2017 Clean Rivers Program San Antonio River Basin Highlight Report

Watershed Characterizations for the Upper San Antonio River, Salado Creek and Upper Cibolo Creek Watersheds

Christopher Vaughn, SARA Aquatic Biologist
Largemouth Bass *(Micropterus salmoides)*

Introduction

Texas Clean Rivers Program, Senate Bill 818 (SB 818), known as the Texas Clean Rivers Act, was enacted in 1991 by the 72nd Legislature to ensure the comprehensive regional assessment of water quality in each watershed and river basin of the State. This program was administered by the Texas Water Commission, now known as the Texas Commission on Environmental Quality (TCEQ) and at the time was very different from any other monitoring program in Texas.

The Clean Rivers Program (CRP) created a partnership with river authorities, local and special area agencies to create a network of monitoring stations that reported data to the TCEQ. Partnering with other agencies created an atmosphere of cooperation, and built bonds and communication between the agencies. Another aspect of the CRP was the early use of stakeholders to guide the program. Currently, the San Antonio River Authority (SARA) uses an Environmental Advisory Committee (EAC) made up of stakeholders from various geographical areas within the basin who represent a variety of professional interests. This group meets quarterly, and is routinely contacted through email. The EAC provides input to the CRP and a variety of other SARA projects and programs that have an environmental component.

Perhaps the most unique aspect of the CRP is the attention to quality assurance. Early on, the CRP provided quality control and data management training to its partners as part of its program. By 1996, all work performed under a TCEQ contract involving the acquisition, generation and collection of environmental data was conducted in accordance with a TCEQ-approved Quality Assurance Project Plan (QAPP). Current QAPP's must meet all applicable TCEQ and U. S. Environmental Protection Agency (EPA) requirements. The EPA describes a QAPP as a formal document that comprehensively details the required quality assurance and quality control (QA/QC) and other technical activities must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria (EPA, 2001). The QAPP must provide a project-specific "blueprint" for obtaining the type and quality of environmental data needed for TCEQ regulatory decisions and assessments. The QAPP should identify,

- The technical and quality objectives;
- The sampling and analytical methods and acceptable criteria to meet the projects objective;
- Any measurement(s) or information describing environmental processes, sampling locations and frequencies, conditions, and ecological conditions;
- All technical and quality aspects of a project, including planning, implementation, and assessment;
- How QA/QC is applied to assure the results obtained are of the type and quality needed and expected.

The CRP and its SARA-funded companion monitoring program, SARA Stream Monitoring, together with the TCEQ monitoring efforts, are the primary programs for the collection of water quality data in the San Antonio River Basin. Data generated from these programs are used in State assessments and compliance decisions. Therefore, CRP monitoring by SARA and the SARA Stream Monitoring programs operate under a TCEQ-approved QAPP.

Otillo Dam,
Upper San Antonio River Watershed

Coordination and Cooperation with Other Basin Entities

Due to the high expense associated with collecting water quality data and limited funding, the importance of leveraging funds and maximizing regional efforts while minimizing duplicative efforts is paramount. To remain adaptable to economic and environmental changes, each year SARA conducts a coordinated monitoring meeting (CMM) with the TCEQ and other basin monitoring partners. During the meeting, resources are coordinated at the watershed level. This level of coordination provides monitoring that is spatially and temporally calibrated to identify water quality issues and changes in the San Antonio River Basin.

The 2014 TCEQ Integrated Report provides information on the states' surface waters, including concerns for public health, fitness for use by aquatic species, and specific pollutants and their sources. It is composed of several documents including the 303(d) List of Impaired Water Bodies, a list of water bodies evaluated, added or removed from previous 303(d) lists and several other reports. The 2014 Integrated Report can be found on the TCEQ website *http://www.tceq.state.tx.us/waterquality/assessment/305_303.html.*

During SARA's annual CMM, held in mid-spring, information from the TCEQ Integrated Report, CRP partners, and the EAC is used to select stations and parameters that enhance the overall water quality monitoring coverage of the San Antonio River Basin. Water monitoring decisions made during the CMM are directed towards:

- Completing data sets where limited data indicates that a water quality criterion shows a standard is not supported;
- Concerns for water bodies that are near nonattainment;
- Water bodies with known water quality concerns;
- Specific priority for water bodies that have no known water quality problems or without current water quality data.

For the TCEQ 2017 fiscal year, the San Antonio River Basin will be monitored by SARA, TCEQ and the Guadalupe-Blanco River Authority. The Bandera County River Authority and Groundwater District (BCRAGD) and the City of Boerne, sub-participants under SARA's CRP QAPP, will collect routine water quality samples in the Upper Medina River Watershed, Segment 1905 and the Upper Cibolo Creek Watershed, Segment 1908. The 2017 Coordinated Monitoring Schedule (CMS) for the San Antonio River Basin is located at *https://cms.lcra.org/*.

Texas Surface Water Quality Standards

The Texas Surface Water Quality Standards (Title 30, Chapter 307 of the Texas Administrative Code) describes the chemical, physical, and biological conditions to be attained in the surface waters of Texas. The standards are periodically revised to adjust designated uses criteria of individual water bodies, to incorporate new scientific data on the effects of specific chemicals and pollutants, and to address new provisions in the Texas Water Code, federal regulations and EPA guidance. At the February 12, 2014 TCEQ Commission Agenda meeting, the Commissioners adopted revisions to the Texas Surface Water Quality Standards (TSWQS). The adopted standards revisions were published in the Texas Register on February 28, 2014 with an effective date of March 6, 2014.

The 2014 TSWQS revisions include a new category of contact recreation, primary contact recreation 2, with a bacteria criterion of 206 colony forming units per 100 milliliters. This category cannot be assumed for any water body and can only be applied based on the results of a recreational use-attainability analysis. Other standard revisions address changes in site–specific designated uses criteria for classified and unclassified segments. The 2014 TSWQS have been submitted to EPA for review and approval. During the EPA's review of the 2014 TSWQS, the 2010 TSWQS will continue to be used in assessing surface water quality data in the San Antonio River Basin (TCEQ website). The 2010 and 2014 TSWQS can be found on the TCEQ's website *https://www.tceq.texas.gov/waterquality/standards/eq_swqs.html.*

Assessment of the Basin: How is water quality measured?

The TCEQ Integrated Report is generated every two years in even-number years and satisfies the requirements of Federal Clean Water Act Sections 305(b) and 303(d). In producing the Integrated Report, the TCEQ utilizes historical water quality data to assess and identify water bodies that do not meet designated use criteria and standards as identified in the TSWQS. If the water quality data indicates that a designated use(s) is not supported, the segment will be identified as "impaired" and included in the Integrated Report's 303(d) List of Impaired Waters. If the data indicates good water quality, the water body is identified as "fully supporting" its designated uses. A "concern" may be identified if a limited amount of data indicates elevated levels of pollutants or if a screening level is exceeded.

Shaun Donovan, SARA Aquatic Biologist
Largemouth Bass ***(Micropterus salmoides)***

In the TSWQS, the TCEQ has assigned five categories of designated uses for all classified water bodies in Texas: aquatic life, contact recreation, fish consumption, public water supply, and general use. Each water body in the San Antonio River Basin is evaluated against its designated aquatic life use, contact recreation standard and general use. Fish consumption use and public water supply use are assessed to specific water bodies.

Aquatic Life Use: Each classified segment in the TSWQS is assigned an aquatic life use (ALU), based on physical, chemical and biological characteristics of the water body. The five ALU categories are exceptional, high, intermediate, limited or minimal (no significant aquatic life). Support of the ALU is based on the assessment of:

- 24 hour and grab dissolved oxygen criteria;
- Toxic substances in water and sediment criteria (metals and organics);
- Ambient water and sediment toxicity test results;
- Habitat, benthic macroinvertebrate and fish community indices.

Provided the minimum number of samples are available, each set of criteria is generally evaluated independently of the others, an impairment of the ALU results when any of the individual criteria are not attained.

For freshwater streams not classified in the TSWQS, the ALU and criteria are presumed based on the stream flow type. Stream flow type is established from flow data associated with samples, information provided by local monitoring staff, previous assessments, or recent receiving water assessments. Stream flow type include perennial, intermittent and intermittent with pools.

Recreation Use: Recreation Use categories and criteria are assigned to all water bodies. Two organisms are routinely analyzed in water samples collected to determine support of the recreation use: Escherichia coli (E. coli) in freshwater, and Enterococci in tidal water bodies and certain inland water bodies. E. coli is used to assess recreation use attainment in the San Antonio River Basin.

Station 12897 San Antonio River at IH 410

General Use: Water quality criteria for several constituents are established in the TSWQS to safeguard general water quality, rather than for protection of one specific use. Support of the General Use is based on the assessment of:

- Water temperature
- pH
- Chloride
- Sulfate
- Total dissolved solids (TDS)
- Conductivity
- Ammonia nitrogen
- Nitrite-nitrogen
- Nitrate-nitrogen
- Total phosphorus
- Chlorophyll a
- Secchi depth

These parameters protect aquatic life, recreation, public water supply and other beneficial uses of water resources. For the purpose of assessment, the criteria protecting these multiple uses are evaluated for attainment of a construct entitled, "general use."

Specific criteria for each of the other parameters are assigned to every classified segment in the TSWQS based on physical, chemical and biological characteristics. Water temperature, pH, chloride, sulfate, TDS and chlorophyll a criteria developed for classified segments do not apply to unclassified water bodies.

Concerns for general uses are identified with screening levels for nutrients and chlorophyll a for both classified and unclassified water bodies with the exception of some classified reservoirs identified in the TSWQS for which chlorophyll a site specific criteria were developed. Although other concerns are reported for general use, attainment of the general use for unclassified water bodies is not assessed and therefore not reported.

Fish Consumption Use: Fish consumption use attainment and concerns are evaluated with three assessment methods:

- Advisories, Closures and Risk Assessments
- Human Health Criteria for Bioaccumulation and Fish Consumption Use
- Human Health Fish Tissue Criteria Concerns

For a full assessment of use attainment for fish consumption and a determination of fully supporting, a Texas Department of State Health Services (DSHS) risk assessment or advisory is required. Risk assessments are costly and conducted only on water bodies where the assessment has indicated a risk from consumption. Additional information may be found on the DSHS website *http://www.dshs.texas.gov/seafood/advisories-bans.aspx*

Public Water Supply Use: Public water supply use (PS) is evaluated for surface water bodies that are designated in the TSWQS for public water supply use. Human health criteria from the TSWQS are used to determine whether the segment is supporting public water supply use. The human health criteria are based, in part, on the primary maximum contaminant levels adopted in the Texas Administrative Code (30 TAC §290). Segments designated for aquifer protection (AP) are capable of recharging the Edwards Aquifer. The principal purpose of this use designation is to protect the quality of water infiltrating into and recharging the aquifer and applies to designated portions that are on the recharge zone, transition zone or contributing zone as defined in the TSWQS.

Additional information on designated uses for all classified water bodies in Texas can be found in the 2014 Guidance for Assessing and Reporting Surface Water Quality in Texas at the TCEQ website *https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/14txir/2014_guidance.pdf.*

Every five years, SARA publishes a Basin Summary Report as required by the CRP. This report, last conducted in 2013, provides a detailed review of parameters analyzed, designated uses and associated water quality concerns and impairments in the San Antonio River Basin. The SARA CRP Basin Summary and annual Basin Highlight Reports are located on the SARA website *https://www.sara-tx.org/environmental-science/basin-highlights-reports/*.

Surface Water Quality Measurements

A major CRP monitoring objective is to provide the TCEQ sufficient data to support the assessment of surface water quality, water quality standards and wastewater permits. With this in mind, monitoring decisions are made considering the monitoring types, parameters analyzed, and the minimum number of samples needed to assess water bodies in the San Antonio River Basin.

Under the SARA CRP, there are two types of sampling events conducted throughout the basin.

Routine Sampling (RT) events are scheduled in advance without intentionally trying to target any certain environmental conditions. Samples are collected regardless of the conditions encountered that day. Bacteria and conventional chemical parameters collected and analyzed for RT sampling events include:

- E. coli
- Chloride
- Sulfate
- Total Kjeldahl nitrogen (TKN)
- Total suspended solids (TSS)
- Ammonia nitrogen
- Nitrite-nitrogen
- Nitrate-nitrogen
- Total phosphorus
- Chlorophyll-a
- Temperature
- pH
- Conductivity
- Dissolved oxygen
- Secchi depth
- Flow
- Metals in sediment (Specific sites throughout the basin)

Biased Season (BS) sampling events are scheduled for a certain time of year and are meant to capture the conditions characteristic of that time of year. Keeping safety in mind, BS samples are collected regardless of the flow condition encountered that day. Parameters collected and analyzed for BS sampling events include:

- Fish, benthic macroinvertebrates and habitat
- 24 hour dissolved oxygen
- Flow measurements

Chris Adkison, 2016 Mike Gonzales Memorial Intern, Cibolo Creek Watershed

The purpose of 2017 CRP Watershed Characterization Report is to review activities within the Upper San Antonio River, Salado Creek and Upper Cibolo Creek watersheds. Characterizations such as segment descriptions, hydrology, land uses, maps, and ongoing projects, are reviewed. Potential sources of impairments and concerns based on the 2014 Texas Integrated Report are identified and recommendations to improve water quality are suggested.

The TCEQ and CRP partners, including SARA, use this report and others submitted throughout the State to develop and prioritize programs that will protect the water quality of healthy water bodies and improve the quality of impaired water bodies. The Report Cycle table identifies reports for the SARA Clean Rivers Program over the last five years.

Basin Highlights Report Cycle	
Year	Report Type
2013	CRP Basin Summary Report
2014	CRP Update Report
2015	CRP Watershed Characterization for Medina River, Leon Creek & Medio Creek
2016	CRP Basin Highlights Report
2017	**CRP Watershed Characterization for Upper San Antonio River, Salado Creek & Upper Cibolo Creek**

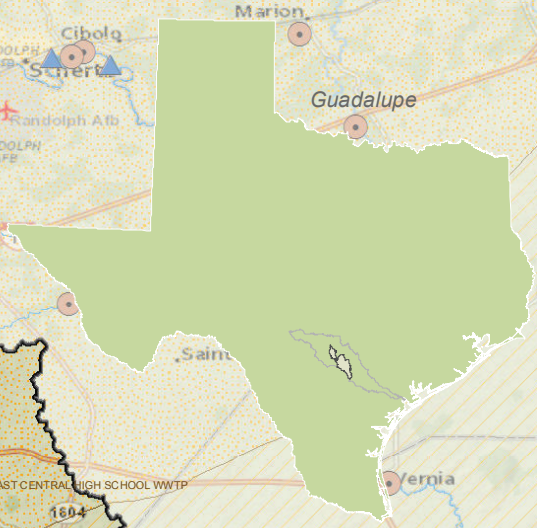
For the purposes of this characterization report, use support is reported at both the segment and assessment unit level.

A **classified segment** is a water body or portion of a water body that is individually defined in the TSWQS. A segment is intended to have relatively homogeneous chemical, physical and hydrological characteristics. A segment provides a basic unit for assigning site-specific standards and for applying water quality management programs of the TCEQ. Classified segments may include streams, rivers, bays, estuaries, wetlands, lakes or reservoirs. Classified segments are protected by site-specific criteria as stated in the TSWQS. The classified segments are assigned four-digit numbers. The first two digits correspond to the major basin in which they are located. The last two digits distinguish individual segments within the particular basin. For example, Segment 1905 is in basin 19 (San Antonio River Basin) and 05 represents the Medina River above Medina Lake from a point immediately upstream of the confluence of Red Bluff Creek in Bandera County to the confluence of the North Prong Medina River and the West Prong Medina River in Bandera County.

Because of the great amount of surface waters in the state, not all bodies of water are classified in the standards. For example, when managing a classified segment of the Medina River above Medina Lake, it may be necessary to examine water quality in the tributaries that flow into that segment. Some of these tributaries may not be part of the classified segment system. When that happens, for management purposes, the tributary is assigned a unique tracking number that is referred to as an **unclassified segment**. This unclassified segment will be designated with the number of the classified segment within the watershed in which it is located, along with a letter. Example 1905A North Prong Medina River is a tributary of the Medina River above Medina Lake. Unclassified segments are small and often intermittent water bodies, normally ceasing flow for weeks or months each year, and are not typically assigned specific water quality standards. Unclassified segments are generally assessed on the flow criteria along with the classified segment into which they flow, but in some cases may be assigned specific water quality standards.

Each segment is further broken down into smaller subareas called **assessment units (AU)**. An AU is defined as the smallest geographic area of use support reported in the assessment. Each AU within a segment is assigned a number such as 1905_01. A segment may consist of more than one AU, 1905_01, 1905_02, and so on. Support of criteria and designated uses are examined for each AU. To address water quality regulatory activity such as permitting, standards development, and remediation, use support information applies to the AU level. The 303(d) List is reported at the AU level for each water body.

UPPER SAN ANTONIO RIVER WATERSHED



17066
21547
12899
21825
12897
21705
16731
12894
12886
12889
12883
12881
12879
1911
1901

KELLY AIR FORCE BASE GW WWTP
SAN ANTONIO WWTP
EAST CENTRAL HIGH SCHOOL WWTP
SOMMER, DEELY, SPRUCE SES OUTFALL 007
SOMMER, DEELY, SPRUCE SES OUTFALL 001
SOMMER, DEELY, SPRUCE SES
SALATRILLO CREEK WWTP
VH BRAUNIG STEAM ELECTRIC ST
OUTFALLS 001, 003, 006-008, 011-013, 015, 016
AQUA UTILITIES
LFT: SALADO CREEK WATER RECYCLING CTR
RGT: DOS RIOS WATER RECYCLING CTR OUTFALL 006
PICOSA WWTP
CITY OF FLORESVILLE WWTP
John B Connally Ranch Airport

Comal
Guadalupe
Atascosa
Karnes
Wilson
Floresville
Somerset
Converse
Universal City
Schertz
Cibolo
Marion
Kirby
Leon Valley
Bexar
Helotes
Vernia

Monitoring Stations
Wastewater Outfalls
Counties
Segment Boundary

N

0 1.5 3 6 9 Miles

ASSESSMENT UNITS

Upper San Antonio River
- 1911_01
- 1911_02
- 1911_03
- 1911_04
- 1911_05
- 1911_06
- 1911_07
- 1911_08
- 1911_09

Olmos Creek
- 1911A_01

Apache Creek
- 1911B_01
- 1911B_02

Alazan Creek
- 1911C_01
- 1911C_02

San Pedro Creek
- 1911D_01
- 1911D_02

Six Mile Creek
- 1911E_01

Picosa Creek
- 1911H_01
- 1911H_02

Martinez Creek
- 1911I_01
- 1911I_02

SEGMENT DESCRIPTION

The Upper San Antonio River Segment 1911 extends from a point 600 meters (660 yards) downstream of FM 791 at Mays Crossing near Falls City in Karnes County to a point 100 meters (110 yards) upstream of Hildebrand Avenue at San Antonio in Bexar County. The segment is approximately 85 miles long and has an approximate drainage area of 558 square miles. See Table 1911-1 and 1911-2 for the stations and number of proposed sampling events to be collected in the TCEQ 2017 fiscal year.

Major tributaries to the Upper San Antonio River include Medina River and Salado Creek. The San Antonio River originates as natural spring flow from the Edwards Aquifer south of the Balcones Fault Zone then flows over the Gulf Coastal Plains of the Central Plains Province. The watershed has an average yearly rainfall of 26 to 34 inches. At its headwaters, the San Antonio River is heavily urbanized and is a small narrow stream sparsely lined with native vegetation. For a short distance the San Antonio River flows through Brackenridge Park as it makes its way through the heavily urbanized downtown district of San Antonio. As the San Antonio River flows past Loop 410 it becomes wide and deep and takes on the natural characteristics of South Texas streams influenced by the geology of the Gulf Coastal Plains. The upper portion of the watershed is largely developed; land use in the lower portion is agricultural and rangeland.

Unclassified segments of the Upper San Antonio River assessed in the 2014 Integrated Report include:

- Segment 1911B Apache Creek
- Segment 1911C Alazan Creek
- Segment 1911D San Pedro Creek
- Segment 1911E Sixmile Creek
- Segment 1911H Picosa Creek
- Segment 1911I Martinez Creek

San Pedro Creek is fed by the San Pedro Springs which discharge at rates from 0 to 17 cfs, depending upon the level of the Edwards Aquifer (SAR WPP, December 2006). As a result of insufficient data, Olmos Creek (1911A), Calaveras Reservoir (1911F) and Braunig Reservoir (1911G) were not assessed in the 2014 Integrated Report. See Table 1911-3 for Site-Specific Uses and Criteria for Segment 1911.

HYDROLOGIC CHARACTERISTICS

According to the United States Geological Survey (USGS) website *http://waterdata.usgs.gov/tx/nwis/current/?type=flow*, accessed on August 2, 2016, the 53 year median flow at USGS gage - 08181800 San Antonio RV near Elmendorf, TX, is 175 cubic feet per second (cfs), and a flow range of 54 (1964) to 6030 (1978) cfs. The USGS 08183500 gage station, San Antonio RV nr Falls City, TX, has a 91 year median annual average flow of 294 cfs, and a flow range of 38 cfs (1956) and 2830 (2007). Base flow of the Upper San Antonio River is artificially maintained with well water discharges from the San Antonio Zoo and reuse water from the City of San Antonio Water Recycling Centers. Groundwater in the area is primarily associated with the Edwards and Carrizo-Wilcox aquifer systems.

IMPAIRMENT/AREA OF INTEREST

Segment 1911 is located in Edwards Plateau, Texas Blackland Prairies and East Central Texas Plains Ecoregions and is identified in the 2014 TCEQ Integrated Report as being a freshwater perennial stream with a high aquatic life use designation. The Upper San Antonio River is not classified for domestic water supply use. Like all segments in the San Antonio River Basin, this segment is designated for primary contact recreation. Primary contact includes activities presumed to involve a significant risk of ingestion of water such as wading by children, swimming, water skiing, diving, tubing, surfing, handfishing as defined by Texas Parks and Wildlife Code, §66.115; including whitewater activities: kayaking, canoeing, and rafting. Impairments and concerns in Segment 1911 include:

Upper San Antonio River

Assessment Unit 1911_01: Concerns for nutrients have been identified.

Assessment Unit 1911_02: Impaired for bacteria,

concerns for nutrients have also been identified.

Assessment Unit 1911_03: Impaired for bacteria, concerns for nutrients have also been identified

Assessment Unit 1911_04: Concerns for nutrients have been identified.

Assessment Unit 1911_05: Concerns for habitat and nutrients have been identified.

Assessment Unit 1911_06: Concerns for nutrients have been identified.

Assessment Unit 1911_07: Impaired for bacteria, concerns for habitat and nutrients have also been identified

Assessment Unit 1911_08: Impaired for bacteria, concerns for fish community, habitat and nutrients have also been identified.

Assessment Unit 1911_09: Impaired for bacteria and fish community. Concerns for habitat and nutrients have also been identified.

Unclassified segments of the Upper San Antonio River

Assessment Unit 1911B_01: Impaired for bacteria, concerns for nutrients and dissolved oxygen screening levels have also been identified.

Assessment Unit 1911C_01: Impaired for bacteria.

Assessment Unit 1911C_02: Impaired for bacteria, a concern for nutrients has also been identified.

Assessment Unit 1911D_01: Impaired for bacteria, a concern for nutrients has also been identified.

Assessment Unit 1911D_02: Impaired for bacteria, concerns for nutrients and dissolved oxygen screening levels have also been identified.

Assessment Unit 1911E_01: Impaired for bacteria.

Assessment Unit 1911H_01: Impaired for dissolved oxygen minimum, a concern for dissolved screen level has also been identified.

Assessment Unit 1911I_01: Impaired for bacteria, a concern for dissolved oxygen screening levels has also been identified.

Details of the impairments and concerns for the Upper San Antonio River Watershed, as identified in the TCEQ 2014 Integrated Report, can be seen in Table 1911-4. A map of impairments and concerns can be seen in Figure 1911-1.

LAND USE/LAND COVER

The Upper San Antonio River Watershed lies within Bexar, Wilson and Karnes Counties, and is characterized by a mixture of land uses and cover. Its headwaters are in southeastern Bexar County within the City of San Antonio. The river runs north to south, from the southern end of San Antonio, past Floresville and Poth, to FM 791 near Falls City in Karnes County. According to the 2015 census, the upper third of the watershed is home to the second most populous incorporated city in the State of Texas, the City of San Antonio with an estimated population of 1,469,845 (United States Census Bureau, 2015). Non-classified water bodies contributing flow to this portion of the watershed include Apache and San Pedro Creeks. Olmos, Alazan, Sixmile and Martinez Creeks are intermittent except during high flow events. The lower two thirds of the watershed is characterized by a mixture of shrub/scrub, agricultural and pasture land, with medium to low urban development southwest of the City of San Antonio and around the cities of Floresville, La Vernia, Poth. There are small areas of forest throughout the middle portion of the watershed.

Information used to generate the Land Cover Maps was obtained from the San Antonio River Authority's GIS Department, and includes National Land Cover Database (NLCD) 2011 data created by the Multi-Resolution Land Characteristics (MRLC) Consortium (*http://www.mrlc.gov/nlcd2011.php*), and TCEQ Assessment Units data created by the Texas Commission on Environmental Quality *http://www.tceq.state.tx.us/gis/download-tceq-gis-data*. See Figure 1911-2 for more detail.

According to the Texas Commission on Environmental Quality Permitted Wastewater Outfalls shapefile, located at *http://www.tceq.state.tx.us/gis/download-tceq-gis-data*, there are nine permitted and one pending permitted dischargers with a total of 28 outfalls in Segment 1911. See Table 1911-5 for details.

POSSIBLE CAUSES OF IMPAIRMENT OR INTEREST

Fish Impairment and Habitat Concerns: Efforts to address flooding in San Antonio between the 1920s and 1960s focused both on San Antonio and downstream of the city. During this time, the U.S. Army Corps of Engineers (USACE) extensively widened and straightened the river channel south of downtown. These flood control measures removed the rivers natural sinuosity, instream physical features and vegetation. In its place, the river channel was straightened and lined with concrete rubble, leaving a flat pathway for the river's flow. Although this effort was successful in expediting flood water out of the city, it was extremely detrimental to the riparian habitat, fish and macrobenthic communities. In 1998, a concerted community effort to revitalize the river began. Bexar County, the City of San Antonio and SARA created the San Antonio River Oversight Committee. The 22 civic and neighborhood leaders appointed to the committee were given the responsibility of overseeing the planning, design, project management, construction and funding necessary to complete the San Antonio River Improvements Project (SARIP). The SARIP was completed in 2013 and restored and enhanced the San Antonio River both north and south of downtown. Additional information can be found at *http://www.sanantonioriver.org/*.

Bacteria Impairment: On July 25, 2007, the TCEQ adopted the Three Total Maximum Daily Loads (TMDL) for Bacteria in the San Antonio Area, including the Upper San Antonio River, Salado Creek and Walzem Creek. The TMDLs were approved by the U.S. Environmental Protection Agency (EPA) on September 25, 2007. The final report identified possible point and nonpoint sources or causes of contamination. Point sources identified as potentially contributing to bacteria are stormwater from Municipal Separate Storm Sewer System (MS4) Phase II dischargers, the San Antonio Zoo, sanitary sewer overflows, and dry weather discharges. Nonpoint sources that could contribute to the E. coli load in the watershed include stormwater outside MS4 areas, failing septic systems, leaking wastewater infrastructure, livestock, and wildlife such as egret rookeries. These sources of pollution may be contributing to the bacterial impairments and nutrient concerns in the upper reaches of the Upper San Antonio River Watershed. Agricultural-related operations and wildlife, such as deer and feral hogs maybe the sources of bacterial impairment and nutrient concerns in the lower part of watershed. Additional information can be found at the TCEQ's website located at *http://www.tceq.state.tx.us/assets/public/waterquality/tmdl/34uppersa/34-uppersanantoniotmdl-adopted.pdf*

Dissolved Oxygen Impairment: Dissolved oxygen impairments in the unclassified water bodies of the Upper San Antonio River are attributed to intermittent low flows, poor riparian buffer vegetation, low channel sinuosity and shallow depth.

POTENTIAL STAKEHOLDERS

- City of San Antonio
- City of Elmendorf
- City of Floresville
- Landowners
- Texas A&M AgriLife Extension Service
- Natural Resource Conservation Service
- Texas Department of Agriculture
- Texas State Soil and Water Conservation Board
- Texas Parks and Wildlife Department
- US Fish and Wildlife Service
- San Antonio Water System

RECOMMENDATIONS FOR IMPROVING WATER QUALITY

SARA should continue routine, biological and stormwater monitoring and provide quality assured data to TCEQ for assessment. SARA should also work with partners to implement and monitor best management practices identified in the Upper San Antonio River TMDL's, Watershed Protection Plan and TMDL Implementation Plan for Bacteria in the Upper San Antonio Watershed.

Critical components of habitat quality and a healthy fish community are substrate stability and instream cover. Large woody debris and instream cover are important components of rivers and streams, providing varying degrees of channel stability and habitat diversity.

Introductions of large woody debris and other instream cover can have significant effect on the production of juvenile and adult fish while also providing habitat for aquatic invertebrates. Given the high flows experienced during stormwater events, SARA should explore ways of permanently installing structures to promote a diverse and ecologically sound environment for fish and aquatic invertebrates in the upper part of the watershed.

SPECIAL PROJECTS

Reintroduction of the Guadalupe Bass into the Upper San Antonio River: Under a National Fish and Wildlife Foundation Grant, SARA, Texas Parks and Wildlife Department (TPWD) and Texas State University (TxST) began reintroducing Guadalupe Bass (*Micropterus treculi*) into the Mission Reach of the Upper San Antonio River. During the project over 60,000 Guadalupe Bass were reintroduced into the river. The Guadalupe Bass were raised at the TPWD, Heart of the Hills Fisheries Science Center in Mountain Home, Texas. Reintroduction and establishment of the Guadalupe Bass in the segment may provide an opportunity to validate ecological improvements as a result of the San Antonio River Improvements Project as well as provide a valued economic and recreational resource to the community. Approximately 84,000 additional Guadalupe Bass have been stocked across four sites on the Upper San Antonio River since the end of the project in 2015. SARA biologists will continue to monitor the population and gather individual fish genetic information to determine if the population is self-sustaining.

Upper San Antonio River Watershed Protection Plan (EPA 319 Grand administered through the TCEQ): In response to the Three Bacteria TMDLs for the Upper San Antonio River, Salado Creek and Walzem Creek, SARA, the City of San Antonio, Bexar County and other partners initiated the Upper San Antonio River Watershed Protection Plan (WPP). The WPP was completed in 2006 with the objective of establishing and tracing efforts that enhanced the urban reaches and bring the Upper San Antonio River back into compliance with water quality contact recreation standards, which is a geometric mean of less than 126 E. coli organisms per 100 milliliters. To help identify and propose water quality best management practices (BMPs), the 2006 WPP was updated to identify a plan for implementation and monitoring of approved BMPs that would aid in reducing E. coli nonpoint source loads to the Upper San Antonio River. On February 18, 2015 the EPA approved the WPP, making the state eligible for CWA Section 319(h) project funding within the Upper San Antonio River watershed. These funds are limited to those activities that address nonpoint source runoff. The Upper San Antonio River WPP Report can be viewed at *http://www.bexarfloodfacts.org/watershed_protection_plan/*.

Implementation Plan for Three Total Maximum Daily Loads for Bacteria in the Upper San Antonio River Watershed: In 2013, Texas A&M AgriLife Research began working with communities, interest groups, and local organizations to involve stakeholders in developing a TMDL Implementation Plan (I-Plan). The I-Plan is designed to guide activities that will improve water quality for the Salado Creek, Walzem Creek, and Upper San Antonio River watersheds. The I-Plan identifies and describes BMPs that will be implemented and tracked to reduce bacteria and establish a timeline for implementation. The I-Plan also includes follow-up tracking and monitoring plans to determine the effectiveness of the selected BMPs. The ultimate goal of this I-Plan is to meet primary contact recreation uses in Segments 1910, 1910A, and 1911 by reducing concentrations of E. coli bacteria to levels established in the TMDLs. The draft I-Plan was submitted to TCEQ in spring 2015 and received final approval on April 6, 2016. The approved I-Plan includes 30 management measures that will be used to improve water quality and reduce E. coli in Salado Creek, Walzem Creek, and the Upper San Antonio River watersheds. Additional information can be found at the TCEQ's site located at *http://www.tceq.state.tx.us/waterquality/tmdl/34-uppersanantoniobac.html.*

USGS Westside Creeks Sediment Study: The Westside Creeks (Alazan, Apache, Martinez and San Pedro Creeks) are four tributaries to the San Antonio River that were channelized by the U.S. Army Corps of Engineers (USACE) in the 1960s and 1970s. A feasibility study, conducted by USACE and SARA and completed in September 2014, evaluated the ecological restoration opportunities of these creeks. This USGS study builds upon the completed feasibility study and

provides additional information about the current creek sediment and water quality conditions to determine if there are concerns about disturbing the stream-bed during potential restoration activities. This ongoing project is a collaborative effort with the U.S. Geological Survey (USGS) that expands employee expertise in assessing sediment and water quality of the Westside Creeks. The data and analysis is used to understand and evaluate sediment and water quality conditions in advance of a future Westside Creeks ecological restoration project. This project also leverages SARA funding with USGS cooperative funds.

SARA Holistic Freshwater Mussel Project: As of 2016, there are 15 mussel species listed as threatened at the state level, six of which are candidates for listing under the United States Fish and Wildlife Service (USFWS) Endangered Species Act. Three Central Texas species are presently among those listed as threatened by the State, the Golden Orb (Quadrula aurea), the Texas Fatmucket (*Lampsilis bracteata*) and the Texas Pimpleback (*Quadrula petrina*). All are historically found within the San Antonio River Basin. In 2015, reconnaissance efforts and intense mussel surveys were conducted on the Lower Cibolo Creek and the West Side Creeks, including Alazan, Apache, San Pedro and Martinez Creeks. Mussel population parameters such as density, abundance, and richness were used to determine and assess the condition of native mussel populations within these watersheds. In 2016 SARA biologists began sampling the Upper San Antonio River. Other water bodies in the San Antonio River Basin will be sampled through the winter of 2018. Final results will be formally documented and sent to the Texas Parks and Wildlife Department and the USFWS where agencies will review and make final recommendations.

Upper San Antonio River Master Plan, 2013: The Upper San Antonio River watershed continues to experience severe flooding even after significant investment in Olmos Dam and San Antonio River Improvements Project. Working through the Bexar Regional Watershed Management Program with its many partners including the City of San Antonio and Bexar County, SARA authorized Pape Dawson Engineers to develop an Upper San Antonio River Master Plan to address flooding issues along major tributaries within the watershed. Following the publication of the plan and in recognition of the impact of development on water quality, SARA developed recommendations to address water quality issues, low impact development, stream restoration, nature based park planning, mitigation banking and conservation easements. The additional components were developed as geospatial datasets and will be summarized in an update to the Watershed Master Plans (expected May 2017). Additional information can be found on SARA's website *https://www.sara-tx.org/wp-content/uploads/2015/04/Upper-San-Antonio-River-Watershed-Master-Plan.pdf.*

MAJOR WATERSHED EVENTS

San Antonio River Improvements Project (SARIP): In 2013, the SARIP was completed, restoring and enhancing 13 miles of the San Antonio River from Hildebrand Avenue south to Loop 410 South. Improvements along the Mission Reach focused on ecosystem restoration using a technique known as fluvial geomorphology. This technique transformed the straightened concrete lined river to replicate the original flow of the river while maintaining flood control, reducing erosion, re-introducing native vegetation and creating an environment more suitable for recreation and wildlife. The project's ecological features included restoring natural pools, riffles, run sequences, restoration of natural backwater habitats and reconnection of historic river remnants. Over time, these improvements are expected to help address the fish community impairment and habitat concerns in the upper portions of the Upper San Antonio River. To monitor variability and changes in the aquatic communities in the Upper San Antonio River Watershed, SARA will continue biological monitoring throughout the watershed, including 4 stations in the upper portion of the Upper San Antonio River Watershed, including: Station 12889 San Antonio River at Padre Road, Station 21547 San Antonio River at VFW Boulevard, Station 12909 San Antonio River at Mulberry Street, and Station 12908 San Antonio River at Woodlawn Avenue.

Fish Kill in the Upper San Antonio River: Common pollutants including oil and grease, pesticides, fertilizers, sediment and carelessly discarded trash are often found in stormwater. This stormwater ultimately is

transported and discharged into local rivers and streams without treatment. When these pollutants are deposited into water bodies they can impair and discourage recreational use of resources, contaminate drinking water supplies and interfere with wildlife, fish and other aquatic organisms. On Tuesday evening, July 26, 2016, SARA Watershed Parks & Operations staff reported several dead fish in the Espada Remnant Channel and Davis Lake area. SARA biologists and investigators were notified. Over all, an estimated 800 live native fish were relocated to an area of the main stem San Antonio River where satisfactory water quality existed. Approximately 12,525 native and non-native fish were killed during the event. Investigation determined the fish kill was cause by low dissolved oxygen as a result of a long period without rainfall followed by a large rain event which caused significant runoff. TPWD was notified and a complete report was sent to document the event.

Stormwater Monitoring: To help characterize water quality influences from stormwater events throughout the San Antonio River Basin, SARA has establish a network of permanent, long-term automated stormwater instream monitoring stations. These stations capture water quality data prior to, during and after storm events. Depending on the station, water quality samples, flow and/or field measurement will be captured. The locations of these stormwater monitoring sites in the Upper San Antonio River Watershed include:

- Station 14256 San Antonio River at Michell Street
- Station 12908 San Antonio River at Woodlawn Avenue
- Station 12909 San Antonio River at Mulberry (pending)
- Station 12707 San Pedro Creek at Furnish Street
- Field measurement stations: San Antonio River at the tunnel inlet, San Antonio River at the Lock and Dam on the River Walk, the San Antonio River at the San Juan Remnant, and San Antonio River at Mulberry.

IMAGES
See Figure 1911-3 to 1911-9 for pictures of this segment.

Common Carp (Cyprinus carpio)

Table 1911-1: 2017 Coordinated Monitoring Schedule for Segment 1911 - Upper San Antonio River														
Seg_AU	TCEQ Segment_AU Description	Stations in the Seg_AU	Station Short Description	Collection Entity	Monitoring Type	24 Hour DO	Habitat	Benthic	Nekton	Metal Sediment*	Conventional	Bacteria	Flow	Field
1911_01	From the lower end of the segment up to just upstream of the confluence with Olmos Creek.	12879	SAN ANTONIO RIVER AT FM 791	SARA	RT						6	52	52	6
1911_02	From the confluence with Olmos Creek up to just upstream of the confluence with Picosa Creek.	NO FY17 MONITORING												
1911_03	From just upstream of the confluence with Picosa Creek up to just upstream of the confluence with Lodi Branch in Floresville, Wilson County, Texas.	12881	SAN ANTONIO RIVER AT SH 97	SARA	RT					2	6	52	52	6
1911_04	From just upstream of the confluence with Lodi Branch in Floresville, Wilson County, Texas up to just upstream of the confluence with Calaveras Creek.	12883	SAN ANTONIO RIVER AT DIETZFIELD ROAD	SARA	RT						6	6	6	6
1911_05	From just upstream of the confluence with Calaveras Creek up to just upstream of the confluence with the Medina River.	12886	SAN ANTONIO RIVER AT LOOP 1604	SARA	RT						6	6	6	6
		12889	SAN ANTONIO RIVER AT IH 37	SARA	BS/RT	1					6	6		6
1911_06	From just upstream of the confluence with the Medina River up to just upstream of the confluence with Salado Creek.	16731	SAN ANTONIO RIVER UPSTREAM OF MEDINA	SARA	BS/RT	2	2		2	2	6	6	6	6
		12894	SAN ANTONIO RIVER AT BLUE WING ROAD	SARA	RT						6	6		6
1911_07	From just upstream of the confluence with Salado Creek up to just upstream of the confluence with Sixmile Creek.	12897	SAN ANTONIO RIVER AT IH 410	SARA	RT					2	6	52	52	6
1911_08	From just upstream of the confluence with Sixmile Creek to just upstream of the confluence with San Pedro Creek.	21547	SAN ANTONIO RIVER AT VFW BOULEVARD	SARA	BS/RT	1	1	1	1		6	6	6	6
		12899	SAN ANTONIO RIVER AT PADRE ROAD	SARA	BS/RT	1	1	1	1		6	6	6	6
		17066	SAN ANTONIO RIVER AT MISSION ROAD	SARA	RT						6	52	52	6
1911_09	From just upstream of the confluence with San Pedro Creek up to the upper end of the segment.	12909	SAN ANTONIO RIVER AT MULBERRY STREET	SARA	BS/RT	1	1		1	2	6	6	6	6
		12911	SA RIVER AT WELL 2 JOSKE PAVILION	SARA	RT					2	6	6	6	6
		15085	SAN ANTONIO RIVER AT NEWELL AVENUE	SARA	RT						6	6		6
		15722	SAN ANTONIO ZOO OUTFALL NO 1	SARA	RT							6	6	6
		12904	SAN ANTONIO RIVER AT ALAMO ST	SARA	RT						6	6	6	6
		12908	SAN ANTONIO RIVER AT WOODLAWN AVE	SARA	BS/RT	1	1		1	2	6	6	6	6
		14223	SAN ANTONIO RIVER AT PRESA STREET	SARA	RT							6		6
		14256	SAN ANTONIO R AT MITCHELL STREET	SARA	RT					2	6	52	52	6
		18865	SAN ANTONIO RIVER AT LEXINGTON	SARA	RT						6	6		6
		20118	SAN ANTONIO RIVER AT HOUSTON STREET	SARA	BS/RT	1					6	6		6
		20122	SAN ANTONIO RIVER LOOP AT LITTLE RHEIN	SARA	BS/RT	1					6	6		6

*Metals in Sediment include: Aluminum, Antimony, Arsenic, Barium, Cadmium, Chromium, Copper, Lead, Manganese, Mercury, Nickel, Selenium, Silver and Zinc.

Table 1911-2: 2017 Coordinated Monitoring Schedule for the unclassified waterbodies of Segment 1911 - Upper San Antonio River														
Seg_AU	TCEQ Segment_AU Description	Stations in the Seg_AU	Station Short Description	Collection Entity	Monitoring Type	24 Hour DO	Habitat	Benthic	Nekton	Metal Sediment *	Conventional	Bacteria	Flow	Field
1911B_01	From the confluence with San Pedro Creek up to just upstream of the confluence with Zarzamora Creek.	18735	APACHE CREEK AT BRAZOS STREET	SARA	RT						6	6	6	6
1911C_01	From the confluence with Apache Creek up to the confluence with Martinez Creek.	12715	ALAZAN CREEK AT TAMPICO RD	SARA	RT						6	6	6	6
1911C_02	From the confluence with Martinez Creek to the upper end of the segment.	20344	ALAZAN CREEK AT ARBOR PLACE	SARA	RT						6	6	6	6
1911D_01	From the confluence with segment 1911 up to the confluence with Apache Creek.	12707	SAN PEDRO CREEK AT FURNISH ST	SARA	RT						6	52	52	6
		21105	SAN PEDRO CREEK AT W MITCHELL STREET	SARA	RT					2			2	2
1911D_02	From the confluence with Apache Creek to the upper end of the segment, NHD RC 12100301000867	20119	SAN PEDRO CREEK IMMEDIATELY UPSTREAM OF IH 10	SARA	RT						6	6	6	6
1911E_01	Entire water body	21705	SIX MILE CREEK AT 2nd SECOND CROSSING OF ASHLEY RD	SARA	RT						6	6	6	6
1911I_01	Martinez Creek from the confluence of Alazan Creek in central San Antonio upstream to the concrete channel portion at San Francisco St in north San Antonio.	12751	MARTINEZ CREEK AT RUIZ ST	SARA	RT						6	6	6	6

*Metals in Sediment include: Aluminum, Antimony, Arsenic, Barium, Cadmium, Chromium, Copper, Lead, Manganese, Mercury, Nickel, Selenium, Silver and Zinc.

Mexican Tetra (Astyanax mexicanus)

Table 1911-3: Site-Specific Uses and Criteria for Segment 1911 - Upper San Antonio River and Tributaries																				
		Uses			Criteria										Nutrient Screening Levels				
Segment	Segment Name	Recreation	Aquatic Life Use	Domestic Water Supply	Chloride (mg/L)[4]	Sulfate (mg/L)[4]	Total Dissolved Solids (mg/L)[4]	Dissolved Oxygen Grab Screening Average (mg/L)	Dissolved Oxygen Grab Minimum(mg/L)	24 Hour Dissolved Oxygen Average (mg/L)	24 Hour Dissolved Oxygen Minimum (mg/L)	pH Range (SU)[4]	Temperature[1,4] (ºC)	*E. coli* geomean[2] (CFU/100ml)	Ammonia Nitrogen (mg/L)	Nitrate Nitrogen (mg/L)	Ortho Phosphorus (mg/L)	Total Phosphorus (mg/L)	Chlorophyll-a (µg/L)[4]
1911	Upper San Antonio River	PCR	High	--	150	150	750	5.0	3.0	5.0	3.0	6.5-9.0	32.2	126	0.33	1.95	0.37	0.69	14.1
1911B	Apache Creek	PCR[3]	High	--	--	--	--	5.0	3.0	5.0	3.0	--	--	126	0.33	1.95	0.37	0.69	--
1911C	Alazan Creek	PCR[3]	Limited	--	--	--	--	3.0	2.0	3.0	2.0	--	--	126	0.33	1.95	0.37	0.69	--
1911D	San Pedro Creek	PCR[3]	High	--	--	--	--	5.0	3.0	5.0	3.0	--	--	126	0.33	1.95	0.37	0.69	--
1911E	Sixmile Creek	PCR[3]	Minimal	--	--	--	--	2.0	1.5	2.0	1.5	--	--	126	0.33	1.95	0.37	0.69	--
1911H	Picosa Creek	PCR[3]	Limited	--	--	--	--	3.0	2.0	3.0	2.0	--	--	126	0.33	1.95	0.37	0.69	--
1911I	Martinez Creek	PCR[3]	Limited	--	--	--	--	3.0	2.0	3.0	2.0	--	--	126	0.33	1.95	0.37	0.69	--

1 Temperature was converted from ºF to ºC, the criteria for temperature are listed as maximum values at any site within the segment.

2 The indicator bacteria for freshwater is *E. coli.*

3 For unclassified waterbodies not specifically identified in the TSWQS, a primary contact recreation is the presumed use.

4 Water temperature, pH, chloride, sulfate, TDS and chlorophyll *a* criteria developed for classified segments do not apply to unclassified water bodies.

Table 1911-4: 2014 Texas Integrated Report: Assessment Results for Segment 1911 -Upper San Antonio River and Unclassified Waterbodies											
Seg_AU	Designated Use	Method	Parameter Description	Criteria	# of Samples Assessed	Mean or Geomean of Samples Assessed	# of Samples Exceeding Criteria	Mean of Samples Exceeding Criteria	Data Set Qualifier	Level of Support	Impairment Category
1911_01	General Use	Nutrient Screening Levels	Nitrate	1.95	85		82	9.92	AD	CS	
	General Use	Nutrient Screening Levels	Total Phosphorus	0.69	85		64	1.21	AD	CS	
1911_02	Recreation Use	Bacteria Geomean	*E. coli*	126.00	44	140.51	1		AD	NS	4a
	General Use	Nutrient Screening Levels	Nitrate	1.95	40		39	9.65	AD	CS	
	General Use	Nutrient Screening Levels	Total Phosphorus	0.69	39		32	1.33	AD	CS	
1911_03	Recreation Use	Bacteria Geomean	*E. coli*	126.00	358	133.30	1		AD	NS	4a
	General Use	Nutrient Screening Levels	Nitrate	1.95	84		81	10.22	AD	CS	
	General Use	Nutrient Screening Levels	Total Phosphorus	0.69	84		71	1.27	AD	CS	
1911_04	General Use	Nutrient Screening Levels	Nitrate	1.95	21		18	10.10	AD	CS	
	General Use	Nutrient Screening Levels	Total Phosphorus	0.69	21		18	1.33	AD	CS	
1911_05	Aquatic Life Use	Habitat	Habitat	20.00	7	18.30			AD	CS	
	General Use	Nutrient Screening Levels	Nitrate	1.95	146		140	12.93	AD	CS	
	General Use	Nutrient Screening Levels	Total Phosphorus	0.69	143		113	1.40	AD	CS	
1911_06	General Use	Nutrient Screening Levels	Nitrate	1.95	129		39	3.36	AD	CS	
1911_07	Aquatic Life Use	Habitat	Habitat	20.00	3	18.70			AD	CS	
	Recreation Use	Bacteria Geomean	*E. coli*	126.00	324	145.23	1		AD	NS	4a
	General Use	Nutrient Screening Levels	Nitrate	1.95	81		40	3.53	AD	CS	
1911_08	Aquatic Life Use	Fish Community	Fish Community	41.00	1	36.40			LD	CN*	
	Aquatic Life Use	Habitat	Habitat	20.00	1	17.00			LD	CS*	
	Recreation Use	Bacteria Geomean	*E. coli*	126.00	122	205.29	1		AD	NS	4a
	General Use	Nutrient Screening Levels	Nitrate	1.95	62		41	4.94	AD	CS	
1911_09	Aquatic Life Use	Fish Community	Fish Community	41.00						NS*	5c
	Aquatic Life Use	Habitat	Habitat	20.00						CS*	
	Recreation Use	Bacteria Geomean	*E. coli*	126.00	903	436.96	1		AD	NS	4a
	General Use	Nutrient Screening Levels	Nitrate	1.95	418		313	8.45	AD	CS	
	General Use	Nutrient Screening Levels	Total Phosphorus	0.69	412		168	1.20	AD	CS	
1911B_01	Aquatic Life Use	Dissolved Oxygen grab screening level	Dissolved Oxygen grab	5.00	255		50	3.40	AD	CS	
	Recreation Use	Bacteria Geomean	*E. coli*	126.00	236	485.23	1		AD	NS	5a
	General Use	Nutrient Screening Levels	Nitrate	1.95	105		32	3.31	AD	CS	
1911C_01	Recreation Use	Bacteria Geomean	*E. coli*	126.00	179	350.33	1		AD	NS	5a
1911C_02	Recreation Use	Bacteria Geomean	*E. coli*	126.00	130	290.15	1		AD	NS	5c
	General Use	Nutrient Screening Levels	Ammonia	0.33	37		11	0.96	AD	CS*	
	General Use	Nutrient Screening Levels	Chorophyll-*a*	14.10	12		7	36.86	AD	CS	
1911D_01	Recreation Use	Bacteria Geomean	*E. coli*	126.00	116	274.14	1		AD	NS	5a
	General Use	Nutrient Screening Levels	Nitrate	1.95	52		16	2.22	AD	CS	
1911D_02	Aquatic Life Use	Dissolved Oxygen grab screening level	Dissolved Oxygen grab	5.00	123		22	3.01	AD	CS	
	Recreation Use	Bacteria Geomean	*E. coli*	126.00	121	924.09	1		AD	NS	5a
	General Use	Nutrient Screening Levels	Nitrate	1.95	38		16	2.02	AD	CS	
1911E_01	Recreation Use	Bacteria Geomean	*E. coli*	126.00	24	385.10	1		AD	NS	5c
1911H_01	Aquatic Life Use	Dissolved Oxygen grab screening level	Dissolved Oxygen grab	3.00	19		10	1.27	AD	CS	
	Aquatic Life Use	Dissolved Oxygen grab minimum	Dissolved Oxygen grab	2.00	19		8	1.05	AD	NS	5c
1911I_01	Aquatic Life Use	Dissolved Oxygen grab screening level	Dissolved Oxygen grab	3.00	41		8	2.19	AD	CS	
	Recreation Use	Bacteria Geomean	*E. coli*	126.00	41	267.68	1		AD	NS	5c

Dataset Qualifier Codes

AD=Adequate Data (10 or more samples)

LD= Limited Data (less than 9, greater than 3 samples)

*=Impairment Level was carried forward from a previous assessment due to inadequate data for this method in this assessment.

Level of Support

CS= Screening level concern

CN=Use Concern

NS=Not Supporting

Impairment Category

4a=All TMDLs have been completed and approved by EPA

5a= TMDLs are underway, scheduled, or may be scheduled for one or more parameters.

5c=Indicating that additional data and information will be collected and/or evaluated for one or more parameters before a management strategy is selected. Concerns for nutrients have also been identified.

Table 1911-5: Municipal and Industrial Wastewater Outfalls in Segment 1911 - Upper San Antonio River			
Permittee	**Facility**	**Status**	**Type**
Aqua Utilities Inc	Aqua Utilities Inc - Outfall 1	Current Permit	Domestic
City of Floresville	City of Floresville WWTP - Outfall 1	Current Permit	Domestic
City Public Service of San Antonio	Sommer, Deely, Spruce SES - Outfall 1, 2, 7	Current Permit	Wastewater
City Public Service of San Antonio	Sommer, Deely, Spruce SES - Outfall 6, 14	Current Permit	Stormwater
City Public Service of San Antonio	VB Braunig Steam Electric ST - Outfall 3, 6, 7, 8, 11, 13, 15, 16	Current Permit	Stormwater
City Public Service of San Antonio	VB Braunig Steam Electric ST - Outfall 1, 12	Current Permit	Wastewater
East Central ISD	East Central High School WWTP	Current Permit	Domestic
Picosa WSC	Picosa WWTP	Current Permit	Domestic
San Antonio River Authority	Salatrillo Creek WWTP	Current Permit	Domestic
San Antonio Water System	Dos Rio Water Recycling Center - Outfall 2, 3, 5, 6	Current Permit	Wastewater
San Antonio Water System	Dos Rio Water Recycling Center - Outfall 1	Current Permit	Wastewater
Tiger Sanitation Inc.	Tiger Sanitation - Outfall 1	Pending Permit	Wastewater
US Dept of the Air Force	Kelly Air Force Base GW WWTO - Outfall 3	Current Permit	Groundwater
Zachry Industrial Inc.	San Antonio WWTP	Current Permit	Wastewater

Domestic: Less than 1 Million Gallon per Day domestic sewage; Wastewater: Greater than or equal to 1 MGD domestic sewage or process water including water treatment plant discharge

Monarch Butterfly (Danaus plexippus)

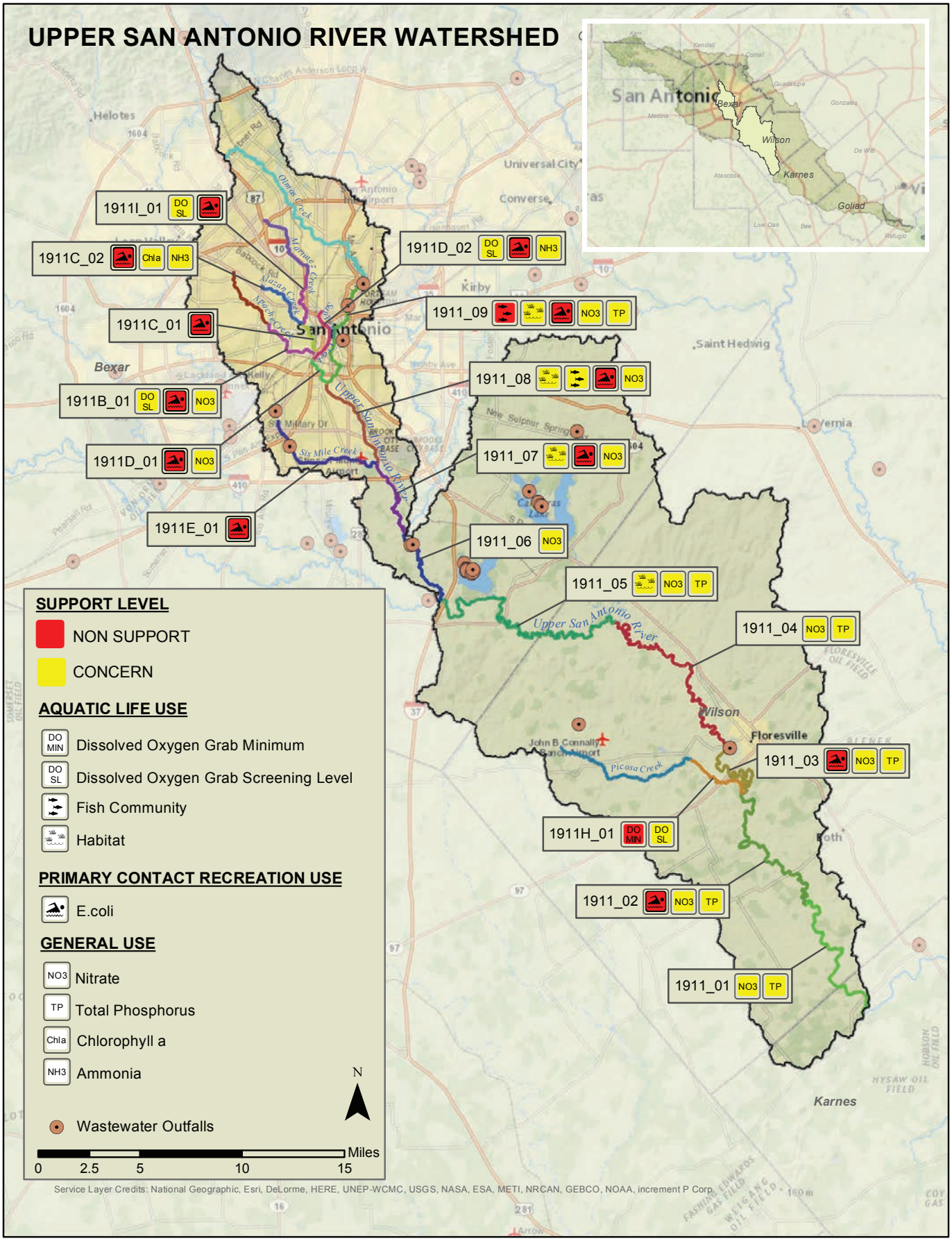


Figure 1911-1 Impairments and concerns for the Upper San Antonio River Watershed

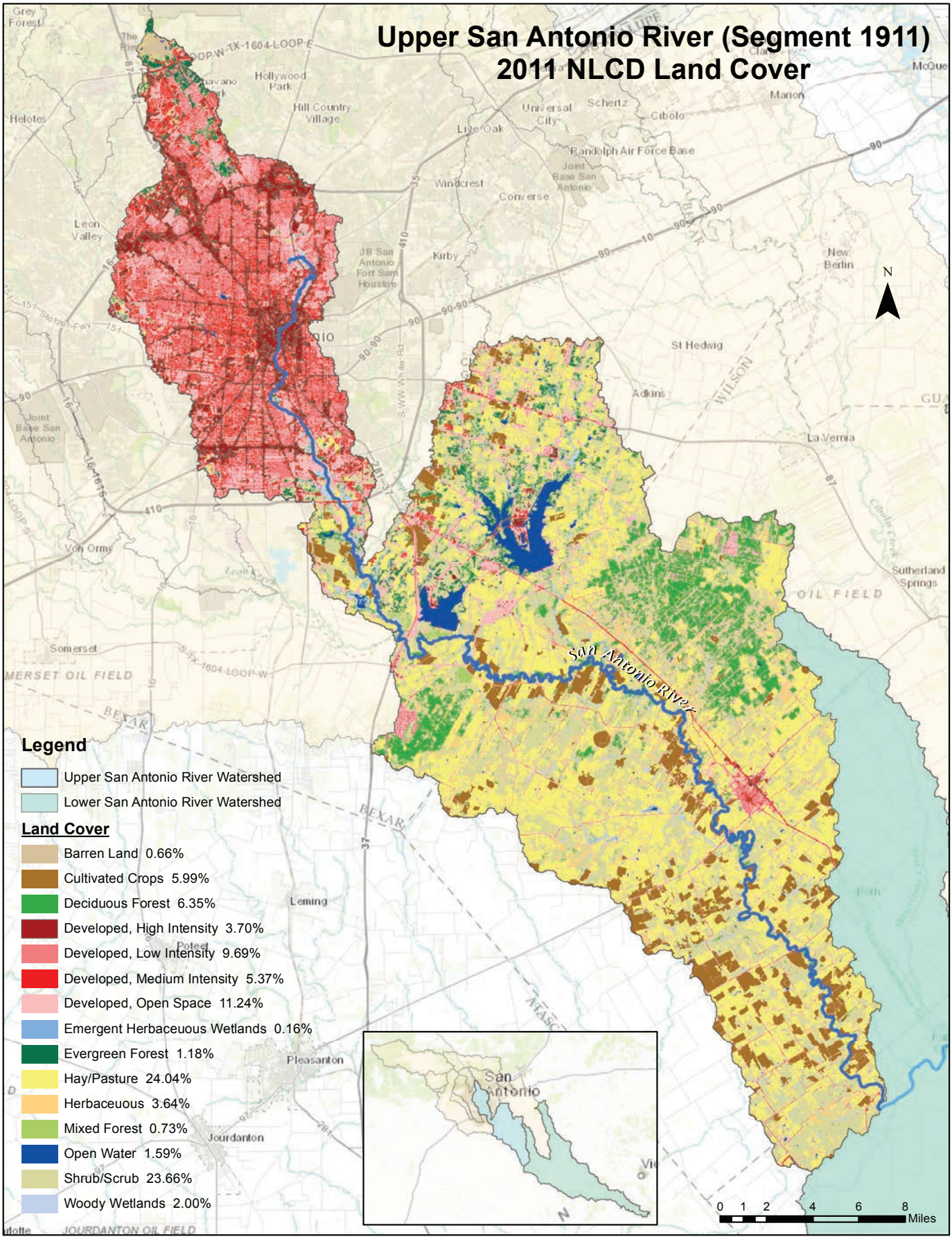


Figure 1911-2 Land Cover Map for the Upper San Antonio River Watershed

Figure 1911-3: Canoe Chute, Upper San Antonio River Watershed (top)

Figure 1911-4: Station 16731 San Antonio River Upstream of the Medina River Confluence

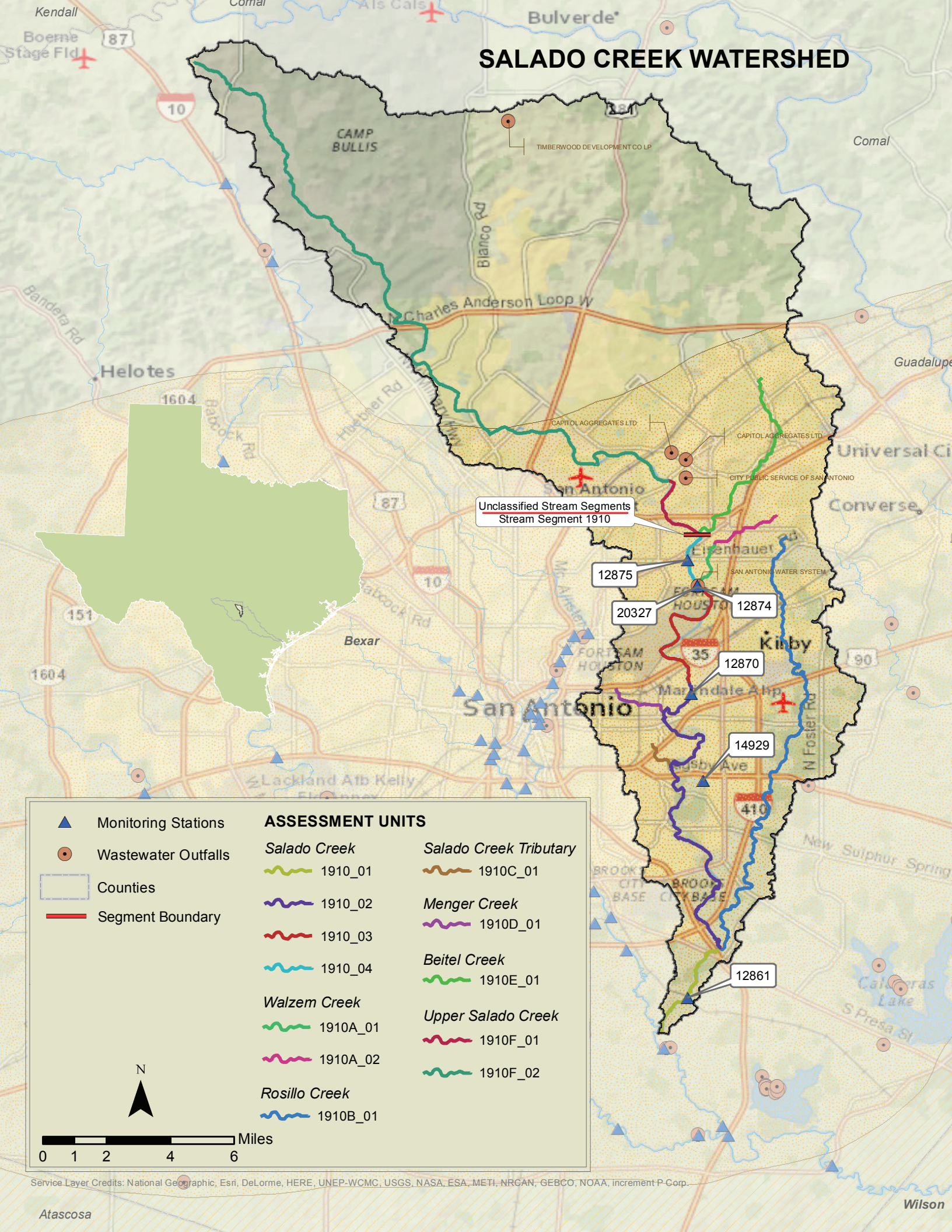
Figure 1911-5: Station 12909
San Antonio River at Mulberry (top)

Figure 1911-6: Station 20344
Alazan Creek at Arbor Place

Figure 1911-7: San Pedro Creek

Figure 1911-8: July 26, 2016, Espada Remnant Channel and Davis Lake area fish kill (top)

Figure 1911-9: Station 12727 San Pedro Creek at Furnish Street, Stormwater


SALADO CREEK WATERSHED
Unclassified Stream Segments
Stream Segment 1910
12875
20327
12874
12870
14929
12861
TIMBERWOOD DEVELOPMENT CO LP
CAPITOL AGGREGATES LTD
CAPITOL AGGREGATES LTD
CITY PUBLIC SERVICE OF SAN ANTONIO
SAN ANTONIO WATER SYSTEM
CAMP BULLIS
Blanco Rd
Charles Anderson Loop W
Helotes
Bexar
Converse
Kirby
Universal Ci
Guadalupe
Comal
Kendall
Atascosa
Wilson
Monitoring Stations
Wastewater Outfalls
Counties
Segment Boundary
ASSESSMENT UNITS
Salado Creek
1910_01
1910_02
1910_03
1910_04
Walzem Creek
1910A_01
1910A_02
Rosillo Creek
1910B_01
Salado Creek Tributary
1910C_01
Menger Creek
1910D_01
Beitel Creek
1910E_01
Upper Salado Creek
1910F_01
1910F_02
N
Miles
0 1 2 4 6
Service Layer Credits: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

SEGMENT DESCRIPTION

Salado Creek Segment 1910 extends upstream from its confluence with the San Antonio River in Bexar County to Rocking Horse Lane west of Camp Bullis in Bexar County. The segment is approximately 35 miles along and has an approximate drainage area of 221 square miles. See Table 1910-1 for the stations and number of proposed sampling events to be collected in the TCEQ 2017 fiscal year.

From its headwaters to approximately one-quarter mile upstream of north Loop 410, Salado Creek traverses the limestone formations of the Edwards Aquifer Recharge Zone. This portion of Salado Creek is intermittent and flows only after major rainfall events, then quickly drains and remains dry until the next major event. Salado Creek becomes perennial from intermittent seeps and springs 0.62 miles downstream of Loop 410. The remaining portions of Salado Creek take on the alluvial characteristics of the Gulf Coastal Plains and become more deeply entrenched as it flows to its confluence with the San Antonio River south of the city between Losoya and Elmendorf. Unclassified segments of the Salado Creek Watershed assessed in the 2014 Integrated Report include:

- Segment 1910A Walzem Creek
- Segment 1910B Rosillo Creek
- Segment 1910C Salado Creek Tributary
- Segment 1910D Menger Creek
- Segment 1910E Beitel Creek
- Segment 1910F Upper Salado Creek

See Table 1910-2 for Site-Specific Uses and Criteria for Segment 1910.

HYDROLOGIC CHARACTERISTICS

According to the United States Geological Survey website *http://waterdata.usgs.gov/tx/nwis/current/?type=flow*, accessed on August 4, 2016, the 55 year median flow at USGS gage - 08178800 Salado Ck at Loop 13, San Antonio, TX, is 9.8 cubic feet per second (cfs), and a flow range of 0.0 (2009) to 201 cfs (1971). In March 2001, the San Antonio Water System's Salado Creek Water Recycling Center began supplementing base flow just upstream of James Park.

IMPAIRMENT/AREA OF INTEREST DESCRIPTION

Segment 1910 is located in the Edwards Plateau and Texas Blackland Prairies Ecoregions and is identified in the 2014 TCEQ Integrated Report as being a freshwater perennial stream with a high aquatic life use designation. Salado Creek is designated for use as a public water supply and aquifer protection, since it contributes to recharge of the Edwards Aquifer. Like all segments in the San Antonio River Basin, this segment is designated for primary contact recreation. Primary contact includes activities presumed to involve a significant risk of ingestion of water such as wading by children, swimming, water skiing, diving, tubing, surfing, handfishing as defined by Texas Parks and Wildlife Code, §66.115; including whitewater activities: kayaking, canoeing, and rafting. Impairments and concerns in Segment 1910 include:

Salado Creek, Segment 1910

Assessment Unit 1910_01: No impairments or concerns have been identified.
Assessment Unit 1910_02: Impaired macrobenthic community, a concern for depressed oxygen has also been identified.
Assessment Unit 1910_03: Impaired for bacteria, a concern for nutrients have also been detected.
Assessment Unit 1910_04: Impairments for bacteria and depressed dissolved oxygen minimum have been identified, a concerns for depressed dissolved oxygen screening levels has also been detected.

Unclassified segments of the Salado Creek

Assessment Unit 1910A_01: Impaired for bacteria.

Assessment Unit 1910B_01: No impairments or concerns have been identified.

Assessment Unit 1910C_01: A concern for bacteria has been detected.

Assessment Unit 1910D_01: Impairments for bacteria and depressed dissolved oxygen minimum have been identified, a concern for depressed dissolved oxygen

screening levels has also been detected.

Assessment Unit 1910E_01: A concern for depressed dissolved oxygen screening level has been detected.

Assessment Unit 1910E_01: A concern for Chlorophyll-a has been detected.

Details of the impairments and concerns for the Salado Creek, as identified in the TCEQ 2014 Integrated Assessment, can be seen in Table 1910-3. A map of impairments and concerns can be seen in Figure 1910-1.

LAND USE/LAND COVER

The majority of the watershed is characterized by dense urban development except in the very upper most portion of the watershed. This portion of the watershed is normally dry except during rain events, is largely undeveloped and is characterized by a mix of forests and vegetation typical of the Texas Hill Country. Non classified water bodies contributing flow to this portion of the watershed include Walzem and Menger Creeks. Beitel Creek, Rosillo Creek and the Salado Creek Tributary are intermittent except during high flow events.

Information used to generate the Land Cover Maps was obtained from the San Antonio River Authority's GIS Department, and includes National Land Cover Database (NLCD) 2011 data created by the Multi-Resolution Land Characteristics (MRLC) Consortium located at *http://www.mrlc.gov/nlcd2011.php*, and TCEQ Assessment Units data created by the Texas Commission on Environmental Quality located at *http://www.tceq.state.tx.us/gis/download-tceq-gis-data*. See Figure 1910-2 for more detail.

According to the Texas Commission on Environmental Quality Permitted Wastewater Outfalls shapefile located at *http://www.tceq.state.tx.us/gis/download-tceq-gis-data*, there are three permitted and one pending permitted dischargers with a total of five outfalls in Segment 1910. See Table 1910-4 for details.

POSSIBLE CAUSES OF IMPAIRMENT OR INTEREST

Macrobenthic and Dissolved Oxygen Impairments: Salado Creek has shallow depth, intermittent low flows, poor bank stability, limited riparian buffer vegetation and minimal channel sinuosity. Although flow augmentation is provided at James Park above Segment 1910_03, inherent ambient low-flow condition is a continuous issue in this segment. The scouring of habitat during violent storm events has also been noted. These factors coupled with direct and indirect stormwater runoff maybe contributing to the macrobenthic and dissolved oxygen impairments in the Salado Creek Watershed.

Bacteria Impairment: On July 25, 2007, the TCEQ adopted the Three Total Maximum Daily Loads (TMDL) for Bacteria in the San Antonio Area, including the Upper San Antonio River, Salado Creek and Walzem Creek. The TMDLs were approved by the U.S. Environmental Protection Agency (EPA) on September 25, 2007. The final report identified possible point and nonpoint sources or causes of contamination. Point sources identified as potentially contributing to bacteria are stormwater from Municipal Separate Storm Sewer System (MS4) Phase II dischargers, the San Antonio Zoo, sanitary sewer overflows, and dry weather discharges. Nonpoint sources that could contribute to the E. coli load in the watershed include stormwater outside MS4 areas, failing septic systems, leaking wastewater infrastructure, livestock, and wildlife such as egret rookeries. These sources of pollution may be contributing to the bacterial impairments and nutrient concerns in the Salado Creek Watershed.

POTENTIAL STAKEHOLDERS

- City of San Antonio
- Landowners
- Texas A&M AgriLife Extension Service
- Natural Resource Conservation Service
- Texas Department of Agriculture
- Texas State Soil and Water Conservation Board
- Texas Parks and Wildlife Department
- US Fish and Wildlife Service
- San Antonio Water System

RECOMMENDATIONS FOR IMPROVING WATER QUALITY

SARA should continue routine and biological monitoring and provide quality assured data to the

TCEQ for assessments. SARA should also work with partners to implement and monitor best management practices identified in the Upper San Antonio River TMDL's, TMDL Implementation Plan, Watershed Protection Plan, and the Salado Creek Master Plan. Stream restoration BMPs may be required to improve water quality and macrobenthic communities in the segment.

SPECIAL PROJECTS

Upper San Antonio River Watershed Protection Plan (EPA 319 Grant administered through the TCEQ): In response to the Three Bacteria TMDLs for the Upper San Antonio River, Salado Creek and Walzem Creek, SARA, the City of San Antonio, Bexar County and other partners initiated the Upper San Antonio River Watershed Protection Plan (WPP). The WPP was completed in 2006 with the objective of establishing and tracing efforts that enhanced the urban reaches, and bringing the Upper San Antonio River back into compliance with water quality contact recreation standards, which is a geometric mean of less than 126 E. coli organisms per 100 milliliters. To help identify and propose water quality best management practices (BMPs), the 2006 WPP was updated to identify a plan for implementation and monitoring of approved BMPs that would aid in reducing E. coli nonpoint source loads to the Upper San Antonio River. On February 18, 2015 the EPA approved the WPP, making the state eligible for CWA Section 319(h) project funding within the Upper San Antonio River watershed. These funds are limited to those activities that address nonpoint source runoff. The Upper San Antonio River WPP Report can be viewed at *http://www.bexarfloodfacts.org/watershed_protection_plan/*.

Implementation Plan for Three Total Maximum Daily Loads for Bacteria in the Upper San Antonio Watersheds: In 2013, Texas A&M AgriLife Research began working with communities, interest groups, and local organizations to involve stakeholders in developing a TMDL Implementation Plan (I-Plan). The Implementation Plan is designed to guide activities that will improve water quality for the Salado Creek, Walzem Creek, and Upper San Antonio River watersheds. The I-Plan identifies and describes BMPs that will be implemented and tracked to reduce bacteria and establish a timeline for implementation. The I-Plan will also include follow-up tracking and monitoring plans to determine the effectiveness of the selected BMPs. The draft Implementation Plan was submitted to TCEQ in spring 2015 and received final approval April 6, 2016. The approved Implementation Plan includes 30 management measures that will be used to improve water quality and reduce E. coli in Salado Creek, Walzem Creek, and the Upper San Antonio River watersheds *http://www.tceq.state.tx.us/assets/public/waterquality/tmdl/34uppersa/34F_UpperSanAntonio_TMDLIPlan_Approved.pdf.*

Salado Creek Watershed Master Plan, 2011: The Salado Creek Watershed has experienced recurring flood problems dating back into the 1800 and 1900s. Past and ongoing urbanization has also resulted in water quality degradation in the watershed with the potential for conditions to become progressively worse. Working through the Bexar Regional Watershed Management Program with its many partners including the City of San Antonio and Bexar County, SARA authorized Atkins North America, Inc. to develop a multi-phased "comprehensive" Salado Creek Watershed Master Plan to address flooding and water quality issues while integrating elements of environmental protection, stream stability, and recreational planning. In 2011, SARA began working to develop more holistic watershed master plans and include additional project opportunities that would address water quality issues, low impact development, stream restoration, nature based park planning, mitigation banking and conservation easements. The additional components were developed as geospatial datasets and will be summarized in an update to the Watershed Master Plans (expected May 2017). Additional information can be found on SARA's website *https://www.sara-tx.org/wp-content/uploads/2015/05/Salado_Creek.pdf.*

MAJOR WATERSHED EVENTS

Above Loop 410 North, Salado Creek is normally dry or intermittent. During stormwater events, runoff normally contains high levels of bacteria, nutrients and other organic matter. In general, there is a relationship between high flows and increased levels of bacteria indicating a nonpoint source of bacterial pollution. The actual source of the pollution whether wildlife, livestock

or human origin has not been determined. Currently there are no numerical standards for nutrients, only screening criteria. Just above James Park the San Antonio Water System (SAWS) is providing recycled water to Salado Creek. Without this additional recycled water, flow would decrease in the creek causing drops in dissolved oxygen and further impair biological communities. However, this recycled water is also high in nutrients which may cause algal blooms and consequently low dissolved oxygen levels. During drought, sections of these rivers would more than likely have intermittent flow without the augmented flow provided by SAWS.

IMAGES

See Figure 1910-3 to 1910-7 for pictures of this segment.

Longear Sunfish (Lepomis megalotis)

Table 1910-1: 2017 Coordinated Monitoring Schedule for Segment 1910 - Salado Creek														
Seg_AU	TCEQ Segment_AU Description	Stations in the Seg_AU	Station Short Description	Collection Entity	Monitoring Type	24 Hour DO	Habitat	Benthic	Nekton	Metal Sediment *	Conventional	Bacteria	Flow	Field
1910_01	From confluence with San Antonio River to confluence with Rosillo Creek	12861	SALADO CREEK AT SOUTHTON ROAD	SARA	BS/RT	2	2		2	2	6	6	6	6
1910_02	From the confluence with Rosillo Creek up to the confluence with Pershing Creek.	12870	SALADO CREEK AT GEMBLER ROAD	SARA	BS/RT	1	1	1	1		6	6	6	6
		14929	SALADO CREEK AT COMANCHE PARK	SARA	BS/RT	1	1	1	1	2	6	6	6	6
1910_03	From the confluence with Pershing Creek up to the confluence with Walzem Creek.	20327	SAWS REUSE DISCHARGE SALADO CREEK AT JAMES PARK	SARA	RT						6	6	6	6
1910_04	From the confluence with Walzem Creek up to the confluence with Beitel Creek.	12874	SALADO CREEK AT RITTIMAN ROAD	SARA	RT						6	6	6	6
		12875	SALADO CREEK AT EISENHAUER RD	SARA	BS/RT	2					6	6	2/6	6

*Metals in Sediment include: Aluminum, Antimony, Arsenic, Barium, Cadmium, Chromium, Copper, Lead, Manganese, Mercury, Nickel, Selenium, Silver and Zinc.

Table 1910-2: Site-Specific Uses and Criteria for Segment 1910 - Salado Creek and Tributaries																			
		Uses			Criteria										Nutrient Screening Levels				
Segment	Segment Name	Recreation	Aquatic Life Use	Domestic Water Supply	Chloride (mg/L)[5]	Sulfate (mg/L)[5]	Total Dissolved Solids (mg/L)[5]	Dissolved Oxygen Grab Screening Average (mg/L)	Dissolved Oxygen Grab Minimum(mg/L)	24 Hour Dissolved Oxygen Average (mg/L)	24 Hour Dissolved Oxygen Minimum (mg/L)	pH Range (SU)[5]	Temperature[1,5] (°C)	*E. coli* geomean[2] (CFU/100ml)	Ammonia Nitrogen (mg/L)	Nitrate Nitrogen (mg/L)	Ortho Phosphorus (mg/L)	Total Phosphorus (mg/L)	Chlorophyll-a (µg/L)[5]
1910	Salado Creek	PCR	High	PS/AP[3]	140	200	600	5.0	3.0	5.0	3.0	6.5-9.0	32.2	126	0.33	1.95	0.37	0.69	14.1
1910A	Walzem Creek	PCR[4]	High	--	--	--	--	5.0	3.0	5.0	3.0	--	--	126	0.33	1.95	0.37	0.69	--
1910B	Rosillo Creek	PCR[4]	Limited	--	--	--	--	3.0	2.0	3.0	2.0	--	--	126	0.33	1.95	0.37	0.69	--
1910C	Salado Creek Tributary	PCR[4]	Minimal	--	--	--	--	2.0	1.5	2.0	1.5	--	--	126	0.33	1.95	0.37	0.69	--
1910D	Menger Creek	PCR[4]	High	--	--	--	--	5.0	3.0	5.0	3.0	--	--	126	0.33	1.95	0.37	0.69	--
1910E	Beitel Creek	PCR[4]	Limited	--	--	--	--	3.0	2.0	3.0	2.0	--	--	126	0.33	1.95	0.37	0.69	--
1910F	Upper Salado Creek	PCR[4]	Limited	--	--	--	--	3.0	2.0	3.0	2.0	--	--	126	0.33	1.95	0.37	0.69	--

1 Temperature was converted from °F to °C, the criteria for temperature are listed

2 The indicator bacteria for freshwater is *E. coli.*

3 The aquifer protection use applies to areas in the contributing, recharge and transition zones of the Edward Aquifer.

4 For unclassified waterbodies not specifically identified in the TSWQS, a primary contact recreation is the presumed use.

5 Water temperature, pH, chloride, sulfate, TDS and chlorophyll *a* criteria developed for classified segments do not apply to unclassified water bodies.

Table 1910-3: 2014 Texas Integrated Report: Assessment Results for Segment 1910 - Salado Creek											
Seg_AU	**Designated Use**	**Method**	**Parameter Description**	**Criteria**	**# of Samples Assessed**	**Mean or Geomean of Samples Assessed**	**# of Samples Exceeding Criteria**	**Mean of Samples Exceeding Criteria**	**Data Set Qualifier**	**Level of Support**	**Impairment Category**
1910_01	No impairments or concerns have been identified.										
1910_02	Aquatic Life Use	Macrobenthic Community	Macrobenthic Community						ID	NS*	**5c**
	Aquatic Life Use	Dissolved Oxygen grab screening level	Dissolved Oxygen grab	5.00	234		54	3.98	AD	CS	
1910_03	Recreation Use	Bacteria Geomean	*E. coli*	126.00	118	145.94	1		AD	NS	**4a**
	General Use	Nutrient Screening Levels	Nitrate	1.95	43		18	6.69	AD	CS	
1910_04	Aquatic Life Use	Dissolved Oxygen grab screening level	Dissolved Oxygen grab	5.00	42		8	3.81	AD	CS	
	Aquatic Life Use	Dissolved Oxygen grab minimum	Dissolved Oxygen grab	3.00	40				AD	NS*	**4a**
	Recreation Use	Bacteria Geomean	*E. coli*	126.00	40	160.09	1		AD	NS	**4a**
1910A_01	Recreation Use	Bacteria Geomean	*E. coli*	126.00	44	289.93	1		AD	NS	**4a**
1910B_01	No impairments or concerns have been identified.										
1910C_01	Recreation Use	Bacteria Geomean	*E. coli*	126.00	19	246.92	1		LD	CN	
1910D_01	Aquatic Life Use	Dissolved Oxygen grab screening level	Dissolved Oxygen grab	5.00	18		8	3.41	AD	CS	
	Aquatic Life Use	Dissolved Oxygen grab minimum	Dissolved Oxygen grab	3.00	18		4	2.23	AD	NS	**5c**
	Recreation Use	Bacteria Geomean	*E. coli*	126.00	18	608.68	1		LD	NS*	**5c**
1910E_01	Aquatic Life Use	Dissolved Oxygen grab screening level	Dissolved Oxygen grab	3.00	23		4	1.85	AD	CS	
1910F_01	General Use	Nutrient Screening Levels	Chlorophyll-*a*	14.10	8		5	30.32	LD	CS	

Dataset Qualifier Codes
AD=Adequate Data (10 or more samples)
LD=Limited Data (less than 9, greater than 3 samples)
ID=Inadequate Data (less than 4 samples)

Level of Support
CN=Use Concern
CS=Screening level concern
NS=Not Supporting

Impairment Category
4a=All TMDLs have been completed and approved by EPA
5c=Indicating that additional data and information will be collected and/or evaluated for one or more parameters before a management strategy is selected.
*=Impairment Level was carried forward from a previous assessment due to inadequate data for this method in this assessment.

Table 1910-4: Municipal and Industrial Wastewater Outfalls in Segment 1910 - Salado Creek			
Permittee	**Facility**	**Status**	**Type**
Capitol Aggregates LTD	Capitol Aggregates - Outfall 1, 2	Current Permit	Wastewater
City Public Service of San Antonio	City Public Service of San Antonio - Outfall 1	Current Permit	Wastewater
San Antonio Water System	San Antonio Water System - Outfall 1	Current Permit	Wastewater
Timberwood Development CO LP	Timberwood Development - Outfall 1	Pending Permit	Domestic

Domestic: Less than 1 Million Gallons per Day domestic sewage; Wastewater: Greater than or equal to 1 MGD domestic sewage or process water including water treatment plant discharge

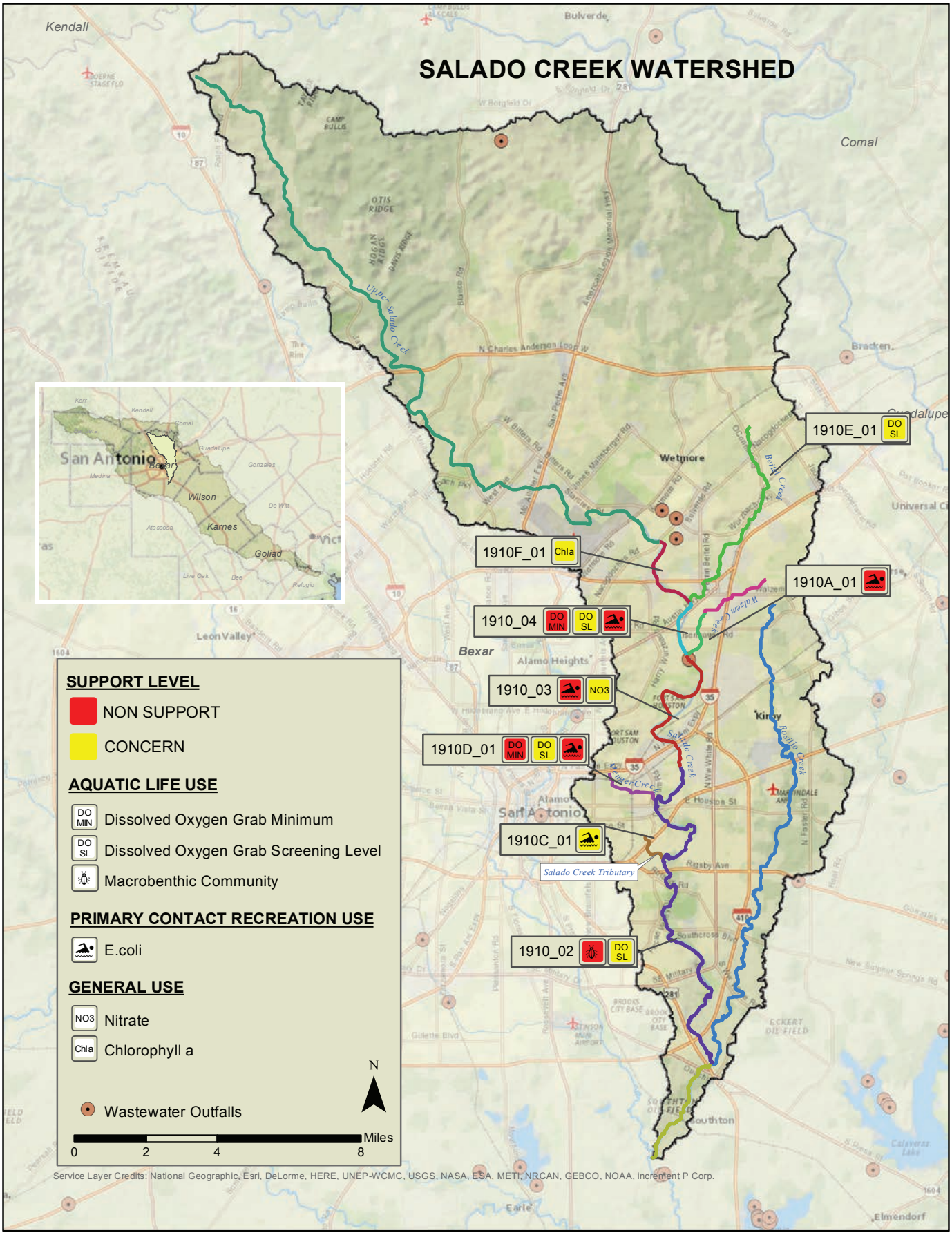


Figure 1910-1 Impairments and concerns for Salado Creek

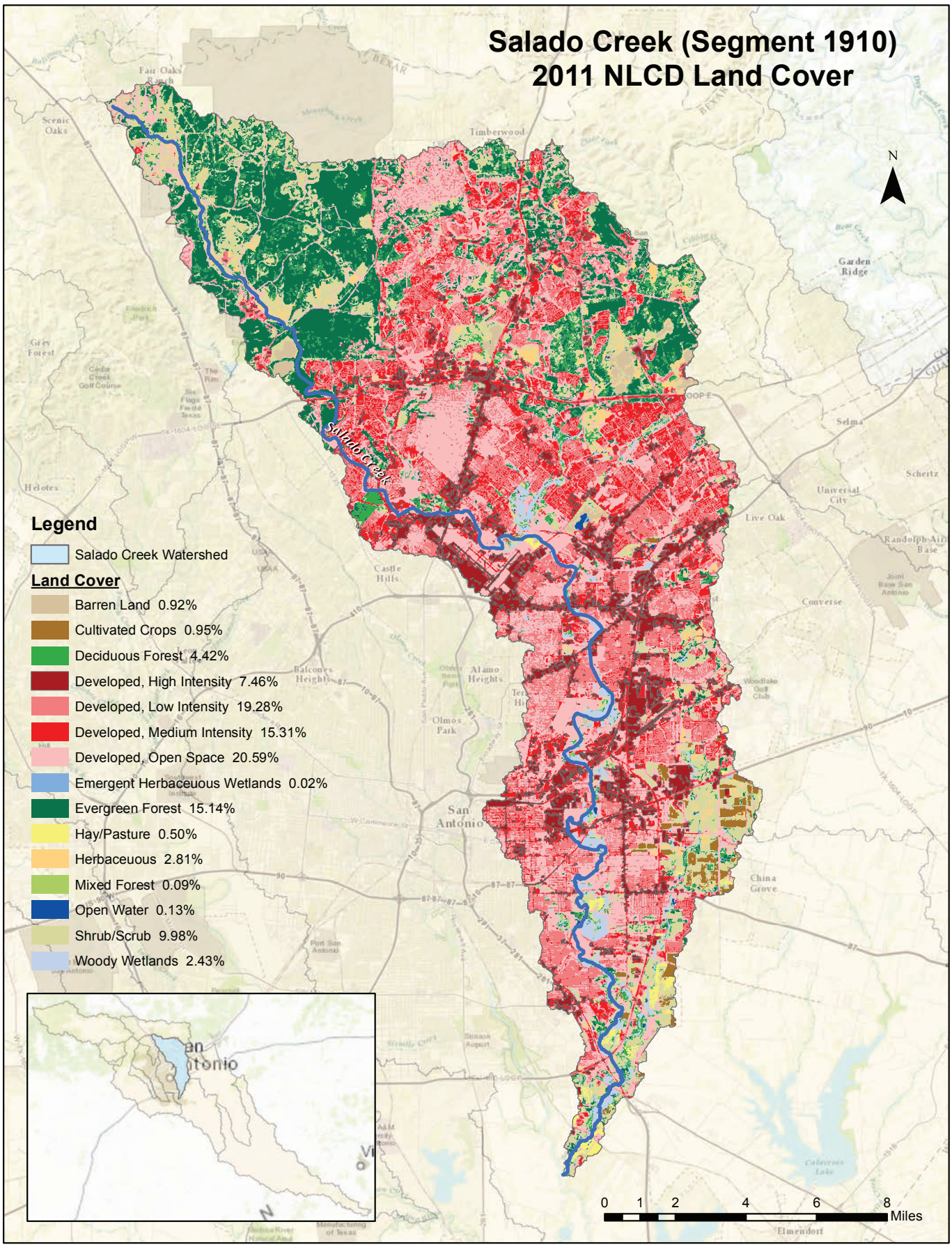


Figure 1910-2 Land Cover Map for Segment 1910

Figure 1910-3: Station 12861 Salado Creek at Southton Road

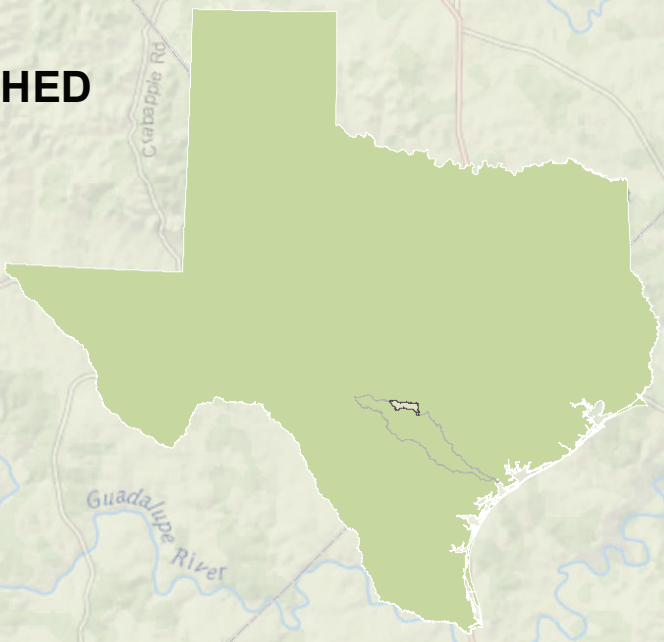
Figure 1910-4: Station 12870 Salado Creek at Gembler Road

Figure 1910-5: Salado Creek at Old Corpus Christi Road

Figure 1910-6: Walzem Creek downstream of Weebles Channel

Figure 1910-7: SAWS recycled water, Salado Creek above James Park

UPPER CIBOLO CREEK WATERSHED



SEGMENT DESCRIPTION

The Upper Cibolo Creek extends from the Missouri-Pacific Railroad Bridge west of Bracken in Comal County to a point 1.5 km (0.9 miles) upstream of the confluence of Champee Springs in Kendall County. The Upper Cibolo Creek Watershed covers approximately 228 square miles and contains the City of Boerne and a portion of Fair Oaks Ranch. See Table 1908-1 for the stations and number of proposed sampling events to be collected in the TCEQ 2017 fiscal year.

This stream segment has intermittent flow, only the portion of the Upper Cibolo Creek in and around the City of Boerne is perennial. Just below the Cibolo Nature Center in Boerne, the perennial creek disappears, recharging into the Edwards Aquifer. Due to significant groundwater recharge through fractures in the streambed, the lower 43 miles of this segment are often dry. The watershed has an average yearly rainfall 28 to 36 inches. There are no unclassified segments of the Upper Cibolo Creek as identified in the 2014 Integrated Report. See Table 1908-2 for Site-Specific Uses and Criteria for Segment 1908.

HYDROLOGIC CHARACTERISTICS

According to the United States Geological Survey website located at *http://waterdata.usgs.gov/tx/nwis/current/?type=flow*, accessed on August 9, 2016, the 38 year median flow at USGS 08183900 Cibolo Ck nr Boerne, TX, is 3.3 cubic feet per second (cfs), and a flow range of 0.00 cfs (1962) to 89 cfs (1973). Base flow in the Upper Cibolo Creek is primarily supplied by springs and seeps throughout the watershed.

Flows in the downstream reach of UCC are supported by wastewater effluent from the City of Boerne's Waste Water Treatment Facility. With an average daily discharge of greater than 700,000 gallons, the effluent maintains perennial conditions throughout this section of UCC, even during extreme drought conditions. Groundwater in the area is primarily associated with the Trinity aquifer (Upper Cibolo Creek WPP, 2013).

IMPAIRMENT/AREA OF INTEREST DESCRIPTION

Segment 1908 is located in the Edwards Plateau Ecoregion and is identified in the 2014 TCEQ Integrated Report as being a freshwater perennial stream with a high aquatic life use designation. The Upper Cibolo Creek is designated for use as a public water supply. Aquifer protection use also applies to this segment because it contributes to recharge of the Edwards Aquifer. Like all segments in the San Antonio River Basin, TCEQ has designated this segment for primary contact recreation. Primary contact includes activities presumed to involve a significant risk of ingestion of water such as wading by children, swimming, water skiing, diving, tubing, surfing, handfishing as defined by Texas Parks and Wildlife Code, §66.115; including whitewater activities: kayaking, canoeing, and rafting. Impairments and concerns in Segment 1908 include:

Upper Cibolo Creek

Assessment Unit 1908_01: A chloride impairment has been identified, concerns for depressed oxygen and nutrients has also been detected.

Assessment Unit 1908_02: Chloride and bacteria impairments have been identified, concerns for impaired habitat has also been detected.

Assessment Unit 1908_03: A chloride impairment has been identified.

Details of the impairments and concerns for the Upper Cibolo Creek Watershed, as identified in the TCEQ 2014 Integrated Report, can be seen in Table 1908-3. A map of impairments and concerns can be seen in Figure 1908-1.

LAND USE/LAND COVER

This segment is largely a mixture of forest, shrub/scrub and herbaceous areas with the higher intensity development around the City of Boerne, Fair Oaks Ranch and northern Timberwood Park.

Information used to generate the Land Cover

Maps was obtained from the San Antonio River Authority's GIS Department, and includes National Land Cover Database (NLCD) 2011 data created by the Multi-Resolution Land Characteristics (MRLC) Consortium *http://www.mrlc.gov/nlcd2011.php*, and TCEQ Assessment Units data created by the Texas Commission on Environmental Quality located at *http://www.tceq.state.tx.us/gis/download-tceq-gis-data*. See Figure 1980-2 for more detail.

According to the Texas Commission on Environmental Quality Permitted Wastewater Outfalls shapefile located at *http://www.tceq.state.tx.us/gis/download-tceq-gis-data*, there are two permitted and five pending permitted dischargers with a total of seven outfalls in Segment 1910. See Table 1908-4 for details.

POSSIBLE CAUSES OF IMPAIRMENT OR INTEREST

General Use, Chloride: The chloride impairment was first identified in the 2012 TCEQ 303(d) List of Impaired Water bodies. The assessed chloride data set, period 12/1/2003 to 11/30/2010, contained 68 measurements with a mean of 55.82 mg/L, exceeding the watershed criteria of 50.0 mg/L. The chloride impairment is mostly like due to an increase water resource demands, and ambient low flow conditions experienced in the watershed coupled with an accumulation of dissolved solids discarded from the wastewater treatment plants.

Bacteria Impairment: The Upper Cibolo Creek Watershed Protection Plan, September 2013, utilized the watershed approach to understand why local water quality problems exist. Sources such as agricultural land management practices, On-Site Sewage Facilities (OSSFs), populations and impacts of feral hogs, spatial distribution of axis deer, pet waste, cliff swallow nesting sites, and seasonal and spatial variations in waterfowl abundance were identified as potential contributors to bacteria loads. As sources were identified it became evident that they could be grouped into 3 broad categories; Wildlife, Agriculture and Urban/Residential.

POTENTIAL STAKEHOLDERS

- City of Fair Oaks Ranch
- Upper Cibolo Creek Land Owners
- Texas A&M AgriLife Extension Service
- Natural Resource Conservation Service
- Texas Department of Agriculture
- Texas Department of Transportation
- Texas State Soil and Water Conservation Board
- Texas Parks and Wildlife Department
- US Fish and Wildlife Service
- Cibolo Nature Center
- Cibolo Preserve
- Cow Creek Groundwater Conservation District
- Kendall Soil and Water Conservation District

RECOMMENDATIONS FOR IMPROVING WATER QUALITY

The City of Boerne and the TCEQ should continue routine monitoring and provide quality assured data to the TCEQ for assessments. The City of Boerne should also continue to work with partners to implement and monitor best management practices identified in the Upper Cibolo Creek WPP. The City of Boerne and SARA should continue to assist the TCEQ in gathering information used to assign aquatic life use designations, including determining segment boundaries and flow type classifications that are more appropriate and representative of the watershed.

SPECIAL PROJECTS

319(h) Water Quality Management Plan – Upper Cibolo Creek Watershed Partnership Sustainability: Working to address ongoing bacteria impairments along Upper Cibolo Creek, the City of Boerne and the Upper Cibolo Creek (UCC) Watershed Partnership continue to implement aspects of the UCC Watershed Protection Plan. With funding provided through a Section 319(h) Clean Water Act Grant by the TCEQ, the COB routinely collects data at eight sites within the watershed as part of a long-term water quality monitoring program. Outreach and education remains a project focus promoted through workshops, newsletters, creek clean-up events, school programs and social media. Currently,

the greater Boerne area is experiencing significant residential growth which is expected to increase nonpoint sources of pollution. Watershed planners are applying greater focus to Low Impact Development (LID) opportunities within the watershed and are working to endorse SARA's LID Technical Guidance Manual as a resource for stormwater management alternatives.

Cibolo Creek Watershed Segment Boundary Re-Definition Effort: The TCEQ assesses Texas water bodies by breaking them into hydrologically and geographically unique segments. This segmenting of water bodies allows for more precise analysis of water quality and aquatic communities. However, historic segment classifications were based on topographic maps and other desktop methods that resulted in portions of segments having completely separate flow regimes or no perennial connecting flow at all; the Cibolo Creek is a perfect example. The TSWQS identify the Cibolo Creek Watershed as having three classified segments all with perennial flow: The Upper Cibolo Creek (Segment 1908), Mid Cibolo Creek (Segment 1913) and Lower Cibolo Creek (Segment 1902). Segment descriptions can be viewed on the TCEQ's website at *https://www.tceq.texas.gov/waterquality/standards/eq_swqs.html.* SARA historical observations indicate the Cibolo Creek from the Cibolo Creek Municipal Authority (CCMA) discharge downstream to the confluence with the San Antonio River is perennial and flows year around. Upstream of the CCMA discharge to just downstream of the Cibolo Preserve, southeast of Boerne, the creek is comprised of intermittent pools and only has connectivity during high flow events. From just downstream of the Cibolo Preserve to the upper part of the watershed flow is perennial. As the existing boundary definitions do not accurately depict the flow of the creek, SARA, in collaboration with the City of Boerne, has completed the process of gathering water quality and flow data to assist the TCEQ in assigning more appropriate segment boundaries and flow type classifications for the 2017 TSWQS revisions for the Upper, Mid and Lower Cibolo Creek Watersheds.

Upper Cibolo Creek (Segment 1908) Aquatic Life Monitoring: A previous Aquatic Life Monitoring (ALM) event conducted by a TCEQ contractor in 2002-2003 resulted in a concern for habitat in the 2006 Texas Integrated Report for 1908_02. A review of the data and field notes indicate one of the stations used during the project, Station 12857 Cibolo Creek at IH10 in Boerne, may not have been representative of the reach due to its proximity to an interstate highway bridge crossing. An alternate station location, Station 20821 Upper Cibolo Creek at Northrup Park, has been identified by staff from TCEQ, SARA, and City of Boerne may better represent conditions in the AU. The study will consist of two biological monitoring events in 1908_02, Station 20821 Upper Cibolo Creek at Northrup Park and in 1908_01, at Station 15126 Cibolo Creek above Menger Creek Confluence to determine if the physical habitat concern determined from previous assessments is valid and to provide additional biological data to determine if the designated Aquatic Life Use is being attained. An alternate station in 1908_01, Station 20649 Cibolo Creek at low water crossing Linde Ranch maybe be used if reconnaissance indicates this site is more representative of the AU. Each site will be sampled for field measurements for conductivity, pH, dissolved oxygen, temperature as well as for flow, biological sampling of fish and benthic macroinvertebrates, measurements of aquatic habitat, and 24-hour field measurements for dissolved oxygen.

Cibolo Creek Watershed Master Plan, in progress: The Cibolo Creek Watershed Master Plan seeks to provide communities with sustainable solutions to address flooding, water quality, and stream health. The study includes analysis of current conditions and recommendations for projects and other actions to address identified concerns. Solutions consider a range of options such as green infrastructure, low impact development programs, storm water best management practices, protection of riparian corridors through voluntary measures such as conservation easements, and development of parks and open spaces

MAJOR WATERSHED EVENTS

In early 2015, the City of Boerne expressed a desire to participate in the 2016 CRP monitoring activities within the Upper Cibolo Creek Watershed. In a collaborative effort to maintain and improve water quality in Segment 1908, Upper Cibolo Creek, SARA and the City of Boerne staff participated in field monitoring training exercises to ensure monitoring in the watershed would

be conducted according to the TCEQ Surface Water Quality Monitoring Protocols. This cooperation allowed the City of Boerne to be a sub-participant under SARA's CRP QAPP and collect water quality samples in Segment 1908. The City of Boerne will sample at three routine monitoring stations and submit samples to SARA's Environmental Sciences NELAC-Accredited Laboratory for analysis. The 2017 Coordinated Monitoring Schedule (CMS) for the Upper Cibolo Creek Watershed is located at *https://cms.lcra.org*. The City of Boerne will also participate in the Aquatic Life Monitoring efforts in the Upper Cibolo Creek (Segment 1908) to determine if the high Aquatic Life Use can be supported.

IMAGES

See Figure 1908-3 to 1908-6 for pictures of this segment.

Table 1908-1: 2017 Coordinated Monitoring Schedule for Segment 1908 - Upper Cibolo Creek

Seg_AU	TCEQ Segment_AU Description	Stations in the Seg_AU	Station Short Description	Collection Entity	Monitoring Type	24 Hour DO	Habitat	Benthic	Nekton	Metal Sediment *	Conventional	Bacteria	Flow	Field
1908_01	From confluence with Balcones Creek to approximately 2 mile upstream of Hwy 87 in Boerne	15126	CIBOLO CREEK IMMEDIATELY DOWNSTREAM OF MENGER CREEK CONFLUENCE	BC	RT						4	4	4	4
		20821	UPPER CIBOLO CREEK AT NORTHRUP PARK	BC	RT					2	4	4	4	4
1908_02	From approximately 2 miles upstream of Hwy 87 in Boerne to upper end of segment	12857	CIBOLO CREEK AT IH10-US87 NW OF BOERNE	BC	RT						4	4	4	4
		12857	CIBOLO CREEK AT IH10-US87 NW OF BOERNE	FO	RT						4	4	4	4

*Metals in Sediment include: Aluminum, Antimony, Arsenic, Barium, Cadmium, Chromium, Copper, Lead, Manganese, Mercury, Nickel, Selenium, Silver and Zinc.

Table 1908-2: Site-Specific Uses and Criteria for Segment 1908 - Upper Cibolo Creek

		Uses			Criteria										Nutrient Screening Levels				
Segment	Segment Name	Recreation	Aquatic Life Use	Domestic Water Supply	Chloride (mg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)	Dissolved Oxygen Grab Screening Average (mg/L)	Dissolved Oxygen Grab Minimum(mg/L)	24 Hour Dissolved Oxygen Average (mg/	24 Hour Dissolved Oxygen Minimum (mg/	pH Range (SU)	Temperature[1] (ºC)	E. coli geomean[2] (CFU/100ml)	Ammonia Nitrogen (mg/L)	Nitrate Nitrogen (mg/L)	Ortho Phosphorus (mg/L)	Total Phosphorus (mg/L)	Chlorophyll-a (µg/L)
1908	Upper Cibolo Creek	PCR	High	PS/AP[3]	50	100	600	5.0	3.0	5.0	3.0	6.5-9.0	32.2	126	0.33	1.95	0.37	0.69	14.1

1 Temperature was converted from ºF to ºC, the criteria for temperature are listed as maximum values at any site within the segment.

2 The indicator bacteria for freshwater is *E. coli.*

3 The aquifer protection use applies to areas in the contributing, recharge and transition zones of the Edward Aquifer.

Table 1908-3: 2014 Texas Integrated Report: Assessment Results for Segment 1908 - Upper Cibolo Creek											
Seg_AU	**Designated Use**	**Method**	**Parameter Description**	**Criteria**	**# of Samples Assessed**	**Mean or Geomean of Samples Assessed**	**# of Samples Exceeding Criteria**	**Mean of Samples Exceeding Criteria**	**Data Set Qualifier**	**Level of Support**	**Impairment Category**
1908_01	Aquatic Life Use	Dissolved Oxygen grab screening level	Dissolved Oxygen grab	5.00	66		15	4.2	AD	CS	
	General Use	Dissolved Solids	Chloride	50.00	66	62.05	1		AD	NS	**5c**
	General Use	Nutrient Screening Levels	Total Phosphorus	0.69	57		35	2.04	AD	CS	
1908_02	Aquatic Life Use	Habitat	Habitat	20.00					ID	CS*	
	Recreation Use	Bacteria Geomean	*E. coli*	126.00	1	180.00	1		ID	NS*	**5c**
	General Use	Dissolved Solids	Chloride	50.00	66	62.05	1		AD	NS	**5c**
1908_03	General Use	Dissolved Solids	Chloride	50.00	66	62.05	1		AD	NS	**5c**

Dataset Qualifier Codes

AD = Adequate Data (10 or more samples)

ID=Inadequate Data (less than 4 samples)

*=Impairment Level was carried forward from a previous assessment due to inadequate data for this method in this assessment.

Level of Support

CS= Screening level concern

NS=Not Supporting

Impairment Category

5c=Indicating that additional data and information will be collected and/or evaluated for one or more parameters before a management strategy is selected. Concerns for nutrients have also been identified.

Table 1908-4: Municipal and Industrial Wastewater Outfalls in Segment 1908 - Upper Cibolo Creek			
Permittee	**Facility**	**Status**	**Type**
633-4S Rnach LTD & Stahl Lane LTD	633-4S Rnach LTD & Stahl Lane LTD- Outfall 1	Pending Permit	Domestic
City of Boerne Esser Road	City of Boerne Esser Road - Outfall 1	Current Permit	Wastewater
City of Boerne Old San Antonio Road	City of Boerne Old San Antonio Road - Outfall 1	Current Permit	Wastewater
DHJB Development LLC	DHJB Development LLC - Outfall 1	Pending Permit	Domestic
Lerin Hills MUD	Lerin Hills MUD - Outfall 1	Pending Permit	Domestic
South Central Water Co	South Central Water Co - Outfall 1	Pending Permit	Domestic
Two Seventy Seven Limited & GBRA	Two Seventy Seven Limited & GBRA - Outfall 1	Pending Permit	Domestic

Domestic: Less than 1 Millon Gallon per Day domestic sewage; Wastewater: Greater than or equal to 1 MGD domestic sewage or process water including water treatment plant discharge

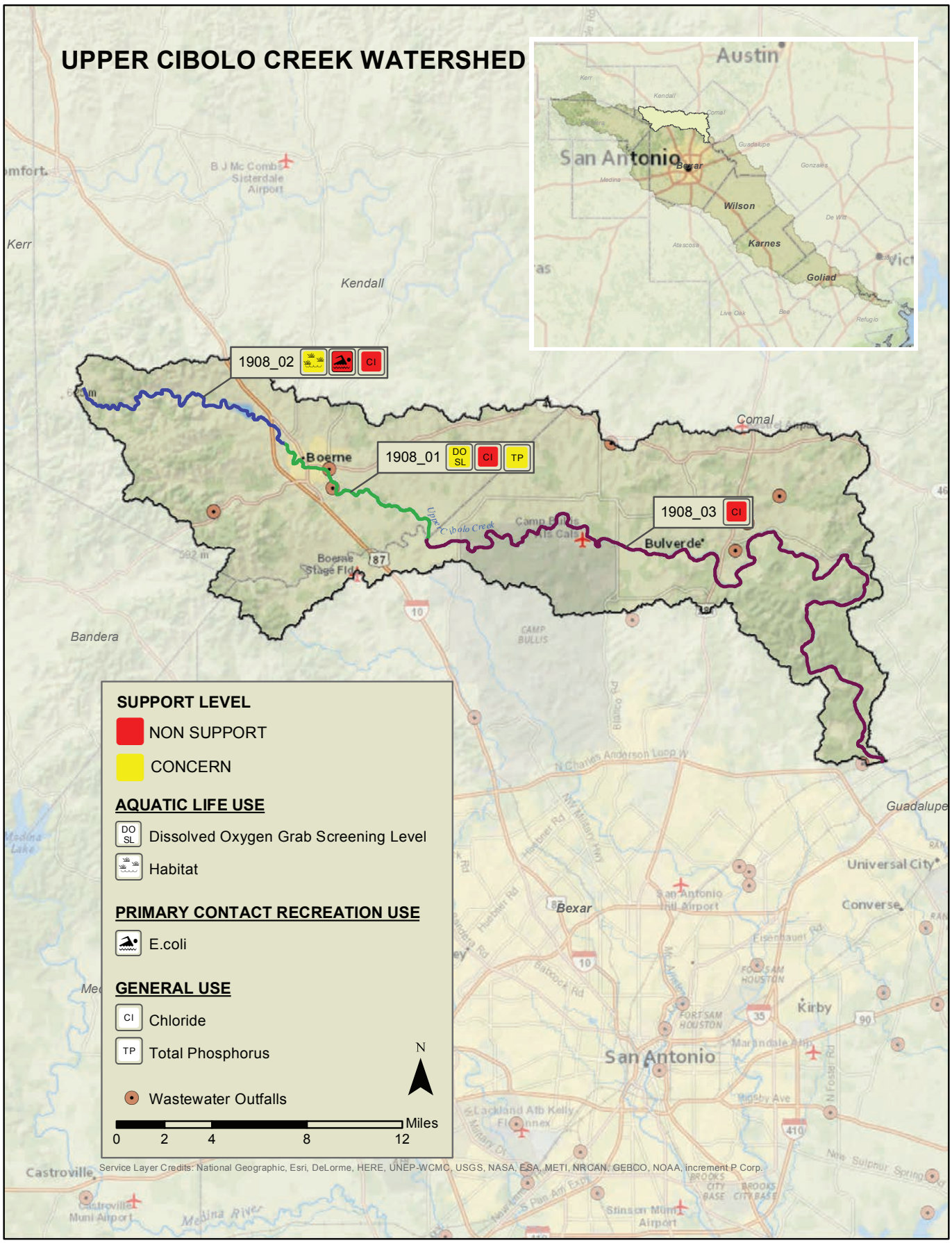


Figure 1908-1 Impairments and concerns for the Upper Cibolo Creek

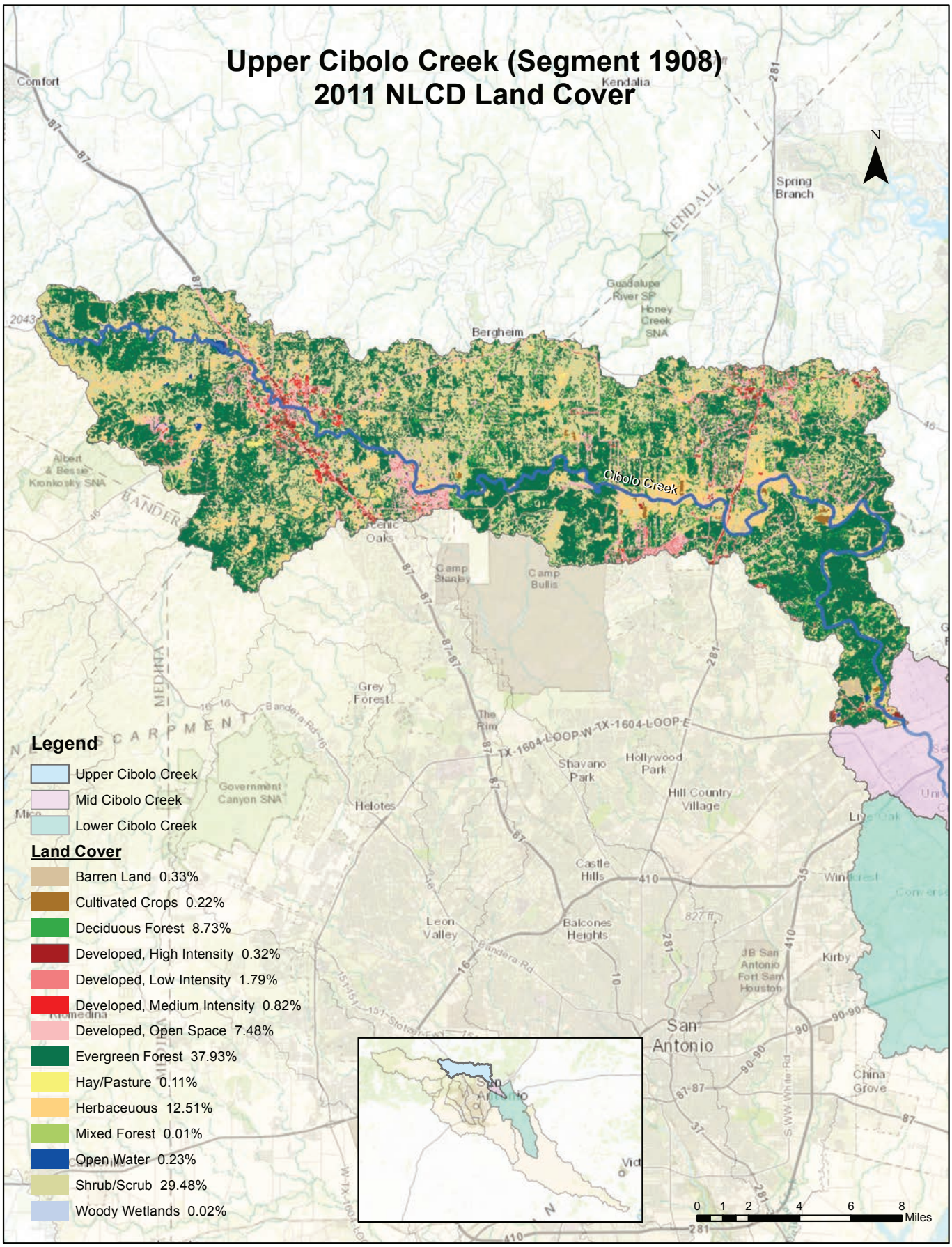


Figure 1908-2 Land Cover Map for Segment 1908

Figure 1908-3: Upper Cibolo Creek above the City of Boerne

Figure 1908-4: Upper Cibolo Creek at Herff Road

Figure 1908-5: Upper Cibolo Creek and Balcones Creek Confluence

Figure 1908-6: Herff Falls Cibolo Creek Preserves

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