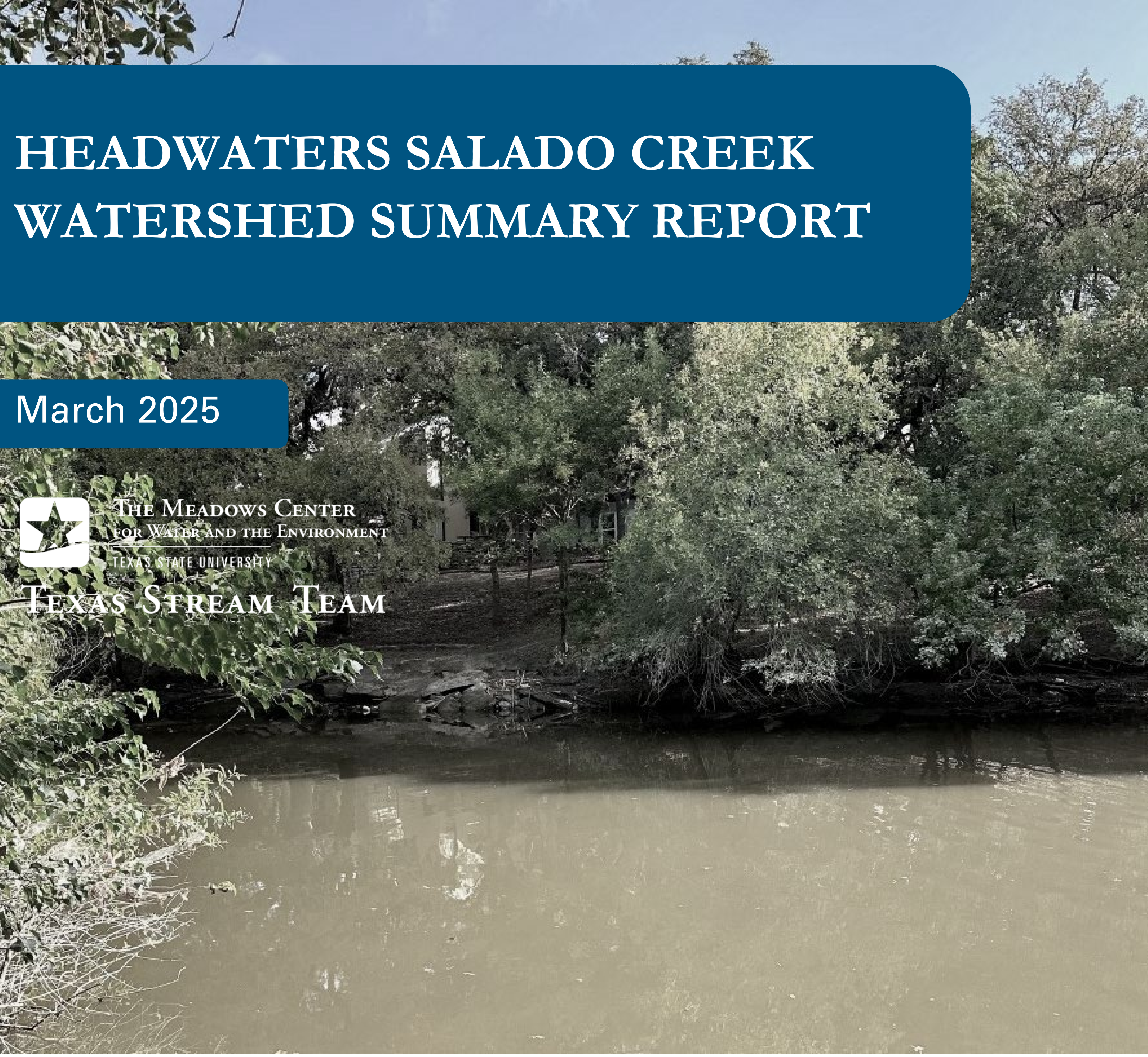
HEADWATERS SALADO CREEK WATERSHED SUMMARY REPORT

March 2025



The Meadows Center for Water and the Environment
Texas State University
Texas Stream Team

Photo credit: Kathleen Finck, Karen Wilson

United States Environmental Protection Agency

Texas Commission on Environmental Quality

Texas State University
The rising STAR of Texas

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ACKNOWLEDGEMENTS

The Texas Stream Team encourages life-long learning about the environment and people's relationship to the environment through its multidisciplinary community science programs. We also provide hands-on opportunities for Texas State University students and inspire future careers and studies in natural resource related fields. Preparation of this report fulfills a contract deliverable for the granting entity, but it also serves as a valuable educational experience for the students that assisted in preparing the report. The Texas Stream Team staff values the student contributions and recognizes each individual for their role. The following staff and student workers assisted in the preparation of this report and are acknowledged for their contributions:

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INTRODUCTION

Texas Stream Team

Texas Stream Team is a volunteer community science water quality monitoring program. Community scientist water quality monitoring occurs at predetermined monitoring sites, at approximately the same time of day each month. Information collected by Texas Stream Team community scientists is covered by a Texas Commission on Environmental Quality-approved Quality Assurance Project Plan to ensure a standard set of methods is used. Community scientist data may be used to identify surface water quality trends, target additional data collection needs, identify potential pollution events and sources of pollution, and to test the effectiveness of water quality management measures. Texas Stream Team community scientist data are not used by the state to assess whether water bodies are meeting the designated surface water quality uses and standards. Data collected by Texas Stream Team provide valuable information, often collected in water bodies professionals are not able to monitor frequently or monitor at all.

For additional information about water quality monitoring methods and procedures, including the differences between professional and volunteer community science monitoring, please refer to the following sources:

- Texas Stream Team Core Water Quality Community Scientist Manual
- Texas Stream Team Advanced Water Quality Community Scientist Manual
- Texas Stream Team Program Volunteer Water Quality Monitoring Program Quality Assurance Project Plan
- Texas Commission on Environmental Quality Surface Water Quality Monitoring Procedures

The purpose of this report is to provide a summary of the data collected by Texas Stream Team community scientists. The data presented in this report should be considered in conjunction with other relevant water quality reports for a holistic view of water quality in the Wichita River watershed within the Red River Basin. Such sources may include, but are not limited to, the following:

- Texas Surface Water Quality Standards
- Texas Water Quality Inventory and 303(d) List (Integrated Report)
- Texas Clean Rivers Program partner reports, such as Basin Summary and Highlight Reports
- Texas Commission on Environmental Quality Total Maximum Daily Load reports

- Texas Commission on Environmental Quality and Texas State Soil and Water Conservation Board Nonpoint Source Program funded reports, including watershed protection plans

To get involved with Texas Stream Team or for questions regarding this watershed data report contact us at TxStreamTeam@txstate.edu or at 512.245.1346. Visit our website for more information on our programs at www.TexasStreamTeam.org.

Recognition of Field Contribution

This report would not have been possible without the dedicated efforts of the Alamo Area Texas Master Naturalist Chapter, River Aid San Antonio, and the San Antonio River Authority. Since 2022, these groups have worked together to revitalize monitoring activities in the San Antonio/Bexar County region, expanding water quality data collection and community engagement.

The San Antonio River Authority currently monitors the majority of the sites used in this watershed report, overseeing seven sites with a total of 88 monitoring events. River Aid San Antonio monitors three sites, with over 56 monitoring events, while the Alamo Area Texas Master Naturalist Chapter monitors one site, with 30 monitoring events. Collectively, their efforts extend to students and faculty at the University of Texas at San Antonio and Texas A&M San Antonio, as well as members of the Alamo Area Texas Master Naturalists and other community partners.

These groups have demonstrated the power of collaboration in expanding monitoring coverage and sharing resources. Their dedication has not only strengthened water quality data collection in the Salado Creek watershed (the watershed) but has also set an example of how organizations can work together to enhance environmental stewardship. The Texas Stream Team is deeply grateful for their dedication, which has not only made this report possible but also contributed to the overarching mission of safeguarding and preserving Texas waterways. The data they have gathered remains an indispensable resource, guiding ongoing conservation efforts and shaping informed policy decisions for the future.

WATERSHED DESCRIPTION

Location and Climate

The watershed covers 219 square miles, encompassing Bexar County (Figure 1). Salado Creek arises in the upper part of the San Antonio River Basin, with its headwaters located in the northern region of Bexar County. Salado Creek flows for 38 miles until it converges with the San Antionio River (Texas Commission on Environmental Quality, n.d.).

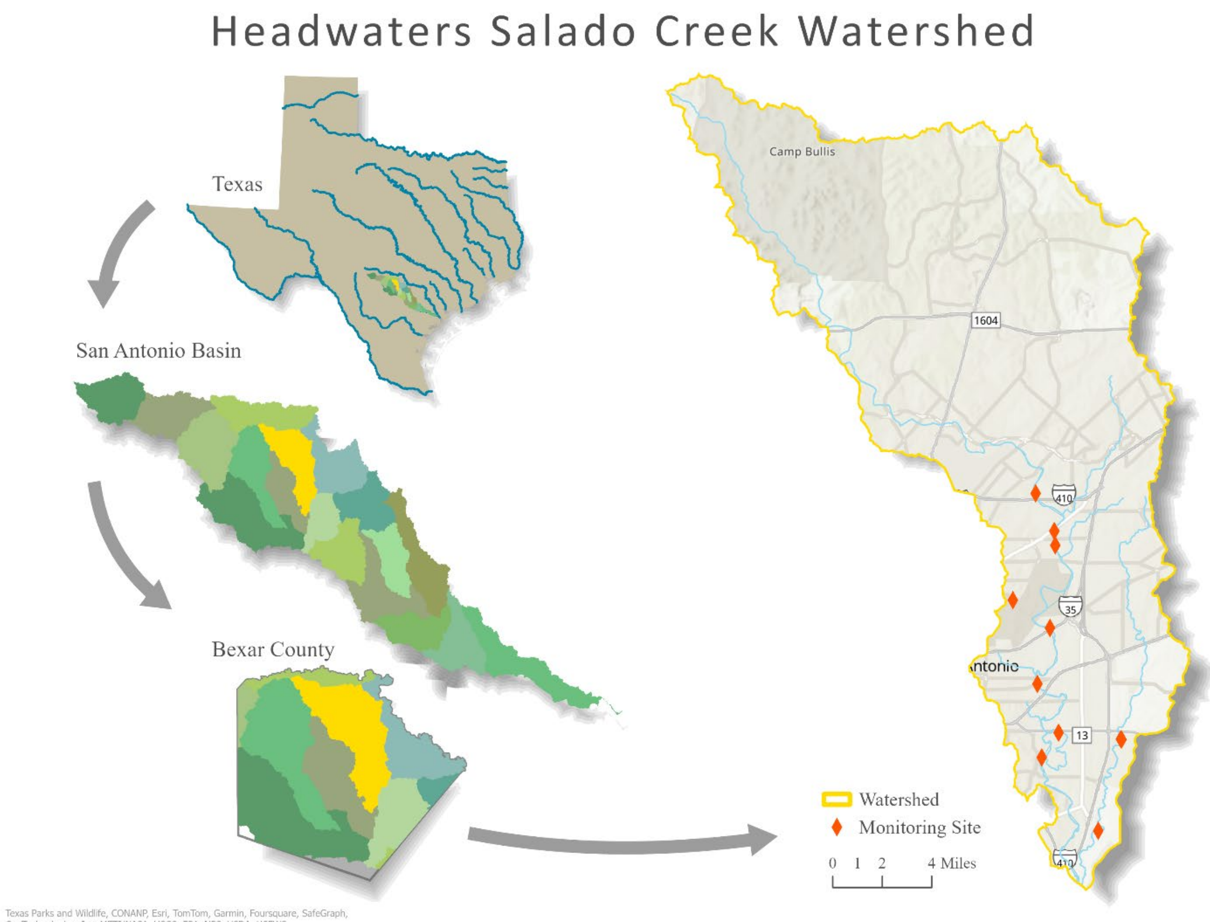

Figure 1. Salado Creek watershed in Bell and Williamson counties, Texas

Salado Creek gained its name from Domingo Ramón, a Spanish military commander, who recorded the stream in his diary during an expedition through Texas (Texas State Historical Association, 1995). Salado Creek played a major role in the Texas Anglo settlement and was the site of two major battles between the Spanish army and the Republic army in the North (Cutter, 2012).

The Texas Commission on Environmental Quality designates classifications for streams, rivers, lakes, and bays throughout Texas, including those within the watershed (Table 1). One classified freshwater stream and seven unclassified freshwater streams within the watershed were monitored by Texas Stream Team community scientists and are included in this summary report. Salado Creek (Segment 1910) is a classified freshwater stream and arises from the confluence with the San Antonio River in Bexar County to the confluence of Beitel Creek in Bexar County. The remaining seven unclassified streams are described in Table 1.

Table 1. Texas Commission on Environmental Quality surface water quality viewer (Texas Commission on Environmental Quality, 2022).

Segment Number	**Segment Name**	**Segment Description**
1910	Salado Creek	From the confluence with the San Antonio River in Bexar County to the confluence of Beitel Creek in Bexar County
1910A	Walzem Creek	From the confluence with Salado Creek to approximately 1.5 mi upstream of Walzem Road in San Antonio
1910B	Rosillo Creek	From the confluence with Salado Creek in Bexar County upstream to the headwaters approximately 1.8 km upstream of FM 1976 in Windcrest
1910C	Salado Creek Tributary	From the confluence with segment 1910 to the upper end of the water body, NHD RC 12100301000902
1910D	Menger Creek	From the confluence with segment 1910 to the upper end of the water body, NHD RC 12100301000147

1910E	Beitel Creek	From the confluence with segment 1910 to the upper end of the water body, NHD RC 12100301000662
1910F	Upper Salado Creek	Upper Salado Creek from the confluence of Beitel Creek upstream to the headwater approximately 1.5 mi upstream of FM 3351 near Fair Oaks Ranch
1910G	Salado Creek West Channel	Salado Creek West Channel from confluence with Salado Creek East channel near Lions Park Lake upstream to the confluence with Salado Creek East channel in Comanche Park

The climate in this area is described as humid, subtropical climate with mild winters and hot summers (Köppen-Geiger climate classification). Climate data from the National Oceanic and Atmospheric Administration, was collected at a weather station at the San Antonio International Airport, Texas and acquired from the National Data Center (National Oceanic and Atmospheric Administration, 2021). The average annual precipitation is 32.38 inches and typically occurs year-round (Figure 2). Long-term monthly average precipitation shows a binomial distribution, with peaks occurring in May and September, averaging 4.14 inches of rainfall during these months. The least amount of rainfall (1.74 inches) occurs in February. The warmest and coldest months of the year are August (29.7°C) and January (11.2°C), respectively.

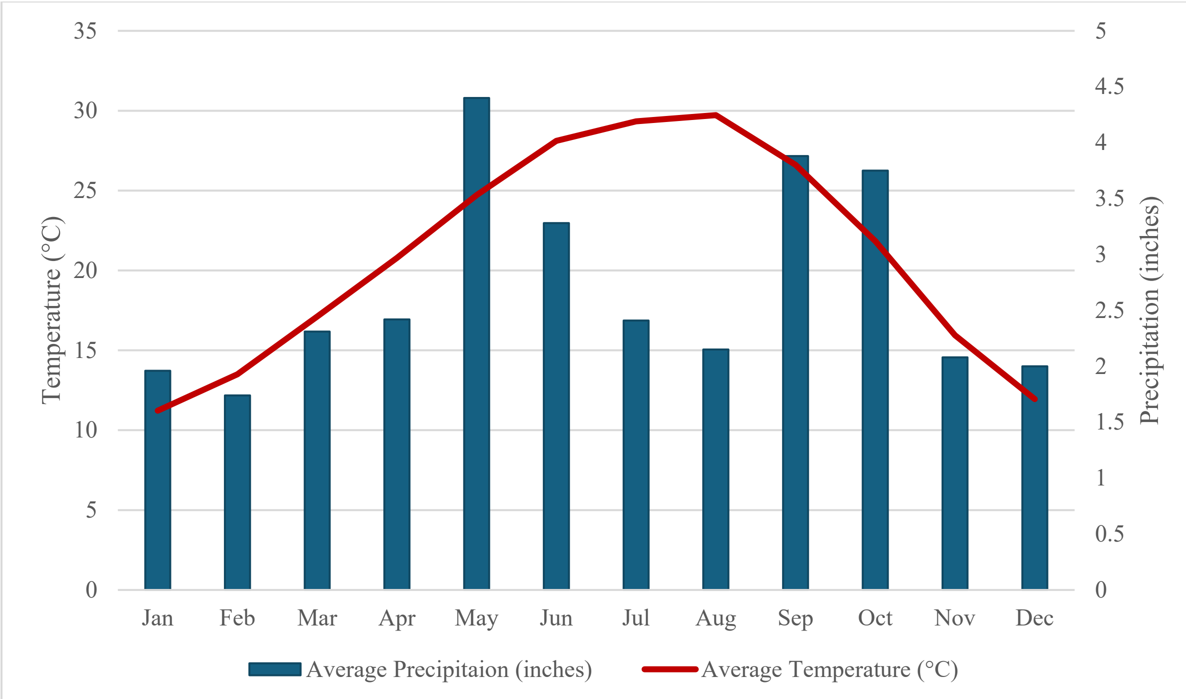

Figure 2. Long-term (1991-2020) monthly average precipitation (inches) and air temperature (°C) from San Antonio International Airport, Texas (National Oceanic and Atmospheric Administration, 2021).

Physical Description

The watershed is located in Bexar County, and the ecoregions in this area are described as Texas Northern Blackland Prairies, East Central Texas Plains, and Edwards Plateau. The predominant vegetation in this region consists of bluestem, eastern gamagrass, oak, elm, mesquite, hackberry, eastern cottonwood, pecan, and coneflowers. There are several different soil types found in this region, including limestone, shale, chalk, and clays. This area serves as a wildlife hotspot for deer, songbirds, waterfowl, game animals, furbearers, and wild cats (Griffith et al., 2007). Additionally, this region is situated upon a portion of the Edwards Aquifer, a karst aquifer that produces about 70% of San Antonio's drinking water. The Edwards Aquifer spans 3,600 square miles and is home to over 40 diverse species, including the eyeless salamander, shrimp, and catfish (San Antonio Parks and Recreation, n.d. & Edwards Aquifer Authority, n.d.).

Land Use

Land cover types were determined from spatial datasets from the National Land Cover Database and processed in Esri ArcGIS Pro for the watershed (Figures 3 and 4).

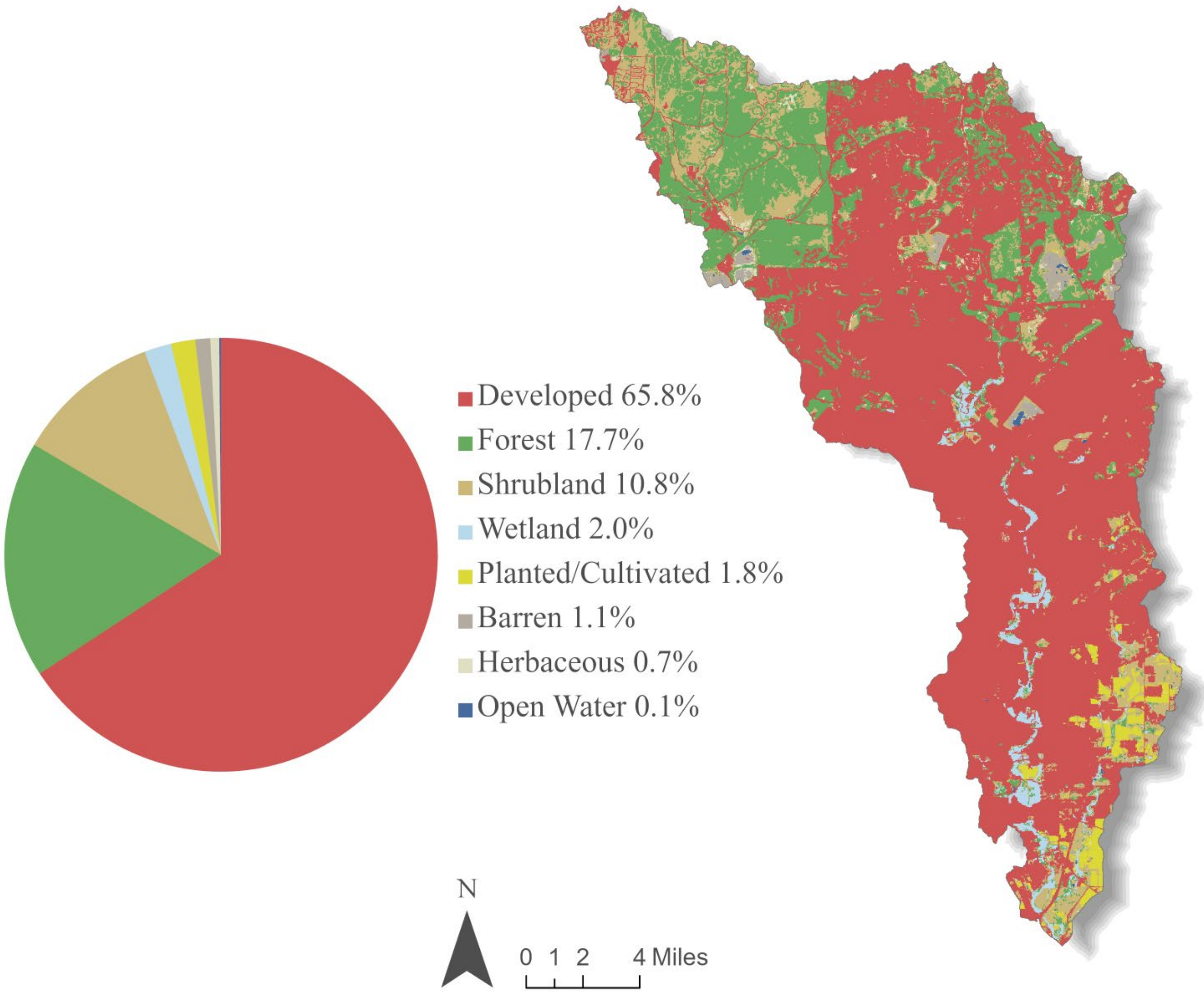

Figure 3. 2019 land use and land cover for the Salado Creek watershed in Bexar County, Texas (National Land Cover Data, 2019).

A majority of the watershed consists of developed land, at 65.8%. Forest and shrubland cover follow, at 17.7% and 10.8%, respectively. The remaining 5.7% of the watershed consists of wetland (2%), planted/cultivated (1.8%), barren (1.1%), herbaceous (0.7%), and open water (0.1%).

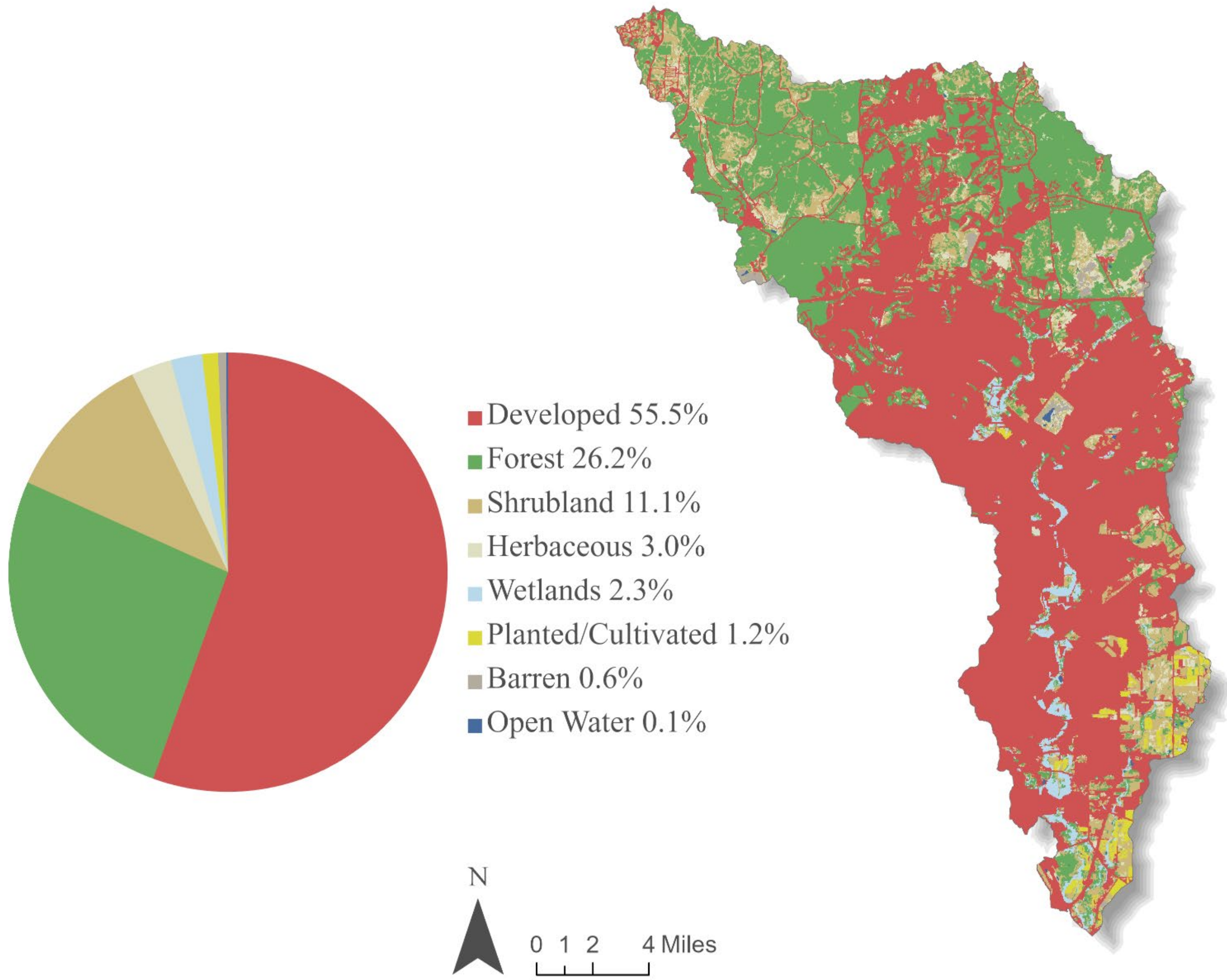

Figure 4. 2001 land use and land cover for the Salado Creek watershed in Bexar County, Texas (National Land Cover Data, 2001).

From 2001 to 2019, developed land cover in the watershed increased from 55.5% to 65.8%, accounting for the combined 10.22% decrease in all other land cover and land use categories. Forest land decreased by 8.5% from 2001 to 2019. Excepting open water, which stayed at 0.1% of the watershed, all other categories decreased by less than 1%.

Table 2. 2001 and 2019 land use and land cover for the Salado Creek watershed in Bexar County, Texas (National Land Cover Data, 2001, 2019).

Land Use	**2001 Acres**	**2001 Percentage**	**2019 Acres**	**2019 Percentages**
Developed	77822.06	55.5%	92141.38	65.8%
Forest	36659.29	26.2%	24807.44	17.7%
Shrubland	15569.84	11.1%	15139.95	10.8%
Herbaceous	4193.47	3.0%	919.82	0.7%
Wetlands	3210.49	2.3%	2821.30	2.0%
Planted/Cultivated	1621.70	1.2%	2523.96	1.8%
Barren	851.10	0.6%	1573.22	1.1%
Open Water	188.81	0.1%	189.04	0.1%

History

The land on which Bexar County was established has been inhabited by humans for more than a millennium. Historically, this area was occupied by the Coahuiltecans, Tonkawas, and Lipan Apaches. European explorers came to this region in 1691, reaching the San Antionio River, naming it in honor of St. Anthony. Spanish colonization began shortly after the arrival of the first European explorers. Many missions and communities were established, attracting the first Anglo settlers in 1821. Bexar County was officially founded in 1836, shortly after Texas had won its independence from Mexico during the Texas Revolution. The county's economy relied heavily on livestock, farming, and railroad industries throughout the 19th and 20th centuries. Today, the economy is comprised of tourism, military bases, federal offices, and higher education (Long, 2024).

Endangered Species and Conservation Needs

The common names of 27 species listed as threatened or endangered (under the authority of Texas State law and/or the United States Endangered Species Act) within the watershed are listed under Appendix A. A summary of the number of species per taxonomic group listed as state, federally endangered, threatened, G1 or G2 (critically imperiled or imperiled), species of greatest conservation need, and/or endemic is provided in Table 3.

Table 3. State and federally listed species in the Salado Creek watershed in Bexar County, Texas.

Taxon	**Endangered (Federal or State)**	**Threatened (Federal or State)**	**G1 or G2 (Critically Imperiled/ Imperiled)**	**Species of Greatest Conservation Need (TPWD) (S1 or S2)**	**Endemic Total Count**
Amphibian	0	2	1	2	3
Bird	3	4	2	9	0
Fish	2	2	2	2	3
Mammal	1	2	0	7	0
Reptile	0	3	0	6	3
Crustacean	0	0	5	4	4
Insect	3	0	8	7	5
Arachnid	5	0	6	8	8
Mollusks	1	0	3	3	2
Arthropod	0	0	0	2	2
Plant	0	1	7	10	27
Total	**15**	**14**	**34**	**60**	**57**

Texas Water Quality Standards

The Texas Surface Water Quality Standards establish explicit goals for the quality of streams, rivers, lakes, and bays throughout the state. The standards are developed to maintain the quality of surface waters in Texas to support public health and protect aquatic life, while being consistent with the state's sustainable economic development. Water quality standards identify appropriate uses for the state's surface waters, including aquatic life, recreation, and sources of public water supply as drinking water. The criteria for evaluating support of these uses at monitoring sites on Saldo Creek (Segment 1910), included in this report, are provided in Table 4. Unclassified water bodies are not defined in the state's standards but are associated with a classified water body because they are in the same watershed. The dissolved oxygen criteria are for dissolved oxygen means at any site within the segment; the minimum and maximum values for pH apply to any site within the segment; the *E. coli* indicator bacteria for freshwater is a geometric mean; and the temperature criteria are a maximum value at any site within the segment.

Table 1. State water quality criteria for the Headwaters of Salado Creek watershed in Bexar County, Texas (Texas Commission on Environmental Quality, 2022).

Segment	**Dissolved Oxygen (mg/L)**	**pH Range (s.u.)**	**Total Dissolved Solids (mg/L)**	***E. coli* Bacteria (#/100 mL)**	**Temperature (°C)**
1910 – Salado Creek	5.0	6.5 – 9.5	600	126	32.2

Water Quality Impairments

The *2024 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d)* (Integrated Report) includes an index of water quality impairments. Of the one classified water body and the seven unclassified streams, three of the water bodies have impairments. Salado Creek (Segment 1910) has two impairments that fall within Category 5c, which means additional data needs to be collected before a management strategy can be selected, and two impairments that fall within Category 4a, which means a Total Maximum Daily Load has been established. Salado Creeks' 5c impairments are for impaired fish and macrobenthic communities whereas the 4a impairments are for depressed dissolved oxygen and bacteria in water. Additionally, unclassified streams Walzem creek (Segment 1910A) and Menger Creek (Segment 1910D) are impaired for bacteria in water and are categorized as 4a.

WATER QUALITY PARAMETERS

Water Temperature

Water temperature influences the physiological processes of aquatic organisms, and each species has an optimum temperature for survival. High water temperatures increase oxygen-demand for aquatic communities and can become stressful for fish and aquatic insects. Water temperature variations are most detrimental when they occur rapidly, leaving the aquatic community no time to adjust. Additionally, the ability of water to hold oxygen in solution (solubility) decreases as temperature increases. This effect is exacerbated in coastal water bodies influenced by tidal, saline waters. Warm water temperatures occur naturally with seasonal variation, as water temperatures tend to increase during summer and decrease in winter in the Northern Hemisphere. Daily (diurnal) water temperature changes occur during normal heating and cooling patterns. Man-made sources of warm water include power plant effluent after it has been used for cooling or hydroelectric plants that discharge warm water. Community scientist monitoring may not identify fluctuating patterns due to diurnal changes or events such as power plant releases because of the monthly sampling frequency. While community scientist data may not show diurnal temperature fluctuations, they could demonstrate the fluctuations over seasons and years when collected consistently at predetermined monitoring sites and monthly frequencies.

Specific Conductance and Salinity

Specific conductance is a measure of the ability of a body of water to conduct electricity. It is measured in microsiemens per centimeter (μS/cm). A body of water is more conductive if it has more total dissolved solids such as nutrients and salts, which indicates poor water quality if they are overly abundant. High concentrations of nutrients can lead to eutrophication, which results in lower levels of dissolved oxygen. High concentrations of salt can inhibit water absorption and limit root growth for vegetation, leading to an abundance of more drought tolerant plants, and can cause dehydration of fish and amphibians. Sources of total dissolved solids can include agricultural runoff, domestic runoff, or discharges from wastewater treatment plants. Salinity is a measure of saltiness or the dissolved inorganic salt concentration in water. Salinity is often measured in ocean, estuarine, or tidal influenced waters, but in Texas there are some inland streams that have a high salt content due to the local geology and require salinity measurements. Some common ions measured as salinity include sodium, chloride, magnesium, sulfate, calcium, and potassium. Seawater typically has a salt content of 35 parts per thousand (ppt or ‰). Like other water quality parameters, salinity affects the homeostasis or the balance of water and solutes within both plants and animals. Too much or too little salt can affect plant and animal cell survival and growth, therefore salinity is an important measurement.

Dissolved Oxygen

Oxygen is necessary for the survival of organisms like fish and aquatic insects. The amount of oxygen needed for survival and reproduction of aquatic communities varies according to species composition and adaptations to watershed characteristics like stream gradient, habitat, and available streamflow.

The dissolved oxygen concentrations can be influenced by other water quality parameters such as nutrients and temperature. High concentrations of nutrients can lead to excessive surface vegetation and algae growth, which may starve subsurface vegetation of sunlight and, therefore, reduce the amount of oxygen they produce via photosynthesis. This process is known as eutrophication. Low dissolved oxygen can also result from high groundwater inflows (which have low dissolved oxygen due to minimal aeration), high temperatures, or water releases from deeper portions of dams where dissolved oxygen stratification occurs. Supersaturation typically occurs underneath waterfalls or dams with water flowing over the top where aeration is abundant.

pH

The pH scale measures the concentration of hydrogen ions in a range from zero to 14 and is reported in standard units (s.u.). The pH of water can provide information regarding acidity or alkalinity. The range is logarithmic; therefore, every one-unit change is representative of a 10-fold increase or decrease in acidity or alkalinity. Acidic sources, indicated by a low pH level, can include acid rain and runoff from acid-laden soils. Acid rain is predominantly caused by coal powered plants with minimal contributions from the burning of other fossil fuels and other natural processes, such as volcanic emissions. Soil-acidity can be caused by excessive rainfall leaching alkaline materials out of soils, acidic parent material, crop decomposition creating hydrogen ions, or high yielding fields that have drained the soil of all alkalinity. Sources of high pH (alkaline) include geologic composition, as in the case of limestone increasing alkalinity and the dissolving of carbon dioxide in water. Carbon dioxide is water soluble, and as it dissolves it forms carbonic acid. A suitable pH range for healthy organisms is between 6.5 and 9.0 s.u.

Water Transparency and Total Depth

Two instruments can be used by Texas Stream Team community scientists to measure water transparency, a Secchi disc or a transparency tube. Both instruments are used to measure water transparency or to determine the clarity of the water, a condition known as turbidity. The Secchi disc is lowered into the water until it is no longer visible, then raised until it becomes visible, and the average of the two depth measurements is recorded. A transparency tube is filled with sample water and water is released until the Secchi pattern at the bottom of the tube can be seen. The tube is marked with two millimeter increments and is used to measure water transparency. Transparency measurements less than the total depth of the monitoring site are indicative of turbid water. Readings that are equal to total depth indicate clear water. Highly turbid waters pose a risk to wildlife by clogging the gills of fish, reducing visibility, and carrying contaminants. Reduced visibility can harm predatory fish or birds that depend on good visibility to find their prey. Turbid waters allow less light to penetrate deep into the water, which, in turn, decreases the density of phytoplankton, algae, and other aquatic plants. This reduces the dissolved oxygen in the water due to reduced photosynthesis. Contaminants are mostly transported in sediment rather than in the water. Turbid waters can result from sediment runoff from construction sites, erosion of farms, or mining operations.

E. coli and Enterococci Bacteria

E. coli bacteria originate in the digestive tract of endothermic organisms. The United States Environmental Protection Agency has determined *E. coli* to be the best indicator of the degree of pathogens in a freshwater system. A pathogen is a biological agent that causes disease. Enterococci bacteria are a subgroup of fecal streptococci bacteria (mainly Streptococcus faecalis and Streptococcus faecium) that are present in the intestinal tracts and feces of warm-blooded animals. It is used by the Texas Commission on Environmental Quality as an indicator of the potential presence of pathogens in tidally influenced saltwater along the Texas Gulf Coast. The standard for a bacteria impairment is based on the geometric mean (geomean) of the bacteria measurements collected. A geometric mean is a type of average that incorporates the high variability found in parameters such as *E. coli* and enterococci which can vary from zero to tens of thousands of colony forming units per 100 milliliters (CFU/100 mL). The standard for contact recreational use of a water body is 126 CFU/100 mL for *E. coli* in freshwater or 35 CFU/100 mL for enterococci in saltwater. A water body is considered impaired if the geometric mean is higher than the corresponding water quality standard. Texas Stream Team does not currently monitor water quality for enterococci in coastal waters. Instead, community scientists can get certified in *E. coli* bacteria monitoring, the indicator used by the Texas Commission on Environmental Quality for freshwater streams.

Nitrate-Nitrogen

Nitrogen is present in terrestrial or aquatic environments as nitrate-nitrogen, nitrites, and ammonia. Nitrate-nitrogen tests are conducted for maximum data compatibility with the Texas Commission on Environmental Quality and other partners. Just like phosphorus, nitrogen is a nutrient necessary for the growth of most living organisms. Nitrogen inputs into a water body may be from livestock and pet waste, excessive fertilizer use, failing septic systems, and industrial discharges that contain corrosion inhibitors. The effect excess nitrogen has on a water body is known as eutrophication and is described previously in the "Dissolved Oxygen" section. Nitrate-nitrogen dissolves more readily than orthophosphate, which attaches to sediment, and, therefore, can serve as a better indicator of possible sewage or manure pollution during dry weather.

Phosphate

Phosphorus almost always exists in the natural environment as phosphate continually cycles through the ecosystem as a nutrient necessary for the growth of most organisms. Testing for phosphate in the water excludes the phosphate bound up in plant and animal tissue. There are other methods to retrieve phosphate from the material to which it is bound, but they are too complicated and expensive to be conducted by community scientists. Testing for phosphate provides an idea of the degree of phosphorus in a water body. It can be used for problem identification, which can be followed up with more detailed professional monitoring, if necessary. Phosphorus inputs into a water body may be caused by the weathering of soils and rocks, discharge from wastewater treatment plants, excessive fertilizer use, failing septic systems, livestock and pet waste, disturbed land areas, drained wetlands, water treatment, and some commercial cleaning products. The effect excess phosphate has on a water body is known as eutrophication and is described above in the "Dissolved Oxygen" section.

DATA COLLECTION, MANAGEMENT, AND ANALYSIS

Data Collection

The field sampling procedures implemented by trained community scientists are documented in the Texas Stream Team Core Water Quality Community Scientist Manual and the Texas Stream Team Advanced Water Quality Community Scientist Manual. The sampling protocols in the manuals adhere closely to the Texas

Commission on Environmental Quality Surface Water Quality Monitoring Procedures Manual, Volume 1 (August 2012). Additionally, all data collection adheres to Texas Stream Team's Texas Commission on Environmental Quality-approved Quality Assurance Project Plan.

Procedures documented in Texas Stream Team Water Quality Community Scientist Manuals or the Texas Commission on Environmental Quality Surface Water Quality Monitoring Procedures Manual, Volume 1 (August 2012) outlines the necessary steps to prevent contamination of samples, including direct collection into sample containers, when possible. Field quality control samples are collected and analyzed to detect whether contamination has occurred and to ensure data accuracy and precision. Field sampling activities are documented on Environmental Monitoring Forms. The following items are recorded for each field sampling event: station ID, location, sampling time, date, depth, sample collector's name/signature, group name, meter calibration information, and reagent expiration dates. Specific conductance values are converted to total dissolved solids using a conversion factor of 0.65 and are reported as mg/L. Values for measured parameters are recorded. If reagents or media are expired, it is noted, and data are flagged and communicated to Texas Stream Team staff. Sampling is not permitted with expired reagents or bacteria media; the corresponding values will be flagged in the database and excluded from data reports. Detailed observational data recorded include water appearance, weather, field observations (biological activity and stream uses), algae cover, unusual odors, days since last significant rainfall, and flow severity. Comments related to field measurements, number of participants, total time spent sampling, and total round-trip distance traveled to the sampling site are also recorded for grant reporting and administrative purposes.

Data Management

The community scientists collect field data and report the measurement results to Texas Stream Team, by submitting a hard copy of the Environmental Monitoring Form, entering the data directly into the online Waterways Dataviewer database, or by using the electronic Environmental Monitoring Form. All data are reviewed to ensure they are representative of the samples analyzed and locations where measurements were made. The measurements and associated quality control data are also reviewed to ensure they conform to specified monitoring procedures and project specifications as stated in the approved Quality Assurance Project Plan. Data review and verification is performed using a quality control checklist and self-assessments, as appropriate to the project task, followed by automated database functions that validate data as the information is entered into the database. The data are verified and evaluated against project specifications and are checked for errors, especially errors in transcription, calculations, and data input. Potential errors are identified by examination of documentation and by manual and computer-assisted examination of corollary or unreasonable data. Issues that can be corrected are corrected and documented. Once entered, the data can be accessed publicly through the online [Texas Stream Team Datamap].

Data Analysis

Data were compiled, analyzed, summarized, and compared to state water quality standards and/or criteria to provide readers with a reference point for parameters that may be of concern. The statewide, biennial assessment performed by the Texas Commission on Environmental Quality involves more stringent monitoring methods and oversight than those used by community scientists and staff in this report. The Texas Stream Team community scientist water quality monitoring data are not currently used in the Texas Commission on Environmental Quality assessments mentioned above. However, the Texas Stream Team data is intended to inform stakeholders about general characteristics and assist professionals in identifying areas of potential concern to plan future monitoring efforts. All data collected by community scientists in the study watersheds were exported from the Texas Stream Team database and grouped by site. Sites with 10 or more monitoring events were maintained in the dataset for analysis. Sites with fewer than 10 monitoring events were excluded from the analysis for this report but may be used in future data summary reports. Once compiled, data were sorted, summary statistics were generated and reviewed, and results were graphed in JMP Pro 14.0.0 (SAS Institute Inc., 2018) using standard methods. Best professional judgement was used to verify outliers. Outlier box or scatter plots were prepared to provide a compact view of the distribution of the data for each parameter and site(s). The horizontal line within the box plot represents the median sample value, while the ends of the box represent the 25th and 75th quantiles or the interquartile range. The lines extending from each end of the box, or whiskers, are computed using the 25th/75th quartiles ± 1.5 x (interquartile range). Outliers are plotted as points outside the box plot.

DATA RESULTS

Water quality data from 11 Texas Stream Team monitoring sites in the watershed were acquired for this report (Figure 5).

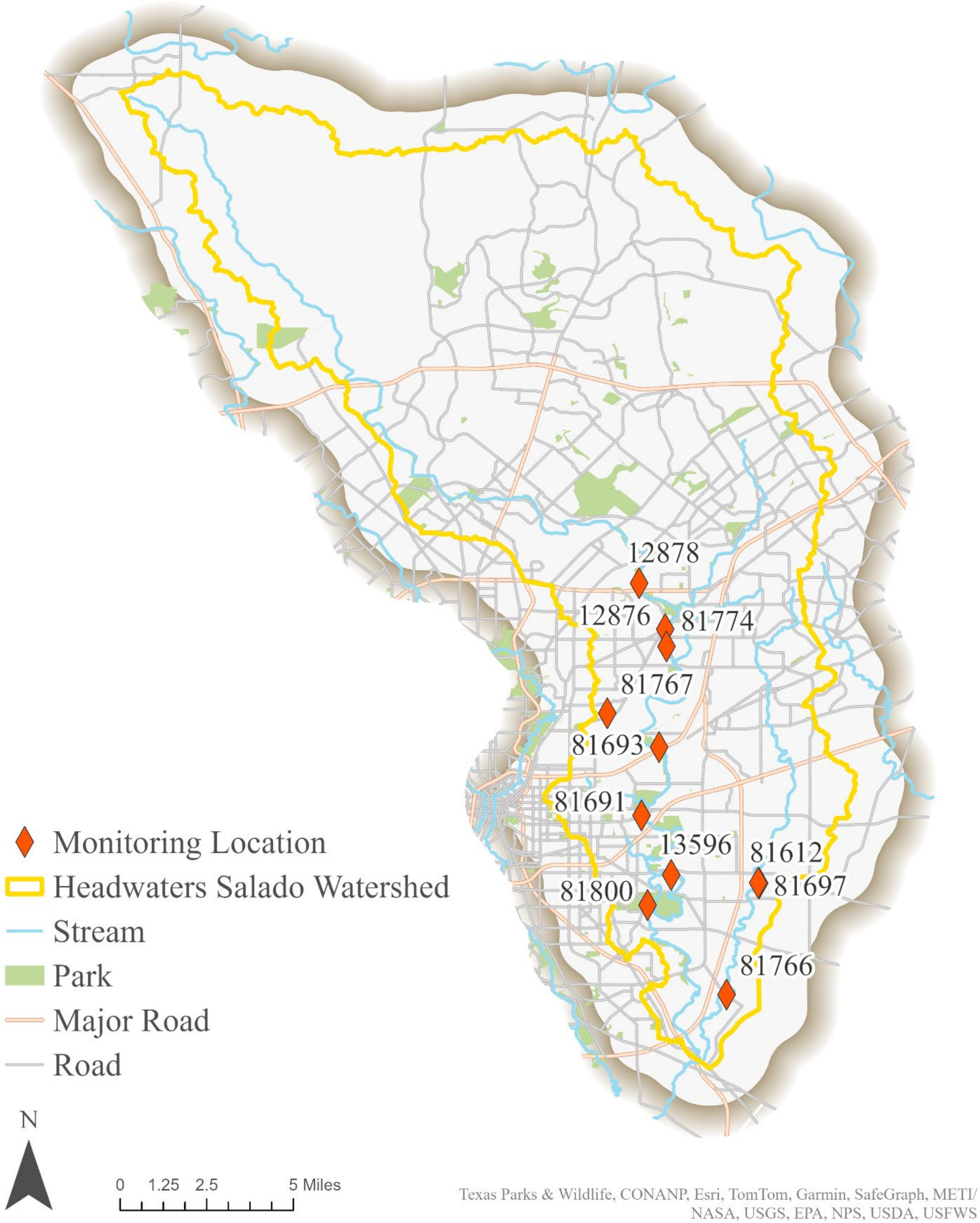

Figure 5. Texas Stream Team monitoring sites in Salado Creek watershed in Bexar County, Texas.

The period of record for the sampling events ranged from November 1992 through February 2025, with some sites experiencing temporal intermittent sampling. Trained community scientists conducted between 3 and 38 monitoring events at each site, for a total of 206 events. Of the 11 sites, nine of the sites had 10 or more monitoring events and were monitored sporadically from November 1992 through January 2025 (Table 5).

Table 2. Texas Stream Team monitoring sites in Salado Creek in Bexar County, Texas.

Site ID	Description	Number of Events	Period of Record
12876	Salado Creek @ Austin HWY (SH 368)	36	Dec 1992 – July 1993, May 2021 – Dec 2024
12878	TCEQ Site 12877 – Salado Creek @ Los Patios (Loop 410 North)	38	Nov 1992 – July 1993, Nov 2022 – Jan 2025
13596	Salado Creek @ Comanche Park 3851 Roland @ Granieri Farms	27	Dec 1992 – July 1993, May 2021 – Sep 2022, April 2024 – May 2024
81612	Lake Verda at Milam Wesley Tealer Park (Unclassified Segment 1910B Rosillo Creek)	28	Feb 2020 – Sep 2021, Jan 2023 – Jan 2025
81691	TCEQ Site 15645 – Salado Creek @ E. Commerce St, near Second Baptist Church	14	Aug 2022 – Jan 2025
81693	TCEQ Site 12871 – Salado Creek at Seguin Rd Bridge	14	Aug 2022 – Jan 2025
81697	Lake Verda at Milam Wesley Tealer Park – Site #2	18	Feb 2023 – Jan 2025
81766	TCEQ Site ID 1269 – Rosillo Creek @ WW White Rd.	10	Nov 2023 – July 2024
81774	TCEQ Site 13594 – Low water Xing on Salado Creek Greenway between Grantham Dr. and Holbrook Rd.	11	Feb 2024 – Dec 2024
81767	Drainage Creek @ Belmeade Park near the Towers on Park Lane	3	Dec 2023 – March 2024

81800	TCEQ Site 12788 – Southside Lions Park East @ Pecan Valley Drive, at the south cement spillway	7	Aug 2024 – Feb 2025
	Total	**206**	

Site Analysis

Water quality monitoring data from sites with 10 or more sampling events were analyzed and summarized, including the number of samples, mean, standard deviation, and range of values (Table 6). Sites 81767 (3 monitoring events) and 81800 (7 monitoring events) were excluded from the analysis due to the limited number of monitoring events that took place at each. Community scientists monitored all sites for standard core parameters, including air and water temperature, specific conductance (total dissolved solids were calculated based on conductance values), dissolved oxygen, pH, Secchi disk transparency, transparency tube, and total depth.

Table 3. Texas Stream Team data summary for sites in the Headwaters of Salado Creek watershed in Bexar County, Texas. (November 1992 to January 2025).

Parameter	Statistic	12876	12878	13596	81612	81691	81693	81697	81766	81774
Air Temperature (° C)	Mean	20.80	19.78	22.66	22.79	21.6	22.68	20.14	21.64	22.85
	Std Dev	7.05	7.17	6.60	6.76	5.87	5.42	6.46	9.79	5.64
	Range	23	25.00	21.40	25	18	18.5	19.5	31	16.8
Water Temperature (° C)	Mean	20.63	19.26	21.13	22.66	21	19.88	21.19	20.41	21.9600
	Std Dev	5.63	6.38	5.91	6.14	5.86	5.28	5.88	9.04	5.64
	Range	20.5	21.00	19.00	20.06	18.5	19.8	16	31	15.5
Conductivity (µS/cm)	Mean	532.31	545.65	632.04	532.92	772.07	864.15	649.88	813.78	457.6
	Std Dev	116.74	284.72	190.84	317.17	281.06	284.12	345.30	283.71	176.24
	Range	536	1165.00	810.00	913	927	833	934	887	503
Total Dissolved Solids (mg/L)*	Mean	346.00	354.67	410.83	346.4	501.85	561.7	422.41	528.96	297.44
	Std Dev	75.88	185.07	124.04	206.16	182.69	184.68	224.44	184.41	114.55
	Range	348.4	757.25	526.50	593.45	602.55	541.45	607.1	576.55	326.95
pH (standard units)	Mean	7.29	7.58	7.44	8.02	7.32	7.27	8.01	7.37	7.14
	Std Dev	0.27	0.34	0.39	0.36	0.37	0.26	0.23	0.21	0.23
	Range	0.7	1.00	2.00	1.5	1	0.51	1	0.7	0.5
Dissolved Oxygen (mg/L)	Mean	4.70	4.17	5.11	6.23	4.27	5.02	5.73	7	6.08
	Std Dev	2.03	1.84	3.28	1.48	1.43	1.38	1.04	2.67	1.45
	Range	6.4	6.30	9.40	5.8	4.7	4.6	4.2	8.8	4.8
	Mean	0.74	0.31	4.88	0.27	0.67	0.75	0.48	ND	ND

Transparency Tube (m)	Std Dev	0.37	0.15	14.50	0.11	0.25	0.26	0.13	ND	ND
	Range	1.11	0.61	50.64	0.35	0.85	0.78	0.37	ND	ND
Secchi Disk (m)	Mean	ND	ND	0.52	ND	ND	ND	ND	ND	ND
	Std Dev	ND	ND	0.29	ND	ND	ND	ND	ND	ND
	Range	ND	ND	0.80	ND	ND	ND	ND	ND	ND
Total Depth (m)	Mean	0.30	2.02	0.60	2.71	0.50	0.37	3.08	0.56	0.15
	Std Dev	0.11	1.40	0.38	1.34	0.37	0.10	1.19	0.44	0.14
	Range	0.6	3.35	1.20	5	1.13	0.2	5	1.3	0.45

*Total dissolved solids were calculated from specific conductance (TDS = specific conductance * 0.65).
ND = no data available.

If a water quality parameter did not have at least 10 separate data points, the parameter was removed from the analysis. Therefore, Secchi disc values from sites 12876, 12878, 21766, and 81774 were removed from the analysis and the transparency tube values from sites 81766 and 81774 were removed from the analysis as well.

Air and Water Temperature

Average air temperature for all sites ranged from 19.78°C to 22.85°C (Table 6). The lowest mean air temperature (19.78°C) was observed at TCEQ Site 12877 – Salado Creek at Los Patios (site 12878) whereas the highest mean air temperature (22.85°C) was observed at TCEQ Site 13594 – Low water Xing on Salado Creek Greenway (site 81774).

The average water temperature at all sites ranged from 19.26°C to 22.66°C (Table 6). The lowest mean water temperature (19.26°C) was observed at TCEQ Site 12877 - Salado Creek at Los Patios (site 12878) whereas the highest mean water temperature (22.66°C) was observed at Lake Verda at Milam Wesley Tealer Park (site 81612). Discrete water temperature measurements met the water quality standard of 32.2°C throughout the period of record except for two occurrences. One occurrence took place at site 81612 on August 18, 2020, with a reading of 33.06°C whereas the other occurrence took place at site 81766 on July 10, 2024, with a reading of 36°C (Figure 6).

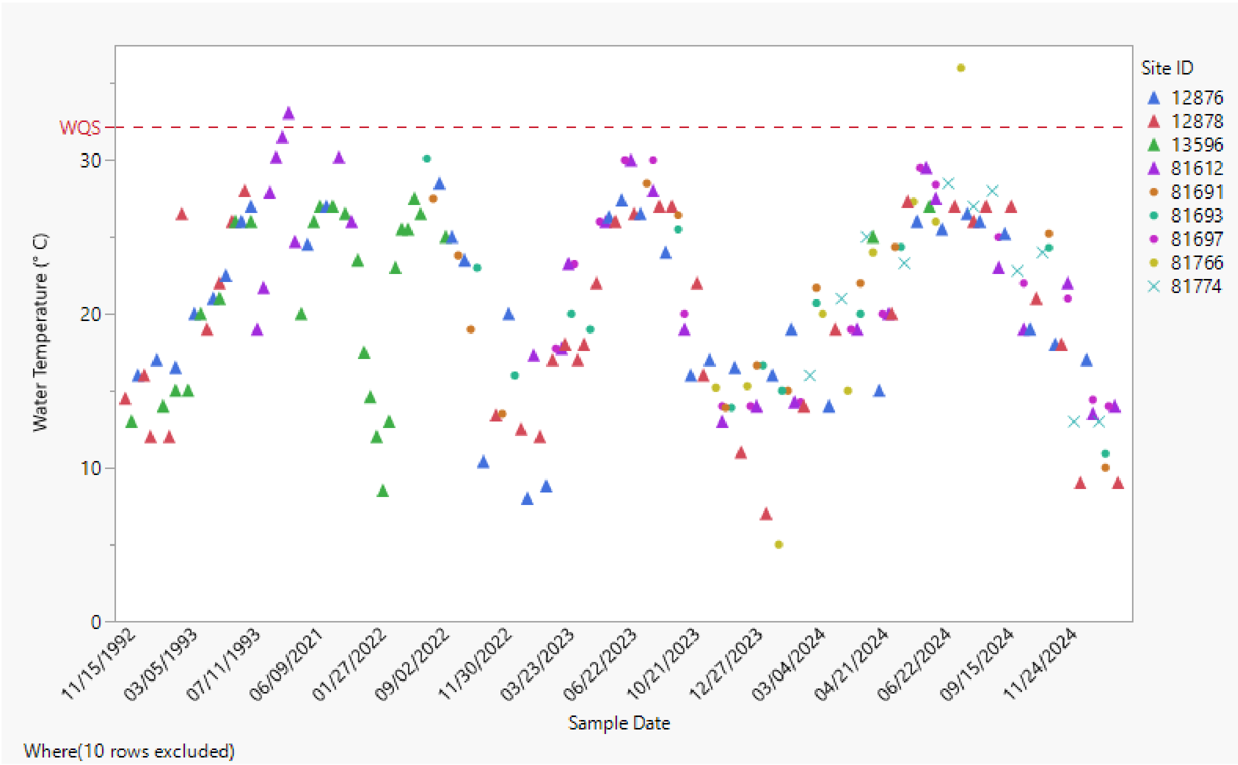

Figure 6. Water Temperature for Texas Stream Team sites in the Headwaters of Salado Creek watershed in Bexar County, Texas (November 1992 to January 2025). WQS = Water Quality Standard.

Specific Conductance and Total Dissolved Solids

Total dissolved solids values were calculated from specific conductance measurements. The average total dissolved solids at all sites ranged from 297.44 to 561.7 mg/L (Table 6). The lowest average total dissolved solids (297.44 mg/L) was observed at TCEQ Site 13594 – Low water Xing on Salado Creek Greenway (site 81774) whereas the highest average total dissolved solids (561.7 mg/L) was observed at TCEQ Site 12871 – Salado Creek at Seguin Rd Bridge (site 81693). Each of the nine sites had discrete measurements of total dissolved solids that exceeded the water quality standard of 600 except for site 12876 and site 81774. However, the average total dissolved solids values for all sites remained below the water quality standard of 600 mg/L (Figure 7).

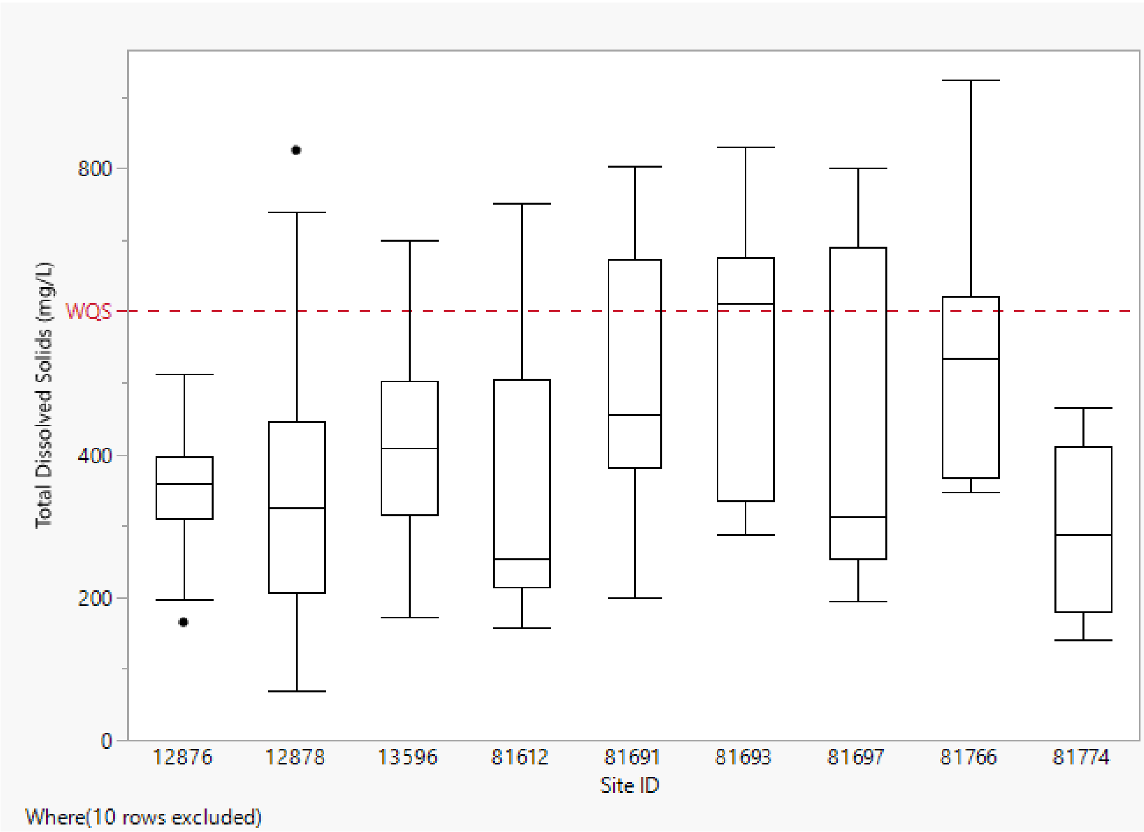

Figure 7. Total Dissolved Solids for Texas Stream Team sites in the Headwaters of Salado Creek watershed in Bexar County, Texas (November 1992 to January 2025). WQS = Water Quality Standard.

Dissolved Oxygen

The average dissolved oxygen for all sites ranged from 4.17 to 7.0 mg/L (Table 6). The lowest average dissolved oxygen (4.17 mg/L) was observed at TCEQ Site 12877 – Salado Creek at Los Patios (site 12878) whereas the highest average dissolved oxygen (7.0mg/L) was observed at TCEQ Site ID 1269 – Rosillo Creek at WW White Rd. (site 81766). Out of the nine sites, three of the sites had average dissolved oxygen values that fell below the water quality standard of 5.0 mg/L. These sites included site 12876, 12878 and 81691. Additionally, all of the sites had discrete measurements that fell below the water quality standard on multiple occasions (Figure 8).

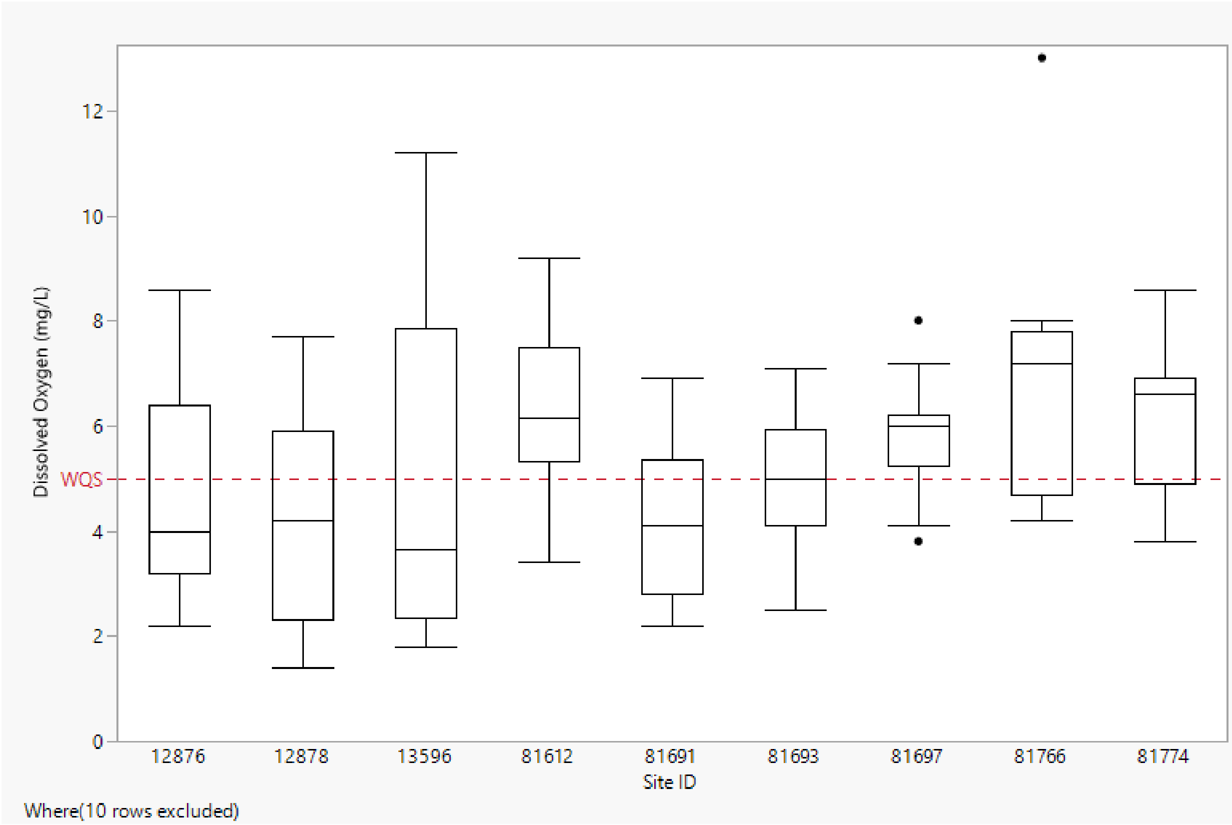

Figure 8. Dissolved Oxygen for Texas Stream Team sites in the Headwaters of Salado Creek watershed in Bexar County, Texas (November 1992 to January 2025). WQS = Water Quality Standard.

pH

The average pH at all sites ranged from 7.14 to 8.02 standard units (Table 6). The lowest average pH value was observed at TCEQ Site 13594 – Low water Xing on Salado Creek Greenway (site 81774) whereas the highest average pH value was observed at Lake Verda at Milam Wesley Tealer Park (site 81612). Additionally, all discrete measurements were found to be within the water quality standards minimum (6.5) and maximum (9.5) (Figure 9).

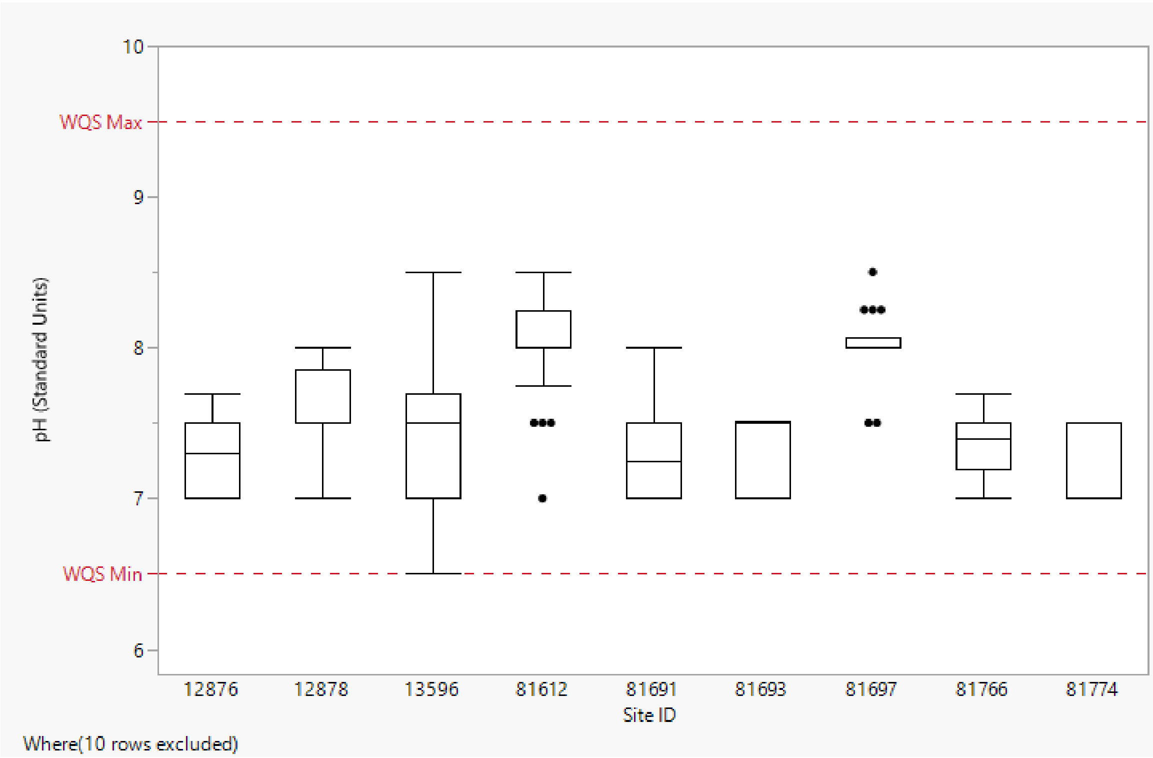

Figure 9. pH for Texas Stream Team sites in the Headwaters of Salado Creek watershed in Bexar County, Texas (November 1992 to January 2025). WQS Max = Maximum Water Quality Standard; WQS Min = Minimum Water Quality Standard.

Transparency and Total Depth

The average total depth at all sites ranged from 0.15 to 3.08 m (Table 6). The largest average depth was observed at Lake Verda at Milam Wesley Tealer Park – Site #2 (site 81697) whereas the smallest was observed at TCEQ Site 13594 – Low water Xing on Salado Creek Greenway (site 81774).

Secchi disks and/or transparency tubes were used to measure transparency at all monitoring sites within the watershed. However, measurements were not analyzed for site 81766 and site 81774 as not enough discrete measurements had been gathered to qualify these sites for a transparency analysis (Figure 10). Average transparency gathered via the transparency tube ranged from 0.27 to 4.88 m with the lowest average recorded at Lake Verda at Milam Wesley Tealer Park (site 81612) and the highest at Salado Creek at Comanche Park 3851 Roland (site 13596) (Table 6).

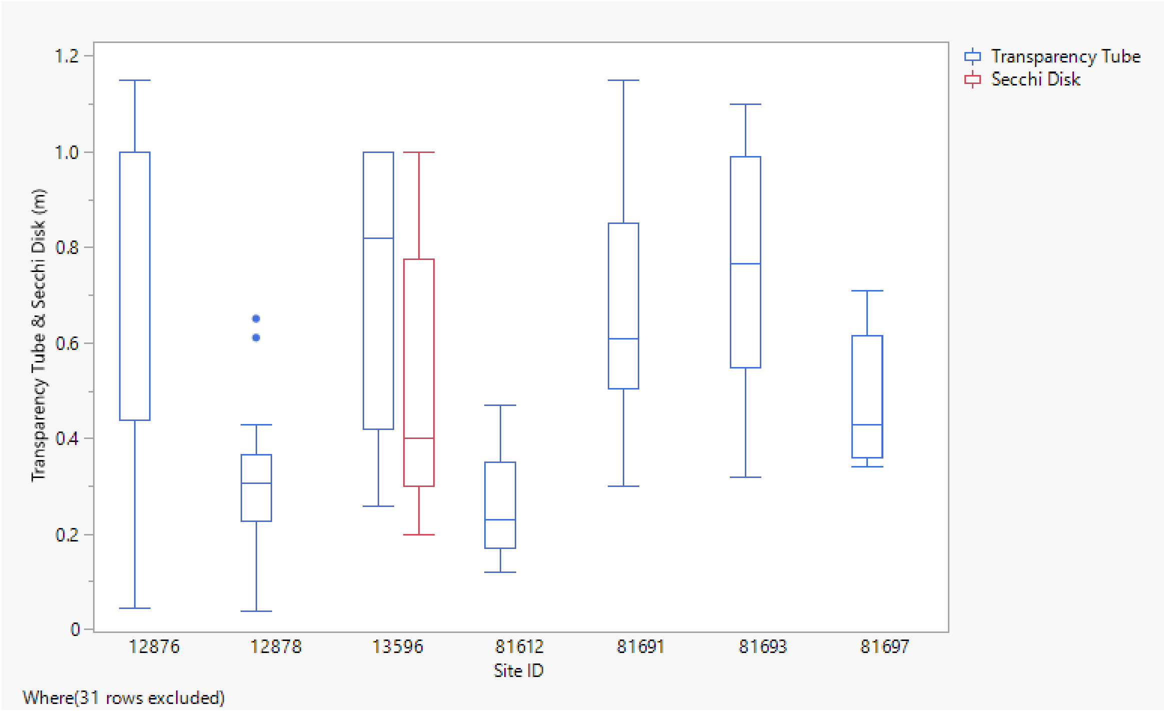

Figure 10. pH for Texas Stream Team sites in the Headwaters of Salado Creek watershed in Bexar County, Texas (November 1992 to January 2025).

WATERSHED SUMMARY

The Salado Creek Watershed (the watershed) is primarily composed of developed land, covering 65.8% of the area. Other land uses include forest and shrubland (17.7%), wetland (2%), planted/cultivated (1.8%), barren (1.1%), herbaceous cover (0.7%), and less than 1% open water.

According to the 2024 Integrated Report by the Texas Commission on Environmental Quality, three water bodies in the Headwaters Salado Creek watershed have impairments. Salado Creek (Segment 1910) has two impairments categorized as 5c for impaired fish and macrobenthic communities, indicating that additional data is needed before a management strategy can be selected. It also has two impairments categorized as 4a for depressed dissolved oxygen and bacteria in water, meaning a Total Maximum Daily Load has been established. Additionally, the unclassified streams Walzem Creek (Segment 1910A) and Menger Creek (Segment 1910D) are impaired for bacteria in water and are also categorized as 4a.

Texas Stream Team community scientists monitored 11 sites in the watershed intermittently from November 1992 to February 2025, recording 206 monitoring events. Nine sites with 10 or more monitoring events were analyzed for water quality, including the number of samples, mean, standard deviation, and range of values (Table 6). Core parameters monitored included air and water temperature, specific conductance (with total dissolved solids calculated from conductance), dissolved oxygen, pH, Secchi disk transparency, transparency tube readings, and total depth. All sites were monitored by Texas Stream Team-trained community scientists.

Water quality standards for designated uses in the watershed were compared to the monitoring results to evaluate overall water quality. Key findings include:

- Discrete water temperature measurements failed to meet the 32.2°C water quality standard once at site 81612 (33.06°C) (8/18/20) and anther time at site 81766 (36°C) (7/10/24).
- Most sites had individual measurements exceeding the 600 mg/L total dissolved solids standard, however all site averages remained below the threshold.
- Three sites—12876, 12878, and 81691—had average dissolved oxygen levels below the 5.0 mg/L standard, and all sites had multiple instances of dissolved oxygen falling below the standard.

Although average water quality standards were generally met, periodic exceedances highlight potential concerns. We recommend that Texas Stream Team community scientists continue their core monitoring while expanding efforts to include regular *E.*

coli and advanced nutrient monitoring—parameters that are not currently being tracked. Increasing sampling frequency during periods of rapid change, such as hot summer days and following storm events, will better capture fluctuations in water temperature, total dissolved solids, and dissolved oxygen. Additionally, targeted investigations at sites with repeated exceedances can help identify potential point or nonpoint sources of impairment. Long-term monitoring remains essential for assessing water quality trends and addressing potential impacts from population growth and development.

This report would not have been possible without the dedicated efforts of the Alamo Area Texas Master Naturalist Chapter, River Aid San Antonio, and the San Antonio River Authority, who have worked together since 2022 to revitalize water quality monitoring in the Headwaters Salado Creek watershed. Their collective efforts have significantly expanded monitoring coverage, with the San Antonio River Authority leading data collection at seven sites, River Aid San Antonio monitoring three sites, and the Alamo Area Texas Master Naturalists monitoring one site. Texas Stream Team will continue to support these efforts by providing technical assistance and training new community scientists to sustain and grow water quality monitoring in this region and beyond.

For more information about Texas Stream Team and upcoming trainings, contact us at TxStreamTeam@txstate.edu or visit the calendar of events on our website at www.TexasStreamTeam.org.

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Appendix A.

Table 7. Endangered species located within the Headwaters of Salado Creek watershed in Bexar County, Texas.

Species Type	**Common Name**	**Federal/State Listing**
Bird	Whooping crane	State Listed as Endangered
	Interior least tern	State Listed as Endangered
	Golden-cheeked warbler	State Listed as Endangered
Fish	Widemouth blindcat	Federally Proposed as Endangered
	Toothless blindcat	Federally Proposed as Endangered
Mammal	Tricolor bat	Federally Proposed as Endangered
Insect	N/A (*Rhadine exilis*)	State Listed as Endangered
	N/A (*Rhadine infernalis*)	State Listed as Endangered
	Helotes mold beetle	State Listed as Endangered
Arachnids	Government Canyon Bat Cave spider	State Listed as Endangered
	Cokendolpher Cave harvestman	State Listed as Endangered
	Robber Baron Cave meshweaver	State Listed as Endangered

	Government Canyon Bat Cave meshweaver	State Listed as Endangered
	Madla Cave meshweaver	State Listed as Endangered
Mollusks	False spike	State Listed as Endangered

Table 8. Threatened species within the Headwaters of Salado Creek watershed in Bexar County, Texas.

Species Type	**Common Name**	**Federal/State Listing**
Amphibia	Texas salamander	State Listed as Threatened
	Cascade Caverns salamander	State Listed as Threatened
Bird	White-faced ibis	State Listed as Threatened
	Wood stork	State Listed as Threatened
	Piping plover	State Listed as Threatened
	Yellow-billed cuckoo	State Listed as Threatened
Fish	Widemouth blindcat	State Listed as Threatened
	Toothless blindcat	State Listed as Threatened
Mammal	Black bear	State Listed as Threatened
	White-nosed coati	State Listed as Threatened
Reptile	Cagle’s map turtle	State Listed as Threatened
	Texas tortoise	State Listed as Threatened
	Texas horned lizard	State Listed as Threatened
Plant	Bracted twistflower	State Listed as Threatened