is located upstream of the discharge from the City of Stockdale's wastewater treatment plant at State Highway 97, and station 20776 which is located downstream of the wastewater discharge at Old Floresville Road.

A review of the data indicates that ammonia exceedances occur only at station 20776 which is downstream of the wastewater treatment plant. Comments by the sample collectors indicate that there are swallow bird nests under the bridge near where they sample and fecal matter on the ground. This is obviously contributing to the nitrogen levels. However, elevated ammonia levels are measured year-round including during the winter when the swallows should have migrated to Central and South America. The wastewater treatment plant is not required to report nitrogen levels, but it is likely also a source of the elevated ammonia nitrogen levels in the creek. Even though it has a concern for ammonia nitrogen, it contributes little nitrogen to Lower Cibolo Creek due to the low flow of Clifton Branch.

Habitat in Water:

AU 1902_03 is in the lower portion of Wilson County. The aquatic life use for Cibolo Creek is designated as high. The habitat quality index for this AU scored intermediate. Two stations have habitat data in that AU:

- Station 21755 – Cibolo Creek upstream of FM 537 Southwest of Stockdale
- Station 12802 – Cibolo Creek at FM 541 West of Kosciusko.

Figure 4-13: SARA intern conducting habitat transect at station 12802. Note bank failure, exposed soil and tree roots.

Both bank stability and bottom substrate were scored moderately unstable. Minimal habitat complexity exists in this area. Several cobble/gravel dominated riffles exist, however, the dominant substrate identified most often was sand, which is unstable in elevated flows. The lack of larger substrates likely also accounted for the low score for available instream cover. Soil maps of Wilson County indicate that the dominant soil type in this area is a sandy loam, which aligns with the lack of bank stability and increased erosion potential in the AU.

Due in part to the highly urbanized area around IH 35 and FM 78 of Mid Cibolo Creek that feeds into the Lower Cibolo Creek and the large watershed, stormwater runoff can cause substantial floods and erosion of the beds and banks of Lower Cibolo Creek. Though the habitat scores as intermittent, the fish community appears to be resilient and is currently fully supporting the high aquatic life use in this AU.

Impaired Macrobenthic Community:

In the 24 IR, AU 1902_02 has a concern for macrobenthic community in water. The concern designation was carried forward from previous years. However, the initial evaluation of the data from this period of record indicated that the data was fully supportive of the aquatic life use designation, but that the data was not temporally representative.

The three metrics that scored low in evaluating benthic macroinvertebrates during the period of record are:

- Ratio of intolerant species to tolerant taxa: The low ratio is an indication of physiochemical degradation.
- Percent of total Trichoptera as Hydropsychidae: benthic macroinvertebrates from the order Trichoptera are common in Texas streams. The family Hydropsychidae is considered the most tolerant to changes (disturbance) in the environment. So, a high percentage of Hydropsychidae is an indication of physicochemical degradation.
- Number of non-insect taxa: in Texas, samples from pristine streams tend to have non-insect taxa while the number of non-insect taxa is typically lower in impaired streams.

Figure 4-14:Station 14211 (AU 1902_02) Cibolo Creek at CR 389 near Cestohowa, Texas.

Depressed Dissolved Oxygen:

Dissolved oxygen (DO) is measured in two distinct ways. The most common way that staff measure dissolved oxygen is through a grab sample. A grab sample is a measurement of dissolved oxygen that is taken at every monitoring site, when water samples are collected for routine analysis. It is a snapshot in time and because of sampling schedules it is almost always collected during the day. The amount of dissolved oxygen changes throughout the day, when the sun is out, photosynthesis occurs creating dissolved oxygen. Dissolved oxygen levels are typically high when grab samples are collected, but when photosynthesis is not occurring at night, and/or excessive algae and plants are decaying dissolved oxygen is not being created through

photosynthesis and oxygen is consumed which can causes levels to get very low, causing stress and even death to aquatic organisms. Because of this change in oxygen levels, 24 hours diurnal monitoring is also conducted. An instrument is placed in the stream and left out for at least 24 hours. This instrument measures dissolved oxygen levels every 15 minutes. This provides a comprehensive understanding of dissolved oxygen levels in a stream.

Stream flow also plays a critical role in providing increased dissolved oxygen levels. Flowing water physically mixes the stream with air allowing more dissolved oxygen in the stream.

Figure 4-15: Station 20776 Clifton Branch at Old Floresville Road. SARA aquatic biologist preparing to measure flow.

Lower Cibolo Creek is dominated by wastewater treatment plants that discharge millions of gallons per day of nutrient rich water into Cibolo Creek. Due in part to the continuous flow even during periods of drought, Lower Cibolo Creek has no impairments or concerns for dissolved oxygen. However, two of the tributaries to the Lower Cibolo Creek (Salitrillo Creek and Santa Clara Creek) do have concerns for the grab collected DO when compared to the average screening level, and one tributary (Clifton Branch) is not supporting the standard for both the 24 hour diurnal dissolved oxygen average and minimum standard.

All three of these creeks have wastewater treatment plant discharges. Salitrillo Creek's discharge is from a major wastewater treatment plant while Clifton Branch and Santa Clara Creek are much smaller plants. Salitrillo and Clifton Branch both have nutrient concerns. Santa Clara Creek does not have any nutrient concerns, but it has very low flows. Forty one percent of the flows collected when sampling are <0.01cfs.

It is believed that the DO impairment on Clifton Branch is due to a combination of very low flow along with elevated nutrient concerns (ammonia nitrogen and total phosphorus).

Potential Stakeholders:

Below is a list of organizations who have a vested interest in water quality and ecological health of the Lower Cibolo Watershed and who may have representatives willing to serve as stakeholders for future implementation plans or watershed protection plans.

- City of La Vernia
- City of Marion
- City of Stockdale
- Concerned citizens
- Evergreen Underground Water Conservation District
- Guadalupe Blanco River Authority
- Guadalupe County
- Guadalupe County Farm Bureau
- Guadalupe County Groundwater District
- Karnes County Farm Bureau
- Karnes County Soil and Water Conservation District
- San Antonio River Authority
- San Antonio River Environmental Advisory Committee
- Texas AgriLife - Texas Water Resources Institute, and County Extension Agents
- Texas Commission on Environmental Quality
- Texas Department of Agriculture
- Texas Parks and Wildlife Department
- Texas State Soil and Water Conservation Board
- Texas Stream Team with the Meadows Center for Water and the Environment at Texas State University
- Texas Water Resources Institute
- The Nature Conservancy
- US Fish and Wildlife Service
- USDA Natural Resources Conservation Service
- Wilson County Farm Bureau
- Wilson County Soil and Water Conservation District

Recommended Actions:

- Continue monitoring on the Lower Cibolo Creek and its tributaries. Recommend adding a station on Martinez Creek.

- Continue to support efforts to provide outreach to the lower basin.

- Continue to support SARA's work on the Cibolo Creek Holistic Watershed Master Plan, and encourage implementation of Master Plan BMPs.

- Encourage the State to develop nutrient standards.

- Continue to study the potential for using constructed wetlands to reduce nutrient levels.

Ongoing Projects:

- SARA continues to conduct monitoring of water quality and biological communities. The TCEQ also continues to monitor water quality.

- Cibolo Creek Holistic Watershed Master Plan: this masterplan is a phased project at SARA designed to provide communities with sustainable solutions that address concerns with flooding, water quality, stream health and recreation. The plan covers Upper, Mid and Lower Cibolo Creek Watershed.

  Water quality data from the TCEQ's Surface Water Quality Monitoring Database (which includes CRP data) along with other relevant databases are used to support water quality modeling efforts in the Cibolo Creek Watershed. The project objective is to identify locations and develop strategies for improvement of water quality in the watershed. Specifically, to determine the location of best management practices to reduce *E. coli* bacteria and nutrients in the watershed. The current Cibolo Creek Watershed Holistic Master Plan can be found at: https://www.sariverauthority.org/wp-content/uploads/2024/02/Cibolo-Creek-Watershed-Holistic-Master-Plan-All-Phases_web.pdf.

  The water quality models and the plan are currently being updated.

- Texas Water Resources Institute (TWRI) continues to provide online and in person training for such subjects as: Texas Watershed Stewards, Introduction to Septic Systems for Homeowners, Texas Riparian and Stream Ecosystem Education, and Lone Star Healthy Streams.

Major Watershed Events:

Development:
Population growth in the Lower Cibolo has been slower than the Mid Cibolo since it is farther away from the City of San Antonio and also due to the decline in drilling in the Eagle Ford Shale in southern Wilson County and Karnes County.

Fish Kills:
A review of data provided by the Texas Parks and Wildlife's Kills and Spills Team (TPWD KAST) from 2015 to the present are listed below.

- On March 15, 2015, due to a permitted dewatering effort so dam repairs could be conducted on Miller Pond in Converse, Texas, 174 fish died due to handling stress or stranding.
- On May 4, 2015, due to a permitted dewatering effort so repairs could be conducted on Martinez Creek Dam No. 3, 766 fish died due to handling stress or stranding.
- On March 17, 2017, due to two oil wells leaking, the operator installed berms to hold the oil. A large rain event caused the berms to fail. Oil washed down into an unnamed intermittent tributary and then into Cibolo Creek. Required bioremediation was conducted, oil wells and the berms were repaired. TPWD saw no evidence of injured wildlife. .
- On February 6, 2019, SARA staff notified TPWD staff of a fish kill in Salitrillo Creek This was due to a leaking sewer pipe reported by a citizen. It had been leaking for approximately 3 days prior to the citizen contacting Universal City staff. SARA staff measured and counted 690 dead fish. Ammonia nitrogen levels ranged from 0 mg/L to 8 mg/L and dissolved oxygen levels ranged from 0.5 mg/L to 1.1 mg/L.
- On December 12, 2019, SARA staff notified TPWD staff that the SARA wastewater treatment plant discharged chlorinated water into Salitrillo Creek. SARA staff measured and collected 1028 dead fish.
- On April 15, 2020, SARA notified the KAST of a fish kill in Martinez Creek in Bexar County. SARA suspected that a recent rainstorm on April 12, 2020 sent runoff from nearby businesses into the creek and caused low dissolved oxygen levels
- On June 2, 2020, a landowner reported a fish kill on Martinez Creek downstream of Loop 1604. SARA staff were contacted by TPWD and were unable to get to the stream, but did see a few dead fish. Dissolved oxygen levels were low at 2.9 mg/L.
- On September 30, 2022, a citizen contacted TPWD of a fish kill in the south lake of the Converse Twin Lakes Park (aka Miller Pond). The dead fish were found on the north shoreline of the lake. TPWD staff suspect that the 204 dead fish were due to low dissolved oxygen levels.

Drought:

Like much of Texas, the Lower Cibolo Creek Watershed was impacted by droughts.

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