2018 Basin Summary Report

June 2018

Texas Rio Grande Basin Program Update

International Boundary and Water Commission, U.S. Section
Texas Clean Rivers Program

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Aspects of the Clean Rivers Program

The International Boundary and Water Commission, U.S. Section (USIBWC) is one of 15 partner agencies that collaborate with the Texas Commission on Environmental Quality (TCEQ) to administer the Texas Clean Rivers Program (CRP) in the 23 river and coastal basins in Texas. The long-term goals of the CRP include:

- Maintain a basin-wide routine water quality monitoring program and water quality database, as detailed in the CRP long-term plan.
- Provide quality-assured data to TCEQ for use in water quality decision-making.
- Identify and evaluate water quality issues and summarize in reports.
- Promote cooperative watershed planning (such as conduct Coordinated Monitoring Meetings and collaborate on watershed plans and water quality initiatives).
- Inform and engage stakeholders (for example, conduct Basin Advisory meetings, watershed education activities, maintain an updated website, and print our annual reports).
- Maintain an efficient use of public funds.
- Adapt the program to emerging water quality issues.

More information about the CRP Long-term plan can be found here:
https://www.tceq.texas.gov/assets/public/waterquality/crp/CRP-LongTermPlan06.pdf

Pictured From Left: Partners at the 2018 Middle RG CMM. USIBWC CRP PM Leslie Grijalva at an outreach event with children. Photo credits: USIBWC CRP staff

Introduction

In 1991, the Texas Legislature passed the Texas Clean Rivers Act (Senate Bill 818) to address water resources in an integrated, systematic manner, creating the Texas Clean Rivers Program (CRP). The CRP is a state fee-funded program created specifically to perform water quality monitoring, assessment, and public outreach, and aims to improve the quality of water within each river basin in Texas through partnerships with the Texas Commission on Environmental Quality (TCEQ) and participating entities. The CRP for the Rio Grande Basin was originally administered by the Border Environment Assessment team of the TCEQ, which at that time was called the Texas Natural Resources Conservation Commission (TNRCC).

In 1998, the State of Texas contracted with the International Boundary and Water Commission, United States Section (USIBWC) to implement the CRP for the Rio Grande Basin, and to monitor and address water quality issues unique to the international water boundary. The USIBWC CRP monitors and assesses the Texas portion of the Rio Grande Basin from the point that it enters the state northwest of El Paso to the Gulf of Mexico. This action has resulted in better monitoring coverage within the basin and a more comprehensive dataset, which is used to facilitate the resolution of issues along the border. The USIBWC has expanded the program to include 20 partners and 94 water quality monitoring stations, supporting for water quality monitoring projects along the border. The partners participate in water quality monitoring, providing advice and suggestions to improve the program and the basin water quality, developing and assisting in special studies, and working with the general public to increase their understanding of and interaction with the river basin.

For the purpose of coordination and planning, the USIBWC CRP has divided the Rio Grande Basin in Texas into four sub-basins: the Pecos, Upper, Middle, and Lower Rio Grande. This report will provide a technical analysis of the water quality data for the Rio Grande and Pecos Rivers, the various factors that impact water quality, and information on activities to improve water quality. The summary statistics presented in the watershed characterization portion of the report are compiled from 10 years of water quality data collected by the USIBWC CRP, from December 1, 2006 through November 30, 2016. Where the data and/or information refers to the TCEQ Integrated Report, it will be so stated. If you have questions on the data or information presented in this report, please contact USIBWC CRP staff.

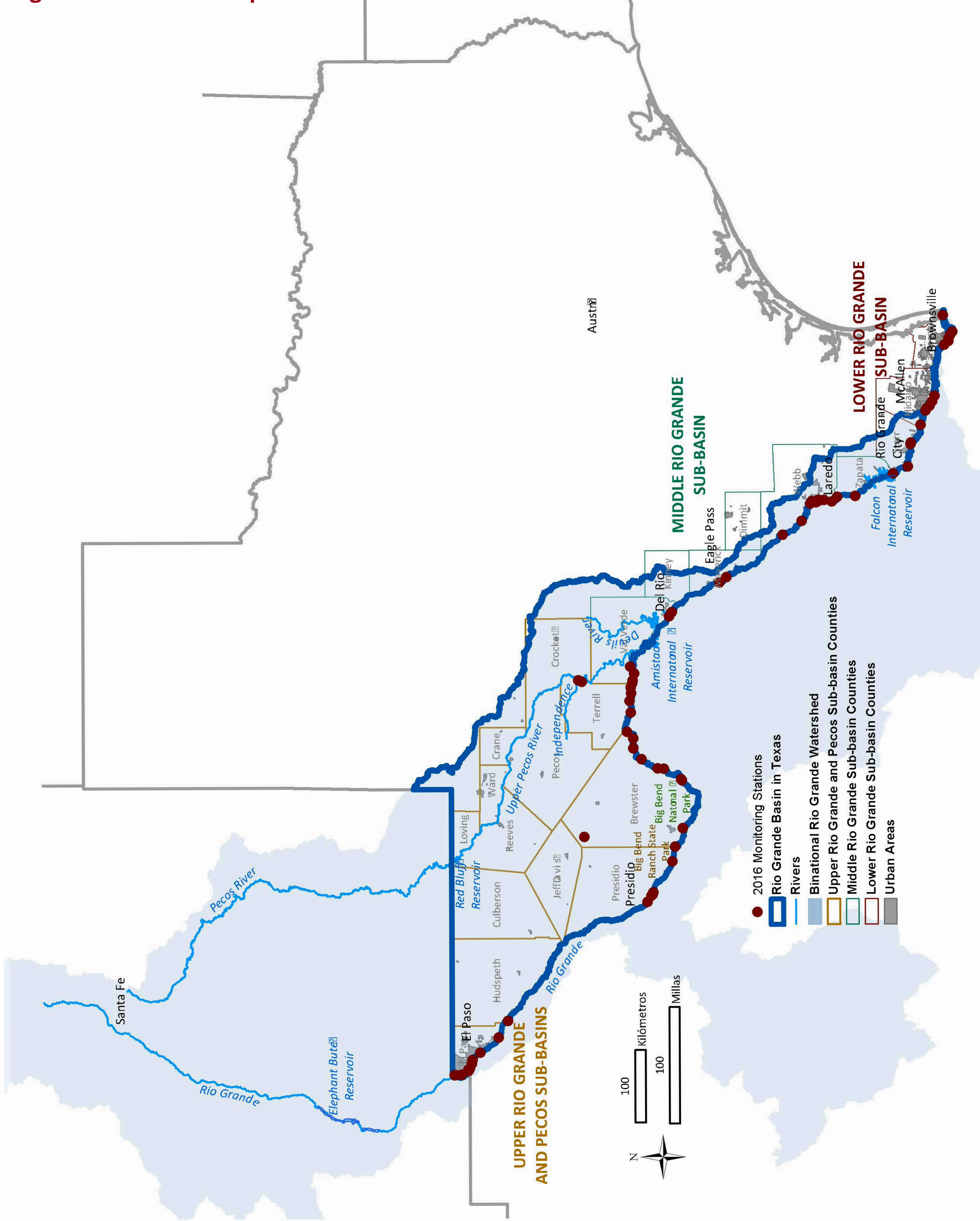
Coordinated Monitoring Meetings and Basin Advisory Committee Meetings

The CRP holds several types of meetings, including an important series of annual meetings called Coordinated Monitoring Meetings (CMMs). The purpose of these meetings is to plan and coordinate water quality monitoring efforts among different entities and partners. These meetings allow for more efficient use of agency resources, and take into consideration concerns from the public. They provide an opportunity for the CRP to hear about local water quality interests and problems, and allows attendees to bring up any questions or concerns they may have about their area to CRP staff. Additionally, USIBWC CRP typically hosts trainings for sampling partners in conjunction with these meetings. Basin Advisory Committee (BAC) meetings are held twice a year, and usually involve an annual water quality update to the public, as well as updates about important issues in the area. This might include fish kills, water quality concerns, and projects in the area. Both meetings are open to anyone interested in the CRP's activities in the Rio Grande Basin.

Figure 1


Rio Grande Watershed
and
Basin States
Colorado
New
Mexico
UNITED STATES
Texas
Chihuahua
MEXICO
Coahuila
Nuevo
Leon
Tamaulipas
N

Figure 2. General Map Overview of the Rio Grande Basin in Texas



Overview of Water Quality Monitoring

How do we determine water quality?

During the past 10 years, the USIBWC CRP maintained its large network of water quality stations. The CRP and the TCEQ determine water quality conditions through routine monitoring, which is performed at fixed locations at regular intervals throughout the year. Tables 1 and 2 show the water quality standards for the segments in the Rio Grande Basin. Table 3 shows the desginated uses for the waters of the Rio Grande, and Table 4 shows many of the parameters that we analyze during routine monitoring and why we collect these parameters.

Pictured: From Top: Amistad Field office sampling. Photo credit USIBWC CRP staff

Routine monitoring helps us understand questions about how the river can be used (Table 3), such as:

- Is the Rio Grande Watershed swimmable?
- Is the Rio Grande Watershed drinkable?
- Is the Rio Grande Watershed fishable?
- Is the habitat in the Rio Grande Watershed healthy for aquatic life?

CRP partners throughout the basin collect water quality and sediment samples at approximately 94 routine monitoring stations. In addition to collecting samples for laboratory analysis, personnel also make field observations to record conditions at the time the sample was taken. Field observations include things such as weather conditions at the time of collection, recent rain events in the area, water color, and other general notes related to water quality and stream uses. Important field measurements are made using different pieces of equipment, including: water and air temperature, water depth, water clarity, stream flow and how that flow compares to the normal flow for that water body. Field parameters are described in more detail in Table 4.

The routine collection of field parameters, together with laboratory parameters, allows us to determine the health of the river ecosystem and directs our focus to potential human health and ecological issues. Data is compared with Texas Surface Water Quality Standards (TSWQS) criteria and screening levels in Tables 1, 2 and 3; these steps are described in the next sections.

When routine monitoring shows a water quality issue or trend, the program may choose to do more intensive monitoring in order to gather information to address a specific water quality issue.

Indicators that are directly tied to support of designated uses and criteria adopted in the TSWQS include:

- Water temperature (general use)
- pH (general use)
- Dissolved Oxygen (DO) (Aquatic Life)
- Chloride (general use and public water supply)
- Sulfate (general use and public water supply)
- Total Dissolved Solids (TDS) (general use and public water supply)
- *E.coli* (contact recreation)

Table 1. Primary Surface Water Quality Standards for the Rio Grande Basin

2014 Texas Surface Water Quality Standards for the Rio Grande Basin											
SEGMENT		USES			CRITERIA						
Segment	Segment Name	Recreation	Aquatic Life	Domestic Water Supply	Cl^- (mg/l)	$SO4^{2-}$ (mg/l)	TDS (mg/l)	DO (mg/l)	pH range (SU)	Bacteria geomean (#/100ml)	Temperature (deg F)
2301	**Rio Grande Tidal**	PCR	E	-	-	-	-	5.0	6.5-9.0	35	95
2302	**RG Below Falcon Reservoir**	PCR	H	PS**	270	350	880	5.0	6.5-9.0	126	90
2303	**Falcon International Reservoir**	PCR	H	PS**	200	300	1,000	5.0	6.5-9.0	126	93
2304	**RG Below Amistad International Reservoir**	PCR	H	PS**	200	300	1,000	5.0	6.5-9.0	126	95
2305	**International Amistad Reservoir**	PCR	H	PS	150	270	800	5.0	6.5-9.0	126	88
2306	**RG Above Amistad International Reservoir**	PCR	H	PS	300	570	1,550	5.0	6.5-9.0	126	93
2307	**RG Below Riverside Diversion Dam**	PCR	H	PS	300	550	1,500	5.0	6.5-9.0	126	93
2308	**RG Below International Dam**	NCR	L	-	250	450	1,400	3.0	6.5-9.0	605	95
2309	**Devils River**	PCR	E	PS	50	50	300	6.0	6.5-9.0	126	90
2310	**Lower Pecos River**	PCR	H	PS	1,700	1,000	4,000	5.0	6.5-9.0	126	92
2311	**Upper Pecos River**	PCR	H	-	7,000	3,500	15,000	5.0	6.5-9.0	33	92
2312	**Red Bluff Reservoir**	PCR	H	-	3,200	2,200	9,400	5.0	6.5-9.0	33	90
2313	**San Felipe Creek**	PCR	H	PS	50	50	400	5.0	6.5-9.0	126	90
2314	**RG Above International Dam**	PCR	H	PS	340	600	1,800	5.0	6.5-9.0	126	92

PCR - Primary Contact Recreation
ALU - Aquatic Life Use
NCR - Noncontact Recreation
PS - Public Water Supply
E - Exceptional Aquatic Life
L - Limited Aquatic Life
H - High Aquatic Life
TDS - Total Dissolved Solids
Geomean - geometric mean
Cl^- - chloride
$SO4^{2-}$ - sulfate
DO - Dissolved Oxygen

The indicator bacteria for freshwater is *E. coli* and *Enterococci* for saltwater (2301, 2311, 2312).
The DO criterion in the upper reach of Segment 2307 (Riverside Diversion Dam to the end of the rectified channel below Fort Quitman) is 3.0 mg/L when head-water flow over the Riverside Diversion Dam is less than 35 cfs.
The critical low-flow for Segments 2309 and 2313 is calculated according to §307.8(a)(2)(A) of the TSWQS.

**Designated in the 2014 TSWQS as a sole-source surface drinking water supply, as provided by the TCEQ Drinking Water Protection Team.

Table 2. 2010 Texas Nutrient Criteria for the Rio Grande Basin			
Segment	Segment Name	Station ID	Chlorophyll-a Criteria (µg/L)
2312	**Red Bluff Reservoir**	13267	25.14***

*** Criteria for chlorophyll-a are attained when they are not exceeded by the median of monitoring data results.
The nutrient criteria has not changed since the 2010 TSWQS.

Designated Uses

The State of Texas assigns designated uses to specific water bodies and determines the TSWQS. Table 3 describes the designated uses for the Rio Grande Basin, and Table 1 lists the uses and standards for each segment. For more info, see the TSWQS website.

Contact recreation (CR) – Defined as fishing, swimming, wading, boating, and direct water contact. *E. Coli* and *Enterococci* bacteria are used as indicators for bacterial contamination. The proposed 2014 revisions to the TSWQS created subcategories of Primary (PCR) and Secondary Contact Recreation (SCR). PCR refers to activities such as swimming, and SCR refers to non-immersing recreation activities such as canoeing and fishing.

Public water supply (PS) – As a drinking water source, the primary concern is total dissolved solids (TDS). The TSWQS includes a list of parameters that are screened to ensure safe domestic water supply use. Please see Table 4 for information on these parameters and their effects on a water body.

Aquatic life use (ALU) – Designed to protect aquatic species including fish and benthic macroinvertebrates (aquatic insects). This designation has four levels depending on the ability of a water body to support aquatic life (exceptional, high, intermediate, and limited). The primary parameter used to determine the ALU of a waterbody is Dissolved Oxygen (DO). Please see Table 4.

Fish consumption (FC) – This designation applies to all water bodies where citizens may collect and consume fish. The TSWQS includes a list of parameters that are screened to ensure the fish consumption use is met.

General use – To safeguard general water quality

Aquatic life studies evaluate the health and diversity of organisms such as fish and insects that live in the water. Photo Credit: TPWD

Table 3. Designated Uses for Freshwater

Designated Uses			
Designated Use	**Description**	**Primary Parameter**	**Criteria**
Contact Recreation (CR)	3 levels depending on the use of the water:Fishing, swimming, wading, boating, etc **Note**: Secondary contact recreation criteria is not applied in any of the segments in the Rio Grande Basin	Bacteria: *E. Coli* Tidal and saline- *Enterococcus (Entero)*	Primary Contact Recreation (significant possibility of water ingestion, i.e. swimming) Geometric mean: 126 colony forming units (CFU) for *E. Coli* 35 CFU *Entero*
			Secondary Contact Recreation (limited body contact that poses a less significant risk of ingestion of water, i.e. fishing, boating) Geometric mean 630 colony forming units (CFU) for *E. Coli* 175 CFU *Entero*
			Non- Contact Recreation: Unsuitable for contact recreation
Public Water Supply (PS)	Drinking water source	See full list of Human Health Criteria in Table 2 of the TSWQS	
Aquatic Life Use (ALU)	4 levels depending on the ability of water body to support aquatic life	Dissolved Oxygen- average values	(E) Exceptional 6.0 mg/L
			(H) High 5.0 mg/L
			(I) Intermediate 4.0 mg/L
			(L) Limited 3.0 mg/L
	Toxics in Water	See full list of Aquatic Life Criteria in Table 1 of the TSWQS	
Fish Consumption (FC)	Prevent contamination to protect human health	See full list of Human Health Criteria in Table 2 of the TSWQS Example: Mercury - 0.0122 ug/L in water & fish	
General Use (GU)	General water quality	Water Temp, High pH, Low pH, Dissolved Solids, Nutrients, and Chlorophyll-a. See Tables 2 and 4 in this document.	

Table 4. Water Quality Parameters

Field Parameters		
Parameter	**Description**	**Effects to Water body**
pH	Measure of how acidic or basic the water is. The values range from 0 to 14, with 7 being neutral. pH values less than 7 indicate acidity, whereas a pH greater than 7 indicates a base.	Values greater than 9.0 and less than 5.0 can have detrimental affects on the health of aquatic life, wildlife, and humans.
Specific Conductance	Indicator of how well the water conducts electricity. Pure water does not conduct electricity; impurities such as salts and metals in water are what allow electricity to pass through the water. Since total and dissolved metal values should be very low, conductivity primarily measures how much salt is in the water. Most naturally-occurring waters have some level of conductivity.	High conductivity can cause physiological effects in animals and plants. It also could be a result of high TDS. Indirect effects of excess dissolved solids are primarily the elimination of desirable food plants and habitat-forming plant species. Agricultural uses of water for livestock watering are limited by excessive dissolved solids and high dissolved solids can be a problem in water used for irrigation.
Dissolved Oxygen (DO)	Measure of the oxygen in the water.	Low DO values can lead to a reduced abundance and diversity in aquatic communities. Very low levels (<2) can be indicative of higher levels of oxygen-demanding plants that use up DO during the decay process.
Secchi Depth	A measure of the transparency of water - the maximum depth at which a black and white disk is visible.	Higher transparency leads to a more robust aquatic plant life (particles in water block sunlight for photosynthesis). High transparency coupled with high nutrients can lead to negative impacts on DO and aquatic life.
Stream Flow	Volume of water moving over a location over a period of time. Low flow conditions common in the warm summer months create critical conditions for aquatic organisms.	At low flows, the stream has a lower assimilative capacity for waste inputs from point and nonpoint sources.
Conventional Laboratory Parameters		
Parameter	**Description**	**Effects to Water body**
Solids	Total and dissolved materials of any kind (calcium, magnesium, potassium, sodium, bicarbonates, chlorides, and sulfates).	High total dissolved solids indicate higher amounts of dissolved salts which can reduce the diversity of aquatic life and can render the water unusable for human consumption, industry and agriculture.
Nutrients	Nutrients include nitrogen compounds, ammonia, and phosphorus.	High levels can cause excessive plant growth, which can lead to reduced dissolved oxygen and fish kills, reduced stream flow and reduced navigability of the waters. Elevated ammonia can also be toxic to aquatic life.
Chlorophyll-a	Chlorophyll-a is used as an indicator of algal growth in water.	High levels for long periods may indicate low water quality and are indicative of excess nutrient levels.
Non-conventional Laboratory Parameters		
Parameter	**Description**	**Effects to Water body**
Metals	Aluminum, arsenic, barium, chromium, copper, lead, mercury, nickel, silver, and zinc. Metals can be tested as total or dissolved metals in water or metals in sediment to determine long-term accumulation.	High concentrations can result in long- and short-term effects on aquatic life and human health.
Organics	Chemicals containing carbon and hydrogen. Organic compounds analyzed are herbicides, pesticides and industrial compounds both in water and in sediment.	Organics can result in long- and short-term effects on aquatic life and human health.
Biological Parameters		
Parameter	**Description**	**Effects to Water body**
Nekton	Fish captured in the river during biological surveys using both electrofishing and seining methods	Using Index of Biologicial Integrity (IBI), indicate biodiversity and overall health of river.
Benthics	Freshwater macroinvertebrates collected during a five-minute kick net method	Using IBI, this biological aquatic assemblage analysis indicates biodiversity and overall health of river. Healthy macroinvertebrate communities can be excellent indicators of high water quality.

Table 5. Summary of Water Quality Impairments and Concerns in the Rio Grande Basin					
Segment	Segment Name	Parameter (s) Impaired	Year First Listed	Parameter(s) of Concern	Type of Concern
2301	Rio Grande Tidal	No Impairment		Bacteria Chlorophyll-a Nitrate	CN CS CS
2302	RG Below Falcon Reservoir	Bacteria	1996	Ammonia Chlorophyll-a Depressed Dissolved Oxygen	CS CS CN
2302A	Los Olmos Arroyo	Bacteria	2004	Chlorophyll-a	CS
2303	International Falcon Reservoir	No Impairment		Toxicity in Water Total Phosphorus Ammonia Nitrate	CS CS CS CS
2304	RG Below Amistad International Reservoir	Bacteria	1996	Toxicity in Water Ammonia	CS CS
2304B	Manadas Creek	No impairment		Bacteria Chlorophyll-a Ammonia	CN CS CS
2305	International Amistad Reservoir	Chloride Total Dissolved Solids	2014 2014	Nitrate	CS
2306	RG Above Amistad International Reservoir	Sulfate Total Dissolved Solids Chloride	2010 2010 2010	Chlorophyll-a Total Phosphorus Fish Kill Report	CS CS CS
2306A	Alamito Creek	No impairment		No Concern	
2307	RG Below Riverside Diversion Dam	Bacteria Chloride Total Dissolved Solids	2002 1996 1996	Nitrate Total Phosphorus Ammonia Chlorophyll-a	CS CS CS CS
2308	RG Below International Dam	Bacteria	2014	Chlorophyll-a Total Phosphorus Ammonia	CS CS CS
2309	Devils Rivers	No Impairment		No Concern	
2310	Lower Pecos River	No Impairment		Harmful algal bloom/golden alga	CS
2310A	Independence Creek	No Impairment		No Concern	
2311	Upper Pecos River	Depressed DO	2006	Harmful algal bloom/golden alga Bacteria Chlorophyll-a Depressed DO	CS CN CS CN
2312	Red Bluff Reservoir	No Impairment		Harmful algal bloom/golden alga Chlorophyll-a Depressed DO	CS CS CN
2313	San Felipe Creek	Bacteria	2014	No Concern	
2314	RG Above International Dam	Bacteria	2002	Chlorophyll-a	CS

CN - Concern for near-nonattainment of the Water Quality Standards
CS - Concern for water quality based on screening levels

Note: Each Segment is further subdivided into Assessment Units (AU). The entire segment may not be impaired. The complete list of impairments and AUs can be found at the TCEQ 303(d) website.

How does the data get collected?

The USIBWC Clean Rivers Program depends on partners that have volunteered to collect water quality data in addition to their own projects and work goals, and this allows the CRP to get spatial monitoring coverage over this large and complex watershed. The program is proud to be affiliated with 18 partners: three laboratories, five USIBWC field offices, four universities, three municipalities, one non-profit organization, one state agency and one federal agency:

El Paso Water International Laboratory
Brownsville Public Utilities Board Laboratory
TPWD- Big Bend Ranch State Park
USIBWC American Dam Field Office
USIBWC Amistad Dam Field Office
USIBWC Mercedes Field Offices
El Paso Community College
University of Texas Rio Grande Valley- Edinburg
City of Laredo Environmental Services
City of Laredo Health Department Laboratory
Big Bend National Park
Rio Grande International Study Center (RGISC)
USIBWC Presidio Field Office
USIBWC Falcon Dam Field Office
University of Texas at El Paso
Sul Ross State University
Midland College
City of Laredo Health Department

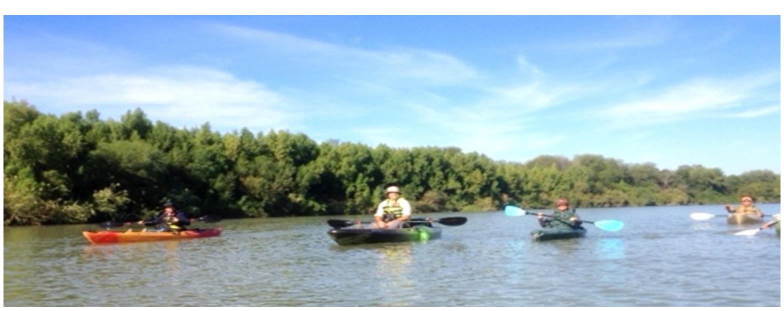
All USIBWC CRP partners are trained by USIBWC CRP staff, and all partners use the sampling methods outlined in TCEQ's Surface Water Quality Monitoring Procedures Manual, Volume 1. The stations monitored are agreed upon by TCEQ, CRP and partners at annual meetings. Field sheets and chain of custody records are kept by both the partner and the USIBWC CRP staff, so that data integrity can be traced if needed. All partners us e the same monitoring equipment. The water samples are sent to laboratories accredited by the State of Texas under the National Environmental Laboratory Accreditation Program (NELAP). The NELAP accreditation is a requirement for data to be accepted by the TCEQ for use in the Integrated Report.

The USIBWC CRP compiles all the field data received from the partners, and the data from laboratory analysis. The staff checks the data against rigorous quality assurance criteria, consolidates the data into usable reports, and sends the data to the TCEQ to be reviewed. Once the TCEQ reviews these reports, the data is uploaded into the state's database, called SWQMIS (Surface Water Quality Monitoring Information System). All data collected by the CRP partners is available to the public on the USIBWC CRP website.

Coordinated Monitoring Schedule

All entities that monitor the Rio Grande in Texas gather annually to discuss and coordinate monitoring activities. Information on monitoring station locations, who is collecting water quality data, and how often within the Rio Grande watershed can be found on the Coordinated Monitoring Schedule.

http://cms.lcra.org/



Pictured: Kayakers traveling down the Rio Grande guided by Dr. Tom Vaughan (photo provided by RGISC)

Technical Summary: What are Impaired Waters?

The Texas Integrated Report of Surface Water Quality, formerly known as the Texas Water Quality Inventory and 303(d) List, evaluates the water quality of surface waters in the State of Texas. It provides water resource managers with the necessary tools and information for making informed decisions when directing programs, including programs such as the Clean Rivers Program. The report is required by the federal Clean Water Act Sections 305(b) and 303(d). The Texas Integrated Report assesses all data in the State's water quality database for a 7- year period, and a new 7-year data set is assessed every two years. In most cases, a minimum of 10 samples is required to conduct the assessment. Most water bodies are assessed in portion, such as the above and below a structure that has an impact on the river (a dam), above and below an outfall, or above and below the the junction of a tributary with the river, to allow for more accurate and site-specific evaluation of effects on the water body. These "portions" of the stream are defined as Assessment Units. The State of Texas determines the Texas Surface Water Quality Standards (TSWQS) for each river basin based on the Texas Integrated Report.

The Clean Water Act (CWA), under sections 303(d) and 305(b), requires each state to submit reports documenting water quality throughout the state. These reports identify water bodies that are meeting, or not meeting, their assigned designated use (e.g. contact recreation, aquatic, or drinking water), which vary by river segment. Results are determined by analyzing the data against established water quality indicators determined by the Texas State Water Quality Standards (Table 1); these standards specify numeric and narrative criteria for water quality parameters. Numeric criteria are specific to the representative river segment, and if that segment (or portion thereof) is found to not meet one of its designated uses, it will be classified as *impaired* and placed on the 303(d) list of impaired waters. To assess water quality using narrative criteria, the state developed screening levels, which are used to determine if there is a water quality *concern*, but does not indicate an *impairment*, for parameters that have historically led to environmental issues in the area.

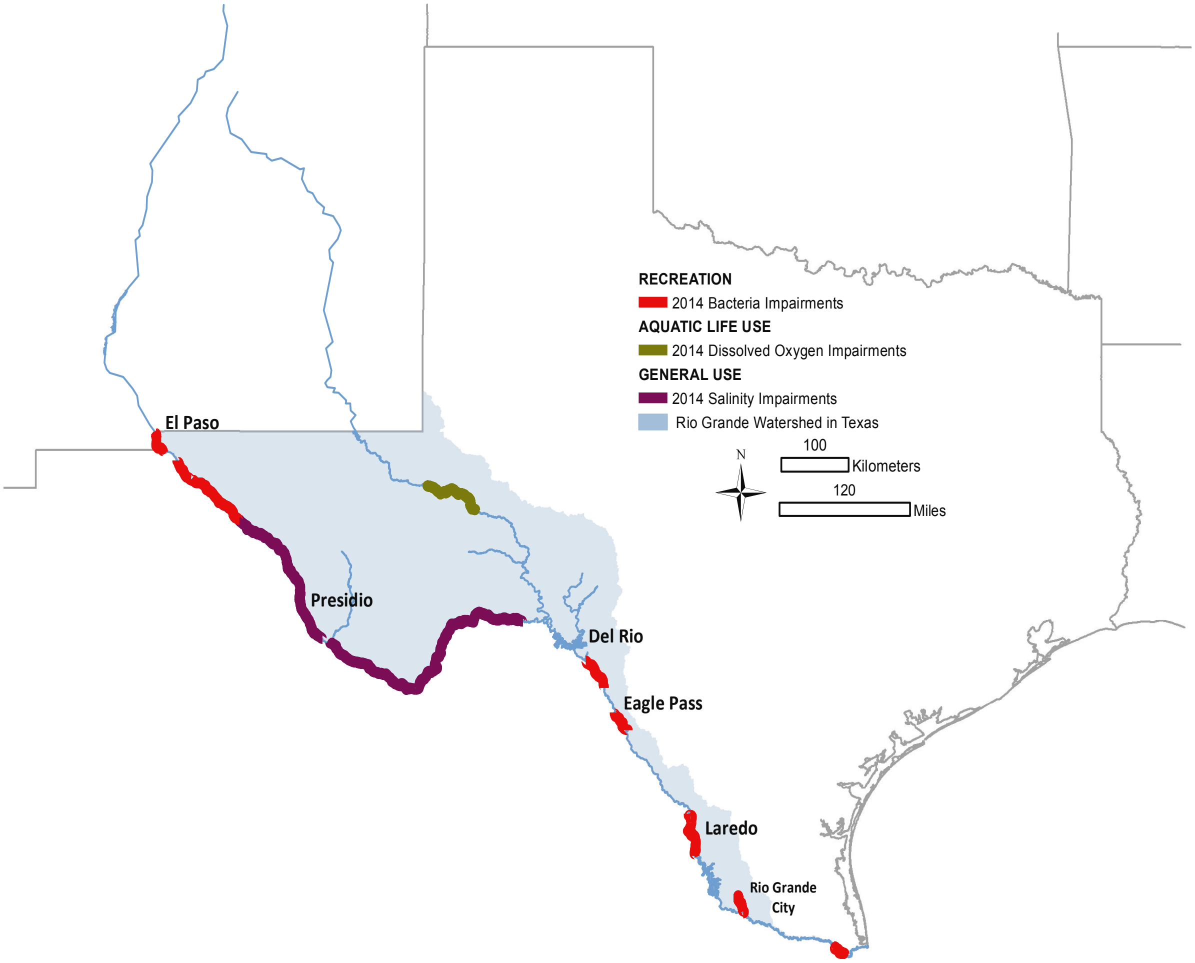
The EPA approved the 2014 TSWQS for the Rio Grande Basin and the 2014 Integrated Report. The TSWQS and Integrated Report can be viewed at the following links:

TSWQS https://www.tceq.texas.gov/waterquality/standards/2014standards.html

Integrated Report: **https://www.tceq.texas.gov/waterquality/assessment/14twqi/14txir**

Pictured: Wastewater treatment Plant effluent discharge upstream of Station 17040, Rio Grande at Anapra in El Paso, TX, taken in 2015. This station has very high bacteria counts. Photo credit USIBWC CRP staff.

Figure 3. Impairments in the Rio Grande Basin



Pictured: A fish kill in January 2017 below the WWTP effluent discharge upstream of Station 17040, Rio Grande at Anapra in El Paso, TX, taken in 2015. Photo credit USIBWC CRP staff.

Data Selection and Methodology

Water quality data used for analysis were obtained from the TCEQ's Surface Water Quality Monitoring Information System (SWQMIS); this database houses surface water quality data for the State of Texas. Data was collected under a TCEQ- approved Quality Assurance Project Plan (QAPP). Data that were found to have quality concerns, identified by a qualifier code in SWQMIS, were not used for analysis. Data used for these analyses were from Rio Grande Basin monitoring stations between December 1, 2006 and November 30, 2016.

Trend analysis for water quality parameters identifies areas that are improving, degrading, or need additional monitoring. Analyses will also identify if water quality improvement projects or management changes are making a difference to water quality. These findings may be used to facilitate discussion and prioritize critical projects within a basin. The USIBWC CRP chose to run trend analysis on stations that had at least 10 sampling events; this number was chosen due to a large number of stations that did not meet the TCEQ recommendation of 20 sampling events. Ten sampling events allowed us to provide a more comprehensive analysis where it was deemed that the depicted trends were important for the characterization of the segment.

Water quality parameters selected for analysis include: pH, dissolved oxygen, ammonia, chlorophyll-a, total phosphorus, bacteria (E.coli or enterococcus), sulfate, chloride, nitrate + nitrite, and total dissolved solids. For each water quality parameter of interest, data analysis consisted of minimums, maximums, means, geomeans (bacteria only), and regression trends. Trend analysis allows for the identification of how water quality parameters changes over time. Regression analyses were not run on stations that had fewer than 10 data points over the period of record (12/01/2006- 11/30/2016); means, minimums, and maximums at these stations are provided for informational purposes. Significance of regression analyses were determined by a t-value equal to or greater than two, combined with a p-value less than 0.1. Data often consisted of variables that were reported at the limit of quantification (LOQ); these were analyzed using the standard LOQ (ex. A value reported as < 3 was analyzed using 3). Over the period of record, analytical labs were able to evaluate nutrient concentrations at lower levels, and thus downward trends may appear in data analysis where they do not exist. To account for this, datasets were individually examined and results which appeared to show a trend due to changing quantitation limits were flagged and not reported as significant.

Pictured: The Rio Grande near Station 13276 in Anthony, TX. Photo credit USIBWC CRP staff.

The Upper Rio Grande Basin

The Upper Rio Grande Sub-basin extends from the New Mexico-Texas state line downstream to the International Amistad Reservoir, a lenght of 650 miles. Due to historical changes in the channel, the Rio Grande meanders in and out of Texas and New Mexico with some sections forming the boundary between the two states. Proceeding downstream, the Rio Grande forms the international boundary between the U.S. and Mexico. The economy of this region is based on agriculture, manufacturing, tourism, wholesale and retail trade, and government, including the Fort Bliss Army installation in El Paso, Texas.

The Upper Rio Grande Sub-basin lies entirely in the Trans-Pecos region. The upper portion of the river traverses the mountains of the Chihuahuan desert, flowing through arid mountains, high hills, and rock outcrops as it passes through Big Bend National Park. This region depends laregely on groundwater sources for its water supply. Two aquifers, the Edwards-Trinity (Plateau) and Hueco-Mesilla Bolsons, combined with six minor aquifers contribute to the majority of the region's water supply.

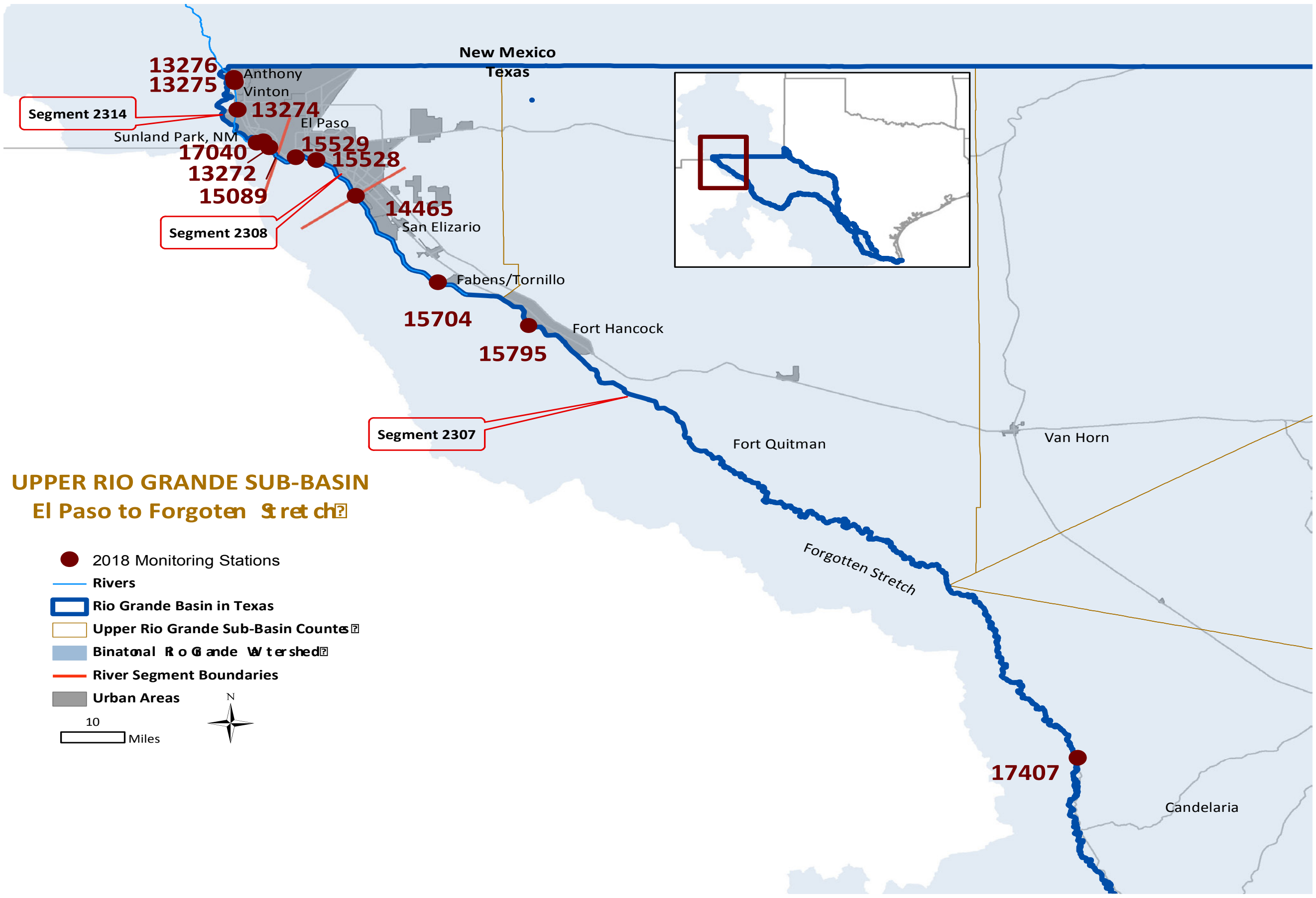
During irrigation season, the water in the Rio Grande is used for agriculture by New Mexico, Texas and Mexico. The City of El Paso also uses the river to provide half of its drinking water supply. The sister cities of El Paso, Texas, and Ciudad Juarez, Chihuahua, have a combined population of more than 2 million people, and lands surrounding the cities are used primarily for agriculture. The agricultural return flows drastically reduce water quality and quantity by introducing highly saline water into the river, as well as high levels of nutrients such as nitrates and phosphates. In addition, water downstream of these cities contains wastwater effluent, and raw or partially treated sewage; as a result, the upper Rio Grande downstream of El Paso and Ciudad Juarez contains very high levels and bacteria. As the river traverses the sister cities of Presidio, Texas and Ojinaga, Chihuahua, the Rio Conchos joins with the Rio Grande, improving water quality and significantly increasing water quantity. The blended water from both rivers then flows through Big Bend Ranch State park, Big Bend National Park, and the Rio Grande Wild and Scenic Area, where tourism and wildlife depend on water quality and quantity.

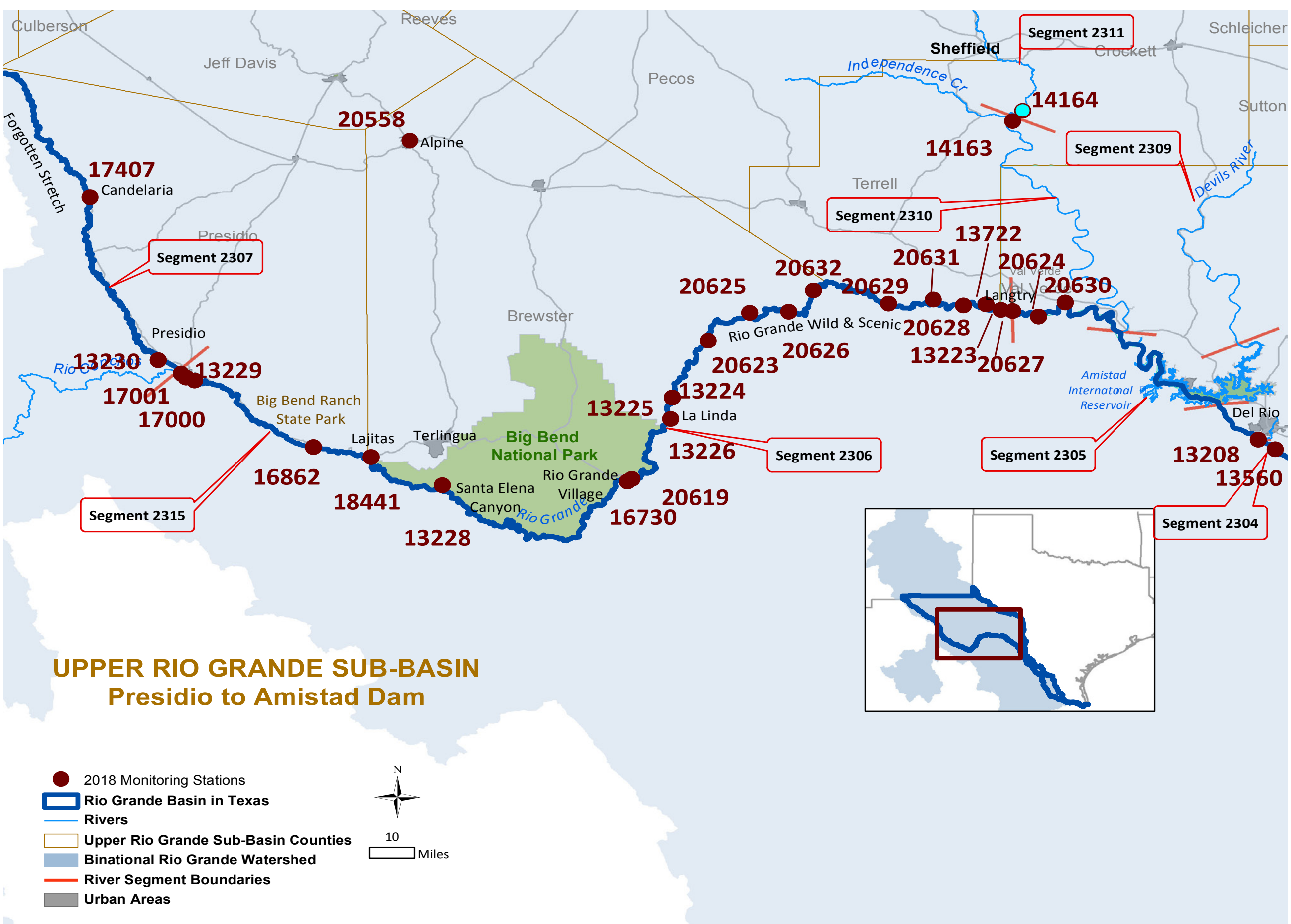
The waters of the Rio Grande flow through the Upper Rio grande Sub-basin until they reach International Amistad Reservoir. Benefits created by the reservoir include flood prevention for downstream communities, improved water quality, water supply, and steady, continuous flow in the river below the dam. The reservoir is also a popular area for fishing and recreation, and the dam contains two hydroelectric plants that produce electricity for communities on both sides of the border.

The USIBWC CRP has 8 partners in the upper Rio Grande: USIBWC American Dam Field Office, USIBWC Presidio Field Office, USIBWC Amistad Dam Field Office, the University of Texas at El Paso (UTEP), El Paso Community College (EPCC), El Paso Water Laboratory, Big Bend Ranch State Park, Big Bend National Park, and Sul Ross State University. These partners monitor 39 stations in Segments 2314, 2308, 2307, 2306, and 2305. TCEQ monitors 13 stations in Segments 2305, 2306, 2307, and 2314. Combined, the USIBWC CRP and TCEQ provide field, flow, and water quality data for the program in this reach to promote the protection, restoration and wise use of Texas surface water resources. Each segment will be discussed in more detail in the following sections.

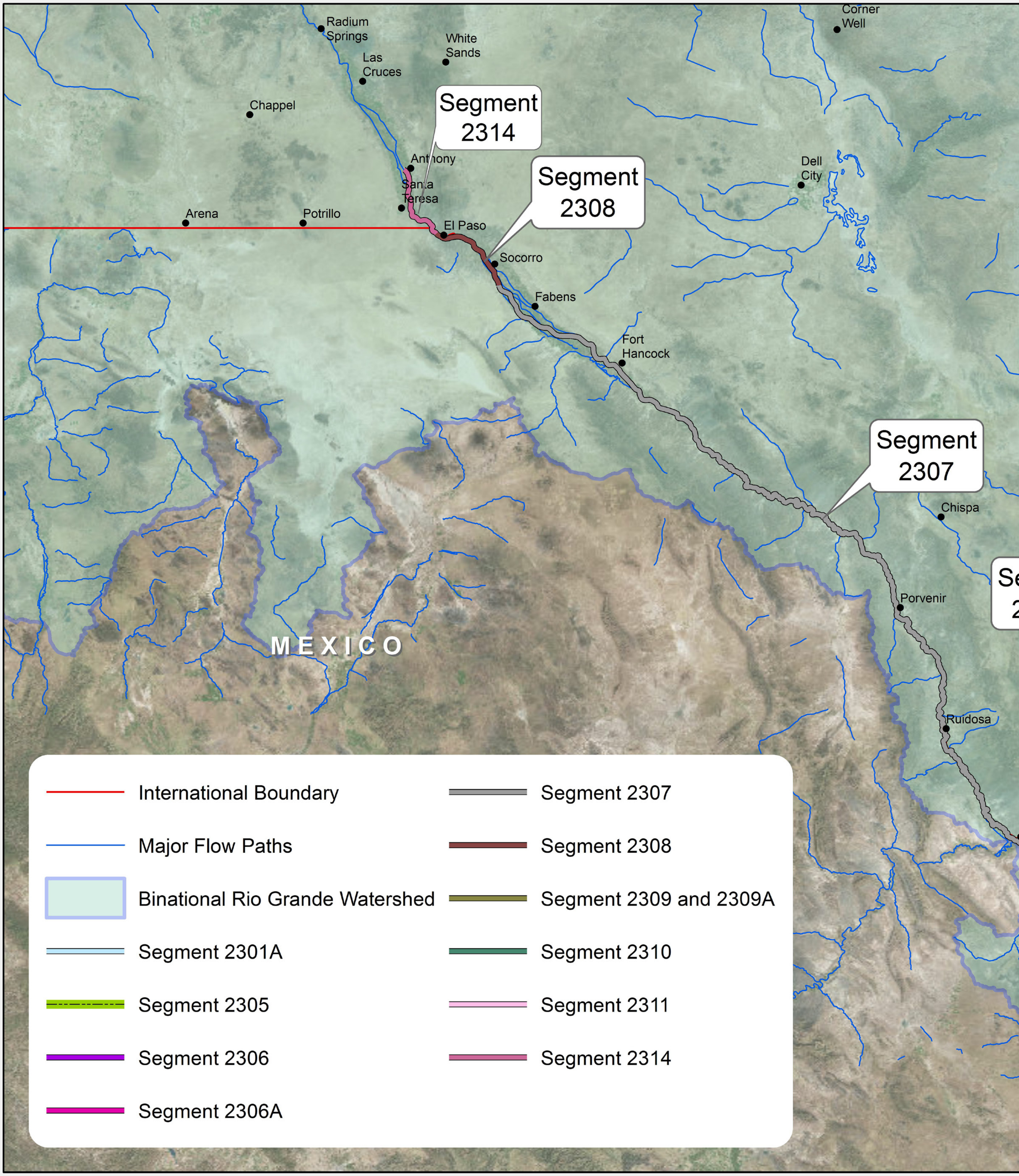
Pictured: Texas Parks and Wildlife Department staff sampling in Big Bend Ranch State Park. Photo credit TPWD.

Figures 4 and 5. Maps of the Upper Rio Grande Basin in Texas





TCEQ Segments, General Topography, Major Flowpaths



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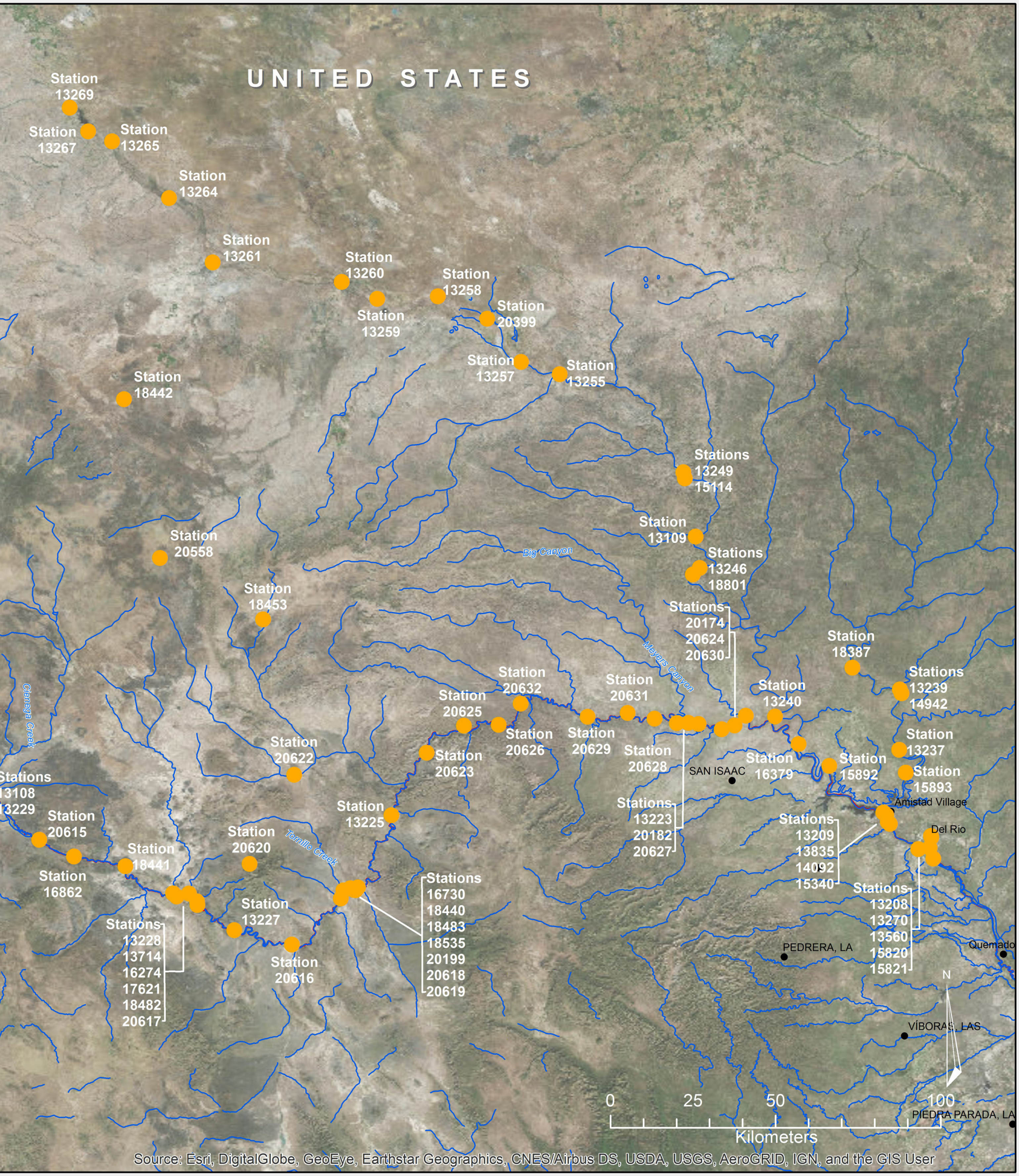

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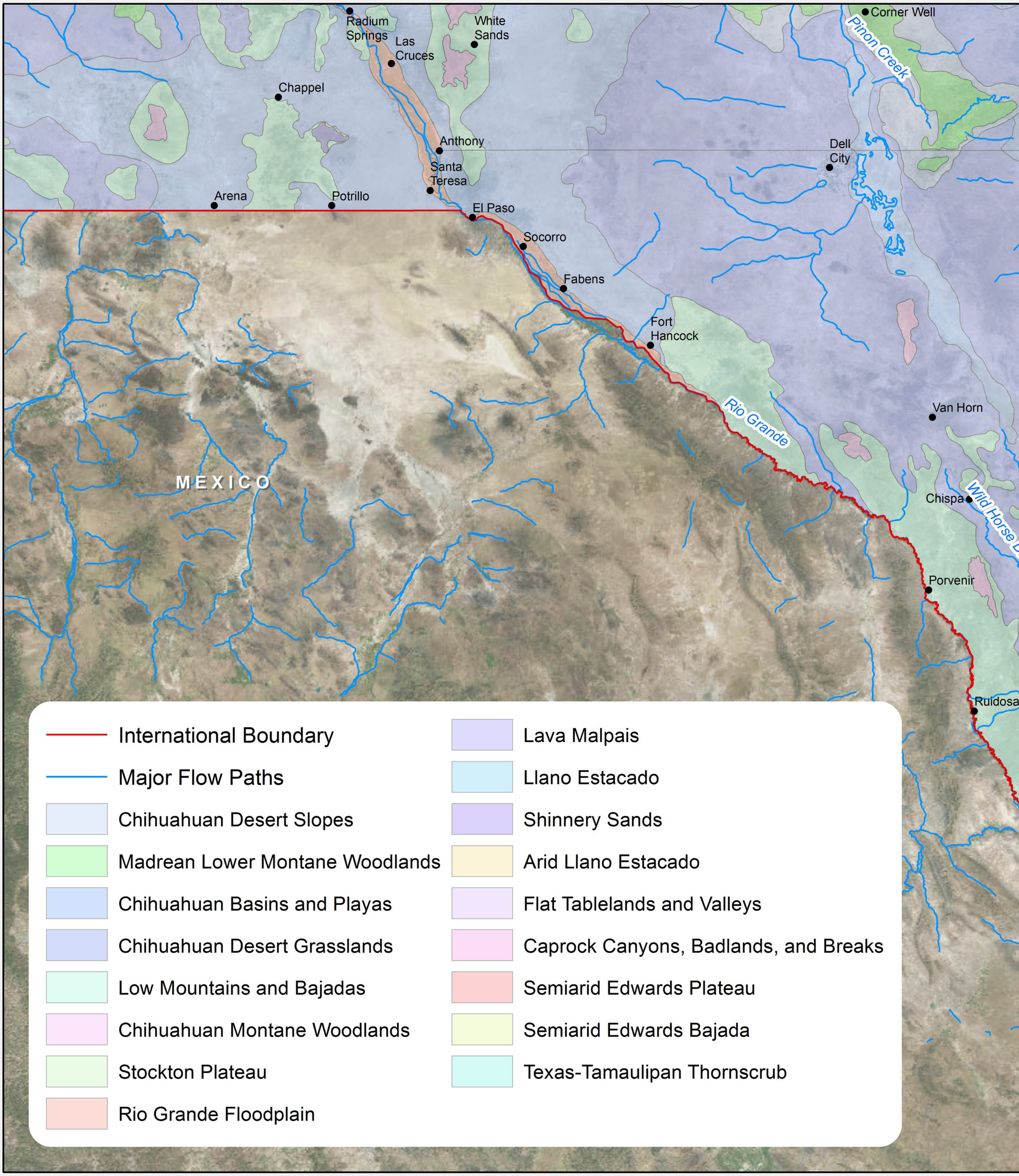

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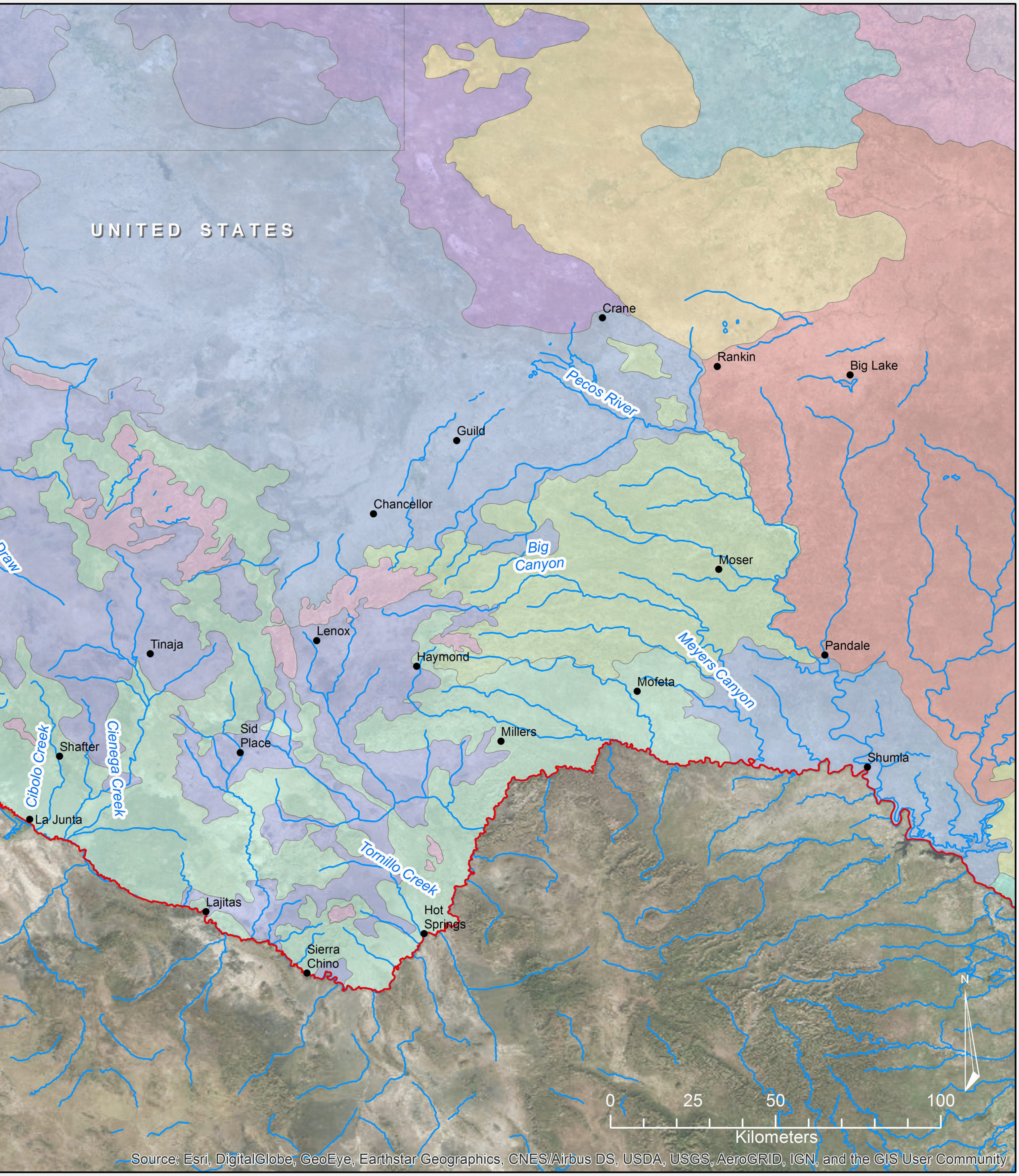

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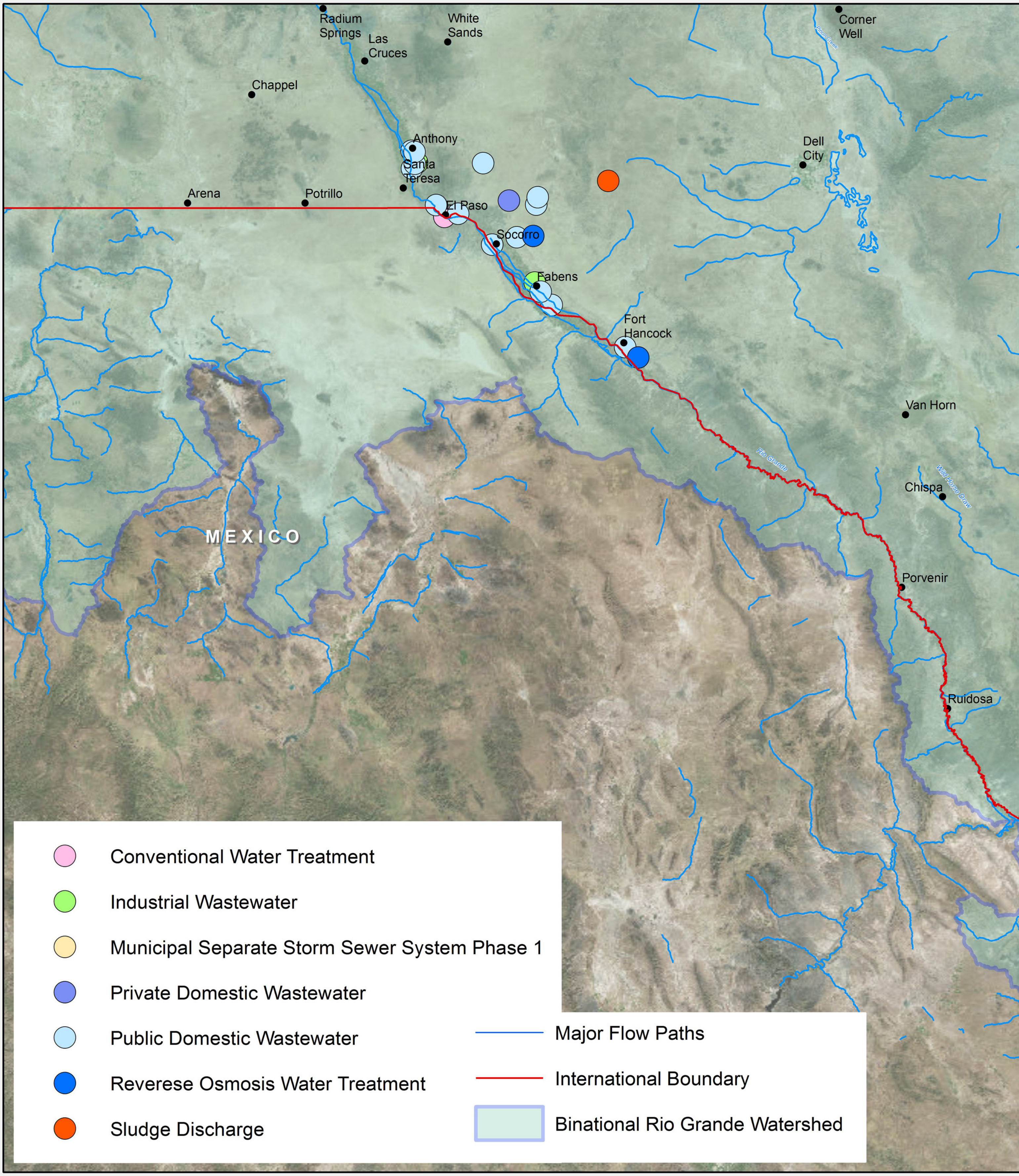

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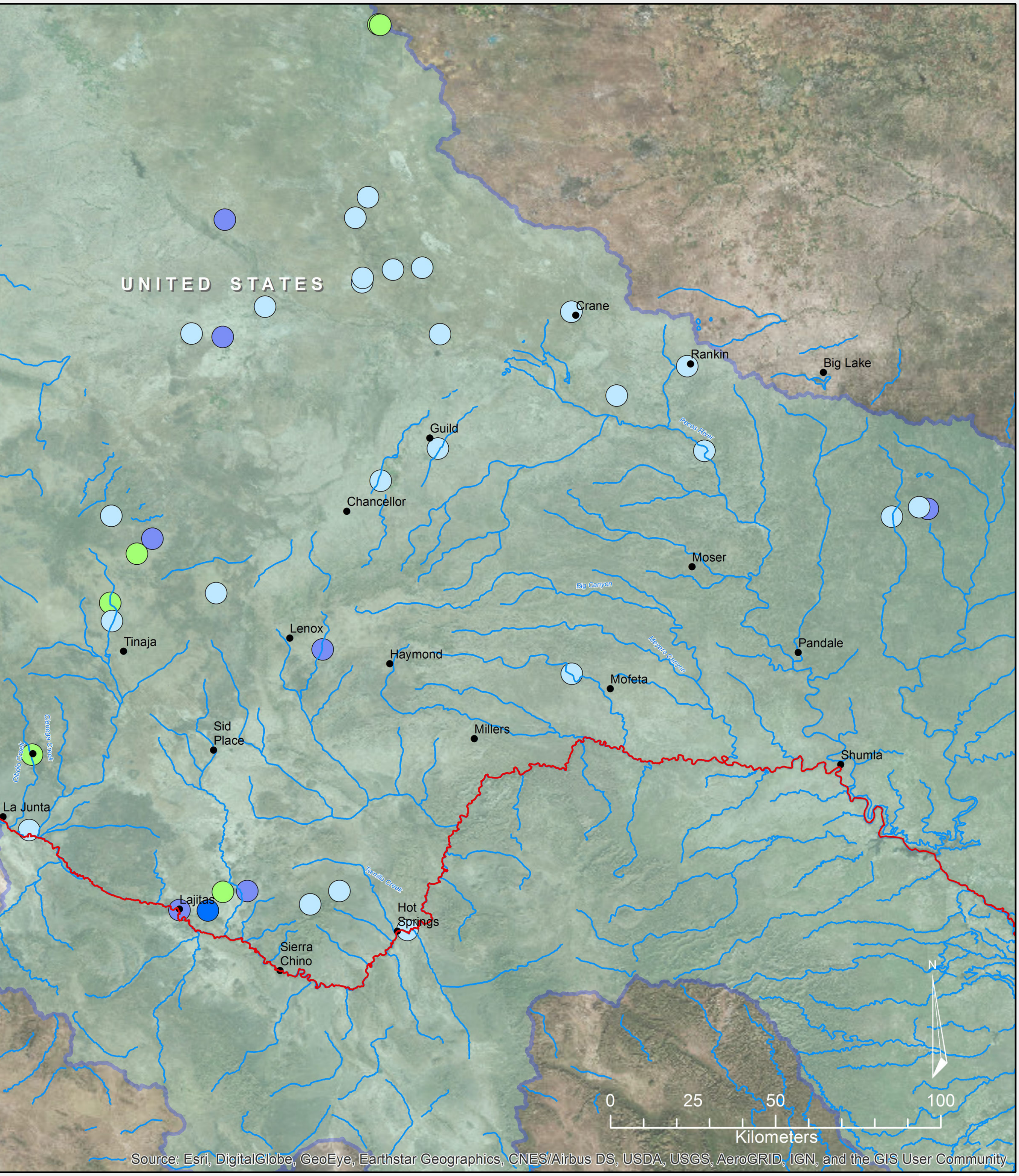

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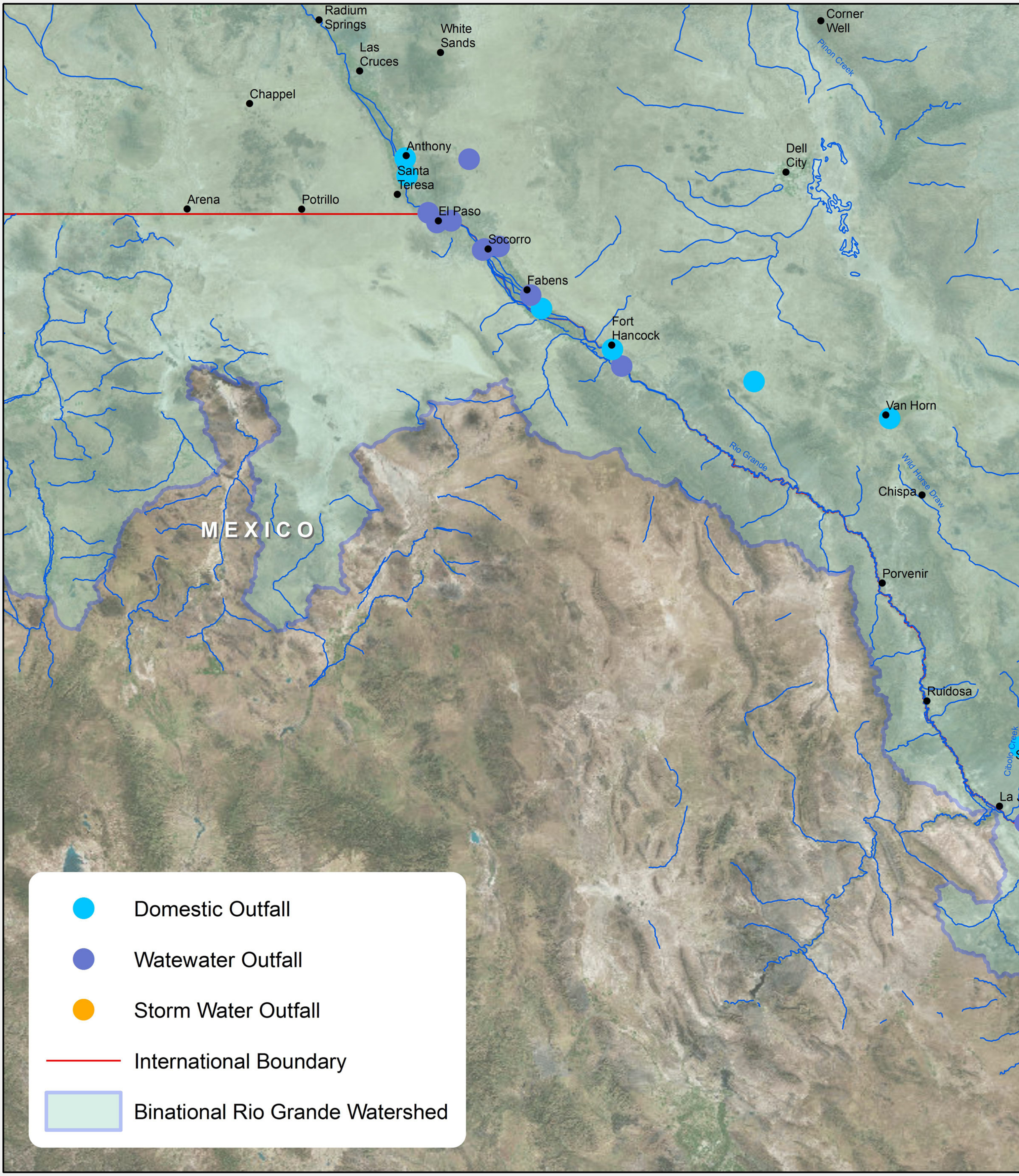

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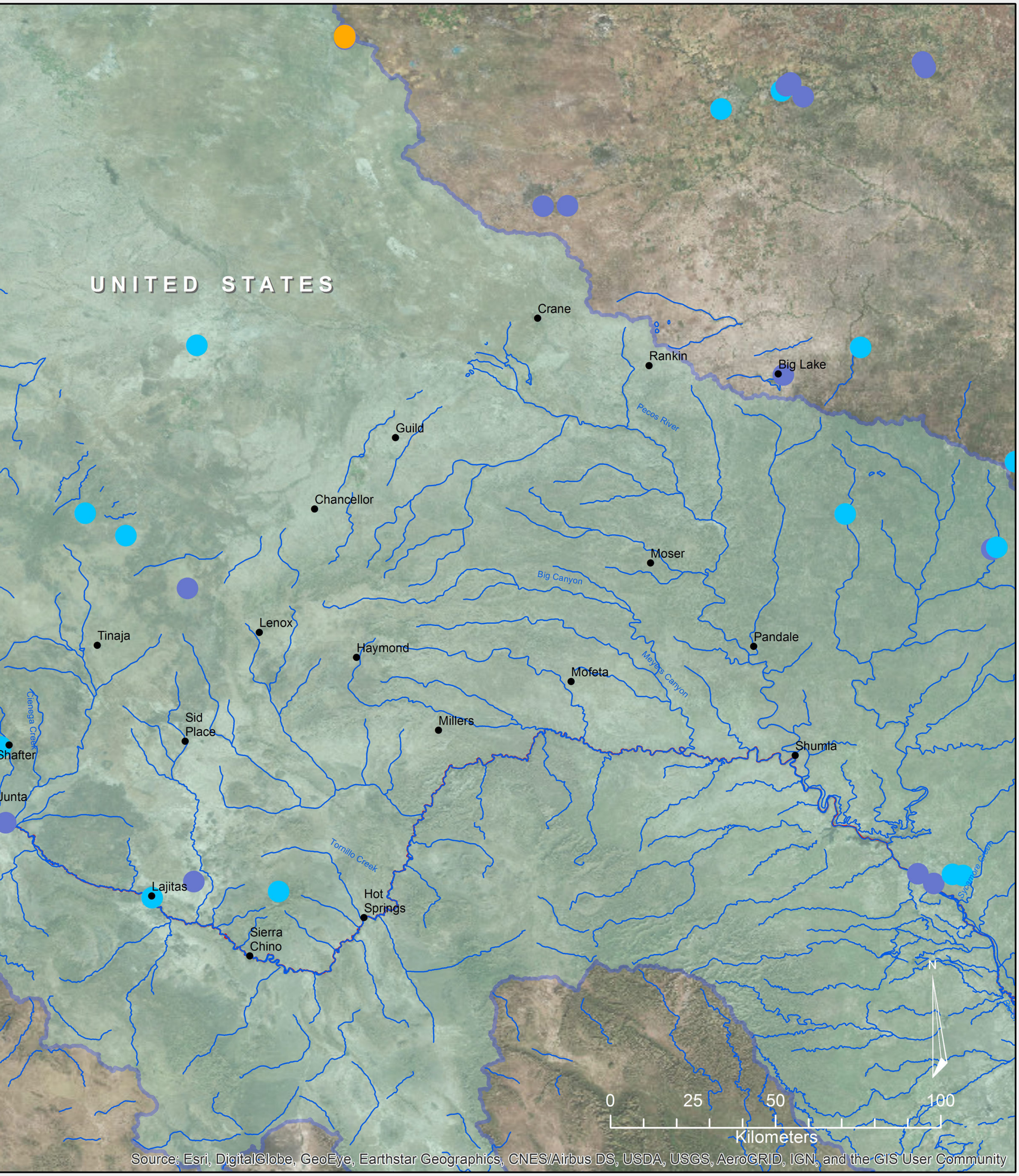

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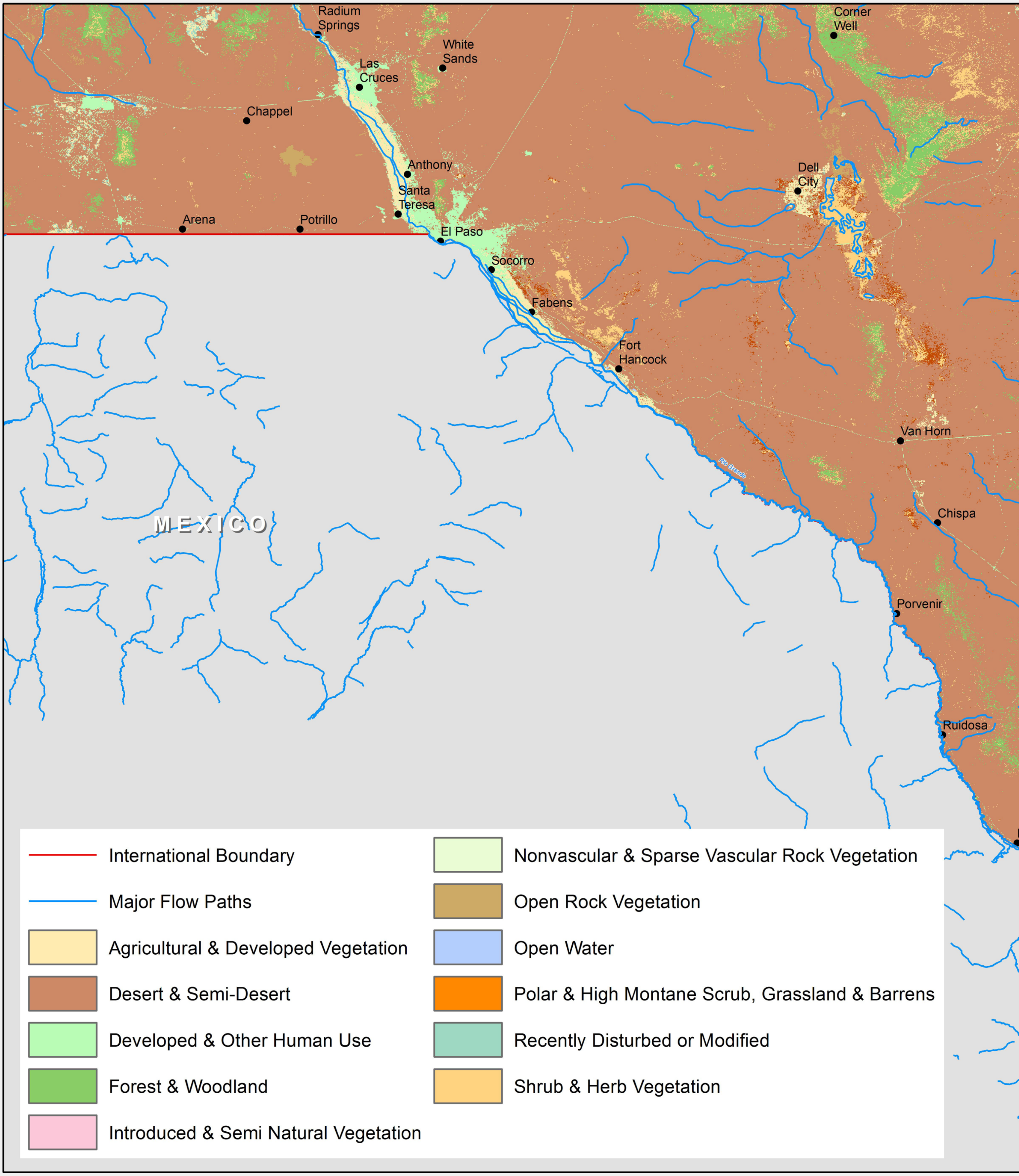

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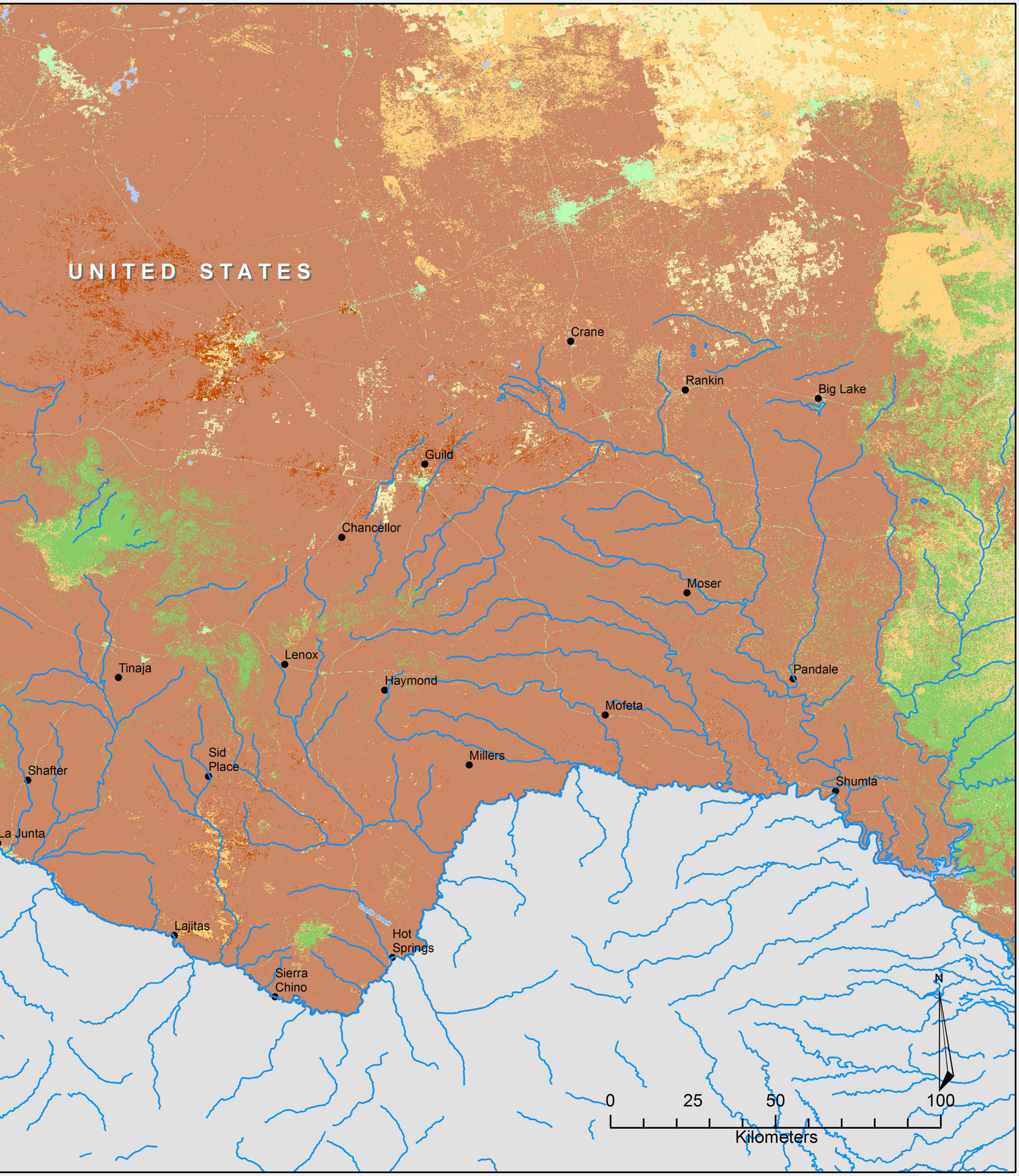

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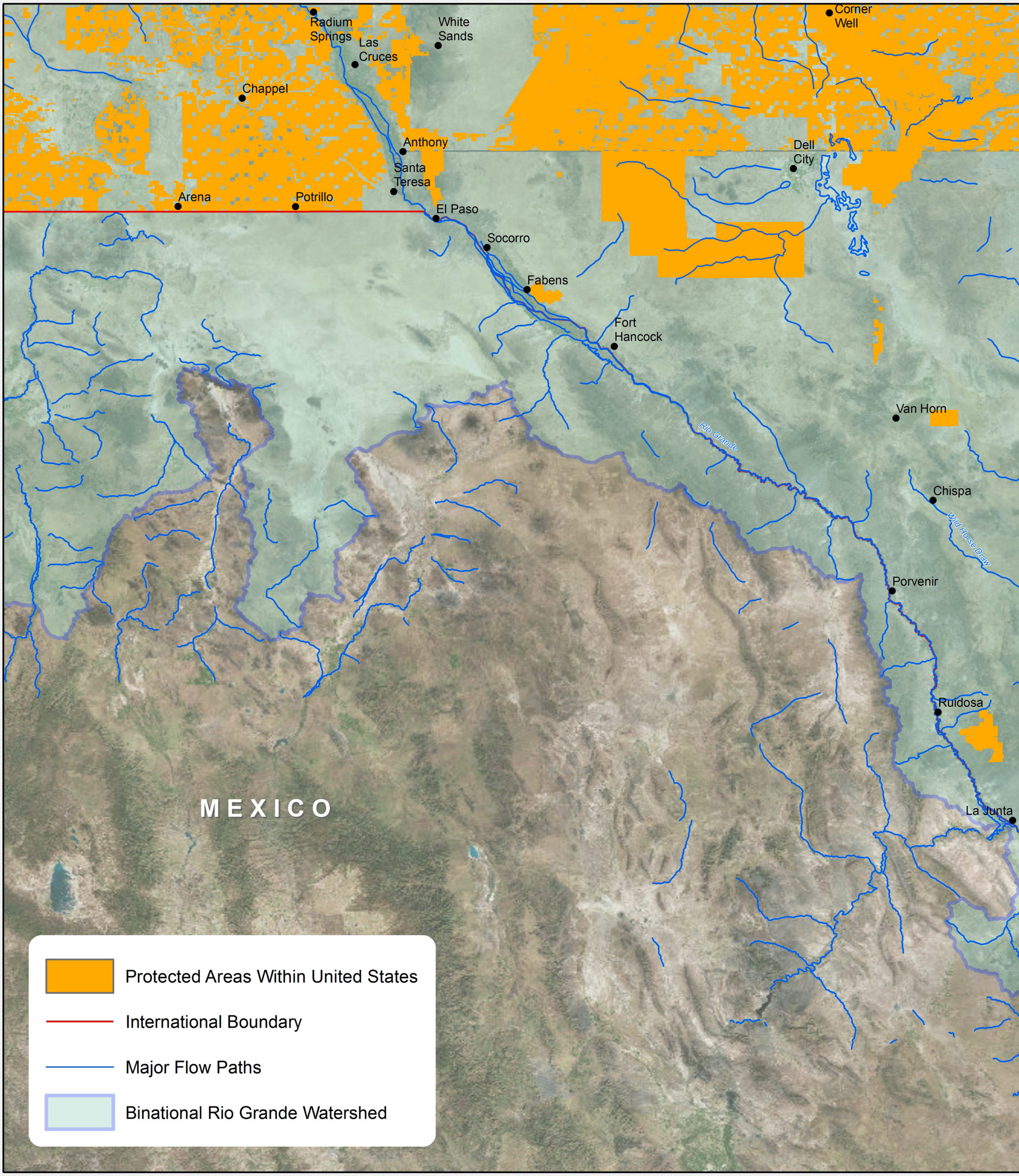

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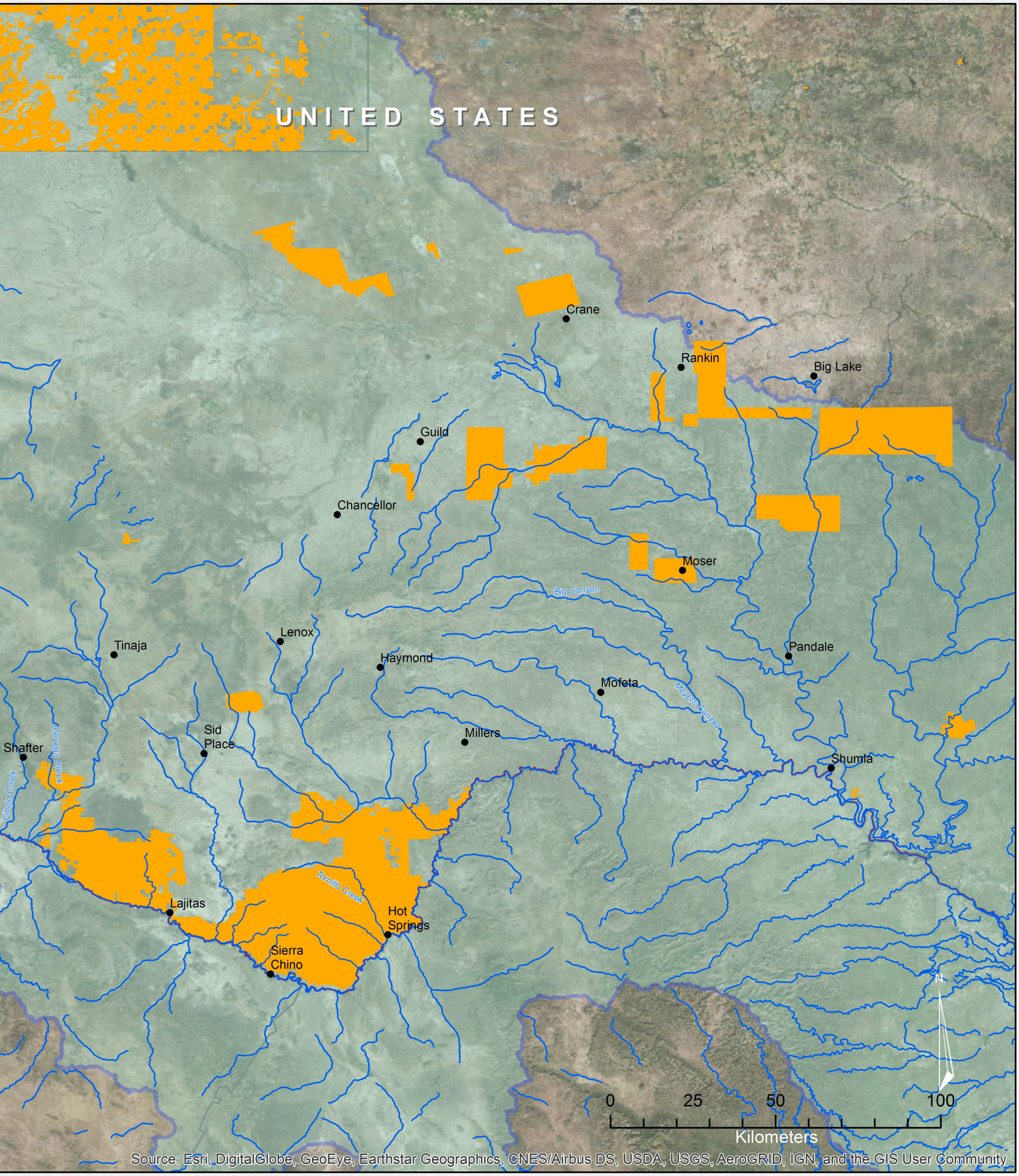

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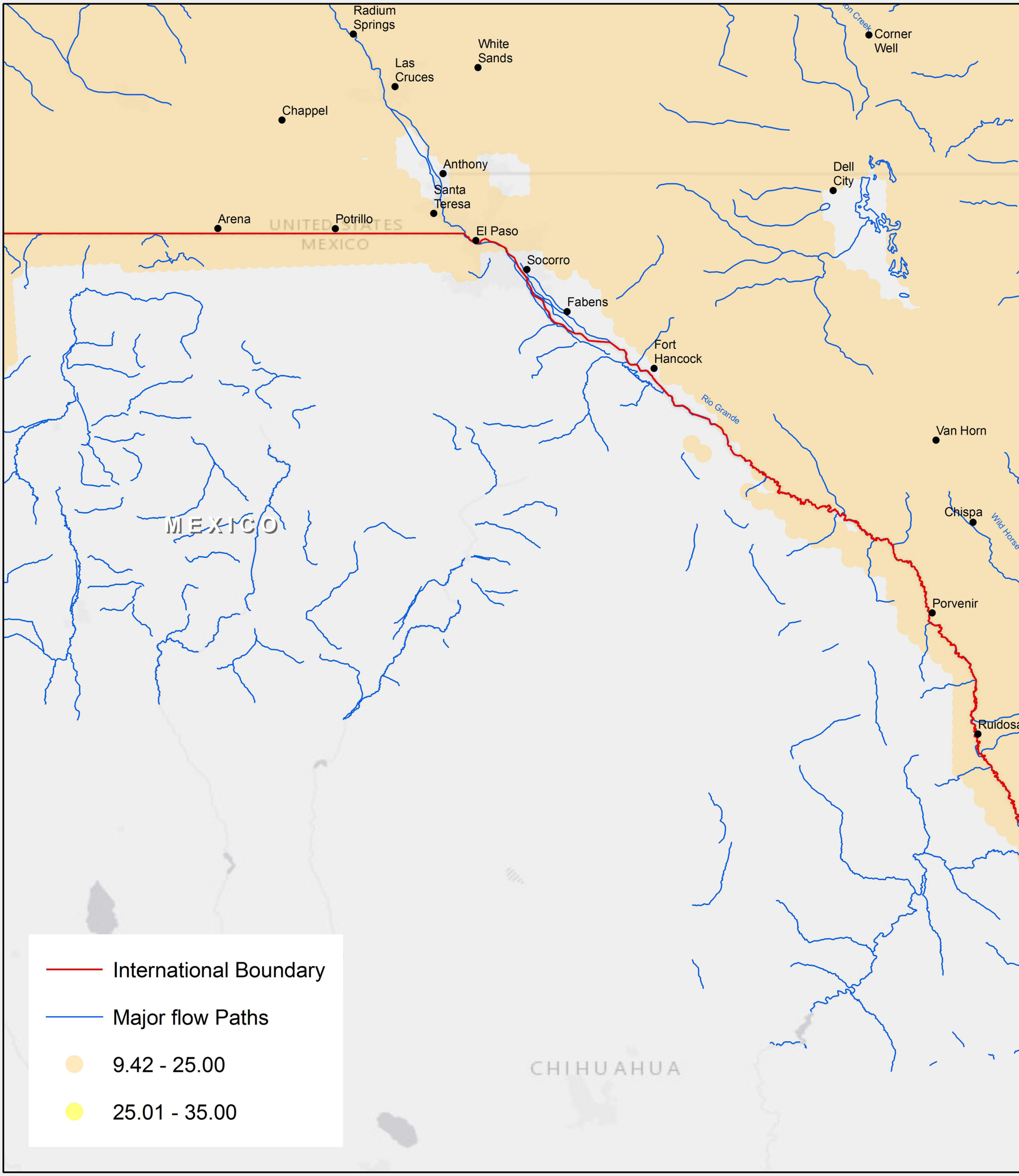

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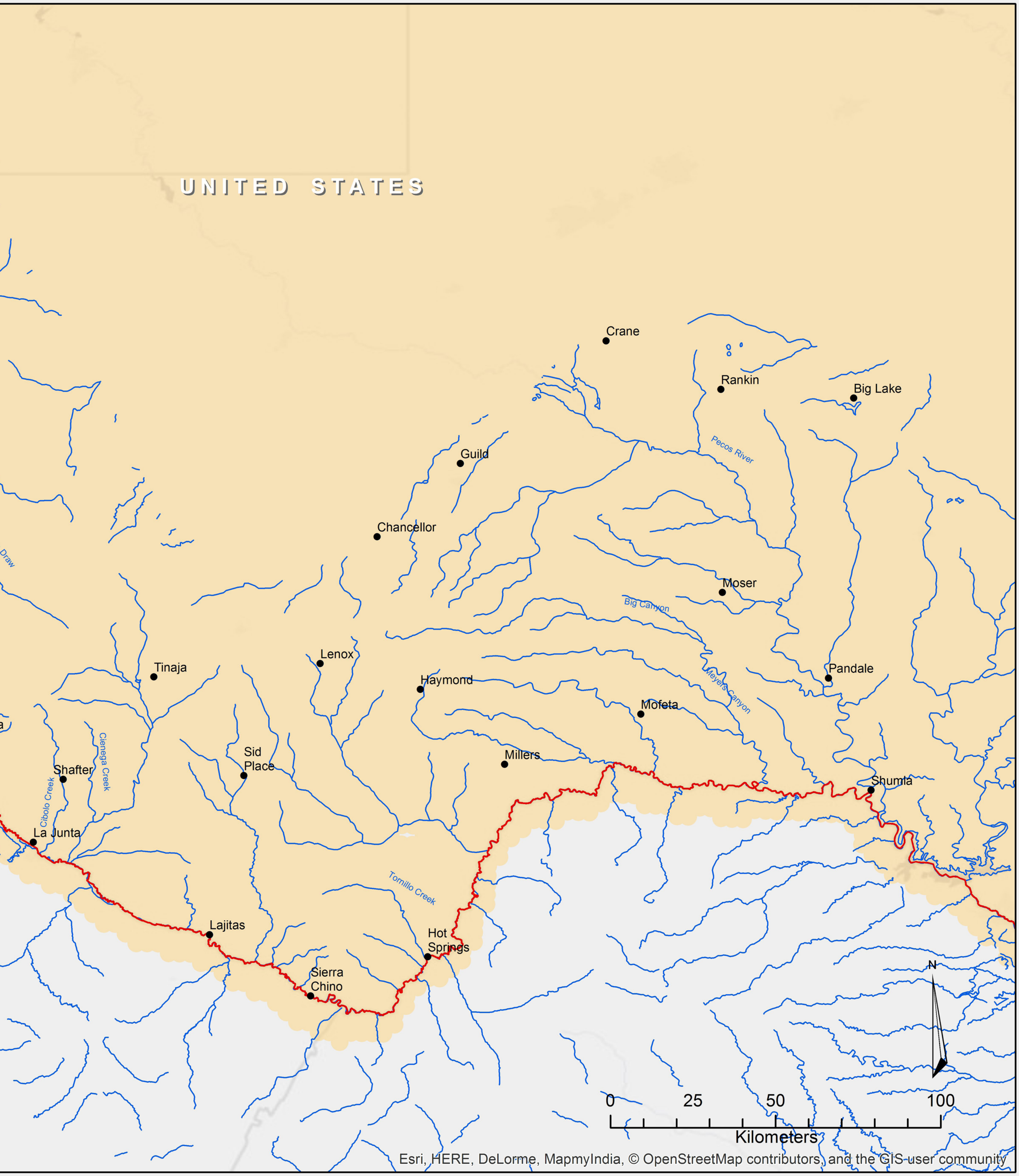

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TCEQ

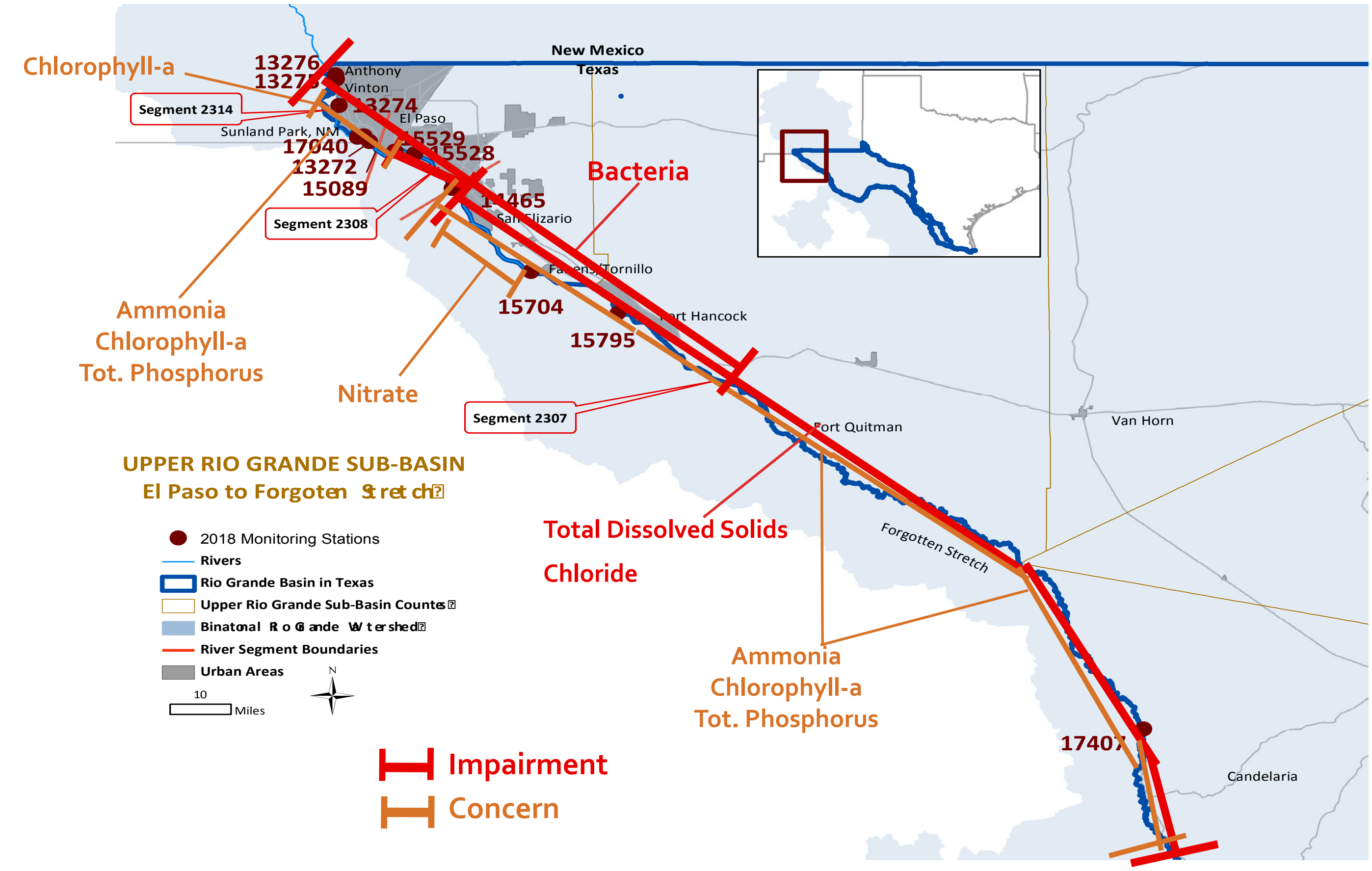
UPPER RIO GRANDE WATER QUALITY UPDATE

Characteristics for the upper sub-basin and its associated segments are listed below, and includes monitoring stations and their associated water quality information. For questions about water quality in the Rio Grande Basin presented in this report, or for information on historical or currently inactive stations, please contact USIBWC CRP staff (contact information located in back cover).

Table 6. Statistical Analysis of Water Quality Data for the Upper Rio Grande Sub-Basin This table describes analytical means for parameters with established water quality standards, as well as parameters for which there are screening levels (most often nutrients). Tables for the individual stations with additional statistical analysis are available in Appendix A. Values in cells represent means or geomeans (bacteria). The blue highlight indicates a statistically significant decreasing trend (p ≤ 0.1), while the yellow indicates a significantly increasing trend (p ≤ 0.1). Red text indicates the mean of the parameter over the period of record is above the Texas State Water Quality Standard, with the exception of dissolved oxygen, where falling below 5 mg/L would indicate impairment. An asterisk (*) indicates that the station had a sample size (n) for that parameter that is less than the samples size required for trend analysis (n ≥ 10).

Station	pH	Dissolved Oxygen (mg/L)	Ammonia (mg/L)	Chlorophyll-a (ug/L)	Total Phosphorus (mg/L)	Bacteria (MPN/100ml)	Sulfate (mg/L)	Chloride (mg/L)	Nitrate + Nitrite (mg/L)	TDS (mg/L)
Segment 2314 | Rio Grande Above International Dam										
13276	8.3	8.0	0.24	19.23	0.28	74	164.45	100.19	1.37	599.37
13275	8.4	8.0	0.37	15.71	0.24	90	138.82	103.72	2.16	556.31
13274	8.4*	8.5	0.17*	14.71*	0.31*	444*	156.71*	108.83*	2.15*	616.29*
17040	8.1	8.4	2.71	17.50	1.07	290	210.67	191	4.78	819.68
13272	8.0	9.2	0.50	17.16	0.65	339	475.91	368.04	1.07	.
15089	8.0	9.0	0.49	14.67	0.77	414	360.53	324.49	9.95	1222.87
Standards and Screening Levels	6.5-9	5	0.33	14.1	0.69	126	600	340	1.95	1800
Segment 2308 | Rio Grande Below International Dam										
15529	8.4	8.9	.	27.67	.	1439	.	.	.	.
15528	8.4	8.7	.	32.06	.	1230	.	.	.	.
14465	8.2	9.5	.	13.50	.	82	.	.	.	.
Standards and Screening Levels	6.5-9	3	0.33	14.1	0.69	605	450	250	1.95	1400
Segment 2307 | Rio Grande Below Riverside Diversion Dam										
16272	8.0	7.7	0.88	18.04	1.13	203	274.67	255.22	2.91	995.45
15704	8.1	8.8	0.74	22.93	1.01	366	289.49	259.97	3.46	1063.49
15795	8.1	9.2	1.96	36.52	1.02	720	365.64	325.20	1.54	1428.48
13232	7.9	8.8	2.54	57.38	1.18	203	561.93	660.40	1.58	5353.13
20648	7.9*	10.7*	0.80*	37.5*	0.58*	8*	539.75*	652.64*	1.30*	2000.50*
17407	7.8*	6.1*	4.92*	24*	0.21*	180*	480.25*	591.03*	1.46*	1261.67*
13230	8.1	8.2	0.18	46.47	0.40	93	599.67	451.47	1.01	1847.42
Standards and Screening Levels	6.5-9	5	0.33	14.1	0.69	126	550	300	1.95	1500
Segment 2306 | Rio Grande Above Amistad Reservoir										
17001	7.9	8.0	.	.	.	97	.	.	.	.
17000	7.9	8.2	.	.	.	112	.	.	.	.
13229	8.0	8.8	0.18	42.43	0.31	65	719.44	313.63	0.57	1772.14
16862	8.1	7.8	0.27	36.15	0.14	9	771.51	348.16	0.65	1761.50
18441	8.2	8.1	0.21	36.92	0.14	14	734.57	324.15	0.61	1622.36
13228	8.0	9.2	0.22	25.41	0.36	29	698.43	314.87	0.65	1700
16730	7.8	8.0	0.28	19.38	0.38	21	548.91	235.63	0.97	1344.46
13225	8.1	8.0	0.05	9.61	0.80	35	432.23	136.90	0.35	1248*
20623	8.0*	7.9*	.	.	.	.	.	.	.	.
20625	8.0*	7.7*	.	.	.	.	.	.	.	.
20631	8.2*	8.4*	.	.	.	.	.	.	.	.
13223	8.1	8.1	0.06	11.64	2.31	56	291.60	83.11	0.90	782.5*
Standards and Screening Levels	6.5-9	5	0.33	14.1	0.69	126	450	200	1.95	1400
Segment 2306A | Alamito Creek										
13108	8.0*	8.1*	.	.	0.46*	.	587.43*	271.67*	.	1571.14*
Standards and Screening Levels	6.5-9	5	0.33	na	0.69	126	450	200	1.95	1400
Segment 2305| International Amistad Reservoir										
13240	8.1*	9.0*	0.05*	3*	0.01*	5*	418.63*	746.88*	0.92*	1993.75*
16379	8.2	8.6	0.07	11.40	0.06	5	340.45	465.45	0.51	1198.40
15892	8.2	7.9	0.05	4.01	0.04	2	230.56	127.69	0.39	618.46
15893	8.2	8.6	0.05	5.25	0.05	2	120.70	69.98	0.44	469
13835	8.2	8.3	0.05	2.54	0.03	2	211	117.44	0.25	588.64
Standards and Screening Levels	6.5-9	5	0.11	26.7	0.2	126	270	150	0.37	800
Segment 2309 | Devils River										
13239	7.8	8.8	0.05	2.06	0.04	15	9.14	15.43	1.22	263.50
14942	7.9	8.3	0.05	2.16	0.04	19	7.89	14.96	1.54	276.55
13237	8.2	9.4	0.05	1.79	0.04	5	8.46	14.42	1.01	235.18
Standards and Screening Levels	6.5-9	5	0.33	14.1	0.69	126	50	50	1.95	300

Figures . Water Quality Impairments and Concerns in the Upper Rio Grande Sub-Basin



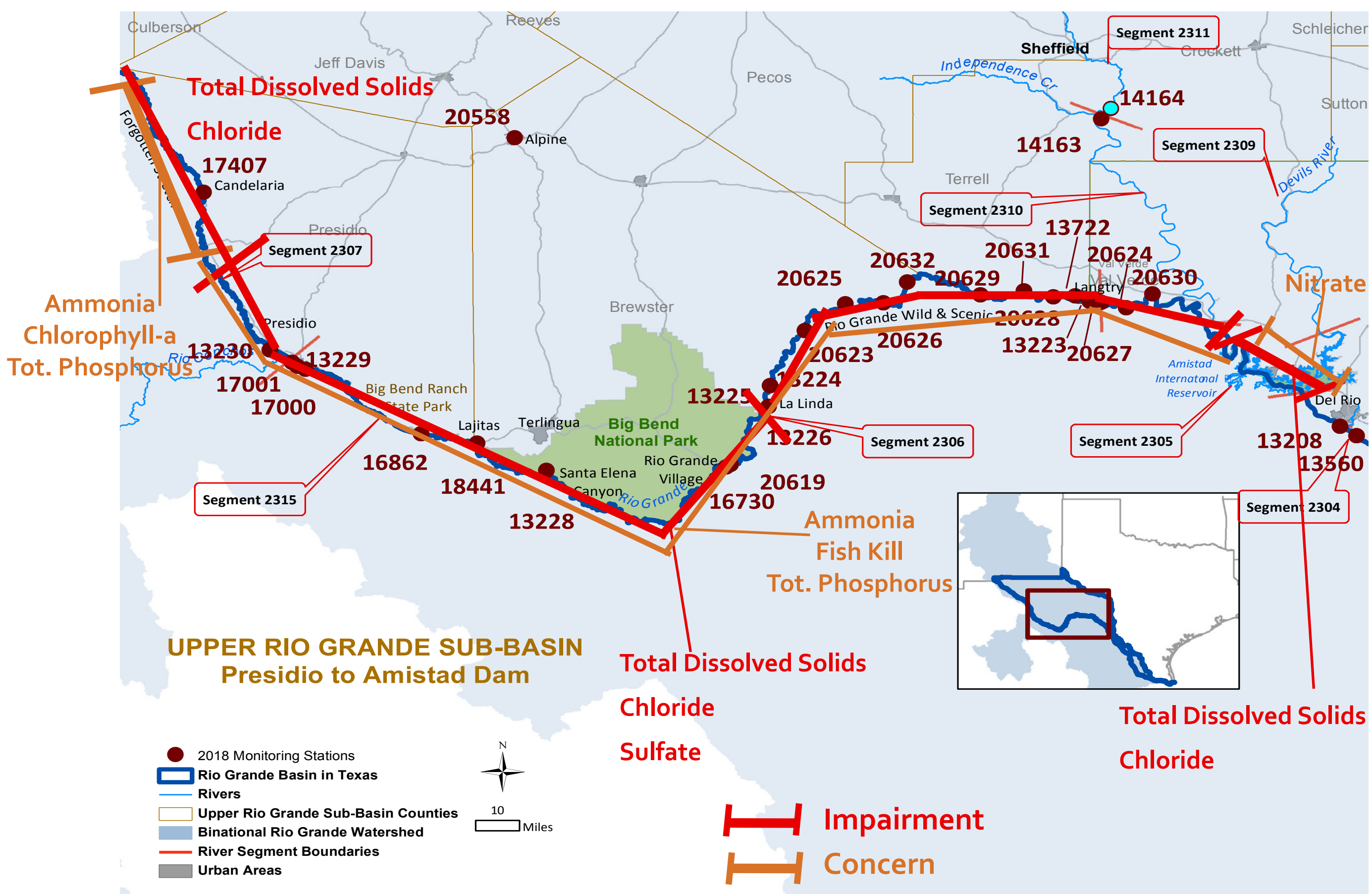


Table 7. Water Quality Review for the Upper Rio Grande Sub-Basin

Water Quality Review for the Upper Rio Grande Sub-Basin					
Segment	*Uses	Stations		Segment Characteristics	Water Quality Summary
Internation-al Amistad Reservoir - Segment 2305	PCR, H, PS	13835, 15892, 15893	75 mi	Defined from Amistad Dam in Val Verde County to a point 1.8 km downstream of the confluence if Ramsey Canyon on the Rio Grande Arm in Val Verde County and to point 0.7 km downstream of the confluence of Painted Canyon on the Pecos Arm	This segment encompasses the international reservoir. It is impaired for chloride and total dissolved solids, and has a concern for nitrate. The reservoir is a popular spot for recreation, including swiming, fishing, and boating. Designated for high aquatic life use, contact recreation, general uses and public water supply.
Rio Grande Above Amistad Reservoir-Segment 2306 and 2306A-Alamito Creek	PCR, H, PS	13223, 13225, 13228, 13229, 16730, 16862, 17000, 17001, 18441, 20623, 20625, 20631	313 mi	Defined as the Rio Grande beginning just downstream of the confluence with the Rio Conchos (in Presidio County) and ending at a point 1.1 miles downstream of the confluence of Ramsey Canyon in Val Verde County and upstream of Internation-al Amistad Reservoir.	This area encompasses the state and national parks.The designated uses for this segment are high aquatic life use, contact recreation, general uses, fish consumption, and public water supply use. This segment is impaired for total dissolved solids, sulfate and chloride, and has concerns for chlorophyll-a, total phosphorus and fish kills. The parks are popular areas for contact recreation, and this segment also encompasses the Wild and Scenic area of the river.
Rio Grande Below Riverside Diversion Dam- Seg-ment 2307	PCR, H, PS	13230, 13232, 15795, 15704, 16272, 17407, 20648	222 mi	Extends from below River-side Diversion Dam in El Paso County downstream to the confluence with the Rio Con-chos (MX) in Presidio County.	This area is designated for contact recreation, public water supply, high aquatic life use, and fish consumption. General use and contact PCR are not fully supported due to this segment being impaired for bacteria, chloride and total dissolved solids. There are also concerns for chlorophyll-a, ammonia, nitrate and total phosphorus.
Rio Grande Below In-ternational Dam- Seg-ment 2308	NCR, L	15528, 15529, 14465	15 mi	Defined as the river in El Paso County from the Riverside Diversion Dam to the Inter-national Dam.	This is the channelized portion of the Rio Grande (12 mi). This section rarely carries water. This is the only non-contact recreation designated segment in the basin. This segment is currently impaired for bacteria, although the only water that runs through here is wastewater effluent, storm flows and possible seepage past the diversion dam.
Devils River-Segment 2309, and 2309A-Dolan Creek	PCR, E, PS	13237, 13239, 14942	67 mi	Defined from a point 0.4 miles downstream of the confluence of Little Satan Creek in Val Verde County to the confluence of Dry Devils River in Sutton County.	Drains into the Amistad International Reservoir. Mostly undisturbed and is characterized by excellent water qual-ity and low salinity content (about half of that of the Rio Grande). Designated uses include exceptional aquatic life use, PCR, public water supply, fish consumption, and general uses. There are no impairments or concerns in this segment.
Rio Grande Above In-ternational Dam- Seg-ment 2314	PCR, H, PS	13272, 13274, 13275, 13276, 15089, 17040	21 mi	Defined as the Rio Grande from the New Mexico-Texas state line downstream to the International Dam in El paso County.	Water levels depend on water rights holders, and the flows are contractually delivered during irrgation season, which typically begins in March. Designated uses include high aquatic life, public water supply, fish consumption, and PCR. This segment is impaired for bacteria and has a concern for chlorophyll-a.

*For an explanation of the uses, please refer to Table 3, Designated Uses for Freshwater on page 23.

Segment 2305, International Amistad Reservoir

Segment 2305 is defined as from Amistad Dam in Val Verde County to a point 1.8 km (1.1 miles) downstream of the confluence of Ramsey Canyon on the Rio Grande Arm in Val Verde County and to a point 0.7 km (0.4 miles) downstream of the confluence of Painted Canyon on the Pecos Arm. In the 2014 Integrated Report, Segment 2305 is impaired for chloride and total dissolved solids. The segment also has a water quality concern for nitrate. In more recent years, it has been suggested that the highly saline waters from the Pecos River may be contributing to the TDS impairment in the reservoir. There are three stations (20624, 20627, 20630) that are monitored once a year that did not meet the minimum number of sampling events required for analysis and are not included. If you wish to see this data, please contact USIBWC CRP staff.

Segment 2305 has four Assessment Units (AUs):

2305_01 Rio Grande Arm

2305_02 Devils River Arm

2305_03 Area around International Boundary Buoy 1 (dam)

2305_04 Remainder of reservoir

There are four active stations within this segment:

13240, Pecos River at Gaging Station 7.4 mi east of Langtry 15.0 mi upstream from confluence with Rio Grande CAMS 0799.

16379, Pecos River 0.7 mi downstream from US 90 W in Val Verde County

15892, Amistad Reservoir Rio Grande Arm at Buoy 28

15893, Amistad Reservoir Devils River Arm at Buoy Drp

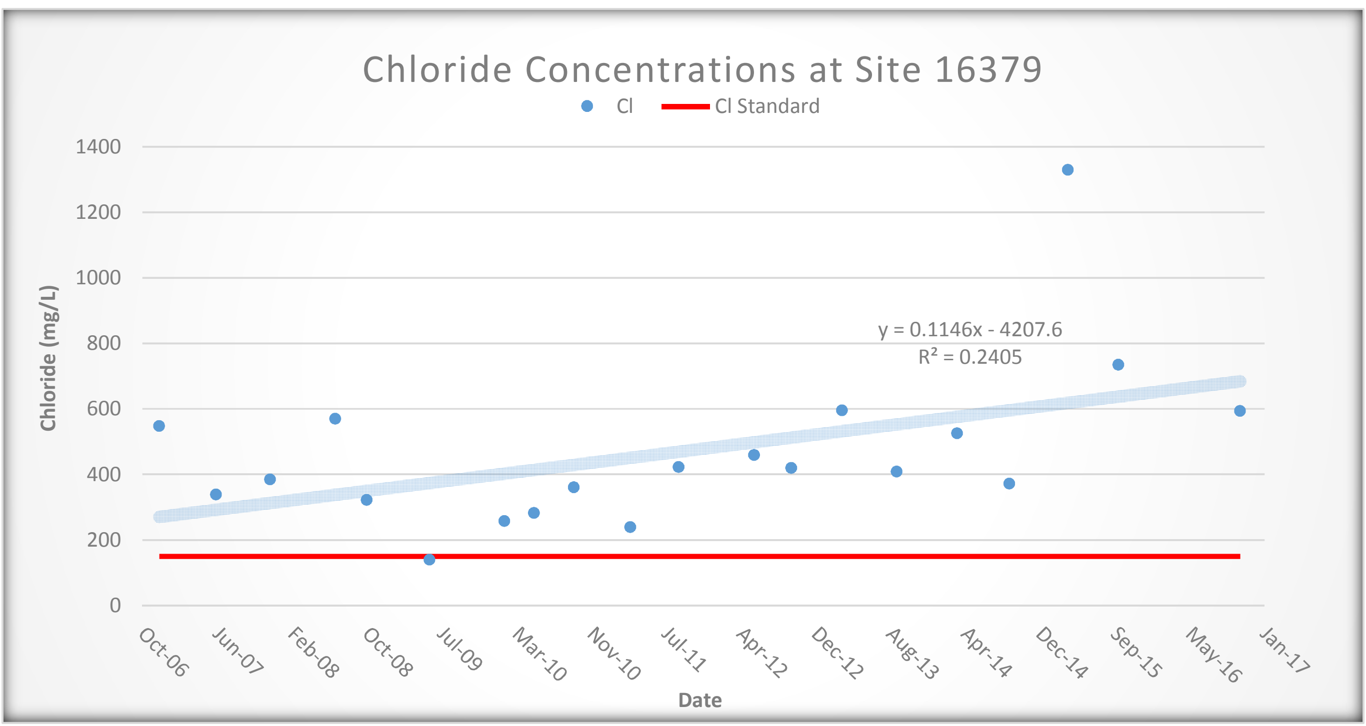
Pictured: Middle of Amistad Dam. Photo Credit USIBWC CRP staff.

Assessment Unit 2305_01 is impaired for chloride and total dissolved solids. This AU is monitored by Stations 13240, 16379, and 15892.

At Station 13240 (Pecos River at Langtry), the sample event size was too small to provide statistically reliable results, and reported data are for informational purposes only. Five *E.coli* bacteria samples resulted in a geomean of 5 MPN (most probable number) per 100 mls of water. The water quality data indicates that dissolved oxygen levels had an mean of 9.0 mg/L, and the mean for pH at this station during the period of record is 8.1. The mean for total dissolved solids is 1993.75 mg/L, which is above the standard of 800 mg/L. Ammonia data for this station shows a mean of 0.05 mg/L.The mean for total phosphorus is 0.01 mg/L. The mean for chlorophyll-a is 3 ug/l. The mean for sulfate is 418.63 mg/L, which is above the standard. This station does show a mean of 746.88 mg/L for chloride, which is above the water quality standard. The mean for nitrate+nitrite is 0.92 mg/L.

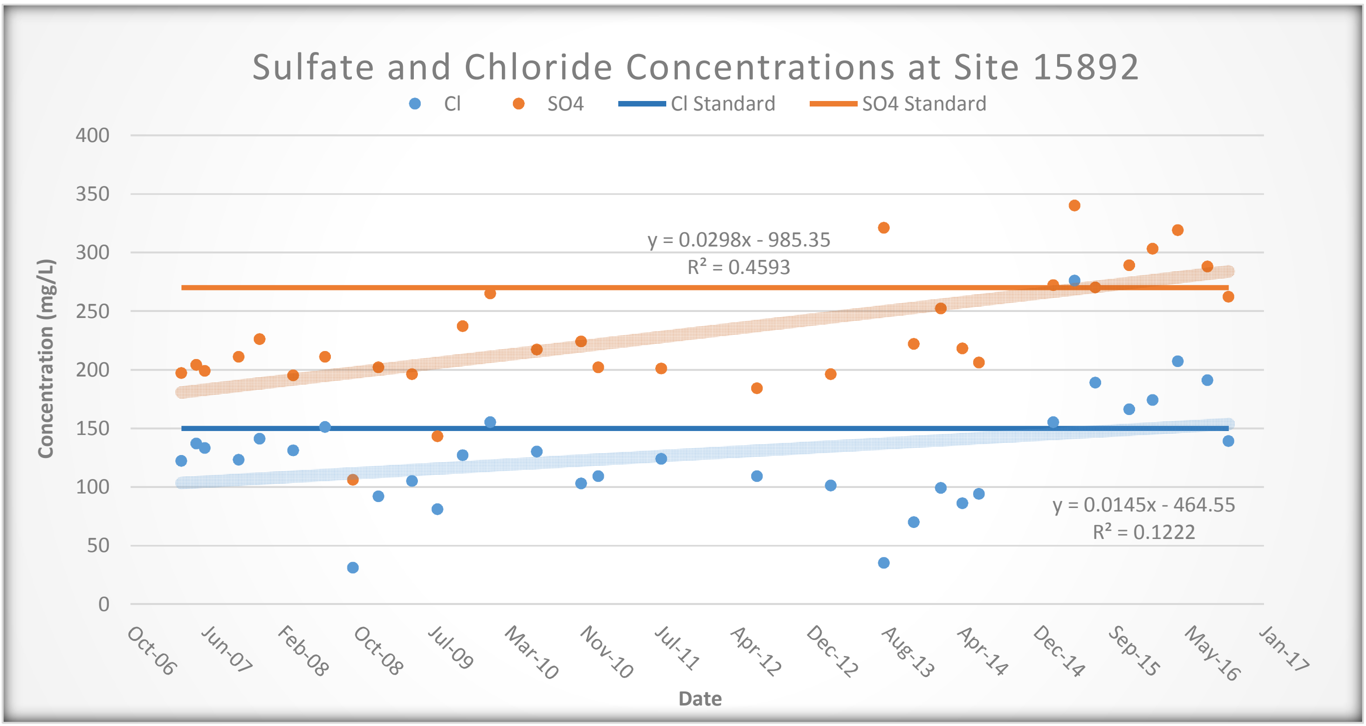
At Station 16379 (Pecos River Below US90 W Bridge), 21 *E.coli* bacteria samples that were analyzed had a geomean of 5 MPN (most probable number). Currently the site shows no statistically relevant trend for bacteria counts. The water quality data indicated that dissolved oxygen levels had an mean of 8.6 mg/L, and the mean for pH at this station during the period of record is 8.2; neither parameter shows a significant trend. The mean for total dissolved solids is 1198.40 mg/L and shows no distinct trend, but is above the water quality standard of 800 mg/L. Ammonia data for this station shows a mean of 0.07 mg/L and shows neither an increasing or decreasing trend. The mean for total phosphorus is 0.06 mg/L, and shows no significant trend. The mean for chlorophyll-a is 11.40 ug/l, and also shows no significant trend. This station does show an increasing trend for chloride, with a mean of 465.45 mg/L, which is above the standard of 150 mg/L. The mean for sulfate is 340.45 mg/L, which is also above the water quality standard of 270 mg/L. The mean for nitrate+nitrite is 0.51 mg/L and shows no significant trend.

Figure 16.



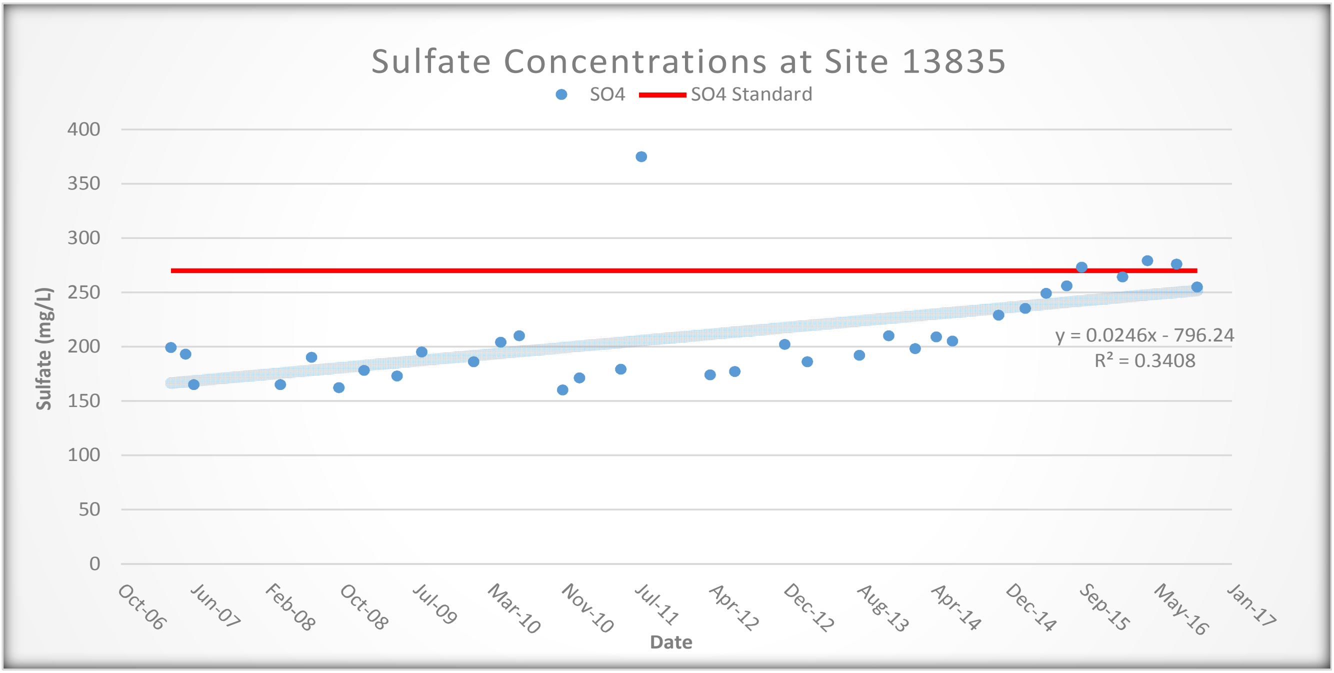
At Station 15892 (Amistad reservoir at Buoy 28), 29 *E.coli* bacteria samples had a geomean of 2 MPN (most probable number). Currently the site shows no statistically relevant trend for bacteria. The water quality data indicated that dissolved oxygen levels had an mean of 7.9 mg/L, and the mean for pH at this station during the period of record is 8.2; neither parameter shows a significant trend. The mean for total dissolved solids is 618.46 mg/L and shows no distinct trend. Ammonia data for this station shows a mean of 0.05 mg/L and shows neither an increasing or decreasing trend. The mean for total phosphorus is 0.04 mg/L, and shows no significant trend. The mean for chlorophyll-a is 4.01 ug/l, and also shows no significant trend. This station does show an increasing trend for sulfates, with a mean of 230.56 mg/L, and chloride, with a mean of 127.69 mg/L. The mean for nitrate+nitrite is 0.39 mg/L and shows no significant trend.

Figure 17.



At Station 13835 (Amistad Reservoir at Buoy 1), 31 *E.coli* bacteria samples had a geomean of 2 MPN (most probable number). Currently the site shows no statistically relevant trend for bacteria. The water quality data indicated that dissolved oxygen levels had an mean of 8.3 mg/L, and shows no significant trend. The mean for pH at this station during the period of record is 8.2, and shows an increasing trend. The mean for total dissolved solids is 588.64 mg/L and shows no distinct trend. Ammonia data for this station shows a mean of 0.05 mg/L and shows neither an increasing or decreasing trend. The mean for total phosphorus is 0.03 mg/L, and shows no significant trend. The mean for chlorophyll-a is 2.54 ug/l, and also shows no significant trend. This station does show an increasing trend for sulfates, with a mean of 211 mg/L. Chloride, with a mean of 117.44 mg/L, shows no significant trend. The mean for nitrate+nitrite is 0.25 mg/L and shows no significant trend. Please see the graph for this station on the next page.

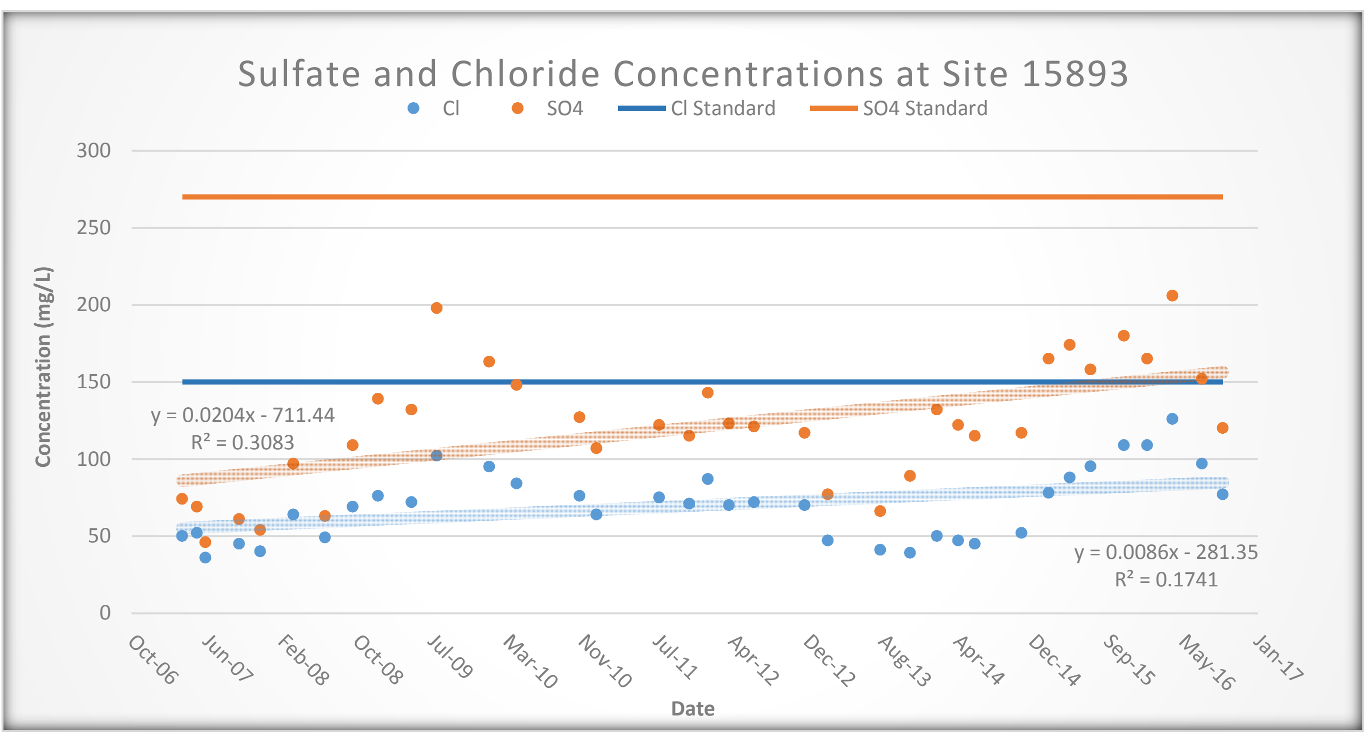
Figure 18.



Assessment Unit 2305_02 is impaired for chloride and total dissolved solids, and has a concern for nitrate. This AU is monitored by Station 15893.

At Station 15893 (Amistad Reservoir Devils River Arm at Buoy Drp), 32 *E.coli* bacteria samples had a geomean of 2 MPN (most probable number). Currently the site shows no statistically relevant trend for bacteria. The water quality data indicated that dissolved oxygen levels had an mean of 8.6 mg/L, and the mean for pH at this station during the period of record is 8.2; neither parameter shows a significant trend. The mean for total dissolved solids is 469 mg/L and shows an increasing trend. Ammonia data for this station shows a mean of 0.05 mg/L and shows no significant trend. The mean for total phosphorus is 0.05 mg/L, and shows no significant trend. The mean for chlorophyll-a is 5.25 ug/l, and also shows no significant trend. This station does show an increasing trend for sulfates, with a mean of 120.70 mg/L, and chloride, with a mean of 69.98 mg/L. The mean for nitrate+nitrite is 0.44 mg/L and shows no significant trend.

Figure 19.



Segment 2306, Rio Grande Above Amistad Reservoir and Segment 2306A, Alamito Creek

Segment 2306 is defined as from a point 1.8 km (1.1 miles) downstream of the confluence of Ramsay Canyon in Val Verde County to the confluence of the Rio Conchos (Mexico) in Presidio County. Segment 2306A is defined as from the Rio Grande confluence upstream to the confluence of the north and south forks of Alamito Creek north of Marfa in Presidio County. This segment encompasses Big Bend Ranch State Park and Big Bend national Park, as well as the Wild and Scenic area of the Rio Grande. In the 2014 Integrated Report, Segment 2306 is impaired for chloride, sulfate, and total dissolved solids. The segment also has a water quality concerns for chlorophyll-a, total phosphorus, and fish kill reports. There are 10 stations that are monitored once a year that did not meet the minimum number of sampling events required for analysis and are not included. If you wish to see this data, please contact USIBWC CRP staff.

Segment 2306 has eight Assessment Unitss, and Segment 2306A has one:

2306_01 From the lower segment boundary at Ramsay Canyon upstream to the confluence of Panther Gulch

2306_02 From the confluence of Panther Gulch upstream to FM 2627

2306_03 From FM 2627 upstream to Boquillas Canyon

2306_04 From Boquillas Canyon upstream to Mariscal Canyon

2306_05 From Mariscal Canyon to a point upstream of the IBWC gage at Johnson Ranch

2306_06 From a point upstream of the IBWC gage at Johnson Ranch to the mouth of Santa Elena Canyon at the Terlingua Creek confluence

2306_07 From the mouth of Santa Elena Canyon at Terlingua Creek confluence upstream to the Alamito Creek confluence

2306_08 From Alamito Creek confluence upstream to the Rio Conchos confluence

Segment 2306A, Alamito Creek

2306A_01 From the Confluence with the Rio Grande upstream to Ranch Road 169 Crossing

There are 12 active stations within this segment:

13223, Rio Grande 1.895 km south and 552 m west from the intersection of Unnamed Street and Foster Ranch Road and 10.1021 km south and 4.37 km west from the intersection of US Hwy 90 and Fosters Ranch Road in Val Verde County CAMS 759

13225, Rio Grande at FM 2627/Gerstacker Bridge downstream Big Bend

20631, Rio Grande at the confluence with Indian Creek in Terrell County

20623, Rio Grande at Taylors Farm southwest of Sanderson

20625, Rio Grande 50 m upstream of Silber Canyon south of Sanderson in Brewster County

16730, Rio Grande at Boat Ramp at Rio Grande Village in Big Bend National Park

13228, Rio Grande at Santa Elena Canyon

16862, Rio Grande at Colorado Canyon approx 30 km SE of Redford on RR170 in Presidio County

18441, Rio Grande at Lajitas Resort/FM 170 Boat Ramp 240 m upstream of Black Hills Creek confluence near Lajitas

13229, Rio Grande 449 m west and 121 m south from the intersection of Ranch Road 170 and Ranch Road 169 in Presidio County CAMS 758

17000, Rio Grande at Presidio Railroad Bridge 3.25 km downstream of US67 south of Presidio

17001, Rio Grande at Presidio/Ojinaga Toll Bridge/International 0.75 km dwnstm of US67 in Presidio

13108, Alamito Creek near FM 170 2.62 km upstream of Terneros Creek confluence and approx 6 mi southeast of Presidio

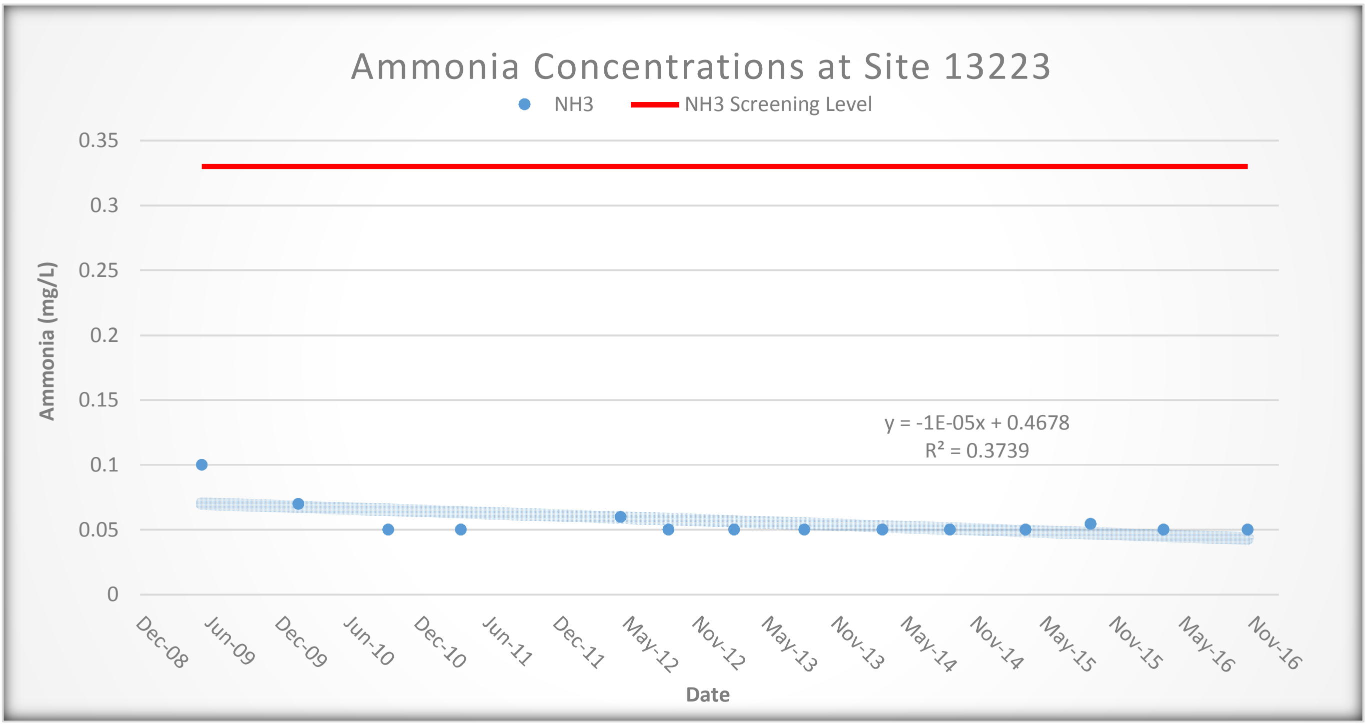
Top Picture: Alamito Creek. Photo Credit USIBWC CRP staff.

Bottom Picture: BBNP, looking downstream into entrance of Masiscal Canyon. Photo Credit USIBWC CRP staff.

Assessment Unit 2306_01 is impaired for chloride, sulfate, and total dissolved solids, and has a concern for total phosphorus. This AU is monitored by Stations 13223 and 20631.

For Station 13223 (Rio Grande at Foster Ranch), 15 *E.coli* bacteria samples had a geomean of 56 MPN (most probable number). Currently the site shows no statistically relevant trend for bacteria. The water quality data indicated that dissolved oxygen levels had an mean of 8.1 mg/L, and the mean for pH at this station during the period of record is 8.1; they show no significant trend. The mean for total dissolved solids is 782.5 mg/L. Ammonia data for this station shows a mean of 0.06 mg/L and shows a decreasing trend. The mean for total phosphorus is 2.31 mg/L, and shows no significant trend.The mean for chlorophyll-a is 11.64 ug/l, and shows neither an increasing nor decreasing trend. The mean for sulfate is 291.60 mg/L, and shows neither an increasing nor decreasing trend. The mean for chloride is 83.11 mg/L, and also shows no significant trend. The mean for nitrate+nitrite is 0.90 mg/L, with no significant statistical trend.

Figure 20.



Station 20631 (Rio Grande at the confluence with Indian Creek) only had three data points, and is one of the stations in the lower canyons that are sampled once a year for field data. This data does not meet the criteria required for number of sampling events during the period of record and was not analyzed for statistical significance. Additional information, or requests for data, for this station can be found on the USIBWC CRP webpage, or you may contact USIBWC CRP staff.

Assessment Unit 2306_02 is impaired for chloride, sulfate, and total dissolved solids, and has no water quality concerns. This AU is monitored by Stations 20623 and 20625.

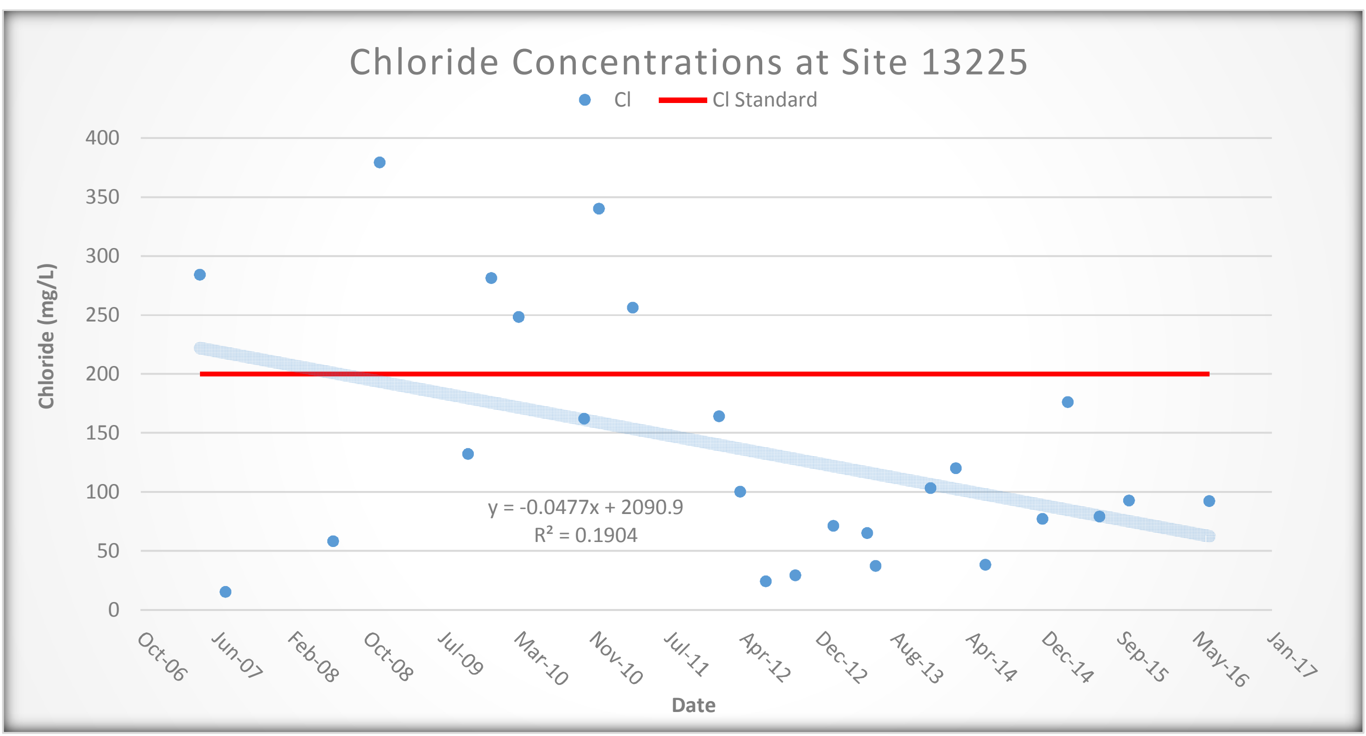
Station 20623 (Rio Grande at Taylor Farm) only had three data points, and is one of the stations in the lower canyons that are sampled once a year for field data. This data does not meet the criteria required for number of sampling events during the period of record and was not analyzed for statistical significance. Additional information, or requests for data, for this station can be found on the USIBWC CRP webpage, or you may contact USIBWC CRP staff.

Station 20625 (Rio Grande at Silber Canyon) only had three data points, and is one of the stations in the lower canyons that are sampled once a year for field data. This data does not meet the criteria required for number of sampling events during the period of record and was not analyzed for statistical significance. Additional information, or requests for data, for this station can be found on the USIBWC CRP webpage, or you may contact USIBWC CRP staff.

Assessment Unit 2306_03 is impaired for chloride, sulfate, and total dissolved solids, and has water quality concerns for chlorophyll-a and fish kills reports. This AU is monitored by Station 13225.

At Station 13225 (Rio Grande Below Big Bend), 18 *E.coli* bacteria samples had a geomean of 35 MPN (most probable number). Currently the site shows no statistically relevant trend for bacteria. The water quality data indicated that dissolved oxygen levels had an mean of 8.0 mg/L, and the mean for pH at this station during the period of record is 8.1; neither showed a significant trend. The mean for total dissolved solids is 1,248 mg/L and shows no distinct trend. Ammonia data for this station shows a mean of 0.05 mg/L and shows no trend. The mean for total phosphorus is 0.80 mg/L, and shows no significant trend.The mean for chlorophyll-a is 9.61 ug/l, and shows neither an increasing nor decreasing trend. This station does show a decreasing trend for chloride, with a mean of 136.90 mg/L. The mean for sulfate is 432.23 mg/L, with no visible trend. Nitrate+nitrite shows a mean of 0.35 mg/L, and shows no significant trend.

Figure 21.



Assessment Unit 2306_04 is impaired for chloride, sulfate, and total dissolved solids, and has water quality concerns for chlorophyll-a and fish kill reports. This AU is monitored by Stations 16730 and 20619; however, 20619 is a lower canyon station that did not meet the minimum number of sampling events required for analysis.

At Station 16730 (Rio Grande at Rio Grande Village), 41 *E.coli* bacteria samples had a geomean of 21 MPN (most probable number). Currently the site shows no statistically relevant trend for bacteria. The water quality data indicated that dissolved oxygen levels had an mean of 8.0 mg/L, and the mean for pH at this station during the period of record is 7.8; neither shows a significant trend. The mean for total dissolved solids is 1344.46 mg/L and shows a decreasing trend. Ammonia data for this station shows a mean of 0.28 mg/L and shows a decreasing trend. The mean for total phosphorus is 0.38 mg/L, and shows no significant trend.The mean for chlorophyll-a is 19.38 ug/l, and shows neither an increasing nor decreasing trend. This station does show a decreasing trend for sulfate, with a mean 548.91 mg/L, and chloride, with a mean of 235.63 mg/L, although both means are above their respective water quality standard. The mean for

Figure 22.

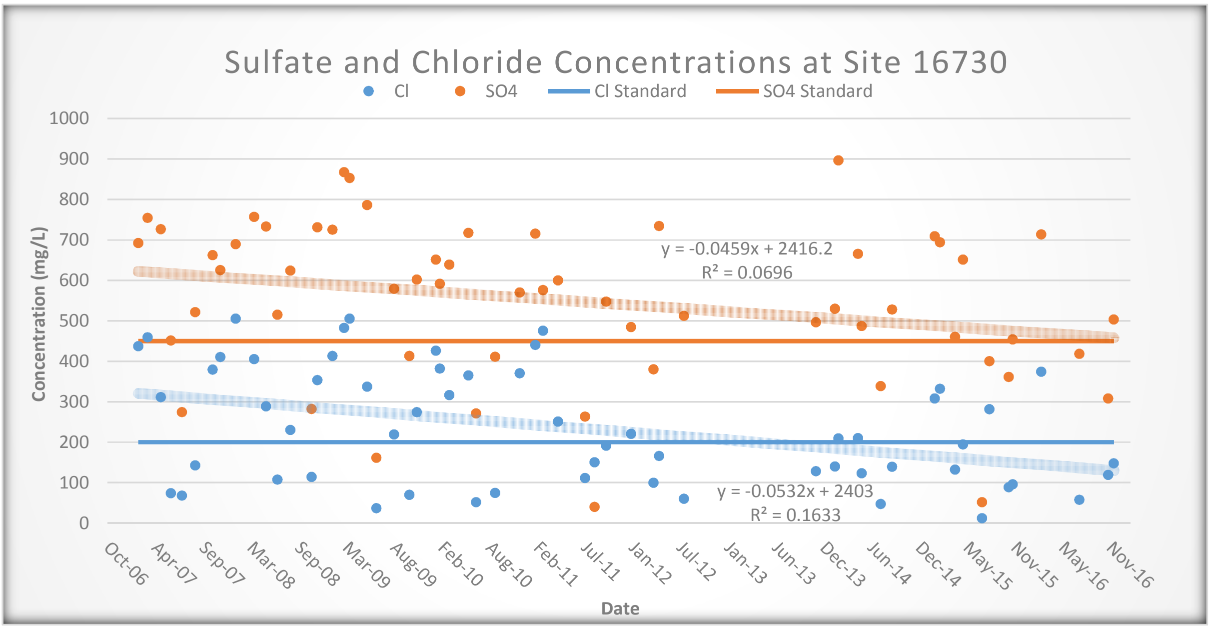
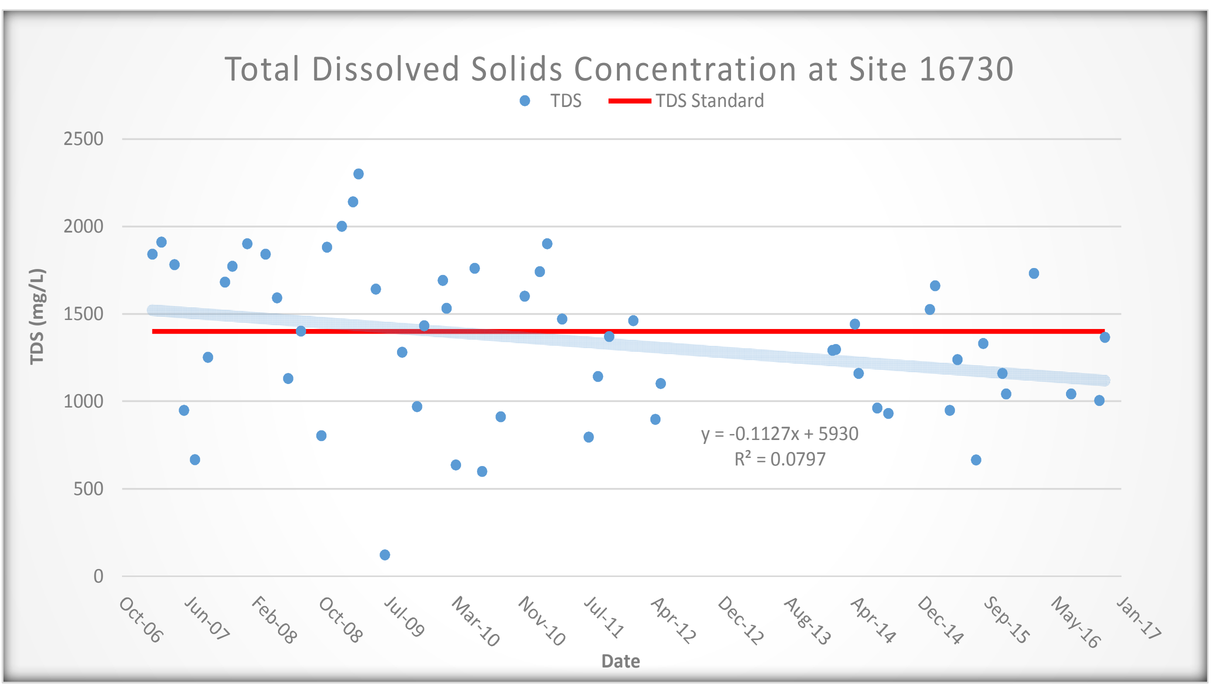


Figure 23.

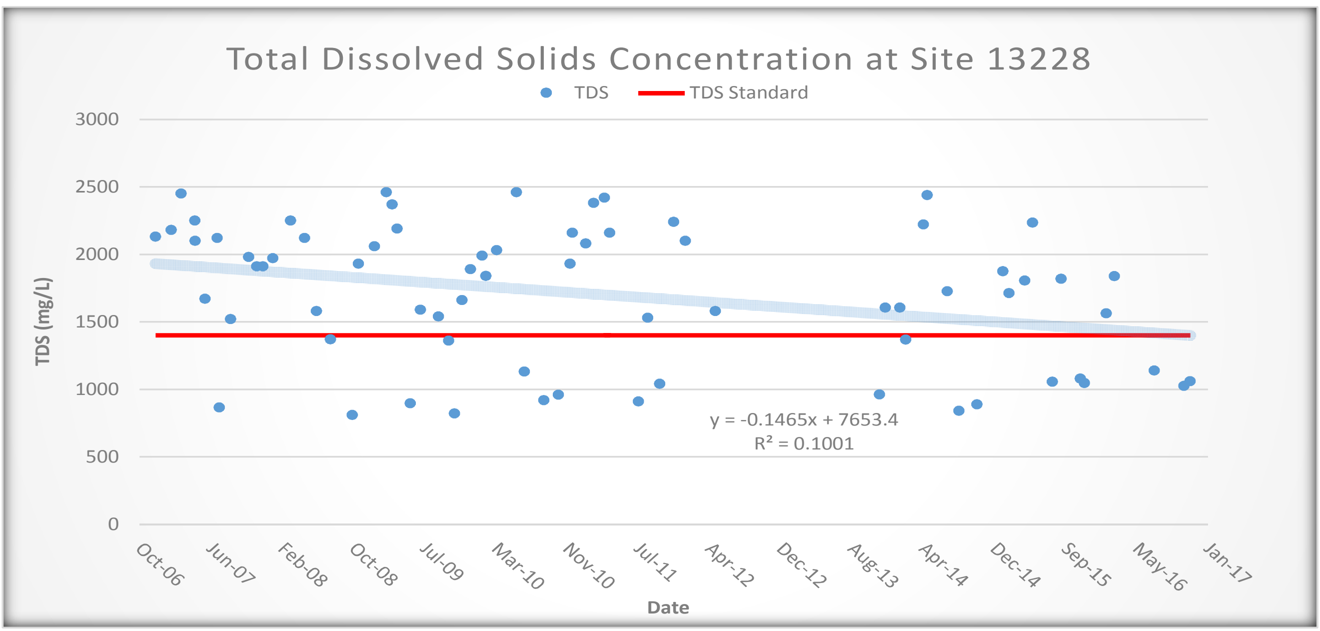


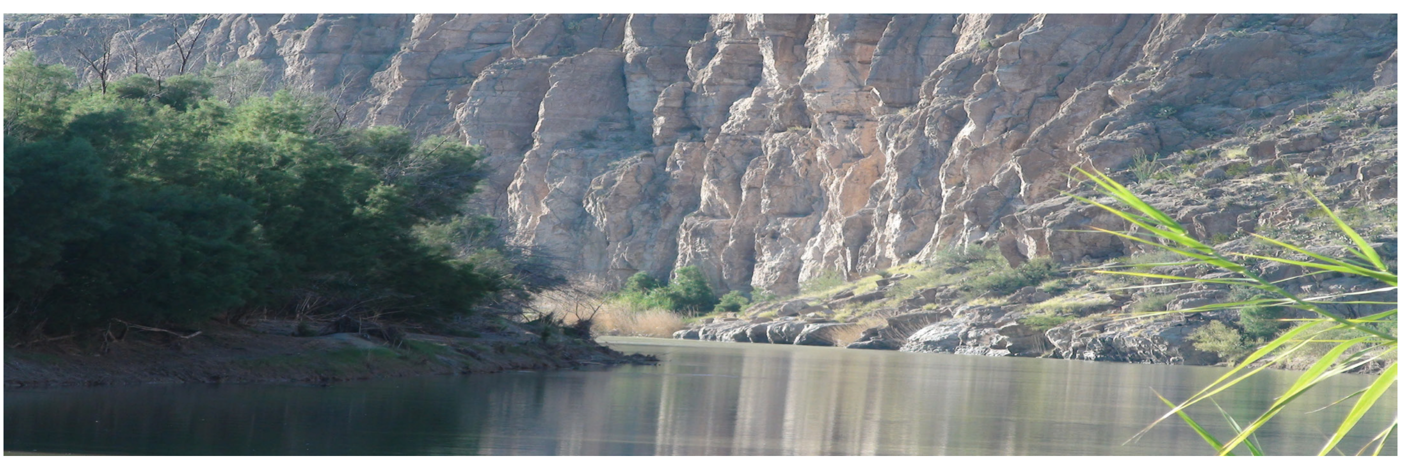
Assessment Unit 2306_05 is impaired for chloride, sulfate, and total dissolved solids, and has water quality concerns for fish kill reports. This AU is currently has no water quality monitoring stations due to the remoteness of the area.

Assessment Unit 2306_06 is impaired for chloride, sulfate, and total dissolved solids, and has water quality concerns for chlorophyll-a and fish kill reports. The water quality concerns may be correlated, since elevated chlorophyll-a levels may lead to algal blooms, and a large algal bloom may cause fish kills. This AU is is monitored by Station 13228.

At Station 13228 (Rio Grande at Santa Elena Canyon), 62 *E.coli* bacteria samples had a geomean of 29 MPN (most probable number). Currently the site shows no statistically relevant trend for bacteria. The water quality data indicated that dissolved oxygen levels had an mean of 9.2 mg/L, and the mean for pH at this station during the period of record is 8.0; neither shows a significant trend. The mean for total dissolved solids is 1700 mg/L, and while is it above the water quality standard of 1400 mg/L, it shows a decreasing trend. Ammonia data for this station shows a mean of 0.22 mg/L and shows no trend. The mean for total phosphorus is 0.36 mg/L, and shows no significant trend. The mean for chlorophyll-a is 25.41 ug/l, and shows a decreasing trend. This is a positive find, since this area has concerns for chlorophyll-a and fish kills. This station does show a deceasing trend for chloride, with a mean of 314.87 mg/L, although the mean is still above the water quality standard of 200 mg/L. The mean for sulfate is 698.43 mg/L and shows no significant trend, but is above the standard of 450 mg/L. The mean for nitrate+nitrite is 0.65 and shows no significant trend. The graph for TDS is below; please see additional graphs for this station in Appendix B.

Figure 24.





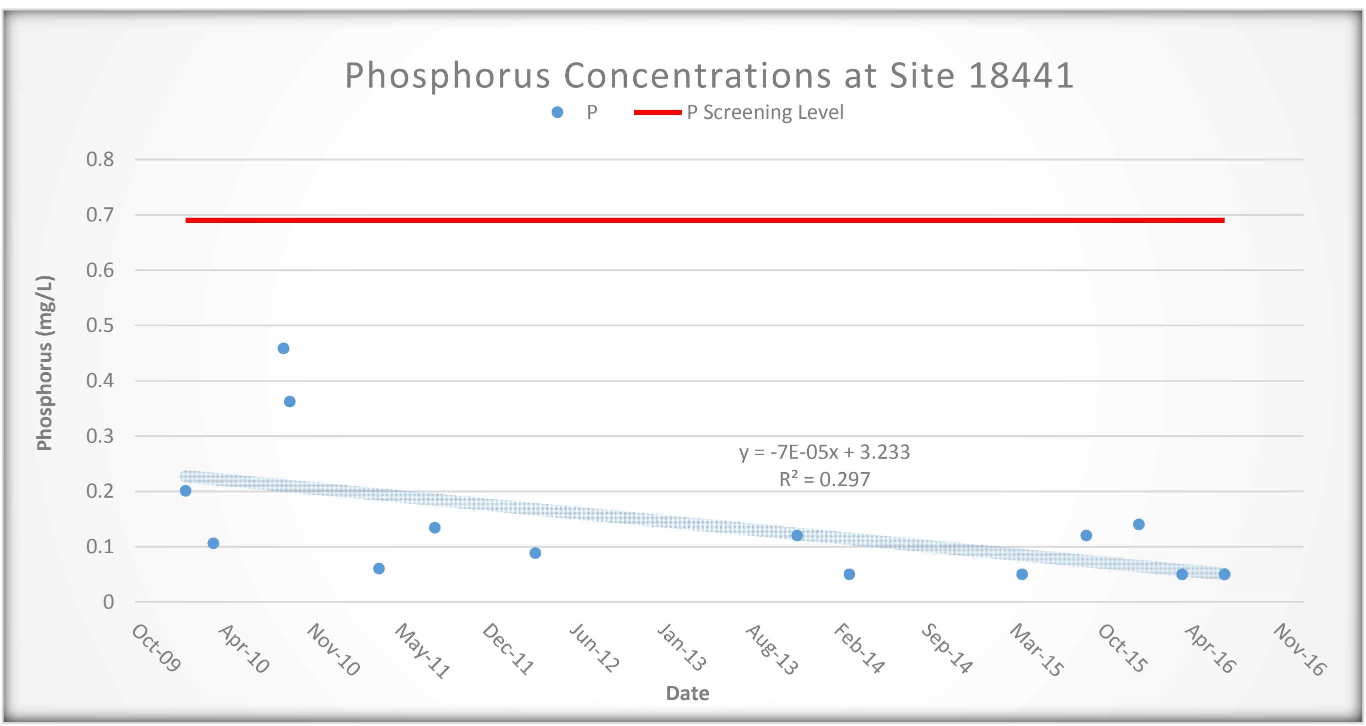
Pictured: Big Bend National Park Station 13228. Photo Credit USIBWC CRP staff.

Assessment Unit 2306_07 is impaired for chloride, sulfate, and total dissolved solids, and has a water quality concern for fish kill reports. This AU is is monitored by Station 16862 and 18441.

At Station 16862 (Rio Grande at Colorado Canyon), 13 *E.coli* bacteria samples had a geomean of 9 MPN (most probable number). Currently the site shows no statistically relevant trend for bacteria. The water quality data indicated that dissolved oxygen levels had an mean of 7.8 mg/L, and the mean for pH at this station during the period of record is 8.1; neither showed a significant trend. The mean for total dissolved solids is 1761.50 mg/L, which is above the water quality standard but shows no significant trend. Ammonia data for this station shows a mean of 0.27 mg/L and shows no significant trend. The mean for total phosphorus is 0.14 mg/L, and shows a decreasing trend. The mean for chlorophyll-a is 36.15 ug/l, and shows no trend. This station does show an inceasing trend for sulfate, with a mean of 771.51 mg/L, which is above the water quality standard. The mean for chloride is 348.16 mg/L, which is also above the standard but shows no significant trend. The mean for nitrate+nitrite is 0.65 mg/L and shows no significant trend. Please see the graph for this station in Appendix B.

At Station 18441 (Rio Grande at Lajitas), 12 *E.coli* bacteria samples had a geomean of 14 MPN (most probable number). Currently the site shows no statistically relevant trend for bacteria. The water quality data indicated that dissolved oxygen levels had an mean of 8.1 mg/L, and the mean for pH at this station during the period of record is 8.2; neither showed a significant trend. The mean for total dissolved solids is 1622.36 mg/L, which is above the water quality standard but shows no significant trend. Ammonia data for this station shows a mean of 0.21 mg/L and no significant trend. The mean for total phosphorus is 0.14 mg/L, and shows a decreasing trend. The mean for chlorophyll-a is 36.92 ug/l, and shows no trend. The mean for sulfate is 734.57 mg/L, which is above the standard of 450 mg/L. The mean for chloride is 348.16 mg/L, which is above the water quality standard of 200 mg/L. Neither sulfate nor chloride show any significant trend. Nitrate+nitrite shows a mean of 0.65 mg/L, and no significant trend. Please see the graph for this station below.

Figure 25.



Pictured: TPWD Station 18441, Rio Grande at Lajitas. Photo credit UISBWC CRP staff.

Assessment Unit 2306_08 is impaired for chloride, sulfate, and total dissolved solids, and has water quality concerns for chlorophyll-a and fish kill reports. This AU is is monitored by Stations 13229, 17000, and 17001.

At Station 13229 (Rio Grande in Presidio County CAMS 758), 94 *E.coli* bacteria samples had a geomean of 65 MPN (most probable number). Currently the site shows no statistically relevant trend for bacteria. The water quality data indicated that dissolved oxygen levels had an mean of 8.8 mg/L, and the mean for pH at this station during the period of record is 8.0; neither shows a significant trend. The mean for total dissolved solids is 1772.14 mg/L, which is above the water quality standard but shows a decreasing trend. Ammonia data for this station shows a mean of 0.18 mg/L and shows no significant trend. The mean for total phosphorus is 0.31 mg/L, and shows no significant trend.The mean for chlorophyll-a is 42.43 ug/l, and shows no trend. This station does show a decreasing trend for chloride, with a mean of 313.63 mg/L, although the mean is still above the standard. The mean for sulfate is 719.44 mg/L, which is above the standard but shows no significant trend. Nitrate+nitrite shows a mean of 0.57 mg/L, which shows a decreasing trend. Please see the graphs for this station in Appendix B.

Pictured: Station 13229 in Presidio, TX. Photo credit USIBWC CRP staff.

At Station 17000 (Rio Grande at Presidio Railroad Bridge), 68 *E.coli* bacteria samples had a geomean of 112 MPN (most probable number). Currently the site shows no statistically relevant trend for bacteria. The water quality data indicated that dissolved oxygen levels had an mean of 8.2 mg/L, and the mean for pH at this station during the period of record is 7.9; neither shows a significant trend. Bacteria, field, and flow are the only parameters reported for this station.

At Station 17001 (Rio Grande at Presidio/Ojinaga International Bridge), 66 *E.coli* bacteria samples had a geomean of 97 MPN (most probable number). Currently the site shows no statistically relevant trend for bacteria. The water quality data indicated that dissolved oxygen levels had an mean of 8.0 mg/L, and the mean for pH at this station during the period of record is 7.9; neither shows a significant trend. Bacteria, field, and flow are the only parameters reported for this station.

Segment 2306A is Alamito Creek, which stretches from its confluence with the Rio Grande upstream to the confluence of North and South Forks of Alamito Creek north of Marfa in Presidio County. It has one Assessment Unit, 2306A_01. It has no current impairments or water quality concerns. It is a perennial freshwater stream, and is monitored by Station 13108.

This station did not have enough data for statistical analysis, and the data is being provided for informational purposes only. At Station 13108, the water quality data indicated that dissolved oxygen levels had an mean of 8.1 mg/L, and the mean for pH at this station during the period of record is 8.0. The mean for total dissolved solids is 1,571.14 mg/L, which is above the water quality standard of 1400 mg/L. The mean for sulfate is 587.43 mg/L, which is above the standard of 450 mg/L. The mean for chloride is 271.67 mg/l, which is above the water quality standard of 200 mg/L. Total phosphorus has a mean of 0.46 mg/L.

Pictured Top: Alamito Creek, dry. Photo Credit USIBWC CRP staff.

Pictured Bottom: BBNP looking upstream toward Solis Vega. Photo Credit USIBWC CRP staff..

Segment 2307, Rio Grande Below Riverside Diversion Dam

Segment 2307 is defined as from the confluence of the Rio Conchos (Mexico) in Presidio County to Riverside Diversion Dam in El Paso County. In the 2014 Integrated Report, Segment 2307 is impaired for bacteria, chloride, and total dissolved solids. The segment also has a water quality concerns for ammonia, chlorophyll-a, nitrate, and total phosphorus. There are four stations that are monitored by the USIBWC CRP program, and three stations that are monitored by the TCEQ.

Segment 2307 has five Assessment Units:

2307_01 From immediately upstream of the Rio Conchos confluence to a point 40.2 km (25 mi) upstream

2307_02 From a point 40.2 km (25 mi) upstream of the Rio Conchos confluence to Little Box Canyon

2307_03 From Litle Box Canyon upstream to the Alamo Grade Control Structure

2307_04 From the Alamo Grade Control Structure upstream to the Guadalupe Bridge

2307_05 From the Guadalupe Bridge to downstream of th Riverside Diversion Dam

There are 7 active stations within this segment:

13230, Rio Grande 3.38 km upstream from the confluence with the Rio Conchos 6.72 km west and 2.445 km north from the intersection of Ranch Road 170 and Rodriguez Road in Presidio County CAMS 757

20648, Rio Grande 1.47 km upstream of the confluence with Green River at Indio Mountains Research Station

13232, Rio Grande at Neely Canyon south of Fort Quitman

15795, Rio Grande at Alamo Control Structure 9.7 km upstream of Ft. Hancock Port of Entry

15704, Rio Grande at Guadalupe Port of Entry Bridge at FM 1109 west of Tornillo

16272, Rio Grande at San Elizario 500 m upstream of Capomo Road end of pavement and 10.2 km downstream of Zaragosa International Bridge

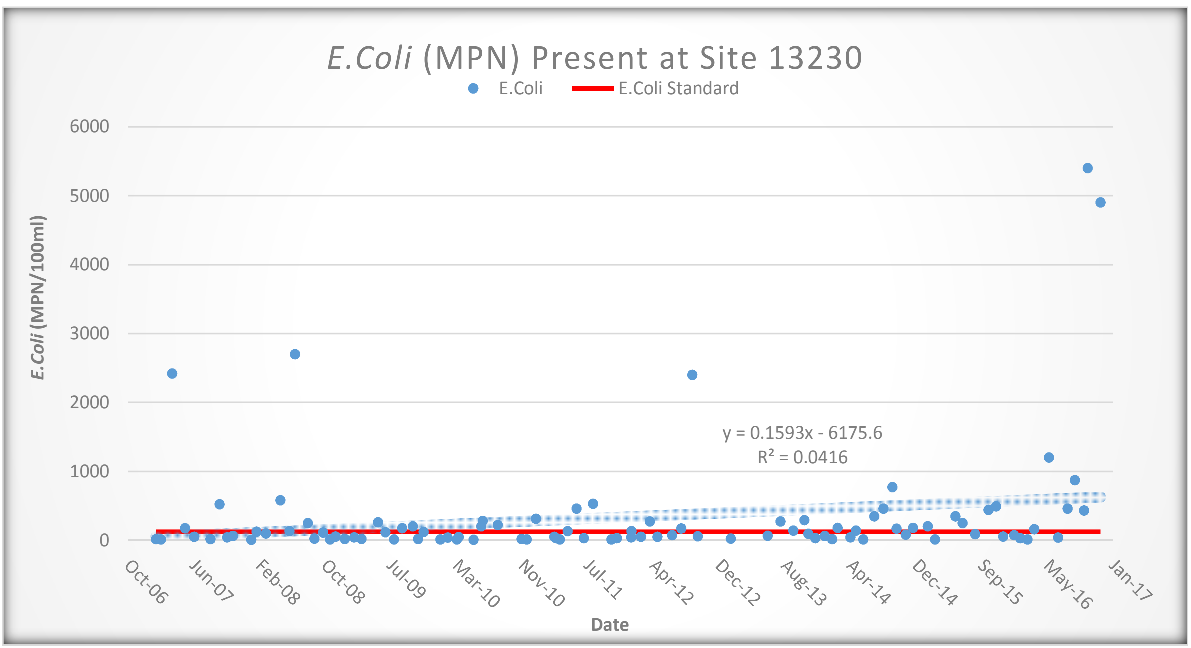
17407, Rio Grande upstream of Candelaria 0.5 km upstreamof Capote Creek confluence

Pictured Top: Rio Grande at San Elizario, Station 16272. Photo Credit USIBWC CRP staff.

Assessment Unit 2307_01 is impaired for chloride and total dissolved solids, and has water quality concerns for chlorophyll-a. This AU is is monitored by Station 13230.

At Station 13230 (Rio Grande near the confluence with the Rio Conchos in Presidio), 97 *E.coli* bacteria samples had a geomean of 93 MPN (most probable number). Currently the site shows a slightly increasing trend for bacteria. The water quality data indicated that dissolved oxygen levels had an mean of 8.2 mg/L, and the mean for pH at this station during the period of record is 8.1; neither showed a significant trend. While the mean for TDS for the period of record is above the water quality standard of 1,500 mg/L for this AU, data analysis indicates a decreasing trend for TDS concentrations in this part of the reach. The mean for chlorophyll-a is 46.47 ug/L and also shows a decreasing trend. The mean for ammonia is 0.18 mg/L, and total phosphorus shows a mean of 0.40 mg/L; neither show significant trends. There is a decreasing trend for chloride, which has a mean of 451.47 mg/L, which is above the standard of 300 mg/L. Nitrate+nitrite, which has a mean of 1.01 mg/L, also shows a decreasing trend. The mean for sulfate is 599.67 mg/L, which is above the water quality standard of 550 mg/L but shows no trends. Please see Appendix B for all other graphs for this station.

Figure 26.



Assessment Unit 2307_02 is impaired for chloride and total dissolved solids, and has water quality concerns for ammonia and total phosphorus. This AU is is monitored by Stations 20648 and 17407. Station 20648 is the only station monitored in the stretch of the Rio Grande nicknamed "the forgotten stretch" due to its remote location and difficult accessibilty.

Station 17407 (Rio Grande upstream of Candelaria) did not have enough events for statistically significant data analysis, so data provided here are for information only. Four *E.coli* bacteria samples had a geomean of 180 MPN (most probable number), which is over the standard. The water quality data indicated that dissolved oxygen levels had an mean of 6.1 mg/L, and the mean for pH at this station during the period of record is 7.8. The mean for total dissolved solids is 1,261.67 mg/L. Ammonia data for this station shows a mean of 4.92 mg/L. The mean for total phosphorus is 0.21 mg/L.The mean for chlorophyll-a is 24 ug/l.The mean for sulfate is 480.25 mg/L. The mean for chloride is 591.03 mg/L, which is above the standard. The mean for nitrate+nitrite is 1.46 mg/L.

Station 20648 (Rio Grande at Indio Mountains Research Station) did not have enough events for statistically significant data analysis, so data provided here are for information only. Four *E.coli* bacteria samples had a geomean of 8 MPN (most probable number). The water quality data indicated that dissolved oxygen levels had an mean of 10.7 mg/L, and the mean for pH at this station during the period of record is 7.9. The mean for total dissolved solids is 2000.5 mg/L, which is above the water quality standard of 1500 mg/L. Ammonia data for this station shows a mean of 0.8 mg/L. The mean for total phosphorus is 0.58 mg/L.The mean for chlorophyll-a is 37.5 ug/l.The mean for sulfate is 539.75 mg/L. The mean for chloride is 652.64 mg/L, which is above the standard of 300 mg/L. The mean for nitrate+nitrite is 1.3 mg/L.

Pictured Top: Rio Grande at Station 20648. Photo Credit USIBWC CRP staff.

Assessment Unit 2307_03 is impaired for bacteria, chloride and total dissolved solids, and has water quality concerns for ammonia, chlorophyll-a, and total phosphorus. This AU is is monitored by Station 13232.

At Station 13232 (Rio Grande at Neely Canyon), 10 *E.coli* bacteria samples had a geomean of 203 MPN (most probable number), which is above the water quality standard of 126 MPN but shows no trend. The water quality data indicated that dissolved oxygen levels had an mean of 8.8 mg/L and shows a decreasing trend. The mean for pH at this station during the period of record is 7.9 and shows no trend. The mean for total dissolved solids is 5,353.13 mg/L, which is above the water quality standard but shows no trend. Ammonia data for this station shows a mean of 2.54 mg/L, with no significant trend. The mean for total phosphorus is 1.18 mg/L, with no significant trend.The mean for chlorophyll-a is 57.38 ug/l and shows a decreasing trend. Sulfate has a mean of 561.93 mg/L, and chloride has a mean of 660.40 mg/L; both are above the water quality standard (550 mg/L for sulfate and 300 mg/L for chloride) and show no trends. The mean for nitrate+nitrite is 1.58 mg/L and shows no significant trend.

Assessment Unit 2307_04 is impaired for bacteria, chloride and total dissolved solids, and has water quality concerns for ammonia, chlorophyll-a, and total phosphorus. This AU is is monitored by Station 15795. Station 15795 was discontinued for a number of years in the middle of the period of record due to safety issues pertaining to the ongoing violence across the border in Ciudad Juarez, Mexico. It was added back into the monitoring schedule in 2015.

Pictured Top: Rio Grande at Station 15795. Photo Credit USIBWC CRP staff.

At Station 15795 (Rio Grande at Alamo Grade Control Structure), 24 *E.coli* bacteria samples had a geomean of 720 MPN (most probable number), which is above the water quality standard but has no trend. The water quality data indicated that dissolved oxygen levels had an mean of 9.2 mg/L, and shows no trend. The mean for pH at this station during the period of record is 8.1 and shows a decreasing trend. The mean for total dissolved solids is 1428.48 mg/L and shows no significant trend. Ammonia data for this station shows a mean of 1.96 mg/L, with no significant trend. The mean for total phosphorus is 1.02 mg/L and shows no significant trend. The mean for chlorophyll-a is 36.52 ug/l and there is no significant trend. The mean for sulfate is 365.64 mg/L, and does not show a significant trend. The mean for chloride is 325.20 mg/L, which is above the standard and does not show a significant trend. The mean for nitrate+nitrite is 1.54 mg/L, and also shows no significant trend.

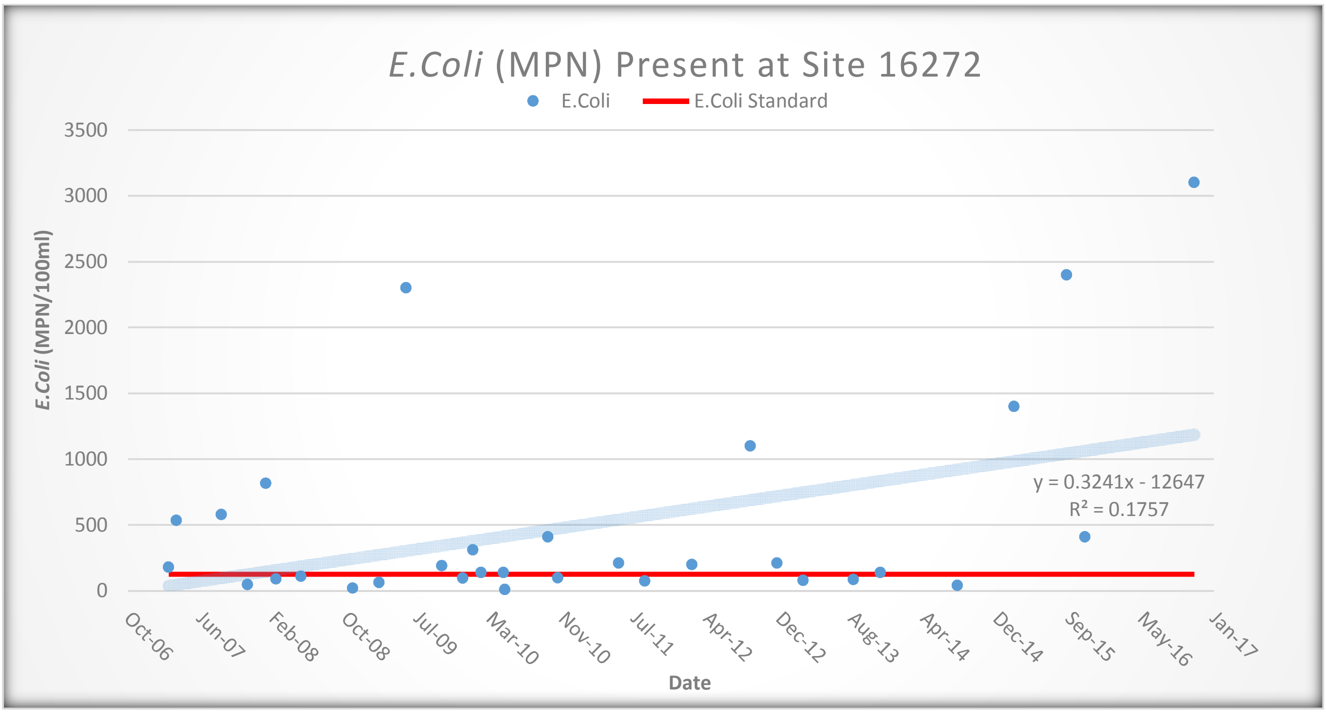
Assessment Unit 2307_05 is impaired for bacteria, chloride and total dissolved solids, and has water quality concerns for ammonia, chlorophyll-a, and total phosphorus. This AU is is monitored by Station 15704 and 16272. Station 16272 was removed from the monitoring scheduled effective 2017 due to hazardous site conditions.

At Station 15704 (Rio Grande at Guadalupe Port of Entry), 31 *E.coli* bacteria samples had a geomean of 366 MPN (most probable number). The water quality data indicated that dissolved oxygen levels had an mean of 8.8 mg/L, and the mean for pH at this station during the period of record is 8.1; both show decreasing trends. The mean for total dissolved solids is 1063.49 mg/L and shows no significant trend. Ammonia data for this station shows a mean of 0.74 mg/L and shows no significant trend. The mean for total phosphorus is 1.01 mg/L and shows an increasing trend.The mean for chlorophyll-a is 22.93 ug/l and shows no significant trend. The mean for sulfate is 289.49 mg/L, and shows no significant trend.

Pictured Top: Rio Grande at Station 15704. Photo Credit USIBWC CRP staff.

At Station 16272 (Rio Grande at San Elizario), 31 *E.coli* bacteria samples had a geomean of 203 MPN (most probable number), which is above the standard of 126 and shows an increasing trend. The water quality data indicated that dissolved oxygen levels had an mean of 7.7 mg/L, and shows no trend. The mean for pH at this station during the period of record is 8.0 and shows a decreasing trend. The mean for total dissolved solids is 995.45 mg/L and shows no significant trend. Ammonia data for this station shows a mean of 0.88 mg/L and shows no trend. The mean for total phosphorus is 1.13 mg/L and shows no significant trend.The mean for chlorophyll-a is 18.04 ug/l and shows no significant trend. This station does show an increasing trend for chloride, which has a mean of 255.22 mg/L, and nitrate+nitrite, which has a mean of 2.91 mg/L. The graph for bacteria is below, but please check Appendix B for additional graphs for this station.

Figure 27.



Pictured Top: Station 16272, looking downstream. Photo Credit USIBWC CRP staff.

Segment 2308, Rio Grande Below International Dam

Segment 2308 is defined as from the Riverside Diversion Dam in El Paso County to International Dam in El Paso County. In the 2014 Integrated Report, Segment 2308 is impaired for bacteria. The segment also has a water quality concerns for ammonia, chlorophyll-a, and total phosphorus. These stations are monitored by the USIBWC CRP program. This segment is the channelized portion of the river that runs for 12 miles through downtown El Paso.The USIBWC CRP is investigating a reclassification of the waterbody as intermittent rather than perennial.

Segment 2308 has one Assessment Unit:

2308_01 From the Riverside Diversion Dam to the International Dam in El Paso County

There are 3 active stations within this segment:

14465, Rio Grande at Riverside Canal 1.8 km downstream of Zaragosa International Bridge

15528, Rio Grande 1.3 km downstream from Haskell St WWTP Outfall

15529, Rio Grande 2.4 km upstream from Haskell St WWTP Outfall south of Bowie High School

Assessment Unit, 2308_01 is impaired for bacteria, and has concerns for ammonia, chlorophyll-a, and total phosphorus. This segment includes the 12 mile stretch of river that is concrete channeled as part of the Chamizal Convention (Treaty) of 1963. By treaty, this portion of the river never carries river water. The river water delivered to Texas by New Mexico is accounted for, designated to, and diverted to irrigation districts and water right holders at American Dam in El Paso for the U.S., and at International Dam for diversion to Mexico. Water in the channelized portion of the Rio Grande is made up of wastewater effluent, stormwater runoff, and seepage from the dams.

Assessment Unit 2308_01 is impaired for bacteria, and has water quality concerns for ammonia, chlorophyll-a, and total phosphorus. This AU is is monitored by Stations 15528, 15529, and 14465. Samples collected at these stations are analyzed by El Paso Water Public Service Board, International Water Quality Laboratory. This lab analyzes an abbreviated list of parameters due to limited NELAP accreditation.

At Station 15528 (Rio Grande downstream of Haskell WWTP Outfall), 16 *E.coli* bacteria samples had a geomean of 1,230 MPN (most probable number), which is more than twice the water quality standard of 126 MPN, but has no trend. The water quality data indicated that dissolved oxygen levels had an mean of 8.7 mg/L, and the mean for pH at this station during the period of record is 8.4; neither showed a significant trend. The mean for chlorophyll-a is 32.06 ug/L and shows an increasing trend. Please see graphs for this station in Appendix B.

Pictured Top: Station 15528. Photo Credit USIBWC CRP staff.

At Station 15529 (, 12 *E.coli* bacteria samples had a geomean of 1,439 MPN (most probable number), which is two-and-a-half times the water quality standard of 126, but has no trend. The water quality data indicated that dissolved oxygen levels had an mean of 8.9 mg/L, and the mean for pH at this station during the period of record is 8.4; neither shows a significant trend. The mean for chlorophyll-a is 27.67 ug/L and shows no significant trend. Please see graphs for this station in Appendix B.

Pictured Top: Station 15529. Photo Credit USIBWC CRP staff.

At Station 14465 (Rio Grande at Riverside Canal), 22 *E.coli* bacteria samples had a geomean of 82 MPN (most probable number) and shows no trend. The water quality data indicated that dissolved oxygen levels had an mean of 9.5 mg/L, and the mean for pH at this station during the period of record is 8.2.; neither shows a significant trend. The mean for chlorophyll-a is 13.50 ug/L and also shows no significant trend. This station is at the end of the segment, downstream of the channelized portion of the river. Please see the graphs for this station in Appendix B.

Pictured Top: Station 14465 Photo Credit USIBWC CRP staff.

Segment 2309, Devils River and Segment 2309A, Dolan Creek

Segment 2309 is defined as from a point 0.6 km (0.4 miles) downstream of the confluence of Little Satan Creek in Val Verde County to the confluence of Dry Devils River in Sutton County. The segment is 67 miles long, and empties into Amistad International Reservoir. This area of the basin is still mostly undisturbed and remains in pristine condition, with excellent water quality and low salinity content. Aside from the tidal segment of the Rio Grande, this is the only other segment with a classification of exceptional aquatic life use. In the 2014 Integrated Report, Segment 2309 has no water quality impairments or concerns. Segment 2309A also has no water quality impairments or concerns.

Segment 2309 has three Assessment Units, and 2309A has one:

2309_01 From the Devils River Arm of Amistad Reservoir upstream to Falls Canyon just below the Dolan Creek confluence

2309_02 From Falls Canyon just below the Dolan Creek confluence upstream to Wallace Canyon

2309_03 From Wallace Canyon to the upper segment boundary at the Dry Devils River confluence

2309A_01 From the Rio Grande confluence to 46.7 km (29 mi) south of Sonora and 4.8 km (3 mi) west of US 277 in Val Verde County

There are 3 active stations within these segments:

13237, Devils River at Pafford crossing near Comstock

13239, Devils River on Devils River State Natural Area 1.7 km upstream of Dolan Creek

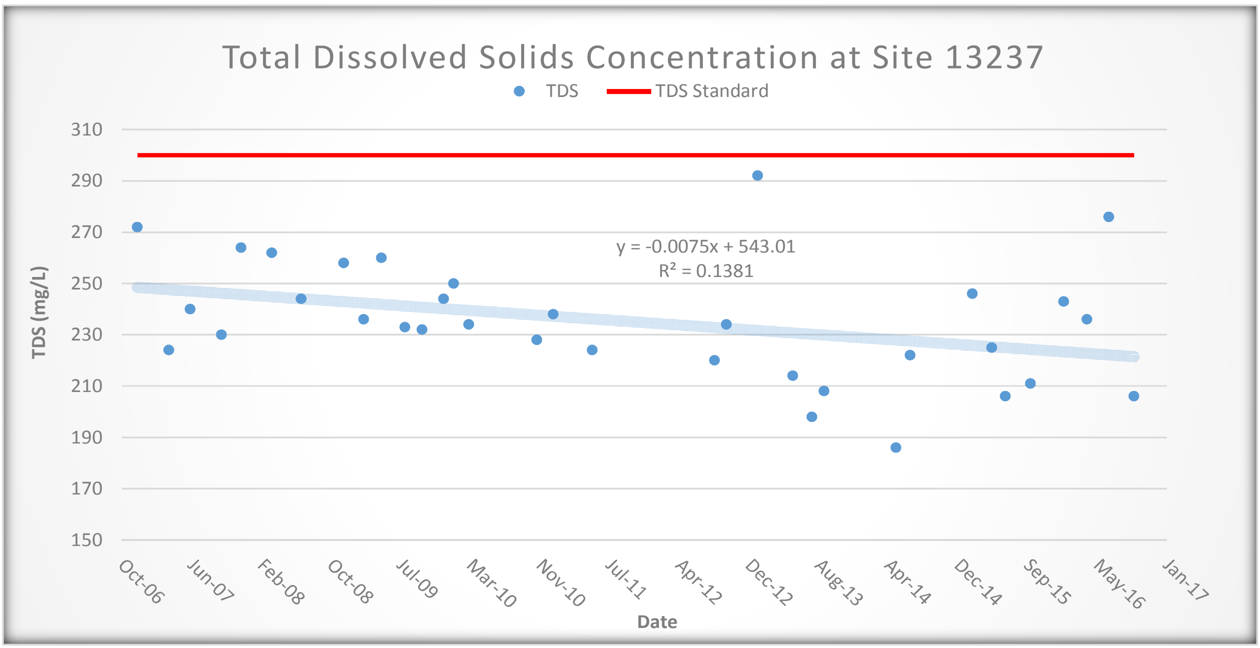
14942, Dolan Springs 100 yds upstream of confluence with Devils River immediately upstream of road crossing

Pictured Top: The Devils River. Photo Credit Laurence Parent.

Assessment Unit 2309_01 has no impairments or concerns. This AU is is monitored by Station 13237.

At Station 13237 (Devils River at Pafford crossing), 33 *E.coli* bacteria samples had a geomean of 5 MPN (most probable number) and has no trend. The water quality data indicated that dissolved oxygen levels had an mean of 9.4 mg/L, and the mean for pH at this station during the period of record is 8.2. neither had a significant trend. The mean for total dissolved solids is 235.18 mg/L, which shows a decreasing trend and is much lower than anywhere else in the basin. The mean for chlorophyll-a is 1.79 ug/L and also shows no significant trend. Ammonia data for this station shows a mean of 0.05 mg/L and shows no trend. The mean for total phosphorus is 0.04 mg/L and shows no trend. There is a decreasing trend for nitrate+nitrite, which has a mean of 1.01 mg/L. The mean for sulfate is 8.46 mg/L, and chloride has a mean of 14.42 mg/L; neither showed a significant trend. Please see the graph for TDS below, and Appendix B for additional graphs for this station.

Figure 28.



Assessment Unit 2309_02 has no impairments or concerns. This AU is monitored by Station 13239.

At Station 13239 (Devils River at Devils River State Natural Area), 31 *E.coli* bacteria samples had a geomean of 15 MPN (most probable number). The water quality data indicated that dissolved oxygen levels had an mean of 8.8 mg/L, and the mean for pH at this station during the period of record is 7.8. The mean for total dissolved solids is 263.50 mg/L, which is much lower than anywhere else in the basin. The mean for chlorophyll-a is 2.06 ug/L. Ammonia data for this station shows a mean of 0.05 mg/L, and total phosphorus shows a mean of 0.04 mg/L. The mean for sulfate is 9.14 mg/L, and for chloride the mean is 15.43 mg/L. Nitrate+nitrite has a mean of 1.22 mg/L. No trends were found for any parameter.

Assessment Unit 2309_03 has no impairments or concerns. This AU does not currently have any monitoring stations.

Pictured Top: Kayakers at Devils River State Natural Area. Photo Credit TPWD.

Pictured Top: Devils River. Photo Credit Chris Hillen.

Segment 2309A is Dolan Creek, an unclassified freshwater creek. It is 29 miles long, encompassing Dolan Springs from Yellow Bluff to Sonora, TX. The 2014 assessment did not identify any impairments or concerns for water quality in this segment. Assessment Unit 2309A_01 has no impairments or concerns. This AU is monitored by Station 14942.

At Station 14942 (Dolan Springs upstream of confluence with Devils River), 36 *E.coli* bacteria samples had a geomean of 19 MPN (most probable number) and show no trend. The water quality data indicated that dissolved oxygen levels had an mean of 8.3 mg/L, which shows no trend. The mean for pH at this station during the period of record is 7.9 and shows a decreasing trend. The mean for total dissolved solids is 276.55 mg/L, which shows no trend. The mean for chlorophyll-a is 2.16 ug/L and also shows no significant trend. Ammonia data for this station shows a mean of 0.05 mg/L, with no significant trend. The mean for total phosphorus is 0.04 mg/L and shows no significant trend. Sulfate has a mean of 7.89 mg/L, and chloride has a mean of 14.96 mg/L; neither shows an increasing trend. Nitrate+nitrite, with a mean of 1.54 mg/L, also shows no significant trend.

Segment 2314, Rio Grande Above International Dam

Segment 2314 is 21 miles long and is defined as from International Dam in El Paso County to the New Mexico State Line in El Paso County. In the 2014 Integrated Report, this segment is impaired for bacteria and has a concern for elevated chlorophyll-a. It also has water quality concerns for chlorophyll-a. The amount of water depends largely on the needs of water rights holders, as most of the water is contractually obligated to the States of New Mexico and Texas, irrigation districts, water rights holders, and Mexico. Water diversion for irrigation in the U.S. is diverted at American Dam into the Rio Grande American Canal Extension. Approximately 2 miles downstream, water in the river is diverted into Mexico by the International Dam. This segment was heavily affected by the drought, and much of the segment is dry when water is not being released for irrigation. The water that does flow during non-irrigation season is mainly wastwater effluent, stormwater runoff, or agricultural return flows, which contribute to the salinity issues in this stretch of the river. An ever-growing population in the sister cities of El Paso and Ciudad Juarez, estimated to be over 2 million people, places hardship on an already over-taxed system. Multiple small communities on the Mexican side with no city sewage services contribute to the bacteria issues, as well as small wastwater treatment plants in surrounding local communities that are frequently operating over capacity and bypass wastewater into the river.

Segment 2314 has two Assessment Units:

2314_01 From the International Dam upstream to the Anthony Drain confluence

2314_02 From the Anthony Drain confluence upstream to the New Mexico/Texas state line.

There are 6 active stations within this segment:

13275, Rio Grande 40 m south of Vinton Bridge approximately 4 km south of Anthony

13274, Rio Grande at Borderland Rd NW of El Paso

13272, Rio Grande at Courchesne Bridge 1.7 mi upstream from American Dam CAMS 718

17040, Rio Grande at Anapra Bridge on Sunland Park Drive 4.2 KM upstream of American Dam in New Mexico.

15089, Rio Grande River at American Eagle Brick Factory Bridge abandoned RR 0.1 mi downstream from Southern Pacific RR at Smeltertown

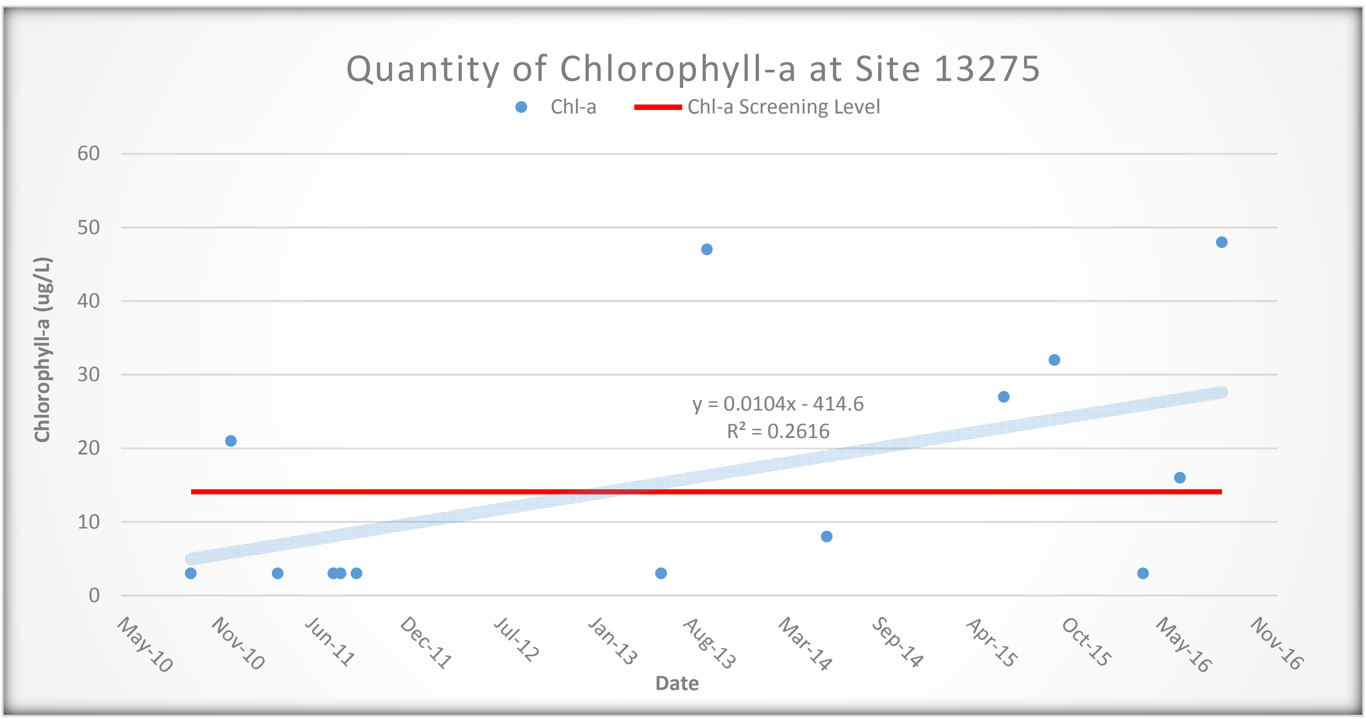
13276, Rio Grande immediately upstream of the confluence with Anthony Drain west of La Tuna Prison near the state line

Pictured: Rio Grande at Courchesne Bridge, Station 13272. Photo credit USIBWC CRP staff.

Assessment Unit 2314_01 is impaired for bacteria and has a concerns for chlorophyll-a. This AU is is monitored by Stations 13275, 13274, 17040, 13272 and 15089.

At Station 13275 (Rio Grande at Vinton Bridge), 15 *E.coli* bacteria samples had a geomean 90 MPN (most probable number) and shows no trend. The water quality data indicated that dissolved oxygen levels had an mean of 8.0 mg/L, and the mean for pH at this station during the period of record is 8.4; neither shows a significant trend. The mean for total dissolved solids is 556.31 mg/L, and shows no significant trend. The mean for chlorophyll-a is 15.71 ug/L and shows an increasing trend. Ammonia data for this station shows a mean of 0.37 mg/L, and the mean for total phosphorus is 0.24 mg/L; neither shows a significant trend. Sulfate shows a mean of 138.82 mg/L, and chloride has a mean of 103.72 mg/L; neither shows a significant trend. Nitrate+nitrite, with a mean of 2.16 mg/L, also shows no significant trend.

Figure 29.



Pictured Top: Rio Grande at Borderland Bridge, Station 13274. Photo credit USIBWC CRP staff.

Station 13274 (Rio Grande at Borderland Bridge) had a small sample size, and data is for informational purposes only. At Station 13274, 5 *E.coli* bacteria samples had a geomean of 444 MPN (most probable number), which is above the water quality standard of 126 MPN. The water quality data indicated that dissolved oxygen levels had an mean of 8.5 mg/L, and the mean for pH at this station during the period of record is 8.4. The mean for total dissolved solids is 612.29 mg/L. The mean for chlorophyll-a is 14.71 ug/L. Ammonia data for this station shows a mean of 0.17 mg/L. The mean for total phosphorus is 0.31 mg/L. The mean for sulfate is 156.71 mg/L. The mean for chloride is 108.83 mg/l, and for nitrate+nitrite the mean is 2.15 mg/L.

At Station 17040 (Rio Grande at Anapra Bridge), 34 *E.coli* bacteria samples had a geomean of 290 MPN (most probable number) and is above the standard of 126 MPN, but shows no trend. The water quality data indicated that dissolved oxygen levels had an mean of 8.4 mg/L, and the mean for pH at this station during the period of record is 8.1. The mean for total dissolved solids is 819.68 mg/L. The mean for chlorophyll-a is 17.50 ug/L . Ammonia data for this station shows a mean of 2.71 mg/L, and the mean for total phosphorus is 1.07 mg/L. The mean for sulfate is 210.67 mg/L, and the mean for chloride is 191 mg/L. The mean for nitrate+nitrite is 4.78 mg/L. None of these parameters showed any significant trends.

Pictured Top: Rio Grande at Anapra, Station 17040. Photo credit USIBWC CRP staff.

Station 13272 (Rio Grande at Couchesne Bridge) is monitored monthly, and is the farthest upstream station in Texas. At Station 13272, 130 *E.coli* bacteria samples had a geomean of 339 MPN (most probable number), which is almost double the standard of 126 MPN. Bacteria shows a increasing trend. The water quality data indicated that dissolved oxygen levels had an mean of 9.2 mg/L, and the mean for pH at this station during the period of record is 8.0; neither shows a trend. The mean for chlorophyll-a is 17.16 ug/L and shows no significant trend. Ammonia data for this station shows a mean of 0.5 mg/L, and the mean for total phosphorus is 0.65 mg/L; both show an increasing trend. This station shows increasing trends for sulfates, with a mean of 475.91 mg/L and chloride, with a mean of 368.04 mg/L. Chloride is also above the standard. Nitrate+nitrite has a mean of 1.07 mg/L and shows no trends. Please see the graphs for bacteria, sulfate and chloride on the following page. Please see Appendix B for additional graphs of this station.

Figure 30.

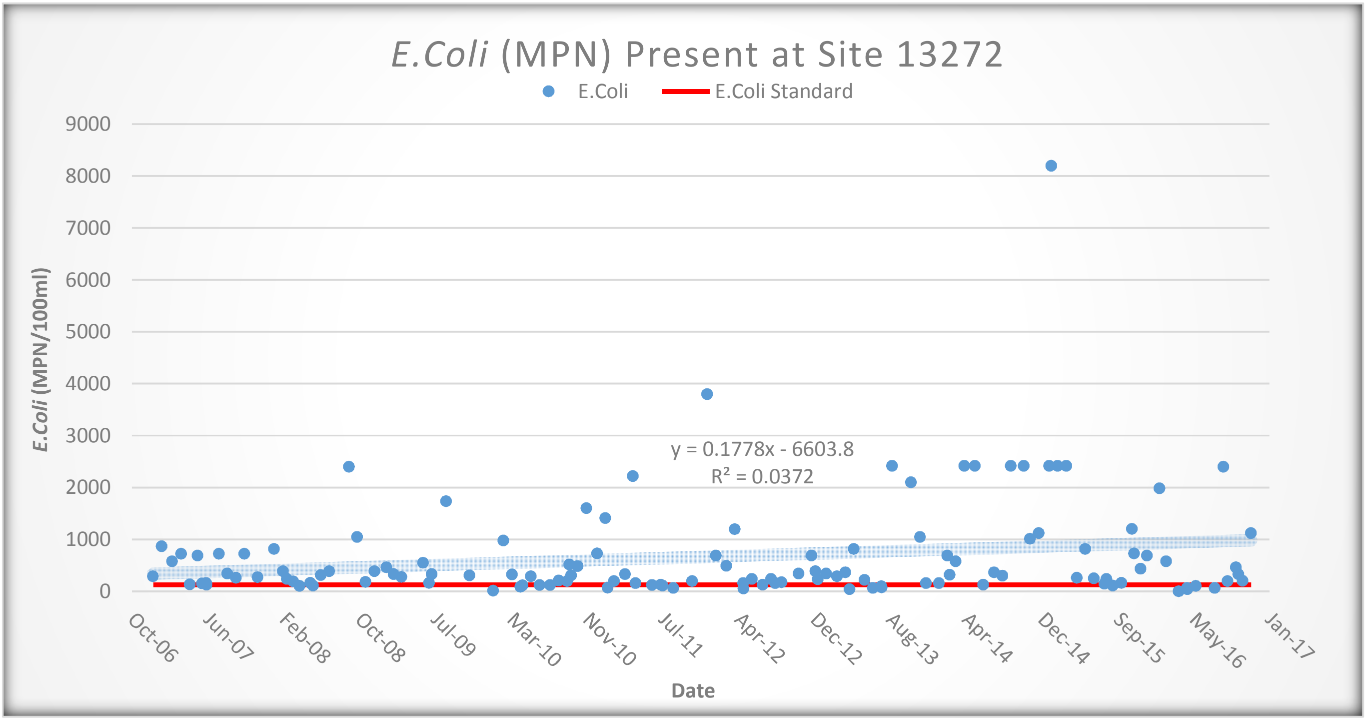
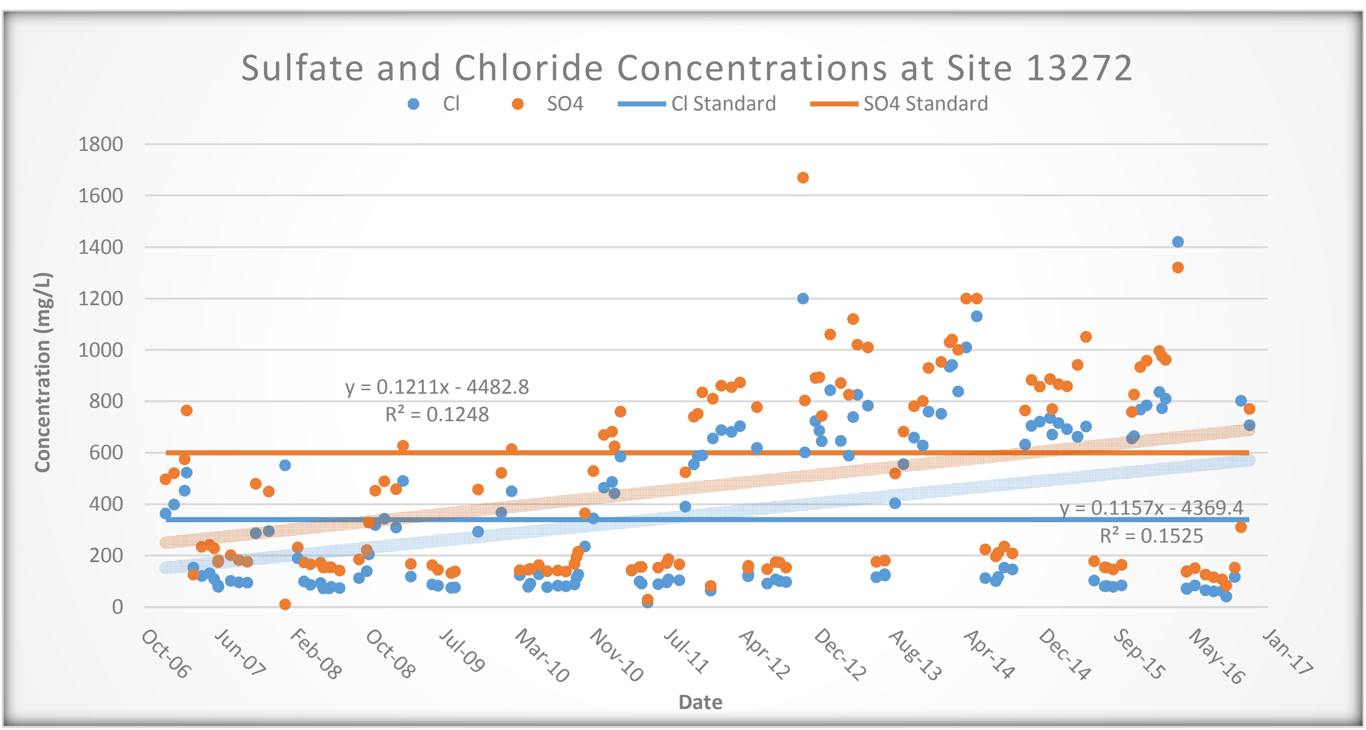


Figure 31.



At Station 15089 (Rio Grande at American Brick Factory), 23 *E.coli* bacteria samples had a geomean of 414 MPN (most probable number), which is over the standard of 126 MPN but shows no trend. The water quality data indicated that dissolved oxygen levels had an mean of 9.0 mg/L, and the mean for pH at this station during the period of record is 8.0; neither parameter showed a significant trend. The mean for total dissolved solids is 1222.87 mg/L, and shows no significant trend. The mean for chlorophyll-a is 14.67 ug/L and shows an increasing trend. Ammonia data for this station shows a mean of 0.49 mg/L and shows no significant trend. The mean for total phosphorus is 0.77 mg/L and also shows no significant trend. This station also shows a decreasing trend for nitrate+nitrite, with a mean of 9.95 mg/L.The mean for sufate is 360.53 mg/L, and for chloride the mean is 324.49 mg/L; neither parameter shows a significant trend. Please see Appendix B for the graphs for this station.

Pictured Top: Rio Grande at Station 15089. Photo credit USIBWC CRP staff.

Assessment Unit 2314_02 has no impairments, but has a concern for chlorophyll-a. This AU is is monitored by Station 13276.

At Station 13276 (Rio Grande above Anthony Drain), 41 *E.coli* bacteria samples had a geomean of 74 MPN (most probable number) and show no trend. The water quality data indicated that dissolved oxygen levels had an mean of 8.0 mg/L, and the mean for pH at this station during the period of record is 8.3; neither parameter showed a significant trend. The mean for total dissolved solids is 599.37 mg/L, and shows no significant trend. The mean for chlorophyll-a is 19.23 ug/L and shows no significant trend. Ammonia data for this station shows a mean of 0.24 mg/L, with no significant trend. The mean for total phosphorus is 0.28 mg/L and shows an increasing trend. This station also shows a decreasing trend for sulfates, which has a mean of 164.45 mg/L. The mean for chloride is 100.19 mg/L, and nitrate+nitrite has a mean of 1.37 mg/L, neither of which show any significant trend. Please see Appendix B for the graphs for this station.

Pictured Top: Rio Grande at Station 13276. Photo credit USIBWC CRP staff.

Land Use in the Upper Rio Grande

Based on satellite imagery, Segment 2314 has very little undeveloped land surrounding the river. This area is surrounded by highly urbanized areas and agricultural fields. This segment stretches from the New Mexico-Texas state line, including the communities of Anthony, Vinton, and Canutillo, down through major cities such as El Paso and Ciudad Juarez, downstream to the smaller outlying communities of Horizon, San Elizario, Clint, Fabens, and Ft. Hancock. In the past five years, this metropolitan area has grown substantially, putting a heavier burden on both drinking and wastwater treatment plants to treat water for the communities. The agricultural industry is a major source of business in these areas, which can be demonstrated in the images below. A large part of the land surrounding the river in these smaller communities are agricultural fields. El Paso/ Cd. Juarez are also home to several ports of entry, which see heavy traffic, both commercial and private, going back and forth across the border.

On the west side of El Paso, across from the University of Texas at El Paso, is an area in Ciudad Juarez named Anapra. This area is one of the more poverty-stricken areas of Ciudad Juarez, a colonia, and many of these communities have little to no access to city services and are exposed to poor sanitary conditions. This area of the river is characterized by high bacteria counts and serious trash issues, which also contribute to the bacteria problems. The area of Sunland Park, New Mexico, which is immediately upstream of El Paso, is also a lower socio-economic area. Many of these homes still have septic systems, or are in the area serviced by the Sunland Park Wastwater Treatment Plant, which is constantly operating over capacity. The areas adjacent to the Rio Grande in many parts of Ciudad Juarez are also heavily populated by industrial plants, which also have an impact on the river.

Figure 32.

Map shows Ciudad Juarez on the bottom left, and El Paso on the top right, with surrounding communities.

Figure 33.

Map shows agricultural lands in New Mexico and Texas, stretching down into El Paso.

Figure 34.

Map shows agricultural lands in the El Paso lower valley and downstream, communities of Socorro, Clint, Fabens, Tornillo, etc.

Below the smaller communities of Tornillo and Ft. Hancock, the river runs, undisturbed, for many miles in an area deemed “The Forgotten Stretch.” This area is remote, and limited access to the river and its surrounding areas. Presidio, TX/Ojinaga, Chihuahua also shows agricultural lands surrounding the river, and a port of entry. A map of the Presidio/Ojinaga area is below.

Figure 35.

Map shows Presidio, TX on the upper right portion, and Ojinaga, Chihuahua on the lower left. Ojinaga is much larger. You are also able to see the agricultural areas on the Mexican side of the border.

There are 12 permitted facilities in Segment 2306. These include two permits for industrial wastewater, three for private domestic wastewater, six for private domestic wastewater treatment, and one for reverse osmosis water treatment. Segment 2307 has 16 permitted facilities, which include one permit for conventional water treatment, three for industrial wastewater, nine for public domestic wastewater, two for reverse osmosis treatment, and one permit for sludge disposal. Segment 2308 has 6 permitted facilities, which includes three for industrial wastewater, one Municipal Separate Storm Sewer System (MS4) permit, one public domestic wastwater permit, and one private domestic wastewater permit. Segment 2309 has 5 permitted facilities, including one for industrial wastwater, one for private domestic wastewater, and three for public domestic wastwater. Segment 2314 has six permitted facilities, including one for industrial wastewater and four permits for public domestic wastewater.

Projects and Studies of Relevance to the Upper Rio Grande River Sub-basin

Paso del Norte Watershed Council- The Paso del Norte Watershed Council works to address issues related to the establishment and maintenance of a viable watershed. The Council is interested in the territory that includes approximately 430 river miles between Elephant Butte Reservoir in southern New Mexico to the confluence of the Rio Conchos in Presidio County, Texas. The group works on multiple projects, including projects that promote improving water quality and quantity, ecosystem integrity, the quality of life, and economic sustainability in the Paso del Norte watershed. The Paso del Norte Watershed Council also provides a forum for exchanging information about any and all activities on the Rio Grande. The Council has several sub-commitees, including an environmental committee that reviews proposed projects in the southern New Mexico/Upper West Texas area. The USIBWC CRP Program Manager is on the environmental committee and provides guidance and opinions on water quality issues. For more information on this group, please visit their website at http://smiley.nmsu.edu/pdnwc/.

University of Texas at El Paso- The University of Texas at El Paso (UTEP) has multiple ongoing projects along the Rio Grande. Students are working on projects looking at the effects of water quality on rotifers, which are excellent water quality indicators. There are also projects looking at endocrine disruptors and personal care products in water, which have become emerging concerns for water quality in more recent years. UTEP also has ongoing projects related to wildlife, including a study on duck and fish species in this area. UTEP has been a USIBWC CRP partner for more than ten years and provides information on their projects in the Rio Grande Basin to the program to keep the public informed.

El Paso Community College- The El Paso Community College has done DNA traceability studies in the past to gain information on possible sources of bacterial contamination in the El Paso area. The Sunland Park, NM/El Paso, TX area has been a place of focus for many years due to the ongoing water quality issues in this area. Students were also conducting studies on mosquitoes and collected mosquitoes while collecting water and sediment samples for other projects. The El Paso Community College has also been a USIBWC CRP partner for many years, and also provide the information from their projects to the program for informational distribution.

Crayfish in the Rio Grande downstream of American Dam in El Paso, TX. Photo credit USIBWC CRP staff.

Large toad in the Rio Grande downstream of American Dam in El Paso. Photo credit USIBWC CRP staff.

Possible negative impacts on water quality

Nonpoint sources- The Rio Grande is heavily impacted by the municipalities on both sides of this section of the river. The El Paso/Ciudad Juarez metropolitan area has grown immensely, and includes a population of over 2 million people in the two major cities alone, without including the multiple surrounding small towns. The sister cities of Presidio, Texas, and Ojinaga, Chihuahua are also located in this part of the Rio Grande Basin. The rapid growth of urban development in El Paso/Juarez area of the basin is a major contributor to the degredation of water quality in this segment of the river. Pedestrian and vehicle traffic at the ports of entry on asphalt bridges and roads can lead to water contamination from the kick-up of dust created by the traffic and polluted runoff from stormwater into the river. Historically, this area has been subjected to discharges of wastewater from both sides of the border, as well as poverty-stricken areas that have little to no access to wastwater services. The untreated wastewater is discharged into the Rio Grande River directly, or to arroyos and creeks that flow to the river. This type of contamination can have repercussions on the water quality for all Texas-Mexico border cities downstream from the point of origin of the contamination. Aside from the colonias, there are wastwater treatment plants that are in dire need of upgrades and repairs, and/or that are operating over capacity due to the closing of private wastwater treatment plants. When operating over capacity, these plants bypass into the river. In New Mexico (in Las Cruces), El Paso, and even in Presidio County, livestock farms and stockyards are also a source of possible bacterial contamination in the river, particularly during storm events. This also includes the Mexican side of the border along the Rio Grande in Presidio County.

Agricultural- Agricultural fields, ranchlands, and livestock ranches near the Rio Grande may affect the water quality near the Rio Grande in the lower New Mexico area, as well as in Texas, due to storm runoff or return flows. Runoff from agricultural land may cause water pollution due to the use of fertilizers, pesticides, and irrigation. The return flows from irrigation are high in nutrients, which can lead to excess algal growth, which can, in turn, lead to decreased DO in the water. These return flows are also highly saline, which contributes to salinity issues in the Rio Grande and may actually raise salinity enough to the point that water from the river can't be used for irrigation. The use of pesticides during irrigation can also lead to water contamination from runoff or remnant spray carried by wind.

Wildlife- Based on information from the Texas Parks and Wildlife Department (TPWD), this segment is home to a number of large and small animals that may contribute to the bacterial issues in the area. The Rio Bosque and Keystone Heritage Park, which are wildlife refuges, attract a significant number of birds to the area. There are watering holes where livestock from nearby ranches may also contribute to bacterial problems. The river itself is a watering area for nearby livestock, which may also contribute to bacteria problems. There are small man-made lakes and ponds in El Paso and surrounding communities that are plagued by algal blooms, which can make their way to the Rio Grande if people are not careful about cleaning boats, fishing equipment and other things used for recreating in these algae-prone water bodies. Small and large urban developments are home to many domesticated animals that possibly contribute to the bacterial concerns in the river as well.

Urban Runoff- There are multiple communities along the river in this span of the basin. Leading into Texas, runoff from Las Cruces, New Mexico, and smaller communities such as Sunland Park, NM makes its way into the Rio Grande. Once in Texas, the cities of El Paso and Ciudad Juarez, by far the largest cities in this area of the basin, and all the smaller communities on both sides of the border along the river also funnel stormwater into the river.

According to a 2014-2015 economic report on the ports of entry, the Texas comptroller department estimated over 1.5 million trucks, 23.8 million personal vehicle, and 13.3 million pedestrians utilized the bridges crossing between Texas and Mexico for this two-year period. According to the report, El Paso's ports of entry see more pedestrian traffic than any other land port in the State of Texas. The Presidio- Ojinaga port of entry sees about 700,000 personal vehicle crossing per year, and about 94,000 pedestrians per year.

Influences of Flow - Segments 2314, 2308, 2307, 2306, and 2305 are heavily influenced by releases from American and International Dams, and from upstream Elephant Butte Dam and Reservoir in New Mexico. As New Mexico releases water to Texas, the water is captured, accounted for, and allocated for U.S. and Mexico use by the IBWC, and subsequently delivered to the U.S. and Mexico through American Dam (for the U.S.) and International Dam (for Mexico). As mentioned in the description of Segment 2308, the channelized portion of the river does not carry water. The river receives the water again, after all necessary municipal use, below the Riverside Diversion Dam in El Paso. This is a highly manipulated water system, as the river does not flow naturally at all until reaching the Forgotten Reach below Ft. Quitman, TX. Since the drought started in 2010, the river now runs completely dry in most of Segments 2314, 2308, and a portion of 2307 when there are no irrigation releases scheduled. The area has also been impacted by several heavy rain events throughout the period of record that caused significant flooding. One event occurred in El Paso in 2006 (50-year flood event), in which a severe thunderstorm cell dropped almost 7,000 cubic feet per second (cfs) on the city in one day and caused significant damage. This storm dramatically changed some of the stations in the El Paso area. Another storm caused significant damage in Presidio in 2008. This storm dropped up to 49,794 cfs on just one day, in a seven day period of severe flooding. Aside from the economic ramifications, the storm also caused public health concerns because the wastewater treatment plant in Ojinaga, Chihuahua flooded, causing wastwater to spill into the river..

Stakeholders

Landowners

US Fish & Wildlife Service

TX Parks and Wildlife

USGS

Smaller communities in MX

University of Texas at El Paso (UTEP)

New Mexico State University

EPA Regional Offices

TCEQ Regional Offices, TCEQ Watermaster Office

Cities of Anthony, Vinton, Canutillo, El Paso, TX

U.S. Bureau of Reclamation

El Paso, Hudspeth, Presidio Counties

El Paso Community College (EPCC)

Texas A&M University

El Paso County Water Improvement District

Hudspeth County Conservation and Reclamation District No.

Elephant Butte Irrigation District

Presidio County Water Improvement District No. 1

Primera Unidad del Distrito de Riego 009 Valle de Juarez

Unidad de Riego El Mulato, Distrito de Riego 006 Palestina

The Cities of Ciudad Juarez and Ojinaga, Chihuahua and Cd. Acuña, Coahuila

The towns of Socorro, Horizon, Clint, Tornillo, Fabens, Ft. Hancock, TX

Recommendations

The USIBWC CRP will continue the routine monitoring at current levels in 2019. The program will continue to monitor and look at increasing or decreasing trends for parameters to identify water quality issues and needs in this area. The USIBWC CRP recommend a reclassification of Segment 2308 to be characterized by intermittent flows, since the segment is not carrying water regularly (any water is storm runoff, seepage or WWTP effluent), and is concrete- lined (not the river in its natural state). There is also no contact recreation in this portion of the river. A reclassification would affect three stations in this segment (15528, 15529, and 14465). The bacteria counts in the upper portion of Segment 2314 continue to increase, and while the monitoring does an effective job of capturing this, more needs to be done to correct the issues with the wastwater treatment plants in lower New Mexico; repairs and upgrades are needed to improve the water quality of the water entering Texas. There will still be bacteria issues in this area because of the communities across the border, but it would still improve the water quality. An effort should be made to regain the station in the Forgotten Stretch, even though the monitoring would be limited to those parameters with longer holding times due to the remoteness. Establishing a station at Ft. Quitman would also help, as this station would capture the beginning of that stretch of river.

The Pecos River Sub-Basin

The headwaters of the Pecos River originate in the Sangre de Cristo Mountains of north-central New Mexico. The Pecos River sub-basin consists of the portion of the Pecos River from the point it enters Texas at Red Bluff Reservoir in Loving County to its confluence with the Rio Grande in Val Verde County. Population centers along the river are relatively few and the region has experienced a general decline in population. Water in the Pecos River is naturally high in dissolved solids and salt concentrations. The high salinity levels are aggravated by low flows and the prevalence of salt cedar, a non-native species that is an enormous water consumer. The introduction of high quality fresh water from natural springs feeding Independence Creek creates significant changes to the aquatic community in the Pecos River.

The Pecos River is one of the salitest rivers in the western U.S. and contributes almost 10 percent of the stream inflow into International Amistad Reservoir and 26 percent of the total salt loading. As the major contributor of salt to the reservoir, lake salinity can get very high (in 1988 the lake salinity exceeded 1,000 ppm for one month) and can fluctuate with the changing flow and salt content of the Pecos River. Therefore, it is important to control the variable salt loading to ensure salinity levels are maintained below the 1,000 ppm drinking water standard.

Watershed data evaluations have revealed issues relating to water quality and quantity. Currently there are eight Continous Water Quality Monitoring Network (CWQMN) stations on the Pecos River, one station at Independence Creek, and one near Red Bluff, New Mexico to monitor conditions and changes in water quality to support the Pecos River Interstate Compact Commission. These stations measure DO, pH, temperature, and conductivity.

The USIBWC CRP has one partner in the Pecos River sub-basin, which is Midland College. The rest of the stations in the Pecos are monitored by the TCEQ Midland Office. Midland College monitors two stations, and the TCEQ Midland Office monitors eight stations in Segments 2310, 2311, and 2312. Combined, the USIBWCR CRP, TCEQ CWQMN, and TCEQ Midland Office work together to provide data for this reach of the basin.

Pictured: Pecos River at Coyanosa, TX. Photo credit USIBWC CRP staff.

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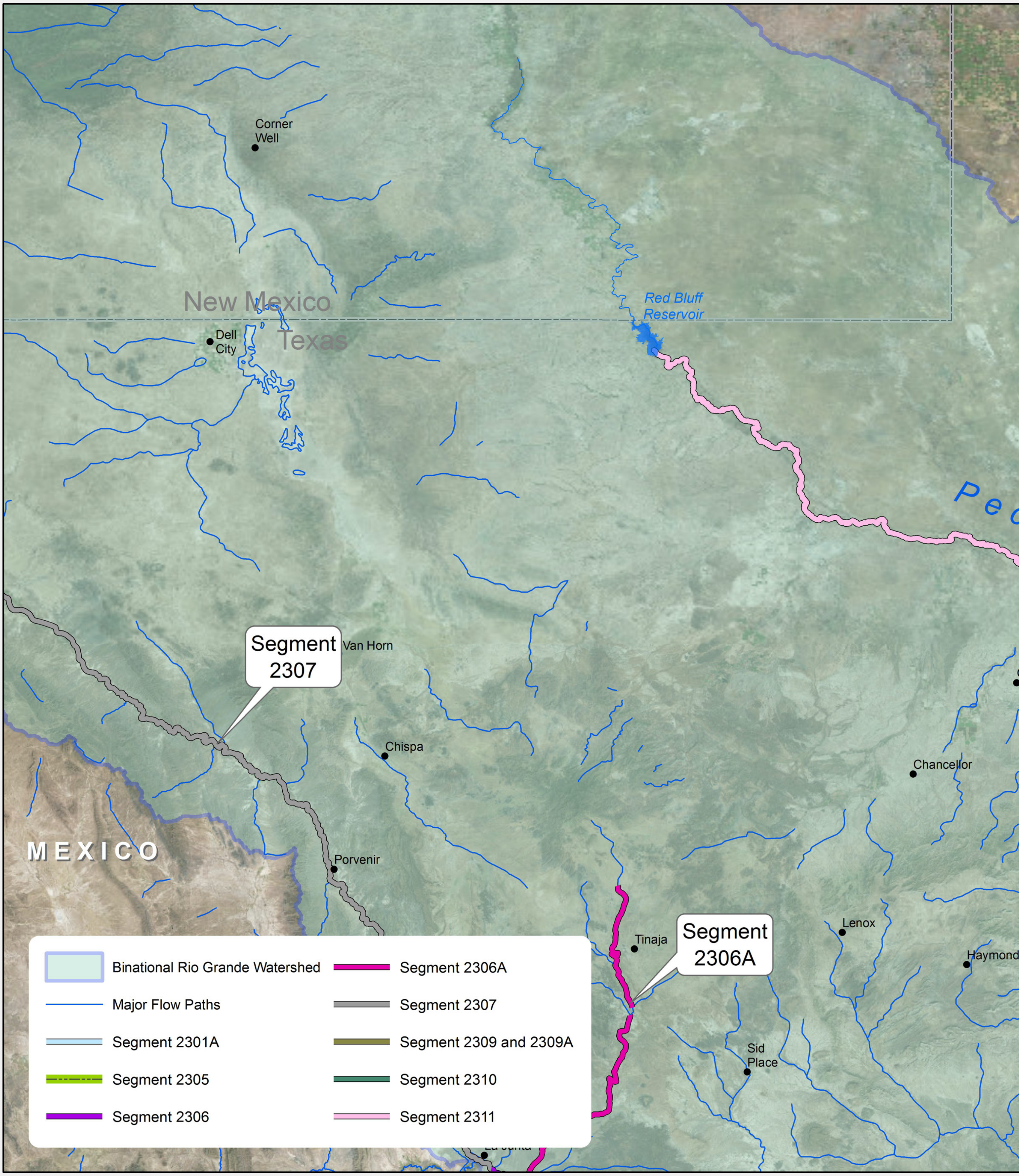

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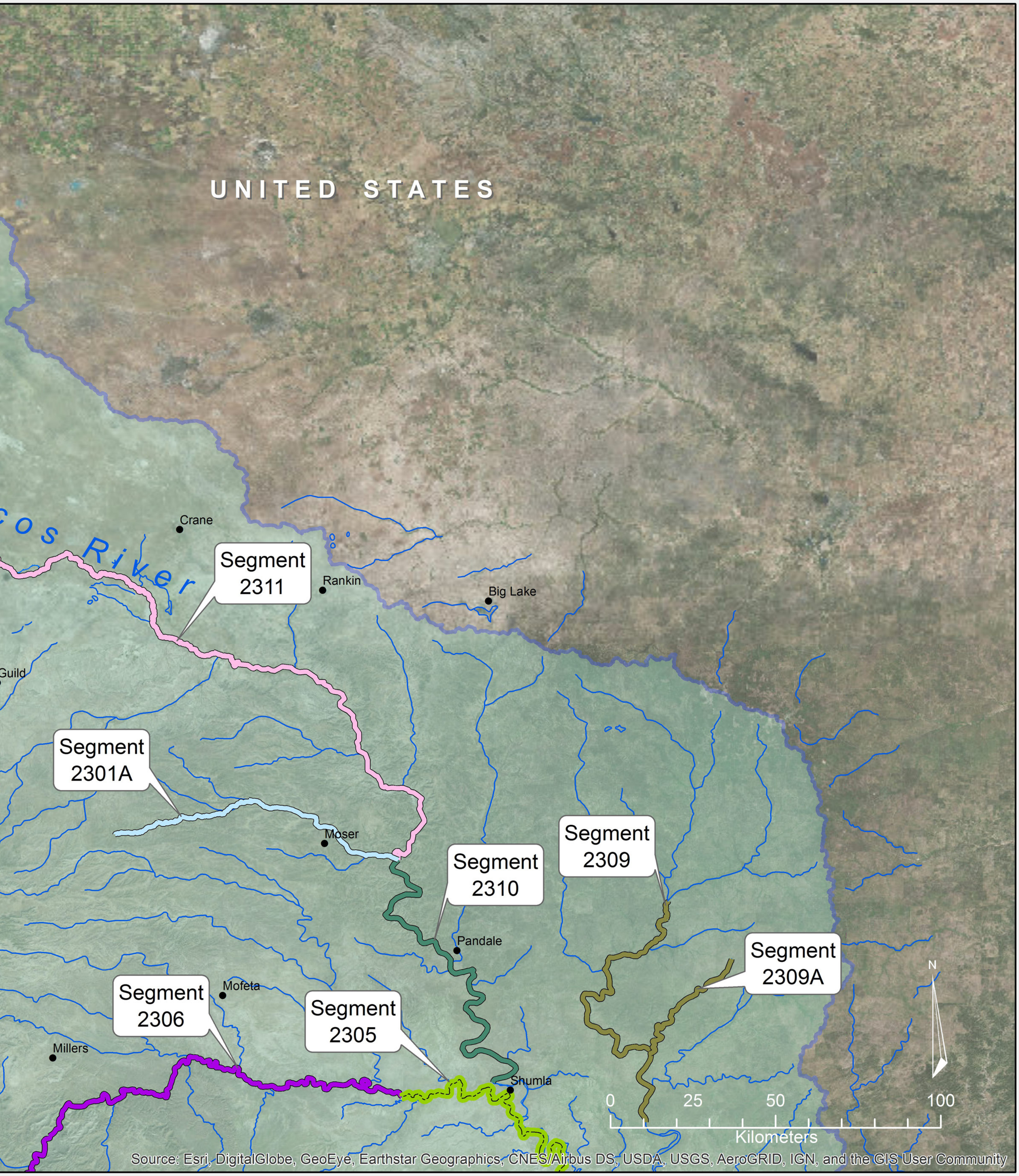

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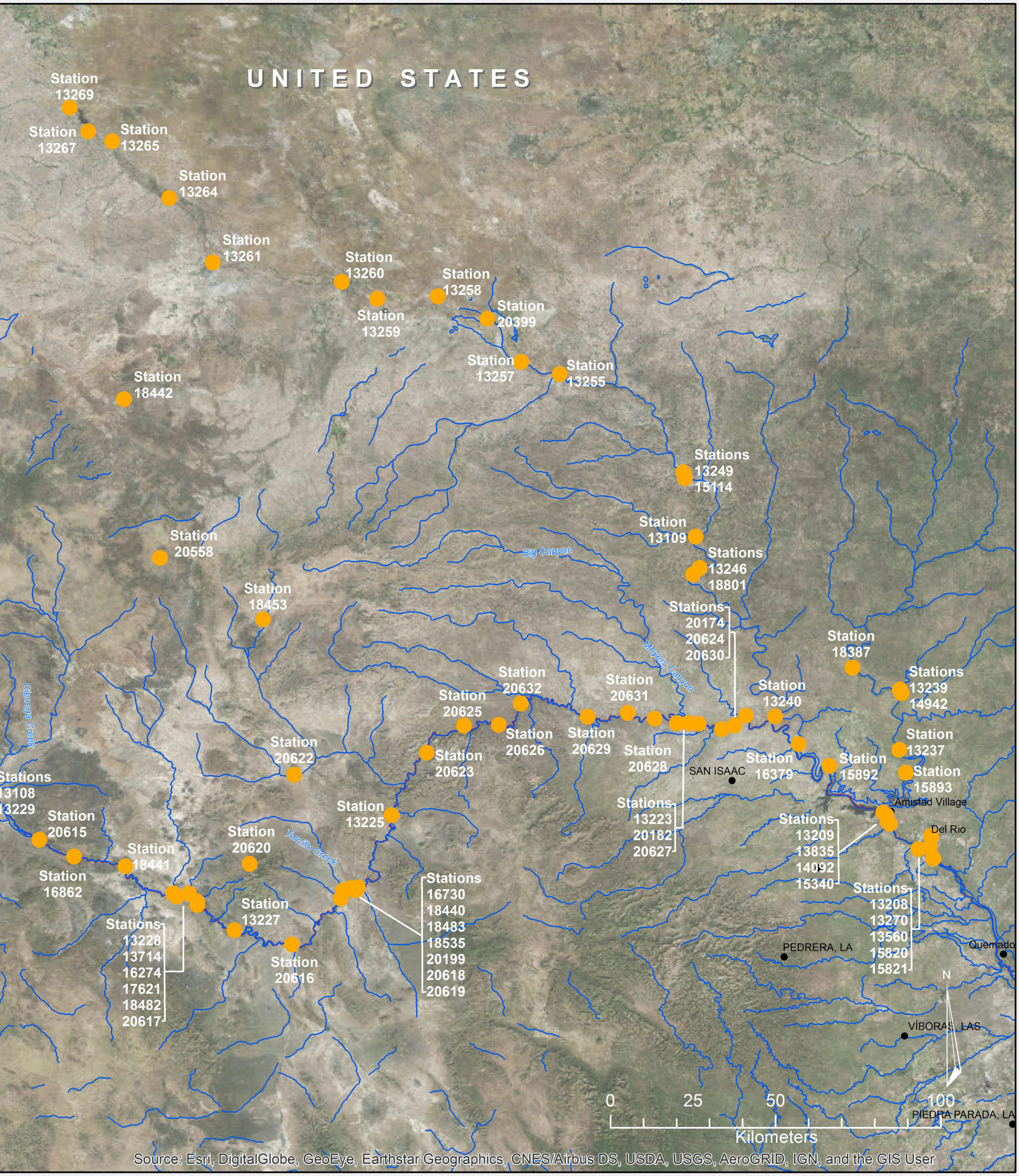

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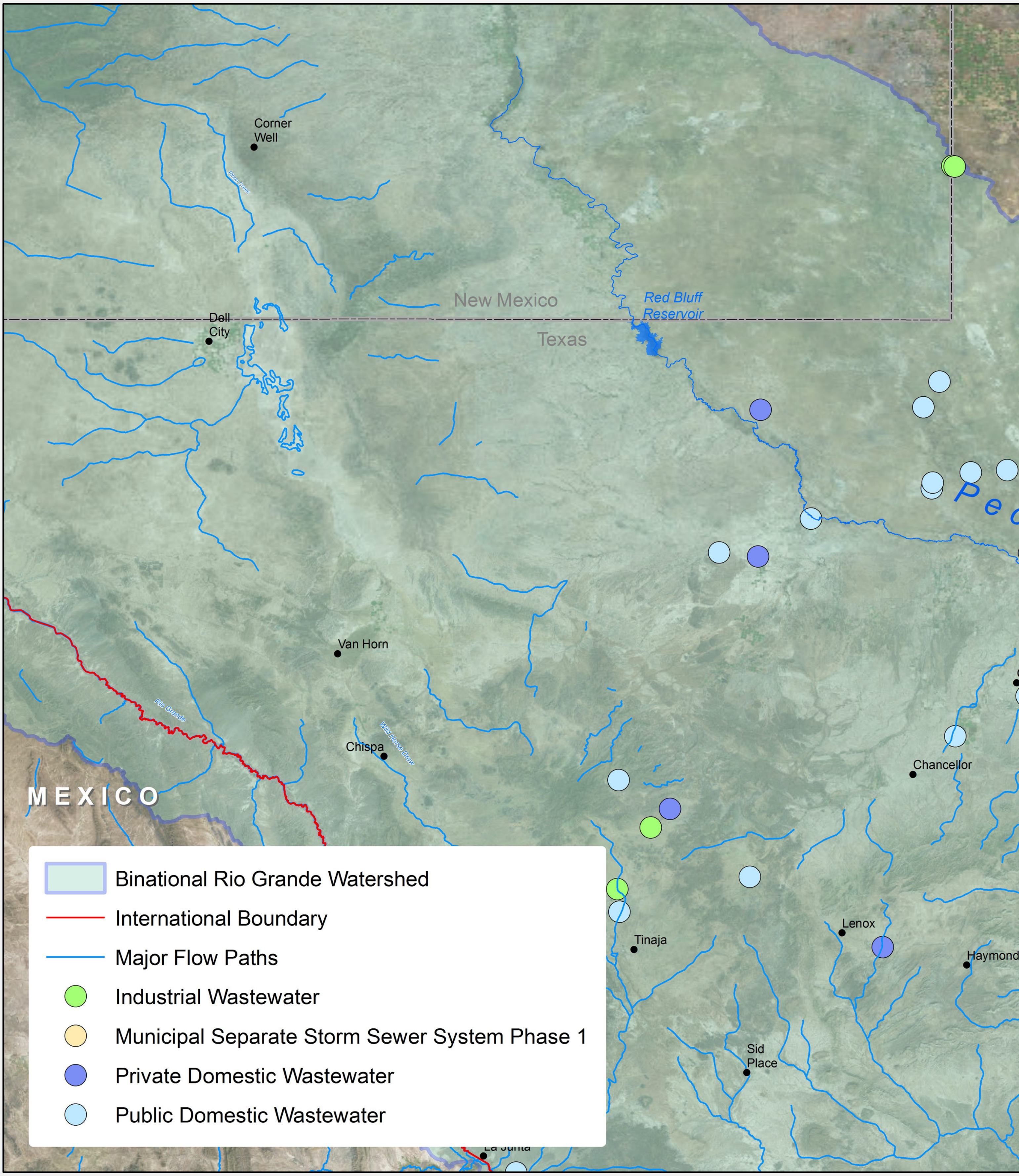

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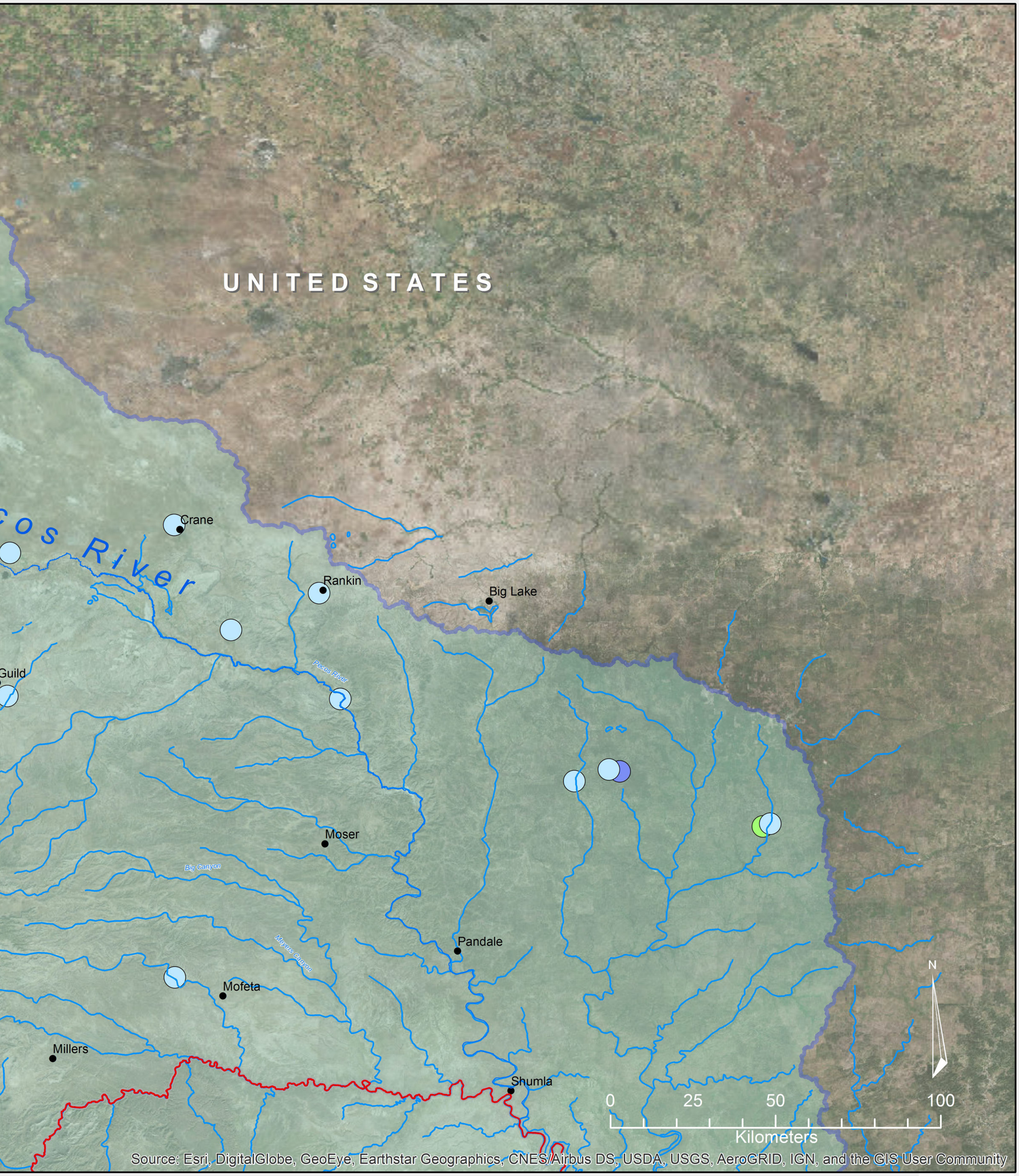

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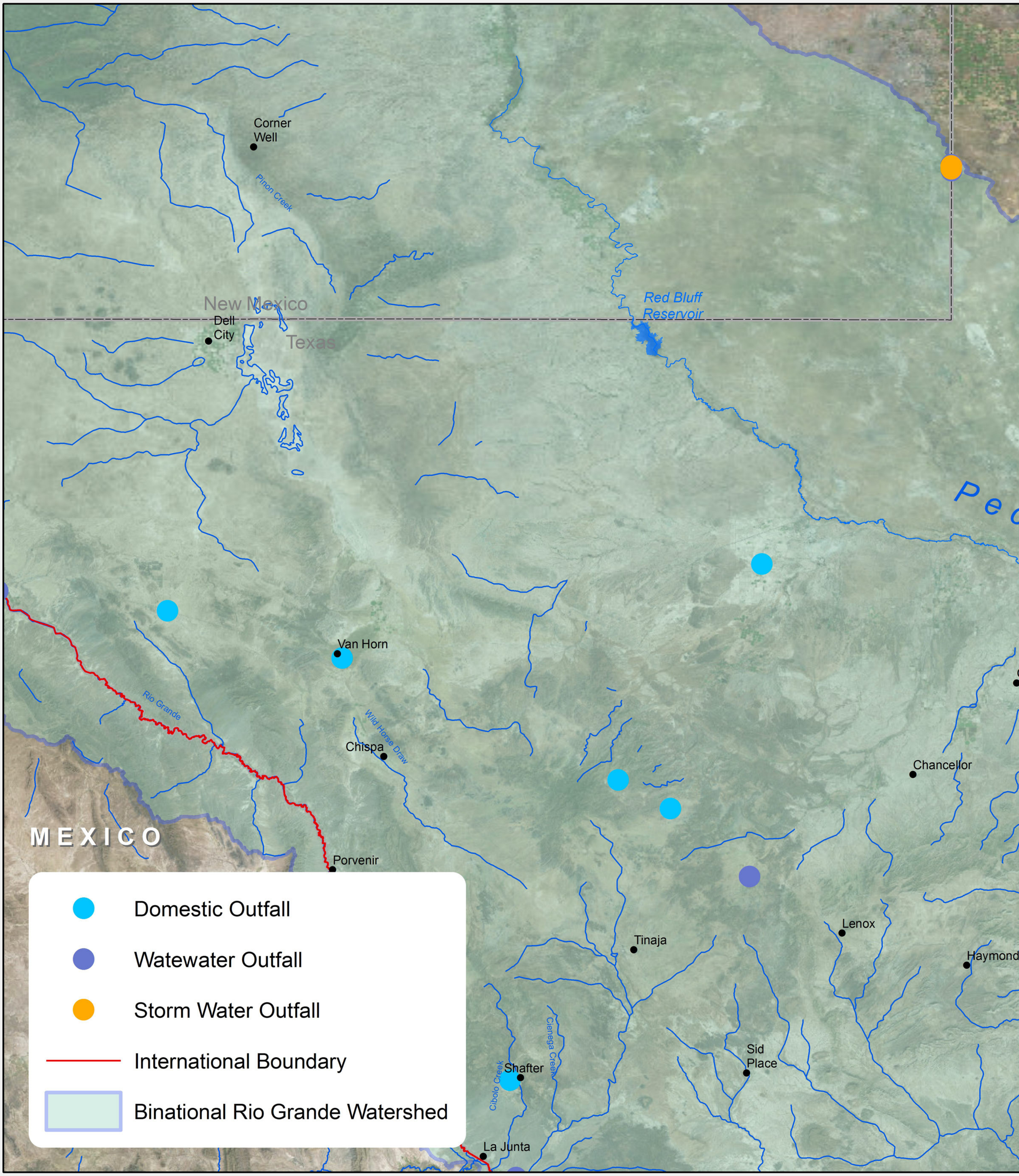

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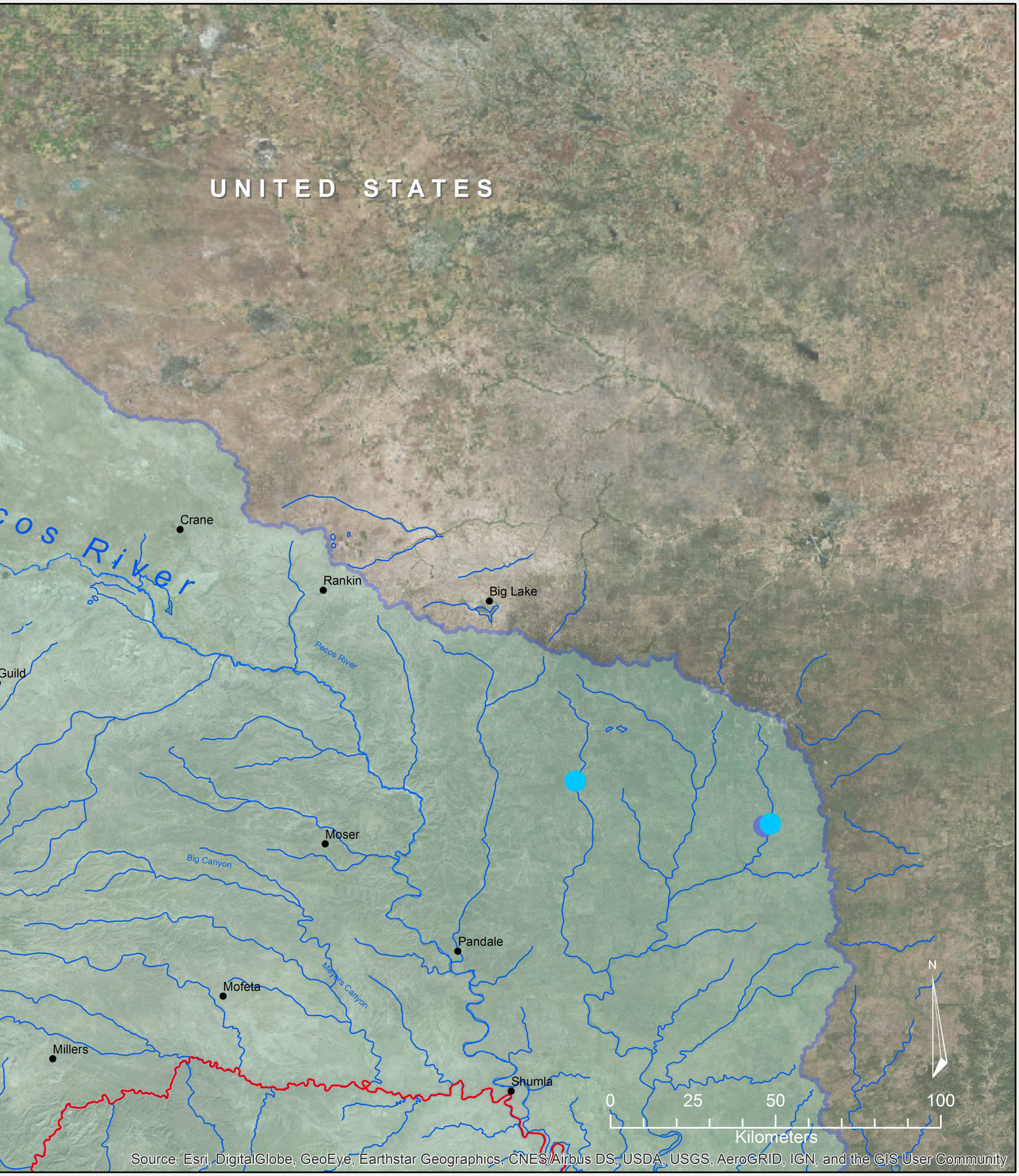

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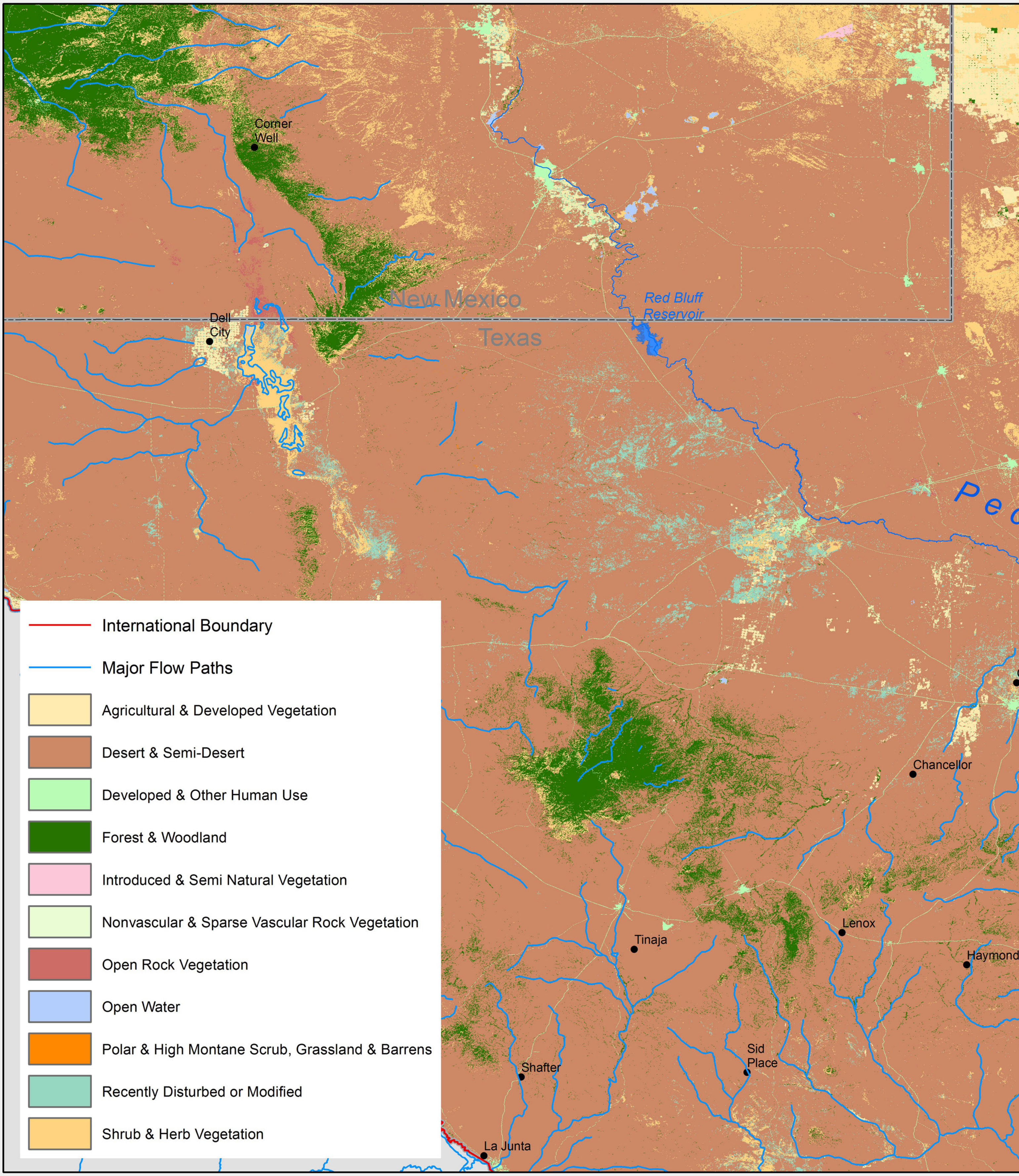

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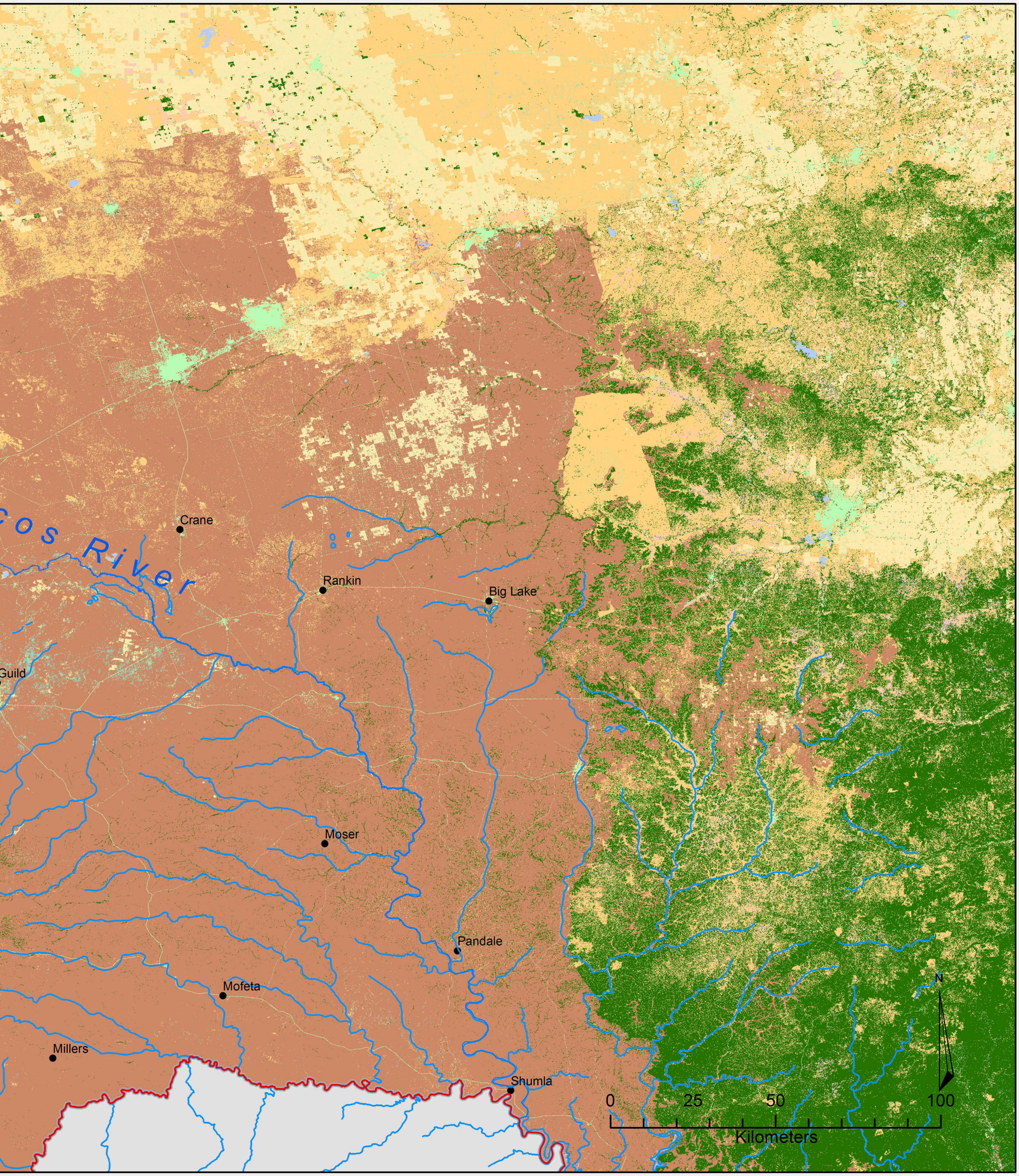

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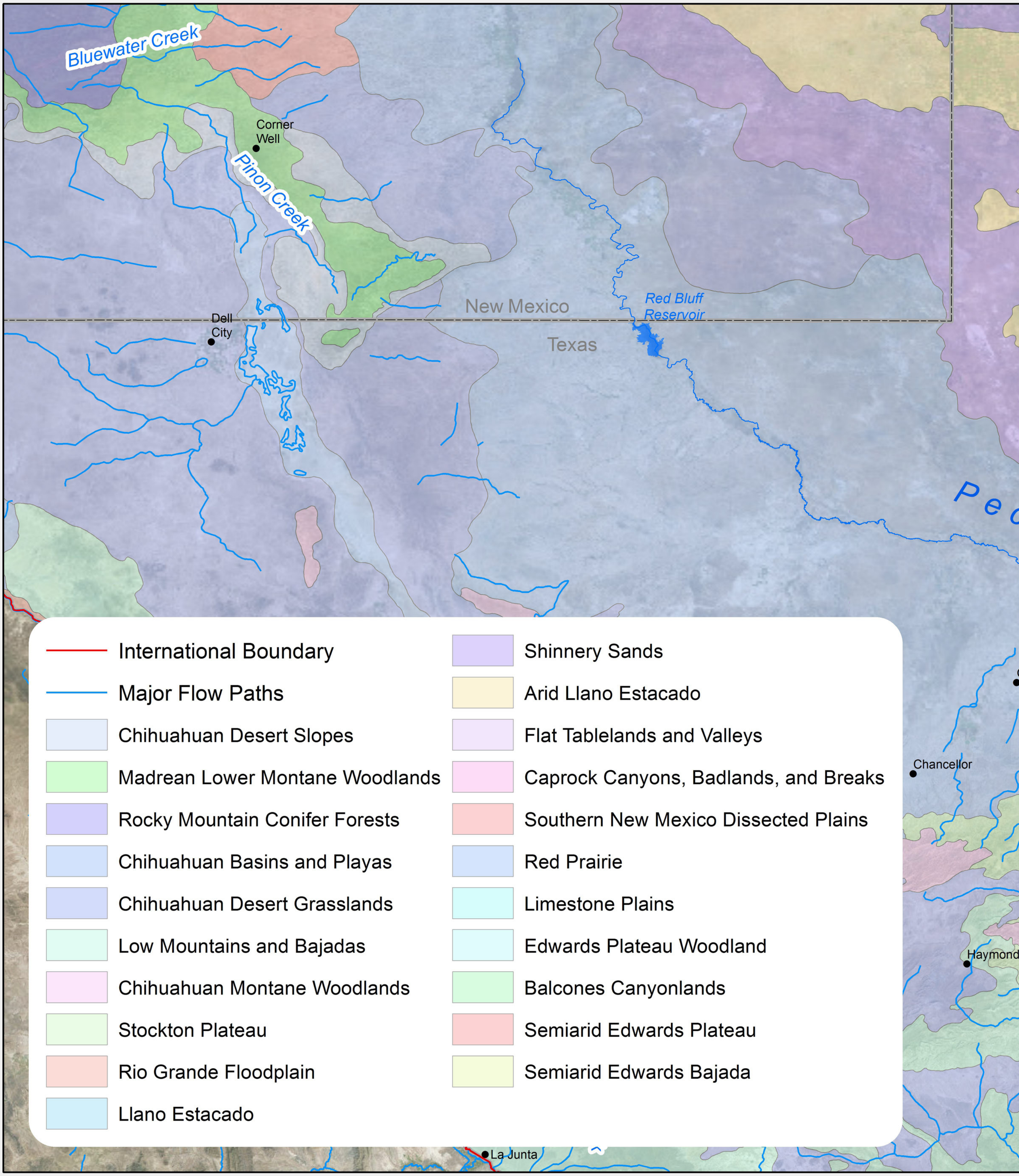

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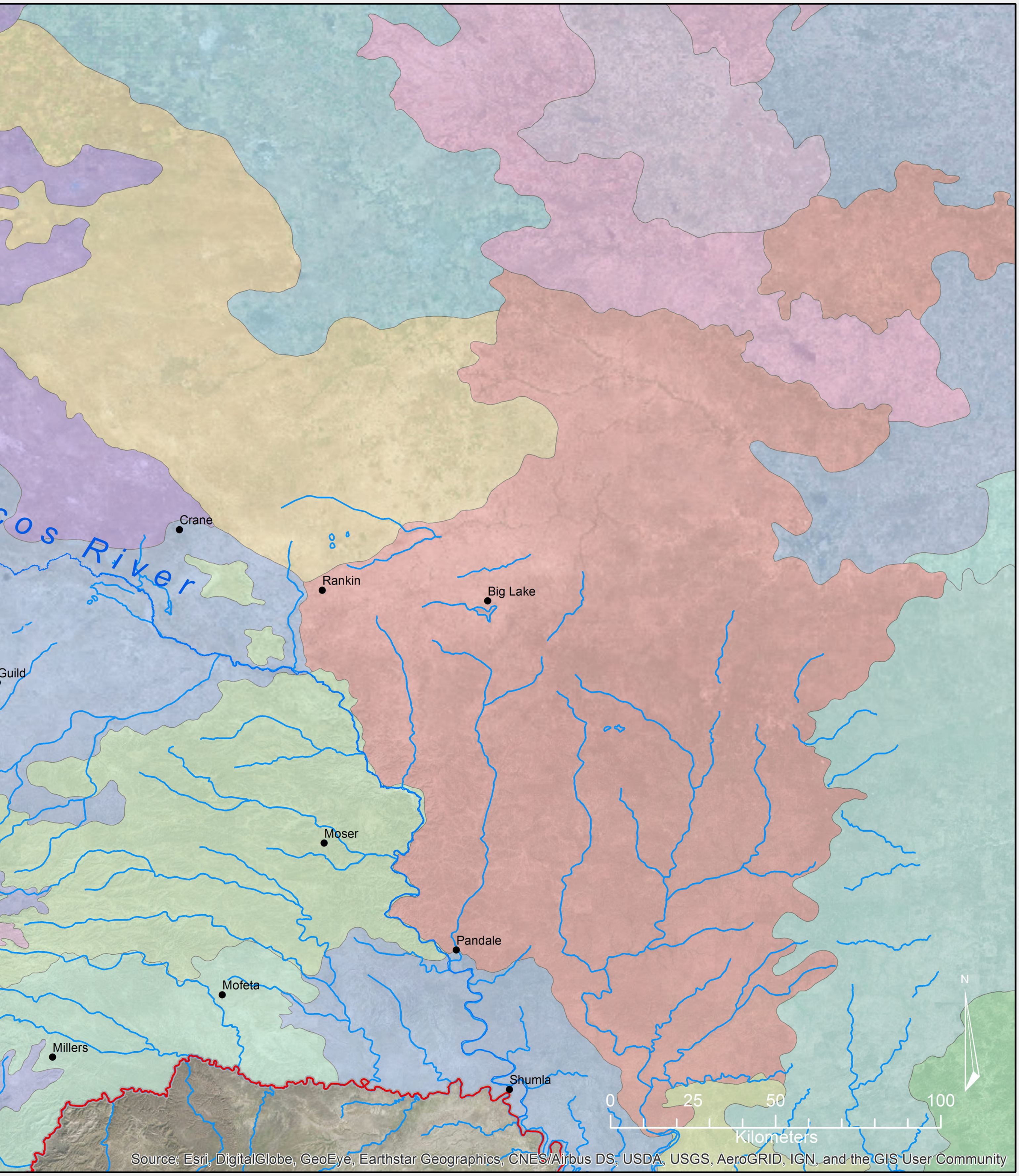

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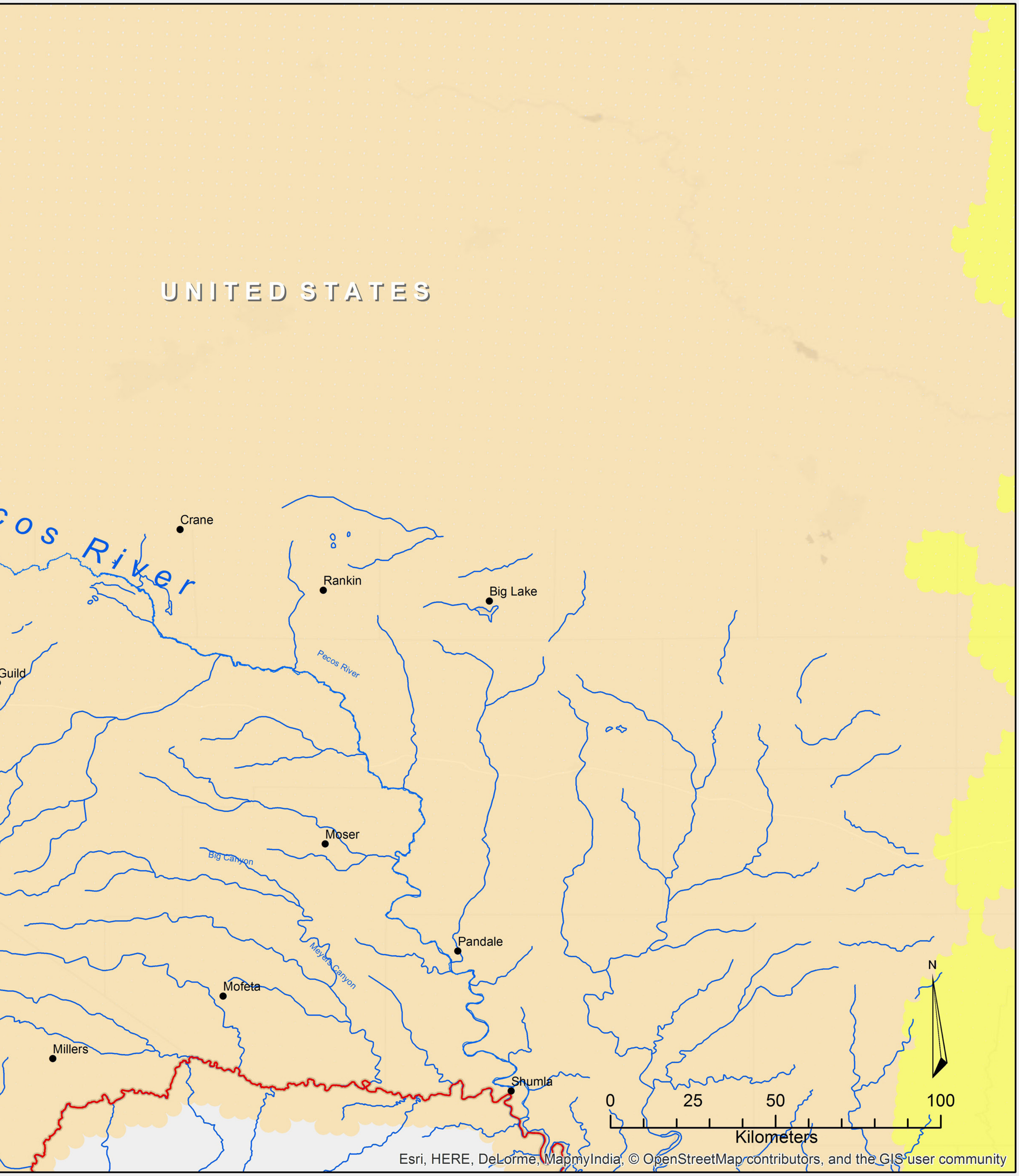

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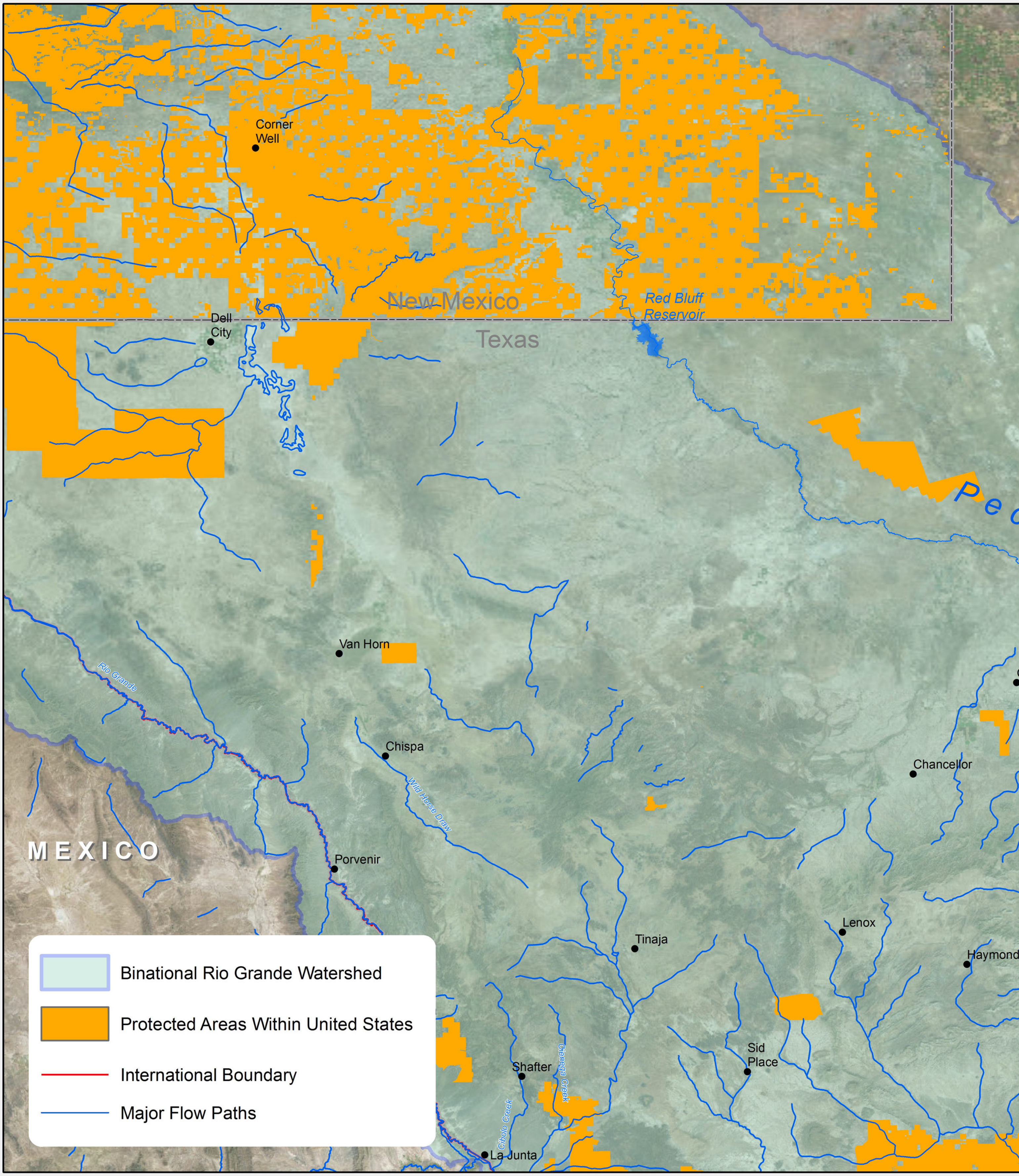

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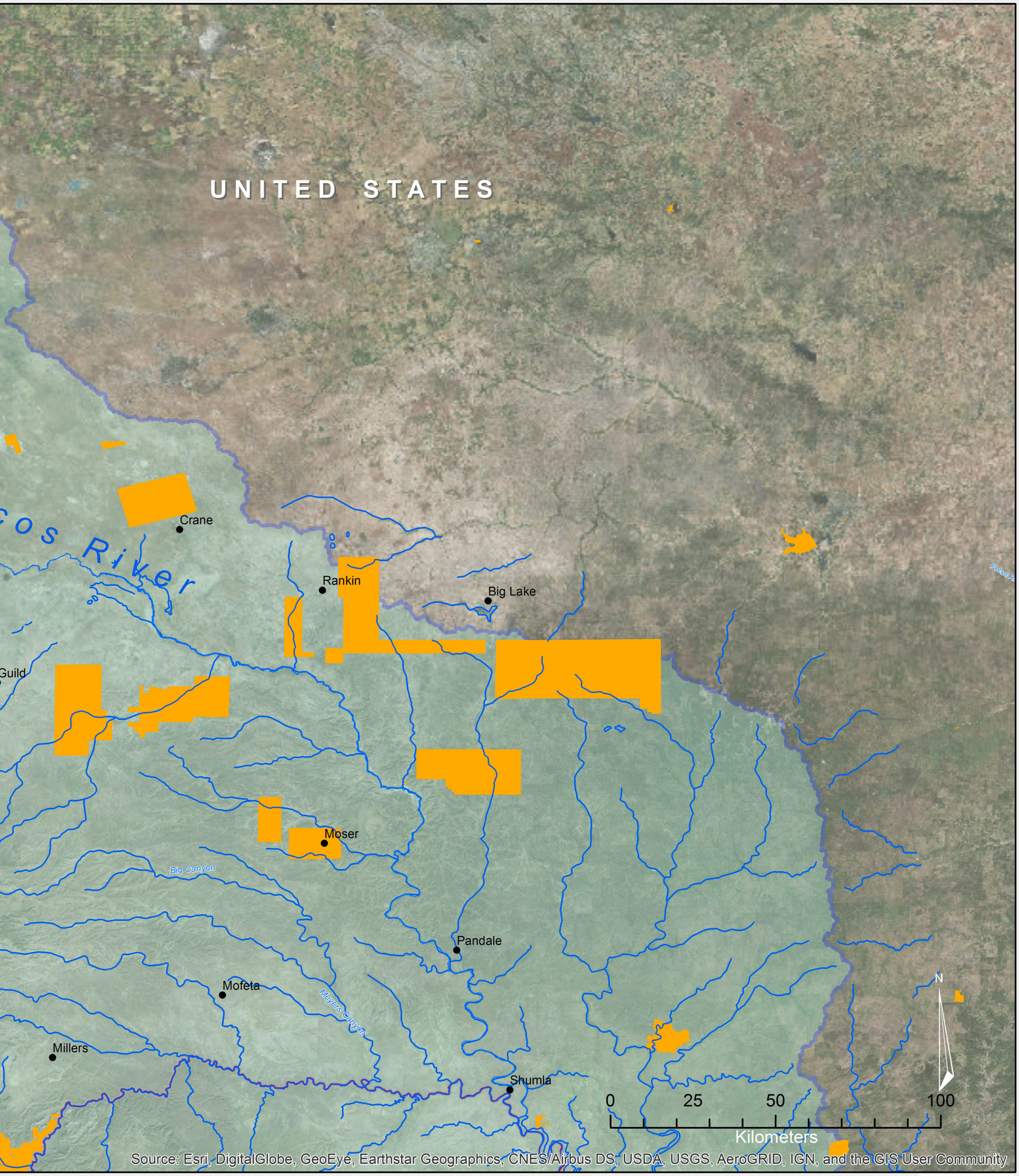

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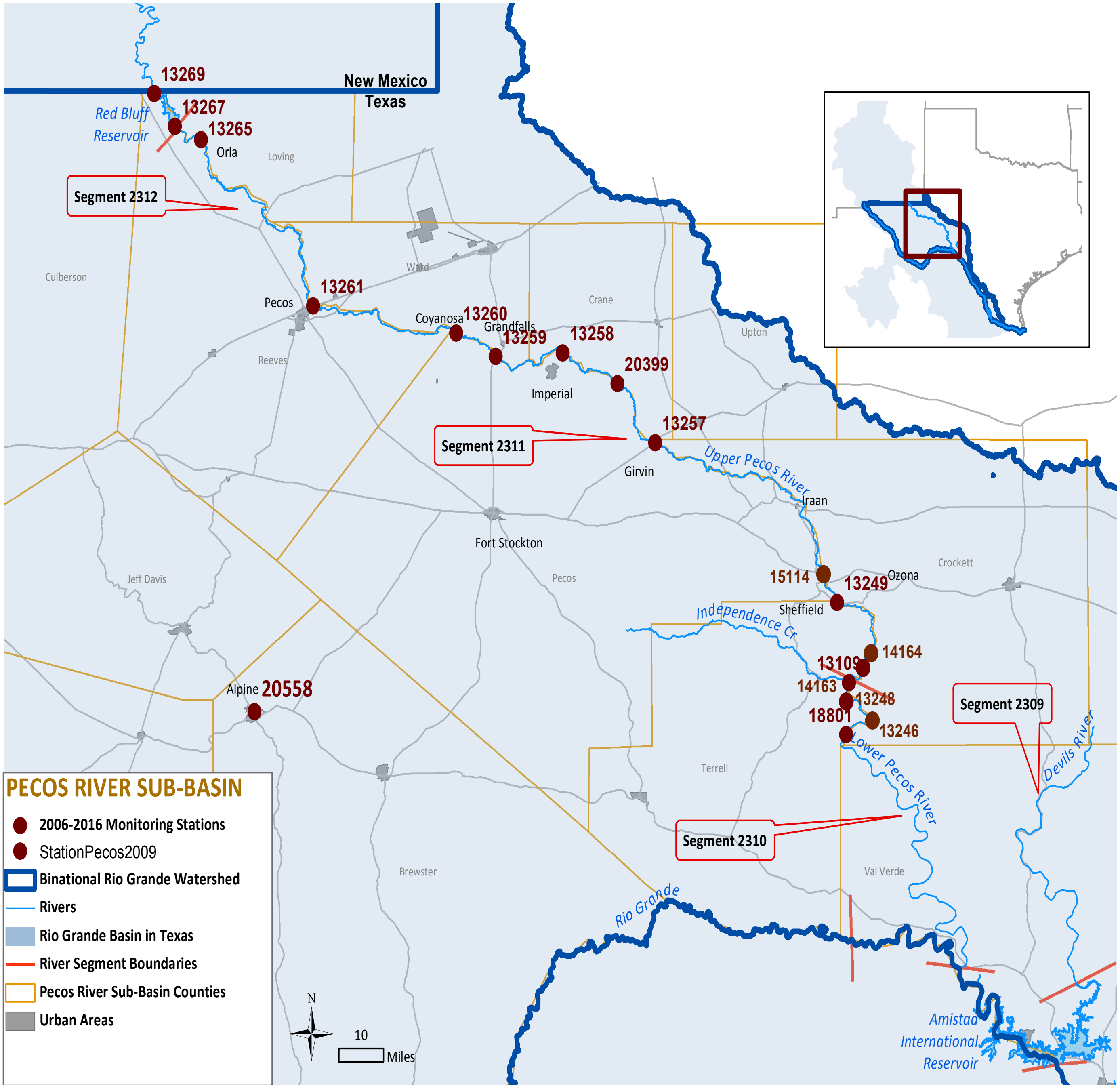
Figure . Map of the Pecos River Sub-Basin in Texas



Pictured: Midland College Professor Greg Larson with USIBWC CRP staff.

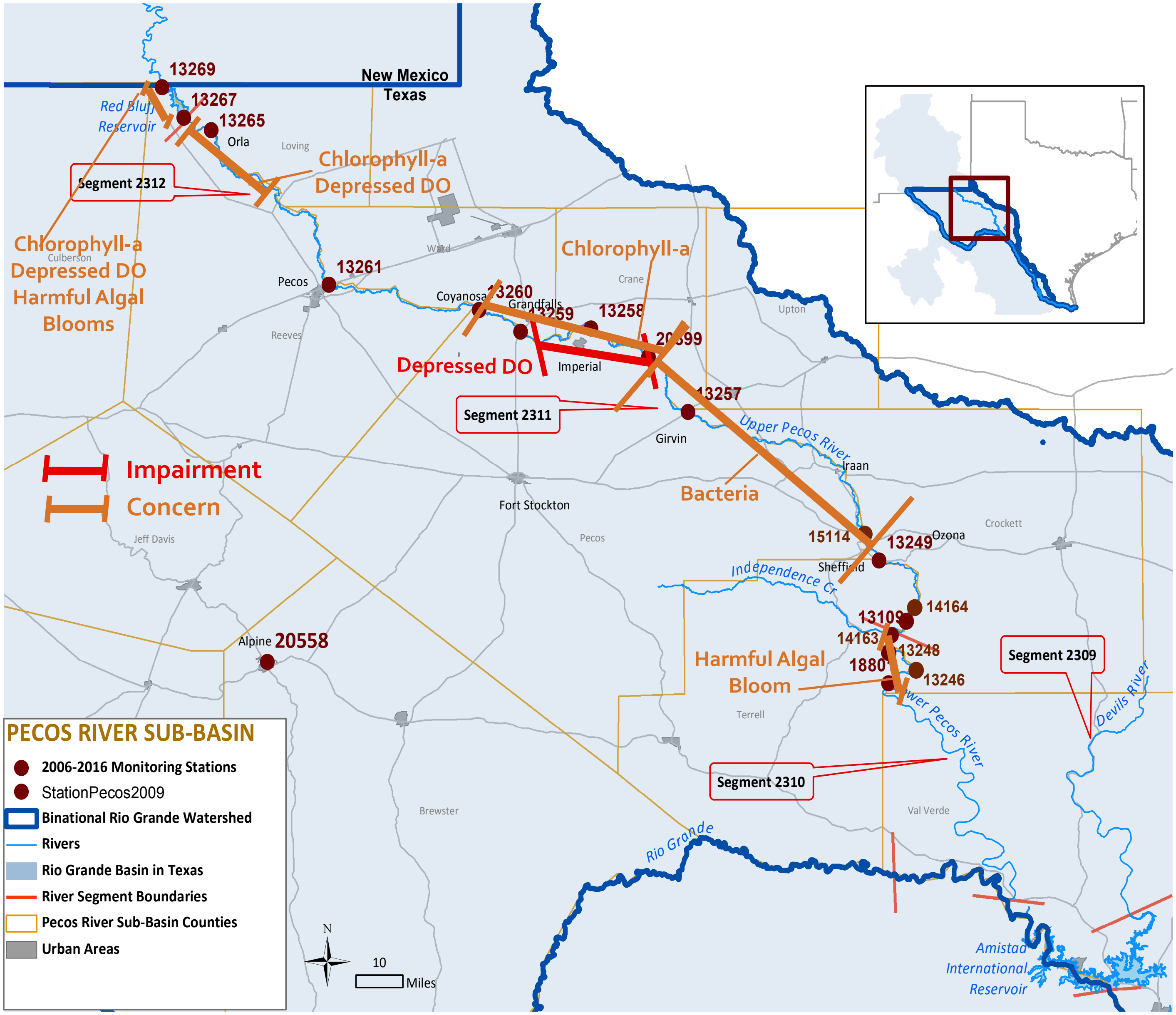
PECOS RIVER WATER QUALITY UPDATE

Table 8 characterizes the Pecos River sub-basin and its associated segments by listing active stations, and providing water quality information. For questions about water quality in the Rio Grande Basin presented in this report, or for information on historical or currently inactive stations, please contact USIBWC CRP staff (contact information located in back cover).

Table 8. Statistical Analysis of Water Quality Data for the Pecos River Sub-Basin This table describes analytical means for parameters with established water quality standards, as well as parameters for which there are screening levels (most often nutrients). Tables for the individual stations with additional statistical analysis are available in Appendix A. Values in cells represent means or geomeans (bacteria). The blue highlight indicates a statistically significant decreasing trend (p ≤ 0.1), while the yellow indicates a significantly increasing trend (p ≤ 0.1). Red text indicates the mean of the parameter over the period of record is above the Texas State Water Quality Standard, with the exception of dissolved oxygen, where falling below 5 mg/L would indicate impairment. An asterisk (*) indicates that the station had a sample size (n) for that parameter that is less than the samples size required for trend analysis (n ≥ 10).

Station	pH	Dissolved Oxygen (mg/L)	Ammonia (mg/L)	Chlorophyll-a (ug/L)	Total Phosphorus (mg/L)	Bacteria (MPN/100ml)	Sulfate (mg/L)	Chloride (mg/L)	Nitrate + Nitrite (mg/L)	TDS (mg/L)
Segment 2312 | Red Bluff Reservoir										
13269	8.1	8.2	0.08	31.06	0.06	29*	1933.68	2606.63	0.08	6256.36
13267	8.0	7.5	0.06	22.59	0.05	6*	2277.89	2812.11	0.04	7378.89*
Standards and Screening Levels	6.5-9	5	0.11	26.7	0.2	33	2200	3200	0.37	9400
Segment 2311 | Upper Pecos River										
13265	7.9	8.3	0.14	21.21	0.04	27*	2494.29	3253.06	0.08	7447.78
13261	.	.	0.06	.	0.06	.	2215.04	2886.25	0.04	7830.80
13260	7.7	8.4	0.12	12.55	0.05	23*	3065.71	5006.67	0.07	9749.67
13259	.	.	0.07	.	0.06	.	2502.85	3940	0.04	9650
13258	.	.	0.09	.	0.06	.	2836.70	4406.40	0.06	11070.40
20399	.	.	0.09	.	0.06	.	3115.77	4913.48	0.04	12247.92
13257	8.0	7.6	0.10	14.04	0.04	51*	4093.56	6390	0.06	12996.40
15114	7.9	8.7	0.06*	9.98*	0.05*	52*	2304.44*	4168.89*	0.27*	9787.78*
13249	7.8	8.1	0.07	12.69	0.04	.	1915.85	3261.82	0.39	8828.18
20558	7.0	5.8	0.64	100.79	0.09	32	47.87	29.71	0.65	449.54
Standards and Screening Levels	6.5-9	5	0.33	14.1	0.69	33	3500	7000	1.95	15000
Segment 2310 | Lower Pecos River										
13248	7.9	7.7	0.10*	17.13*	0.05*	.	1324.75*	2382.57*	0.21*	6157.71*
13109	8.1	8.8	0.05	1.72	0.04	12	149.21	101.41	1.01	618.28
14163	7.9	7.9	0.10*	13.25*	0.05*	46*	1055.38*	1832.57*	0.36*	7840.75*
13246	8.0*	7.8*	0.05*	6.80*	0.06*	25*	799.71*	1306*	0.67*	3532.86*
18801	8.0	8.8	0.05	5.89	0.04	33	823.88	1293.24	0.48	3689.09
Standards and Screening Levels	6.5-9	6	0.33	14.1	0.69	126	1000	1700	1.95	4000

Figure . Water Quality Impairments and Concerns in the Pecos River Sub-Basin



Pictured: USIBWC staff with TCEQ SWQM Staff during Pecos Aquatic Life Monitoring Study in 2011.

Table 9. Water Quality Review for the Pecos River Sub-Basin

Water Quality Review for the Upper Rio Grande Sub-Basin					
Segment	***Uses**	**Stations**		**Segment Characteristics**	**Water Quality Summary**
Lower Pecos River-Segment 2310 and Independence Creek-Segment 2310A	PCR, H, PS	13109, 13246, 13248, 14163, 18801	89 mi	Defined as from a point 0.7 km (0.4 miles) downstream of the confluence with Painted Canyon in Val Verde County to a point immediately upstream of the confluence with Independence Creek in Crockett/Terrell County	Designated uses are high aquatic life use, PCR, general use, fish consumption, and public water supply. Waters from Independence Creek have brought TDS values down to drinking level standard, but recent years shows these values increasing again. Water quality concerns for golden algae blooms and associated fish kills.
Upper pecos River-Segment 2311	PCR, L	13249, 13257, 13258, 13259, 13260, 13261, 13265, 15114, 20399, 20558	349 mi	Defined as from a point immediately upstream of the confluence of Independence Creek in Crokett/Terrell County to Red Bluff Dam in Loving/Reeves County	This segment is naturally high in salts due to groundwater passing through salt-bearing geologic formations. The high salinity prohibits its use as public water supply and limits agriculture to salt-tolerant crops. Salinity progressively increases going downstream toward Girvin.
Red Bluff Reservoir-Segment 2312	PCR, H	13267, 13269		The Texas portion of Red Bluff Reservoir, which is an on-channel impoundment encompassing 11,700 acres. Red Bluff Dam impounds the waters of the Pecos River entering from New Mexico.	Naturally occurring salt springs situated upstream of the reservoir in New Mexico contribute to very high levels of TDS and chlorides (typically over 6,000 mg/L). The high salinity prohibits its use as public water supply and limits agriculture to salt-tolerant crops.

*For an explanation of the uses, please refer to Table 3, Designated Uses for Freshwater on page 11.

Pictured: Red Bluff Reservoir. Photo courtesy of Sandra Mireles

Segment 2312, Red Bluff Reservoir

Segment 2312 is defined as from Red Bluff Dam in Loving/Reeves County to New Mexico State Line in Loving/Reeves County, up to normal pool elevation 2,842 feet (impounds Pecos River). It is the Texas portion of Red Bluff Reservoir, an on-channel impoundment encompassing 11,700 acres. The Red Bluff Dam, which was constructed in 1936 for irrigation and hydroelectric power, impounds the waters of the Pecos River entering from New Mexico. Naturally occurring salt springs situated upstream of the reservoir in New Mexico contribute to very high levels of TDS and chlorides (typically over 6,000 mg/L). The high salinity prohibits the use of this water for public water supply, and limits agriculture to salt-tolerant crops. Most of the documented golden algae blooms have occurred either in Red Bluff Reservoir or the Upper Pecos River where the water is very saline. The majority of golden algae-related fish kills occur during the winter and spring months when the water temperatures are cold. This segment has no current impairments, but does have water quality concerns for chlorophyll-a, depressed dissolved oxygen levels, and harmful algae bloom/golden alga. In the 2014 Integrated Report, Segment 2312 has no water quality impairments. It does, however, have water quality concerns for chlorophyll-a, depressed dissolved oxygen, and harmful algal bloom/golden alga.

Segment 2312 has two Assessment Units:

2312_01 From From the Red Bluff Dam to mid-lake

2312_02 From mid-lake to the Texas/New Mexico state line

There are 2 active stations within this segment:

13267, Red Bluff Reservoir upstream Dam north of Orla

13269, Red Bluff Reservoir 1/2 mile south of Texas-New Mexico Border

Pictured: Red Bluff Reservoir during flood in 2014. Photo Courtesy of the National Weather Service.

Assessment Unit 2312_01 has no impairments, but has concerns for chlorophyll-a, depressed dissolved oxygen, and harmful algal blooms. This AU is monitored by Station 13267.

At Station 13267 (Red Bluff Reservoir north of Orla), bacteria data did not meet the minimum number of sampling events required for trend analysis, and the geomean is being provided for informational purposes only. Eight *E.coli* bacteria samples had a geomean of 6 MPN (most probable number). The water quality data indicated that dissolved oxygen levels had an mean of 7.5 mg/L, and the mean for pH at this station during the period of record is 8.0. The mean for total dissolved solids is 7,378.89 mg/L, which is below the standard set at 9,400 mg/L for this segment. Ammonia data for this station shows a mean of 0.06 mg/L. The mean for total phosphorus is 0.05 mg/L. The mean for chlorophyll-a is 22.59 ug/l. The mean for sulfate is 2277.89 mg/L, which is above the water quality standard. The mean for chloride is 2812.11 mg/L. The mean for nitrate+nitrite is 0.04 mg/L. There were no trends for any parameters.

Assessment Unit 2312_02 has no impairments, but has concerns for chlorophyll-a, depressed dissolved oxygen, and harmful algal blooms. This AU is monitored by Station 13269.

At Station 13269 (Red Bluff south of TX/NM Border), the sample size for bacteria was very small, so the data are not statistically reliable and are for informational purposes only. Three *E.coli* bacteria samples had a geomean of 29 MPN (most probable number). The water quality data indicated that dissolved oxygen levels had an mean of 8.2 mg/L, and the mean for pH at this station during the period of record is 8.1. The mean for total dissolved solids is 6,256.36 mg/L. Ammonia data for this station shows a mean of 0.08 mg/L. The mean for total phosphorus is .06 mg/L. The mean for chlorophyll-a is 31.06 ug/L. The mean for sulfate is 1933.68 m/L, and the mean for chloride is 2606.63 mg/L. The mean for nitrate+nitrite is 0.08 mg/L, and shows a decreasing trend. No other parameter shows a statistically significant trend. The concerns for fish kills require additional sampling efforts and is carried forward from the 2014 Integrated Report.

Pictured: Red Bluff Reservoir during flood in 2014. Photos Courtesy of the National Weather Service. Top picture shows the reservoir filled up past conservation capacity. Bottom picture shows debris field behind the dam.

Segment 2311, Upper Pecos River

Segment 2311 is classified as a freshwater stream and is defined as from a point immediately upstream of the confluence of Independence Creek in Crockett/Terrell County to Red Bluff Dam in Loving/Reeves County. This reach of the river is naturally high in salts due to groundwater passing through salt-bearing geologic formations. The water in this segment is also too saline for public consumption. The salinity progressively increases going downstream until reaching Girvin, TX where TDS can measure up to 21,000 mg/L. In the 2014 Integrated Report, Segment 2311 is impaired for depressed dissolved oxygen levels in water. It also has water quality concerns for bacteria, chlorophyll-a, depressed dissolved oxygen, and harmful algal bloom/golden alga. Segment 2311 does not monitor for *E.coli* due to the high salinity.

Segment 2311 has eight Assessment Units:

2311_01 From just upstream of the Independence Creek confluence upstream to US Hwy 290
2311_02 From US Hwy 290 upstream to US Hwy 67
2311_03 From US Hwy 67 upstream to the Ward Two Irrigation Turnout
2311_04 From the Ward Two Irrigation Turnout upstream to US Hwy 80 (Bus 20)
2311_05 From US Hwy 80 (Bus 20) upstream to the Barstow Dam
2311_06 From the Barstow Dam upstream to State Hwy 302
2311_07 From State Hwy 302 upstream to FM 652
2311_08 From FM 652 upstream to the Red Bluff Dam

There are 11 stations within this segment:

13249, Upper Pecos River at Bridge on SH 290 SE of Sheffield CAM 0735
13257, Pecos River at US 67 NE of Girvin
13258, Pecos River at FM 1053 NE of Imperial
20399, Pecos River 62 Meters North and 17 Meters East to the end of Horse Head Road and 5.02 km North and 927 meters east to the intersection of RR 11 and Horse Head Rd
13259, Pecos River at SH 18 SSW of Grandfalls
13260, Pecos River at FM 1776 SW of Monahans CAMS 709
13261, Pecos River at US 80 NE of Pecos at CAMS 710
15114, Pecos River 1.6 mi Upstream of SH 290 Bridge SE of Sheffield
13265, Pecos River at FM 652 Bridge NE of Orla CAMS 0798
13248, Pecos River 0.1 km Upstream of the Confluence with Independence Creek Chandler Ranch
20558, Kokernot Springs 105 m South 20 m east from the intersection of Alpine Creek and Hendryx Drive/Harrison Street/SH 223 and 40 meters east of the Kokernot Lodge on Sul Ross University Campus in Alpine

Assessment Unit 2311_01 has no impairments, but has concerns for harmful algal blooms. This AU is not currently being monitored.

Assessment Unit 2311_02 has no impairments, but has concerns for bacteria and harmful algal blooms. This AU is monitored by Station 13249.

At Station 13249 (Upper Pecos River near Sheffield), the water quality data indicated that dissolved oxygen levels had an mean of 8.1 mg/L, and shows no trend. The mean for pH at this station during the period of record is 7.8 and shows a decreasing trend. The mean for total dissolved solids is 8,828.18 mg/L and shows no distinct trend. Ammonia data for this station shows a mean of 0.07 mg/L and shows neither an increasing or decreasing trend. The mean for total phosphorus is 0.04 mg/L, and shows a decreasing trend. The mean for chlorophyll-a is 12.69 ug/l, and also shows no significant trend. This station also shows a decreasing trend for nitrate+nitrite, which shows a mean of 0.39 mg/L. The mean for sulfate is 1,933.68 mg/L, and chloride has a mean of 2,606.63 mg/L; neither show a significant trend. Please see the graphs for this station in Appendix B.

Assessment Unit 2311_03 is impaired for depressed dissolved oxygen, and has concerns for bacteria, chlorophyll-a, and harmful algal blooms. This AU is monitored by Stations 13257, 13258, and 20399.

At Station 13257 (Pecos River at Girvin), the bacteria sample size was very small, so the data are not statistically reliable and are for informational purposes only. Seven *Enteroccocus* samples had a geomean of 51 MPN, which is above the standard. The mean for DO is 7.6 mg/L. The mean for pH is 8.0. The mean for total dissolved solids is 12,996.40 mg/L. Ammonia data for this station shows a mean of 0.10 mg/L. The mean for total phosphorus is 0.04 mg/L. The mean for chlorophyll-a is 14.04 ug/L. The mean for sulfate is 4,093.56 mg/L, which is above the standard. The mean for chloride is 6,390 mg/L, and the mean for nitrate+nitrite is 0.06 mg/L. There were no statistically significant trends for any parameter.

At Station 13258 (Pecos River NE of Imperial), there was not enough data collected to determine means for pH and DO. The mean for total dissolved solids is 11,070.40 mg/L and shows no distinct trend. Ammonia data for this station shows a mean of 0.09 mg/L and shows neither an increasing or decreasing trend. The mean for total phosphorus is 0.06 mg/L, and shows no distinct trend. There is not enough data to determine a mean for chlorophyll-a. The mean for sulfate is 2,836.70 mg/L. The mean for chloride is 4,406.40 mg/L, and the mean for nitrate+nitrite is 0.06 mg/L. None of these parameters showed significant trends.

At Station 20399 (Pecos River near Horse Head Road), there was not enough data collected to determine means for pH and DO. The mean for total dissolved solids is 12,247.92 mg/L and shows no distinct trend. Ammonia data shows a mean of 0.09 mg/L and shows neither an increasing or decreasing trend. The mean for total phosphorus is 0.06 mg/L, and shows no significant trend. There is not enough data to determine a mean for chlorophyll-a. The mean for sulfate is 3,115.77 mg/L with no significant trend. The mean for chloride is 4,913.48 mg/L, and the mean for nitrate+nitrite is 0.04 mg/L; neither parameter showed significant trends.

Pictured: Pecos River near Grandfalls, TX. Photo from Wikipedia.

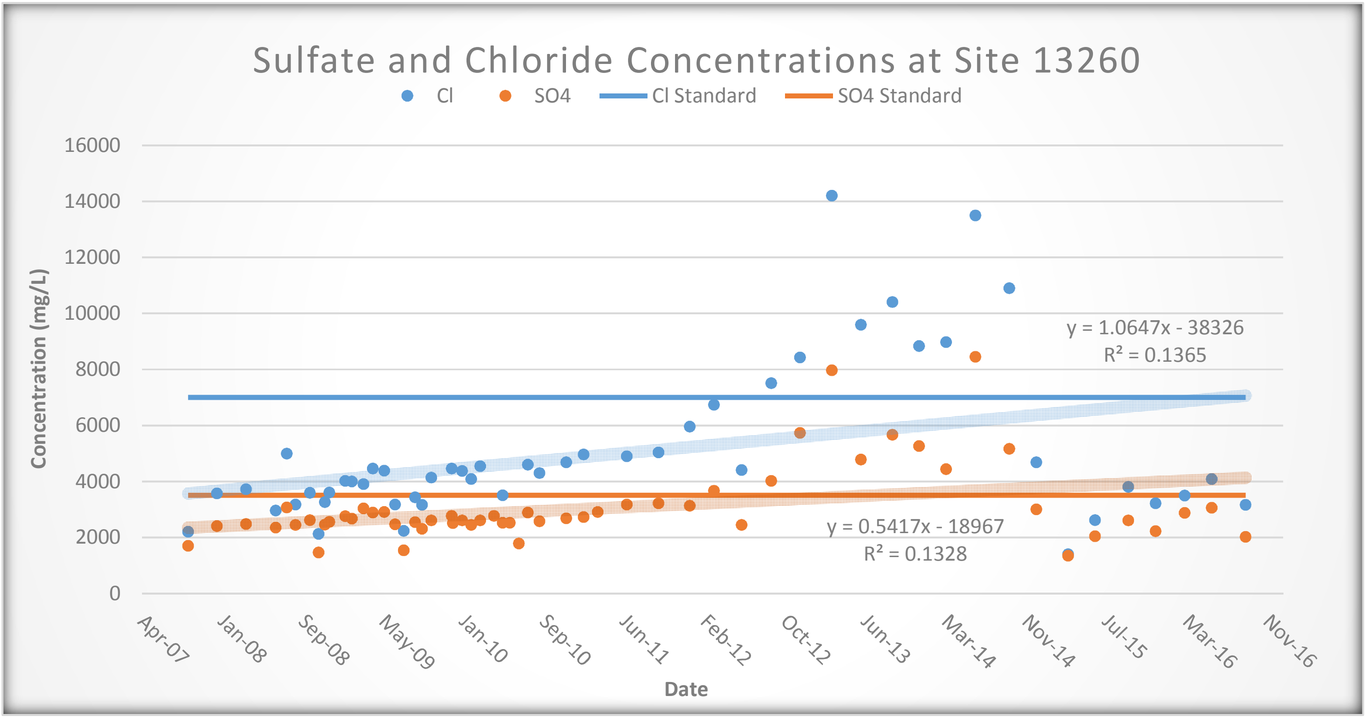
Assessment Unit 2311_04 has no impairments, but has concerns for chlorophyll-a and harmful algal blooms. This AU is monitored by Stations 13259 and 13260.

Sampling at Station 13259 (Pecos River near Grandfalls) stopped in 2010. At that time, there was not enough data collected to determine means for pH and DO. The means are provided for informational purposes, since there has not been water sampling at this location since then. The mean for total dissolved solids is 9,650 mg/L. Ammonia data for this station shows a mean of 0.07 mg/L. The mean for total phosphorus is 0.06 mg/L. There is not enough data to determine a mean for chlorophyll-a. This mean for chloride is 3,940 mg/L. The mean for sulfate is 2,502.85 mg/L, and the mean for nitrate+nitrite is 0.04 mg/L. Please see the graph for this station below.

The Pecos River, dry, due to severe drought, circa 2012. Photo credit USIBWC CRP partner Midland College.

At Station 13260 (Pecos River near Monahans CAMS 709), the mean for DO is 8.4 mg/L, and shows no distinct trend. The mean for pH is 7.7 and also shows no significant trend. The mean for total dissolved solids is 9,749.67 mg/L. Ammonia data shows a mean of 0.12 mg/L and shows neither an increasing or decreasing trend. The mean for total phosphorus is 0.05 mg/L, and shows no distinct trend. The mean for chlorophyll-a is 12.55 ug/L and shows no distinct trend. This station shows an increasing trend for sulfate, with a mean of 3,065.71 mg/L. Chloride has a mean of 5,006.67 mg/L. The increasing trends for both sulfate and chloride may be drought-related, because there seems to be an increase in the values in 2010, when the drought began to worsen. The mean for nitrate+nitrite is 0.07 and shows no significant trend. Please see graphs for this station on the following page.

Figure 46.



Pictured: A cow grazing at the Pecos River near Imperial. Photo credit USIBWC CRP staff.

Assessment Unit 2311_05 has no impairments, but has concerns for harmful algal blooms. This AU is monitored by Station 13261.

At Station 13261 (Pecos River NE of Pecos at CAMS 710), there was not enough data collected to determine means for pH and DO. Means for additional parameters are provided for informational purposes only. The mean for total dissolved solids is 7,830.80 mg/L. Ammonia data for this station shows a mean of 0.06 mg/L. The mean for total phosphorus is 0.06 mg/L. There is not enough data to determine a mean for chlorophyll-a. The mean for sulfate is 2,215.04 mg/L. The mean for chloride is 2,886.25 mg/L. The mean for nitrate+nitrite is 0.04 mg/L.

Assessment Unit 2311_06 has no impairments, but has concerns for harmful algal blooms. This AU is currently not being monitored.

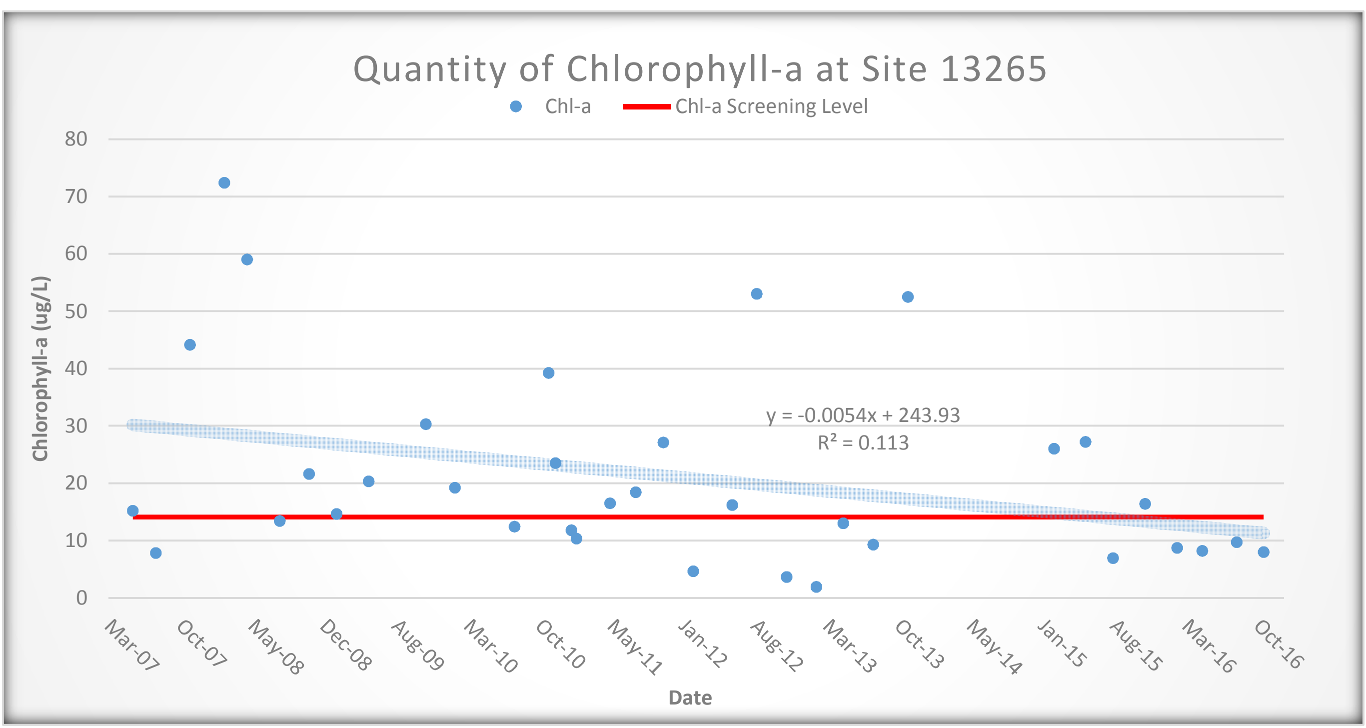
Assessment Unit 2311_07 has no impairments, but has concerns for harmful algal blooms. This AU is monitored by Station 15114.

Sampling at Station 15114 (Pecos River upstream of Sheffield) has not been conducted since 2013. The mean for DO is 8.7 mg/L. The mean for pH is 7.9. The sample size for the rest of the parameters was too small, and data is provided for information only.The mean for total dissolved solids is 9,787.78 mg/L. Ammonia data for this station shows a mean of 0.06 mg/L. The mean for total phosphorus is 0.05 mg/L. The mean for chlorophyll-a is 9.98 ug/L. Sulfate has a mean of 2,304.44 mg/L, and chloride has a mean of 4,168.89 mg/L. The mean for nitrate+nitrite is 0.27 mg/L.

Assessment Unit 2311_08 has no impairments, but has concerns for harmful algal blooms. This AU is monitored by Station 13265, 13248, and 20558.

At Station 13265 (Pecos River NE of Orla at CAMS 0798), the mean for DO is 8.3 mg/L, and shows no distinct trend. The mean for pH is 7.9 and also shows no significant trend. The mean for total dissolved solids is 7,447.78 mg/L and shows no distinct trend. Ammonia data for this station shows a mean of 0.14 mg/L and shows neither an increasing or decreasing trend. The mean for total phosphorus is 0.04 mg/L, and shows no distinct trend. The mean for chlorophyll-a is 21.21 ug/L and shows a decreasing trend. Sulfate has a mean of 2,494.29 mg/L, and chloride has a mean of 3,253.06 mg/L; neither parameter shows a significant trend. The mean for nitrate+nitrite is 0.08 mg/L, and shows no significant trend. Please see graph for this station below.

Figure 47.



At Station 13248 (Pecos River at Chandler Ranch), the mean for DO is 7.7 mg/L, and shows no distinct trend. The mean for pH is 7.9 and also shows no significant trend. This station had no monitoring from 1993-2013, so the sample size for the rest of the parameters was less than 10 and data is provided for information only. The mean for total dissolved solids is 6,157.71 mg/L and is above the standard. Ammonia data for this station shows a mean of 0.10 mg/L. The mean for total phosphorus is 0.05 mg/L. The mean for chlorophyll-a is 17.13 ug/L. Sulfate has a mean of 1,324.75 mg/L, which is above the standard. The mean for chloride is 2,382.57 mg/L, which is above the standard. The mean for nitrate+nitrite is 0.21 mg/L.

Station 20558 is a spring, Kokernot Springs, located in Alpine, TX. For Station 20558, 14 *E.coli* samples had a geomean of 32 MPN. The mean for DO is 5.8 mg/L, and shows no distinct trend. The mean for pH is 7.0 and also shows no significant trend. The mean for total dissolved solids is 449.54 mg/L and shows no distinct trend. Ammonia data for this station shows a mean of 0.64 mg/L and shows neither an increasing or decreasing trend. The mean for total phosphorus is 0.09 mg/L, and shows no distinct trend. The mean for chlorophyll-a is 100.79 ug/L and shows no significant trend. The mean for nitrate+nitrite is 0.65 mg/L. The mean for sulfate is 47.87 mg/L, with no significant trend. The mean for chloride is 29.71 mg/L, and also shows no significant trend.

Segment 2310, Lower Pecos River

Segment 2310 is classified as a freshwater stream and is the lower reach of the Pecos River. The water in this reach is designated for high aquatic life use, PCR, general use, fish consumption, and public water supply. Waters from Independence Creek have historically brought dissolved solids values down enough to treatable drinking water levels, but more recent data have shown increasing chloride, sulfate and TDS. This segment currently has no impairments, but has concerns for harmful algae bloom/ golden algae.

Segment 2310 has two Assessment Unitss:

2310_01 From the Devils River Arm of Amistad Reservoir confluence upstream to FM 2083 near Pan Dale

2310_02 From FM 2083 near Pan Dale upstream to just upstream of the Independence Creek confluence

There are three stations within this segment:

13246, Pecos River 7.52 km upstrm from the Val Verde/Terrell/Crockett County Line convergence

14163, Pecos River approx 355 meters downstream from the confluence with Independence Creek

18801, Lower Pecos River west bank 3.56 km/2.3 mi upstream of Terrell/Val Verde/Crockett County line convergence CAMS 0729 on Brotherton Ranch

Assessment Unit 2310_01 has no impairments, but has concerns for harmful algal blooms. This AU is not currently being monitored.

Assessment Unit 2310_02 has no impairments, but has concerns for bacteria and harmful algal blooms. This AU is monitored by Stations 13246, 14163, and 18801.

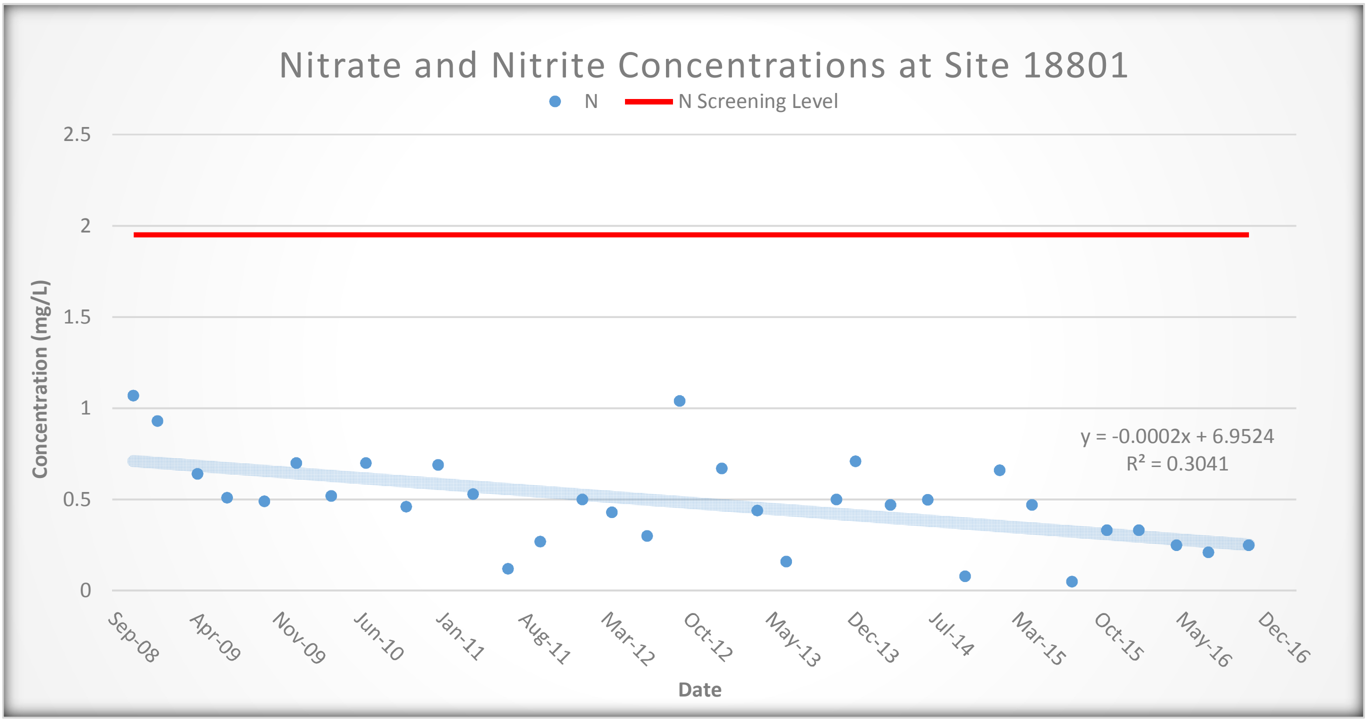
Station 13246 (Pecos River upstream of county line convergence) has not been sampled since 2008, and therefore the sample size is too small to indicate any statistical significance. The geomean of 7 *E.coli* bacteria samples taken is 25 MPN. The water quality data indicated that dissolved oxygen levels had an mean of 7.8 mg/L, and the mean for pH at this station during the period of record is 8.0. The mean for total dissolved solids is 3,532.86 mg/L. Ammonia data for this station shows a mean of 0.05 mg/L. The mean for total phosphorus is 0.06 mg/L. The mean for chlorophyll-a is 6.80 ug/l. The mean for sulfate is 799.71 mg/L. The mean for chloride is 1,306 mg/L. The mean for nitrate+nitrite is 0.67 mg/L.

Station 14163 was not sampled between 1993- 2013, and was only added back as a monitoring station in 2014. The water quality data indicated that dissolved oxygen levels had an mean of 7.9 mg/L, and the mean for pH at this station during the period of record is 7.9; neither showed a trend. The sample size for the rest of the parameters was too small, and data is provided for information only. Two *E.coli* bacteria samples had a geomean of 46 MPN. The mean for total dissolved solids is 7,840.75 mg/L and is above the standard. Ammonia data for this station shows a mean of 0.10 mg/L. The mean for total phosphorus is 0.05 mg/L. The mean for chlorophyll-a is 13.25 ug/l. The mean for sulfate is 1,055.38 mg/L, which is above the standard. The mean for chloride is 1,832.57 mg/L, which is also above the standard. The mean for nitrate+nitrite is 0.36 mg/L.

Independence Creek. Photo Credit: Rebecca Stuch

At Station 18801 (Lower Pecos River near CAMS 0729), 29 *E.coli* bacteria samples had a geomean of 33 MPN. The water quality data indicated that dissolved oxygen levels had an mean of 8.8 mg/L, and the mean for pH at this station during the period of record is 8.0; neither parameter showed any significant trends. The mean for total dissolved solids is 3,689.09 mg/L and shows no distinct trend. Ammonia data for this station shows a mean of 0.05 mg/L and shows neither an increasing or decreasing trend. The mean for total phosphorus is 0.04 mg/L, and shows no distinct trend. The mean for chlorophyll-a is 5.89 ug/l, and also shows no significant trend. This station does show a decreasing trend for nitrate+nitrite, which shows a mean of 0.48 mg/L. The mean for sulfate is 823.88 mg/L, and the mean ffor chloride is 1,293.24 mg/L; neither showed significant trends. Please see graph for this station below.

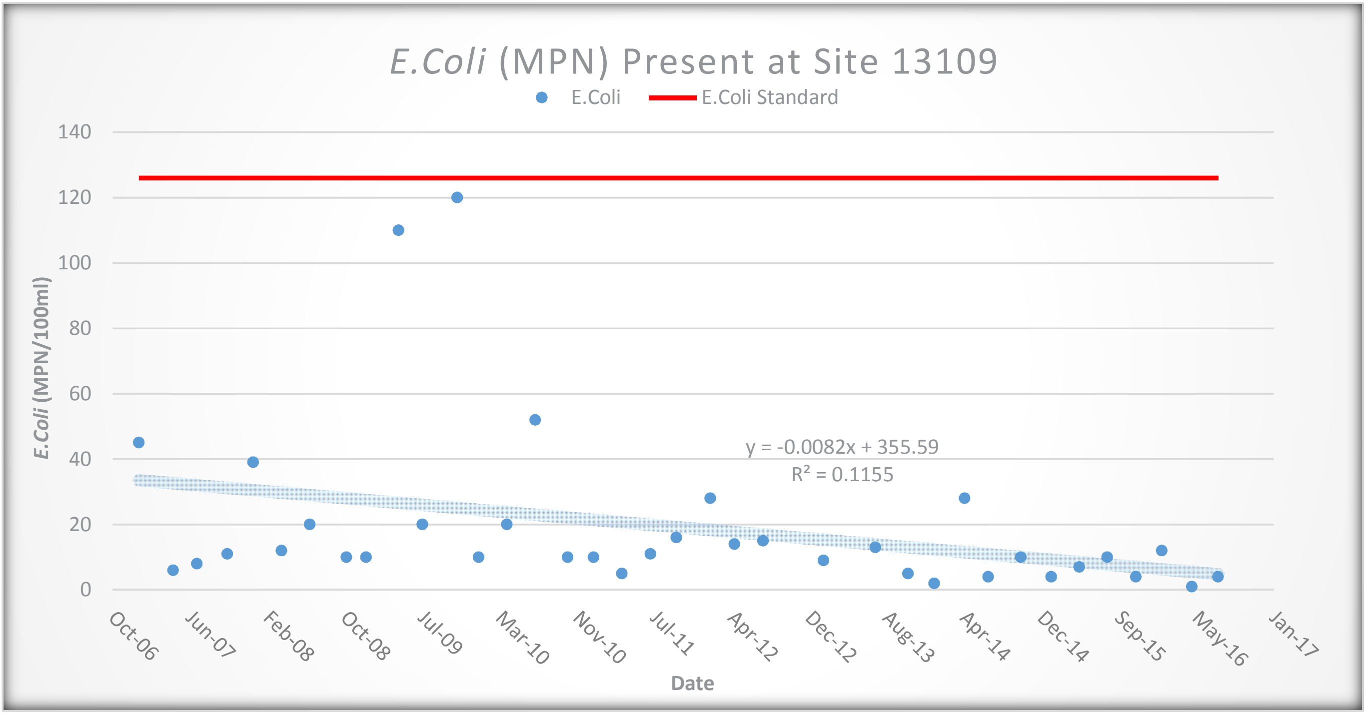
Figure 48.



Segment 2310A is Independence Creek, which is classified as an intermittent water body. This segment currently has no impairments and no waterquality concerns. This segment has one assessment unit that is monitored by Station 13109.

At Station 13109, 37 *E.coli* bacteria samples had a geomean of 12 MPN. This is 10 times below the water quality standard of 126 MPN. Bacteria data shows a decreasing trend. The water quality data indicated that dissolved oxygen levels had an mean of 8.8 mg/L, and the mean for pH at this station during the period of record is 8.1; neither parameter showed significant trends. The mean for total dissolved solids is 618.28 mg/L and shows no distinct trend. Ammonia data for this station shows a mean of 0.05 mg/L and shows neither an increasing or decreasing trend. The mean for total phosphorus is 0.04 mg/L, and shows no distinct trend. The mean for chlorophyll-a is 1.72 ug/l, and also shows no significant trend. The mean for sulfate is 149.21 mg/L and shows no trends. The mean for chloride is 101.41 mg/L, and also shows no significant trends. The mean for nitrate+nitrite is 1.01 mg/L, and shows no significant trends. This water body is considered almost pristine, and was monitored as part of the Least Disturbed Streams project by the TCEQ. Please see the graph for this station on the following page.

Figure 49.



Projects and Studies of Relevance to the Pecos River Sub-basin

Aquatic Life Monitoring- TCEQ conducted aquatic life monitoring in the Sheffield area in late 2010 and early 2011 to document the biological response to a transition in the river between turbid high salinity water and spring-fed freshwater conditions between the communities of Orla and Girvin. The *Pecos River Aquatic Life Monitoring- Segments 2310 and 2311* project supplemented TCEQ's Use Attainability Analysis data to help demonstrate whether or not a water classification involving the removal of a use designation or site-specific adjustment to the applicable water quality criteria is appropriate. The results of this study indicated that the high aquatic life use designation in Segment 2311 was not supported, and recommended a limited aquatic life use designation instead. Dissolved oxygen concentrations were too low to sustain aquatic habitats, possibly due to high levels of dissolved minerals naturally present in this ecosystem. This would also result in less diverse fish and benthic communities.

Pecos River Water Quality Coalition- The coalition's goal is to reduce salinity concentrations and impacts to increase usable water supplies for agricultural, urban, and environmental purposes. This coalition works in both the New Mexico and Texas portions of the watershed in conjunction with the Pecos River WPP. This coalition was authored by Texas State Senator Carlos Uresti and Texas State Respresentative Pete Gallego. This was passed to reauthorize appropriate funding to the U.S. Army Corps of Engineers to solve the salinity problems in the Rio Grande Basin, including the Pecos River watershed. The coalition works with the Pecos River Compact Commission, which ensures that Texas receives its equitable share of quality water from the Pecos River and its tributaries as apportioned by the Pecos River Compact. For information on this topic, please visit https://www.tceq.texas.gov/permitting/compacts/pecos.html.

Land Use

The waters of the Pecos River may be used for salt-tolerant crops; however, overviews in Google Earth do not indicate many farm lands around the river. There are more farms visible near the Sheffield area, but the lower portions of the Pecos are dotted by what look to be private residences right along the banks of the river, which may or may not be farms or ranches. This area of the basin also has significant oil and refining industries, and these industries own large portions of land.

Figure 50.

Lower part of the Pecos River. Shows what look like private residences along the river.

There are 27 permitted facilities, all of them in Segment 2311. However, 21 of these permits do not have discharges. They include six permits for industrial wastewater permits, three private domestic wastwater, and 18 public domestic wastewater permits.

Possible negative impacts on water quality

Nonpoint sources- The Pecos River is heavily impacted by the oil industry. Although oil derricks and industrial plants are not directly next to the Pecos River, the drilling for oil may potentially affect both groundwater and surface water. In more recent years, the severe drought has made the Pecos susceptible to flooding, and the area floods frequently during monsoon season. The stormwater runoff may also contribute to salinity and bacteria issues. The salinity issues encountered in the Pecos are two-fold. There are scientific studies that indicate that much of it is naturally-occurring due to salt springs and salt-bearing geological formations. However, low flows due to drought and the proliferation of salt cedar made the salinity issues much worse over the years. The presence of stockyards or cattle farms, or other domesticated livestock, may also contribute to non-point source pollution in this reach.

Agricultural- This sub-basin is impacted by agricultural activities, mainly because the water in the Pecos River is already extremely saline. Agricultural fields and their return flows may contribute saline water to an already saline environment. This results in water that is too salty to water crops (unless they are salt-tolerant crops). The crop lands may also cause water pollution due to the use of fertilizers, pesticides, and other chemicals used during irrigation. The use of chemicals during irrigation can lead to water contamination from runoff or remnant spray carried by wind. The return flows from irrigation are also high in nutrients, which can lead to excess algae growth, potentially proliferating into algal blooms, which can, in turn, lead to decreased DO in the water. Since we are seeing issues with algal blooms and high values for TDS and specific conductivity, which are related to, and used to calculate, high salinity in many of the stations, agriculture must be seriously looked at as a possible cause.

Figure 51.

Pecos River near Sheffield. Agricultural lands are very visible in this map.

Wildlife- Based on information from the Texas Parks and Wildlife Department (TPWD), this sub-basin is home to a number of domestic and wild animals, such as cattle and other livestock and many avian species, that may contribute to the bacterial issues in the area. The map overviews showed many small ponds and watering holes, which may be for private homes and their domesticated animals, but they are also water sources for the local wildlife. Several species of birds, small rodents and small mammals call this area home; wildlife can be impacted by the highly saline waters and drought conditions.

Urban Runoff- The Midland/Odessa area is a huge hub for the oil industry in Texas. This area sees constant commercial traffic from oil rigs, heavy machinery, and private traffic related to the oil industry. During major storm events, everything on the roads, bridges, and parking lots has the potential to flow into the river. You also run the risk of oil spills, motor vehicle accidents involving an oil tanker that can cause a spill, and other environmentally catastrophic scenarios. The majority of the population in the Pecos region resides in cities such as Midland and Odessa, but there are many smaller towns and communities throughout the area.

Influences of Flow - The Pecos River is heavily influenced by releases from Red Bluff Reservoir. During drought, the reservoir may not release as much water, and portions of the Pecos River have run dry. The area has seen heavy rain events throughout period of record, which have caused flooding, but this is also an effect of the drought. As mentioned before, a significant portion of the salinity is naturally-occuring, but agricultural return flows, low flows, and salt cedar have made the issue worse. Salinity is also increasing as the water flows downstream, and may be contributing to the salinity issues in down-tream International Amistad Reservoir, where the Pecos empties.

Stakeholders

Landowners

US Fish & Wildlife Service

TX Parks and Wildlife

TX Water Resources Institute

Sul Ross State University

New Mexico Interstate Stream Commission

Carlsbad Irrigation District

Pecos Valley Artesian Conservation District

Red Bluff Water Control District

TCEQ Regional Offices

Cities of Midland, Odessa, Sheffield, etc.

Midland College

Pecos Compact Commision

Pecos River Water Coalition

Railroad Commission

Crane County Water District

Reeves County Water District

Ward County Irrigation District

Terrell County Water Control and Improvement District #1

Loving, Reeves, Ward, Pecos, Crane, Crockett and Terrell Counties

Pecos County Water Improvment District No. 1 & 2

Crockett County Water Improvement District #1, Crockett County SWCD #235

Recommendations

The USIBWC CRP will continue routine monitoring for a full assessment in 2019. The program will continue to monitor and look at increasing or decreasing trends for parameters to identify water quality issues and needs in this area. Additional studies should be considered to reassess the salinity issues and possible sources in this area. Past studies, including the watershed protection plan implemented in 2009, may need updating to determine if issues are worsening or improving. The initial watershed protection plan should be used as a guide. The USIBWC CRP would greatly benefit from new partners in this reach to monitor additional stations, which would provide more adequate coverage of this reach.

The Middle Rio Grande Basin

The Middle Rio Grande Sub-basin encompasses the portion of the Rio Grande flowing from just below International Amistad Reservoir to just above International Falcon Reservoir. The 303-mile (487-km) stretch of the Middle Rio Grande spans five counties in Texas and the Mexican States of Coahuila, Nuevo Leon, and Tamaulipas. Del Rio, Eagle Pass and Laredo, Texas, along with Mexican sister cities Ciudad Acuna, Coahuila, and Nuevo Laredo, Tamaulipas, compose the majority of the population living along the Rio Grande in this reach. Laredo, in particular, is one of the fastest growing cities in Texas. Increased trade with Mexico, manufacturing growth, and tourism have all contributed to population increases in the area.

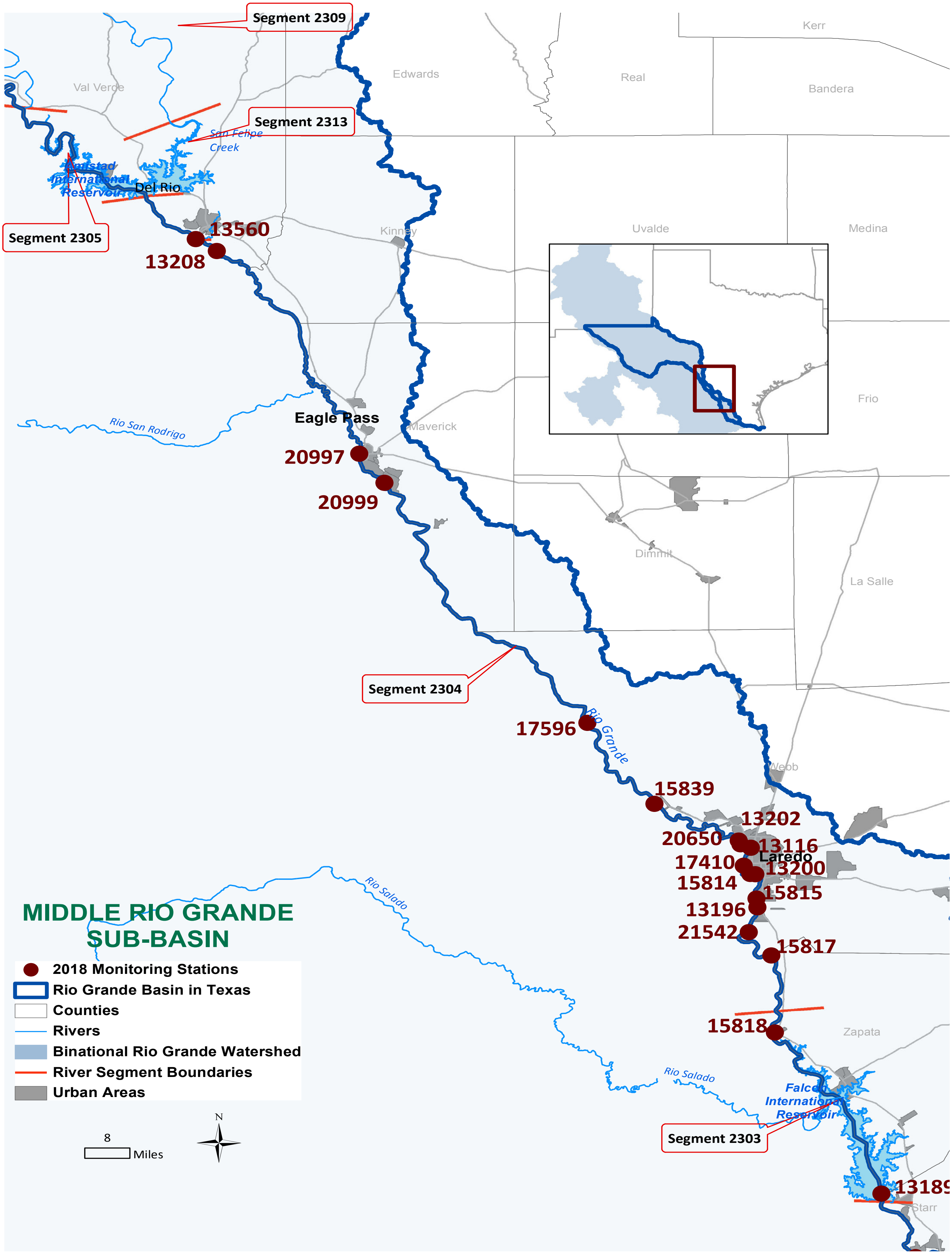
Pictured: CRP Station 17596, Rio Grande at Apache Ranch

The northernmost and easternmost portions of the Middle Rio Grande Sub-basin lie in the Edwards Plateau region with the remainder of the Sub-basin occurring in the South Texas Brush Country. In areas located downstream of the International Amistad Reservoir, the terrain transitions to form rolling, irregular plains and continues with this pattern until it turns into coastal plains as the river approaches the Gulf of Mexico in the Lower Rio Grande Sub-basin. Water impounded behind International Amistad Dam slows in velocity and much of the suspended solids carried from the Upper Rio Grande Sub-basin sinks within this area. Most municipalities along this portion of the Rio Grande are dependent on surface water for domestic, agricultural, and industrial use. Del Rio is the only major city in this Sub-basin that relies on groundwater for its water needs. San Felipe Creek, a major spring-fed tributary located within Del Rio, enters the Rio Grande in Val Verde County, downstream of the International Amistad Dam. Groundwater is primarily provided by the Edwards-Trinity (Aquifer) that underlies most of this region. The largest economic sectors are based primarily on tourism, hunting, ranching, and government (e.g., Laughlin Air Force Base in Del Rio).

The USIBWC has two dams along this stretch of the river: Amistad International Reservoir and Falcon International Reservoir. Falcon International Reservoir is used for conservation purposes, and water is released during scheduled water releases to both countries, as well as during severe weather-related occurrences (hurricanes, tropical storms) that require large amounts of water to be carefully released to prevent flooding of the urban areas downstream. Amistad International Reservoir was constructed for the primary purpose of flood control to prevent loss of life and damage to property below the dam as well as water conservation storage for the benefit of the United States and Mexico during times of drought for domestic and agricultural use.

The USIBWC CRP has 5 partners in the Middle Rio Grande: USIBWC Amistad Dam Field Office, USIBWC Laredo Field Office, City of Laredo Health Services, Laredo Environmental Services, and Rio Grande International Study Center (RGISC). These partners monitor 15 stations in Segment 2304 and the TCEQ regional office in Laredo monitors three stations in Segment 2313, providing field, flow, and water quality data for the program to promote the protection, restoration, and wise use of Texas surface-water resources. Each segment will be discussed in more detail in the proceeding sections.

Figure 52. Map of the Middle Rio Grande Basin in Texas



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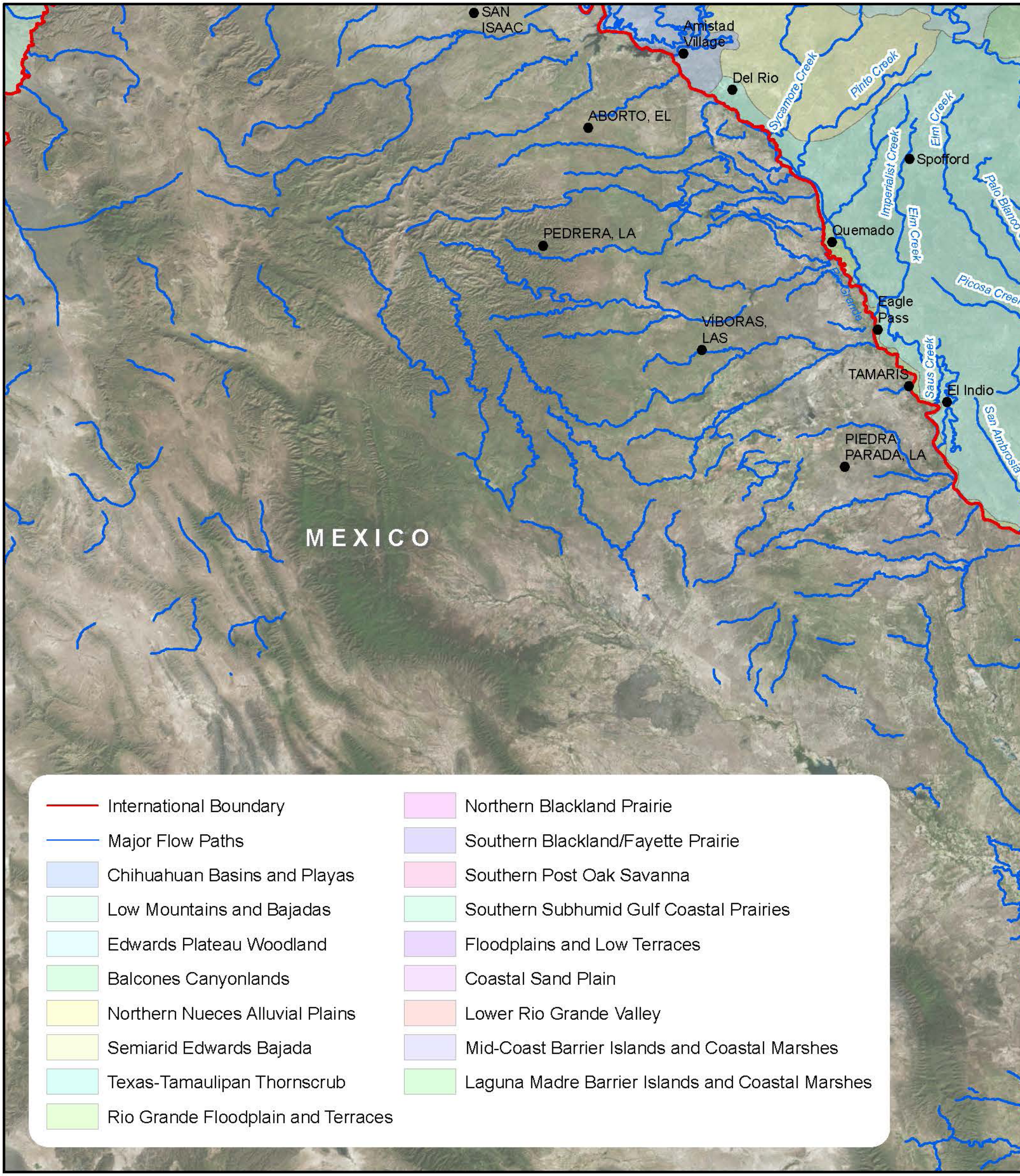

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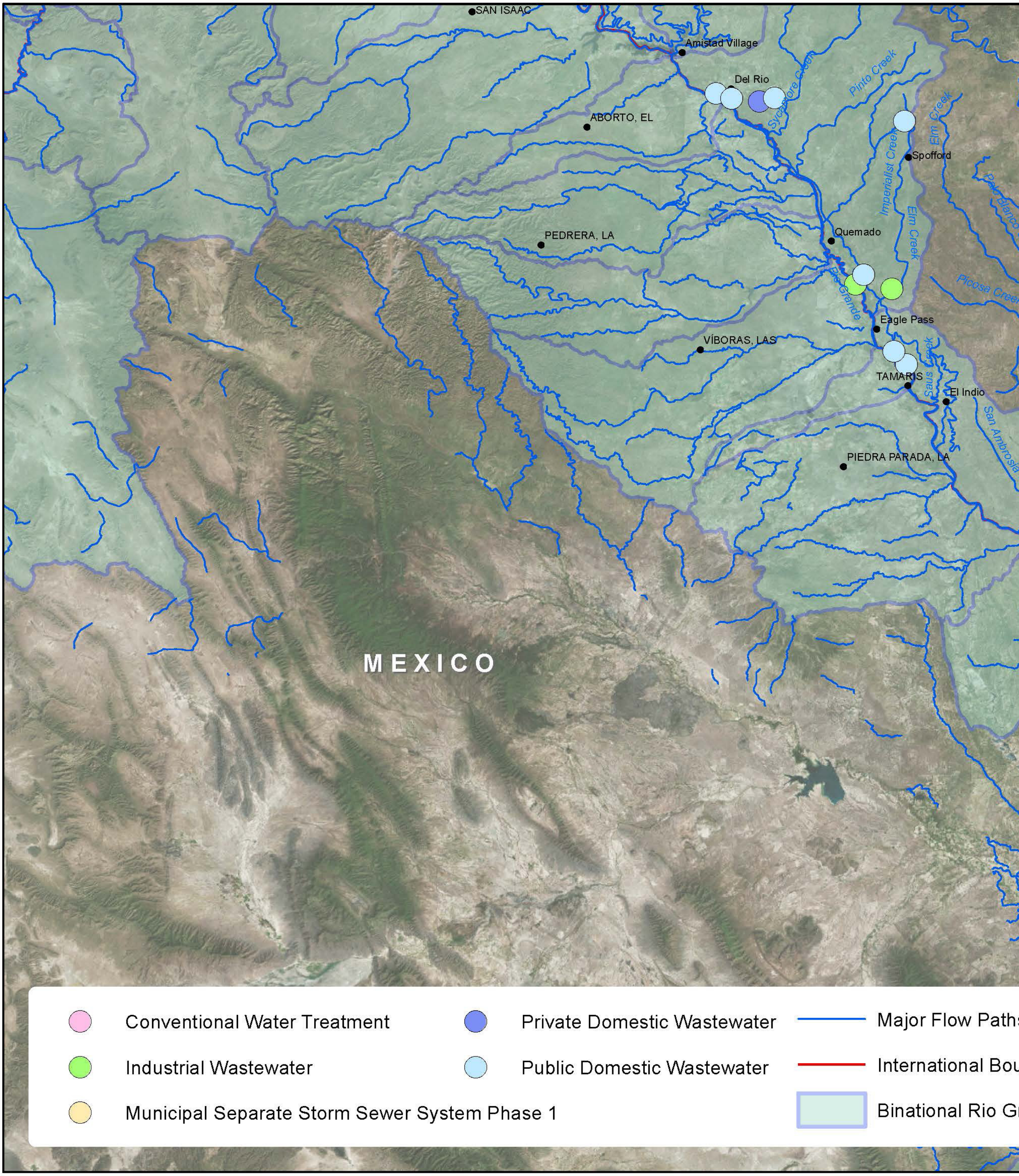

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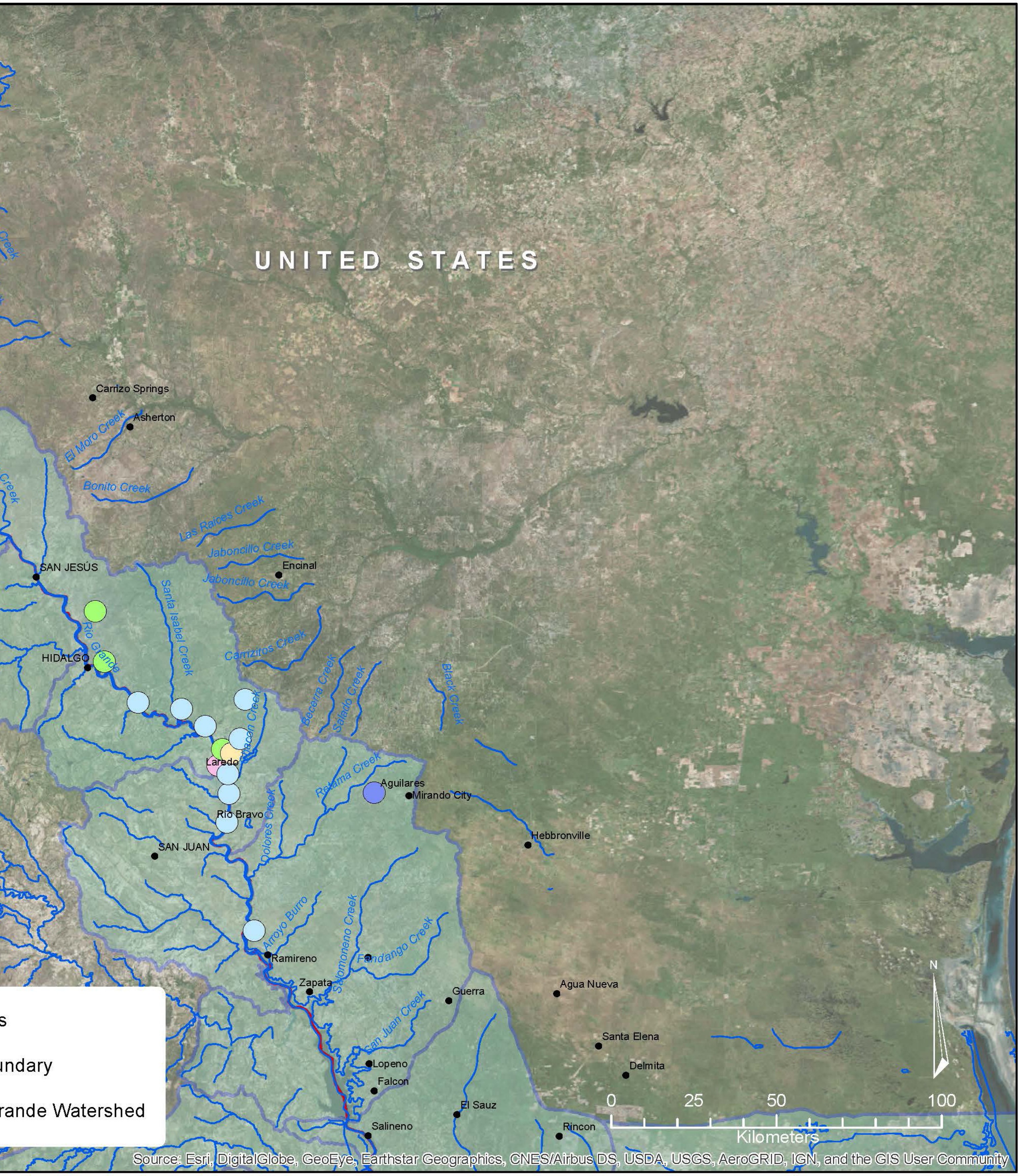

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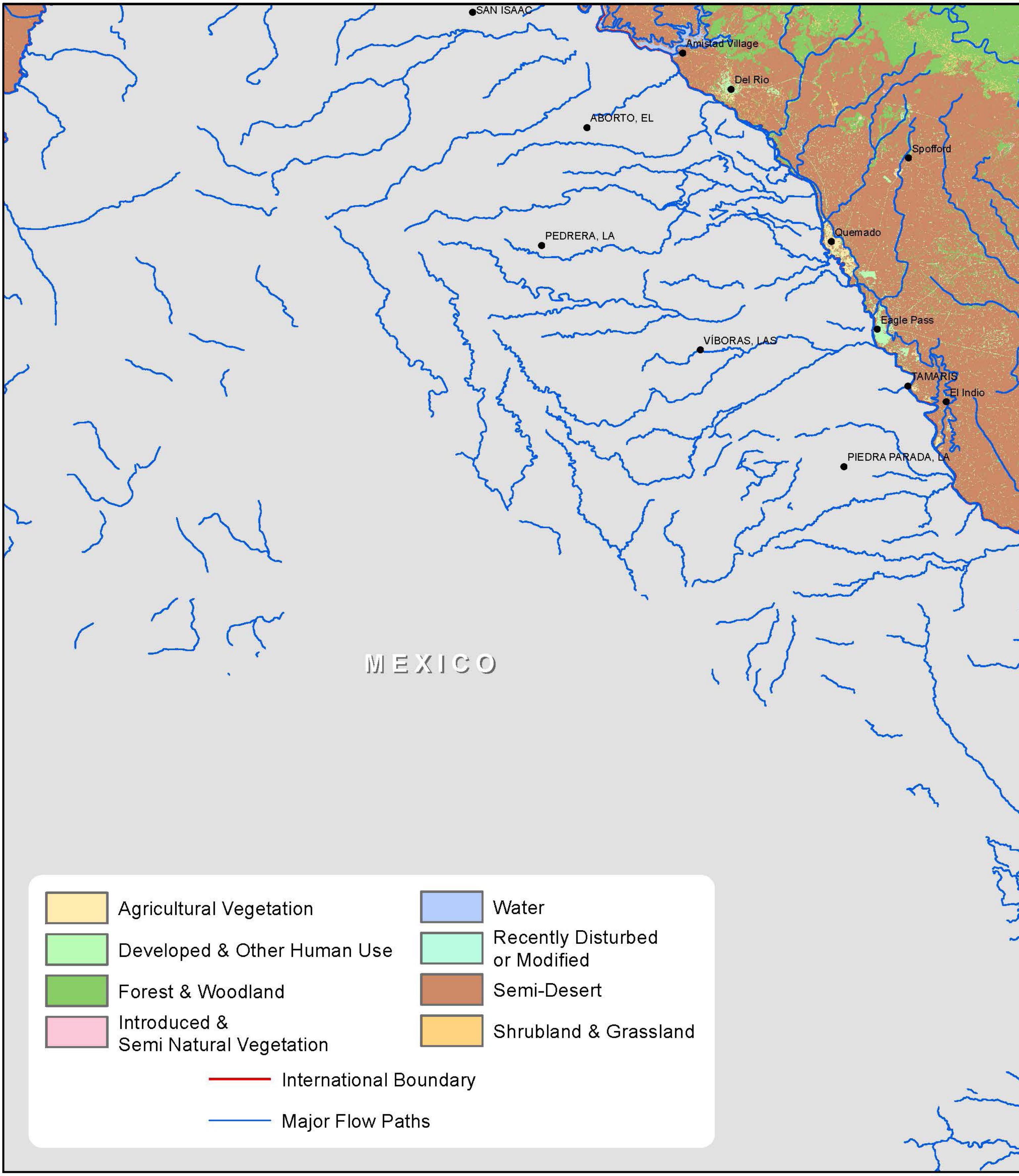

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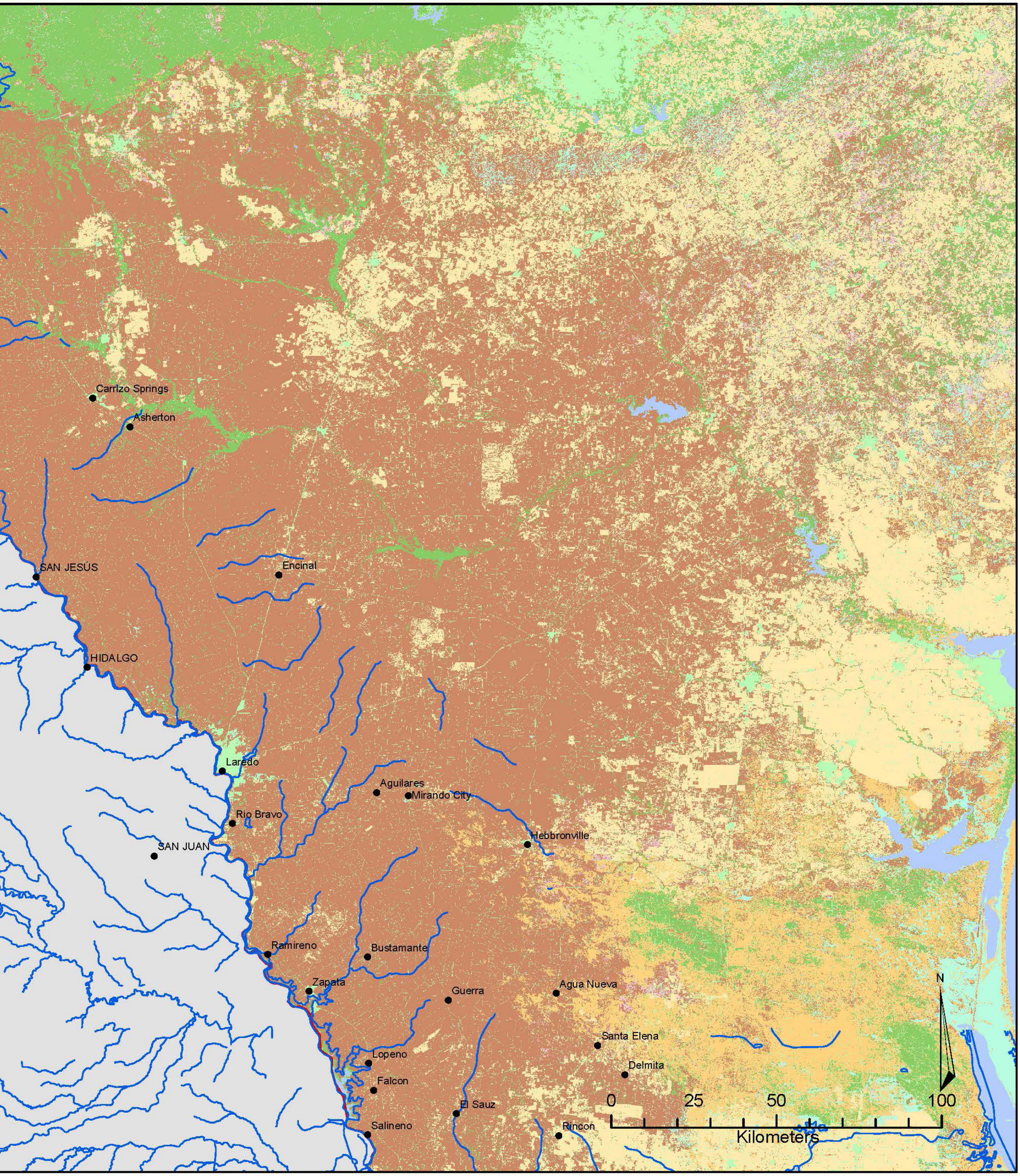

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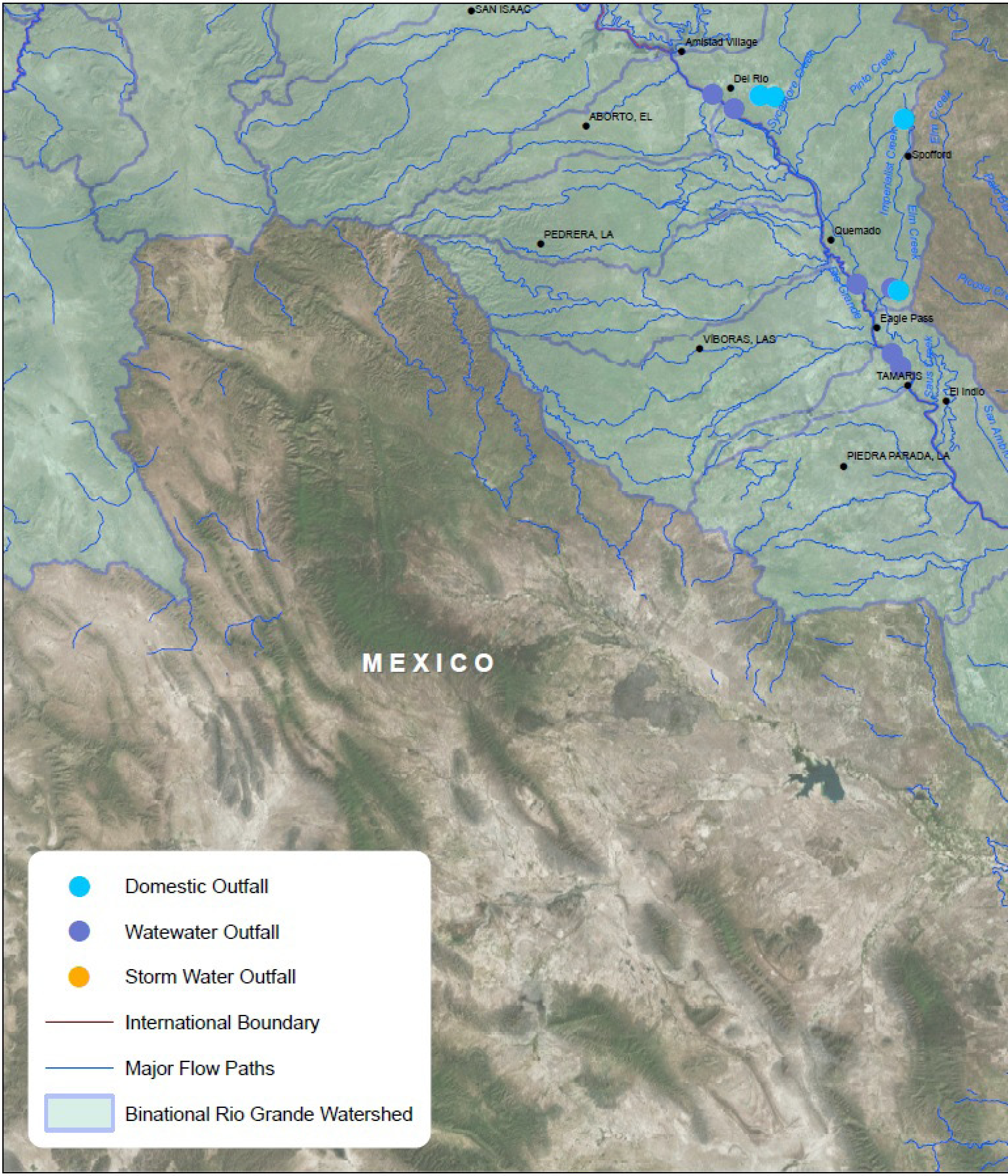

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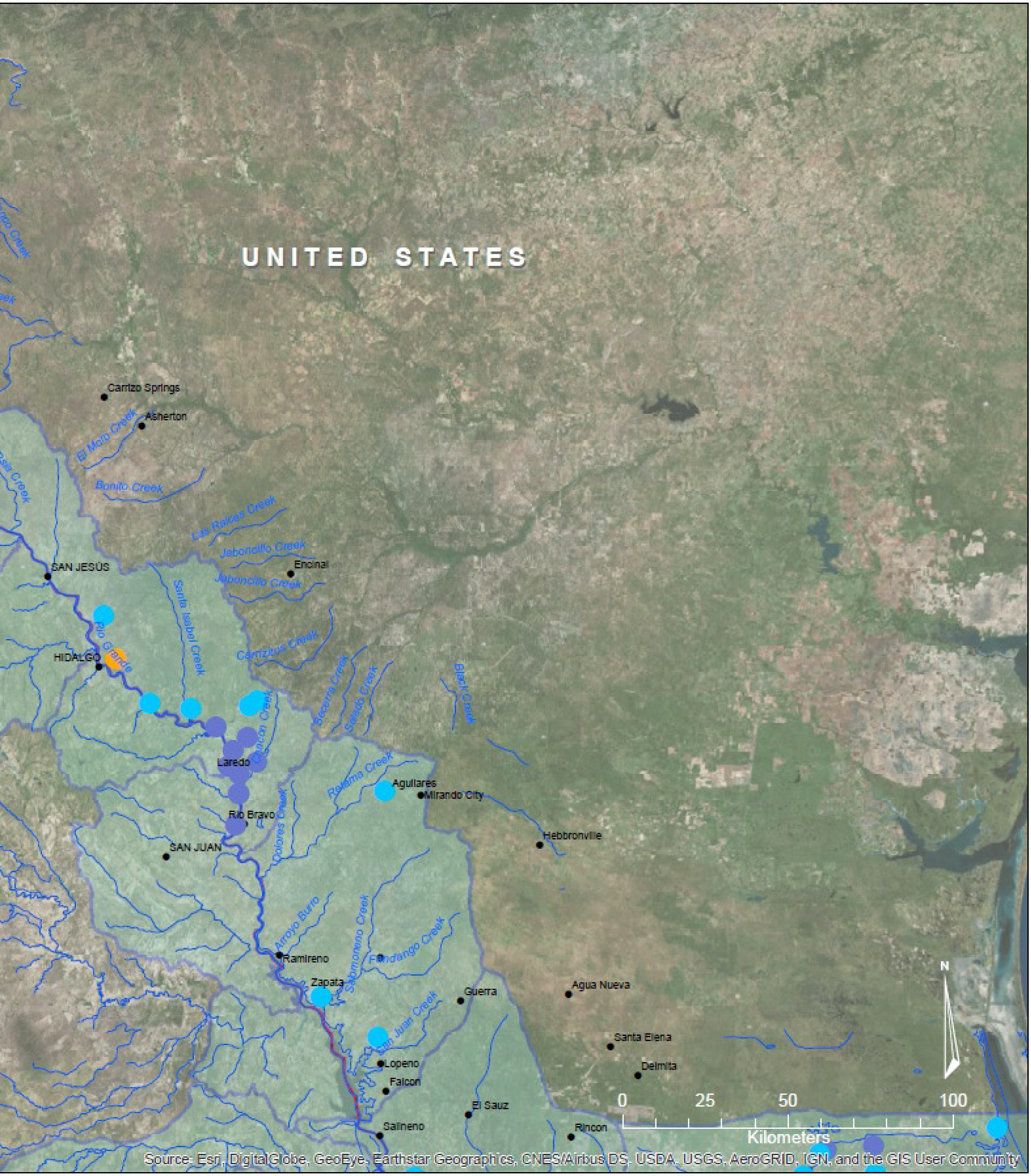

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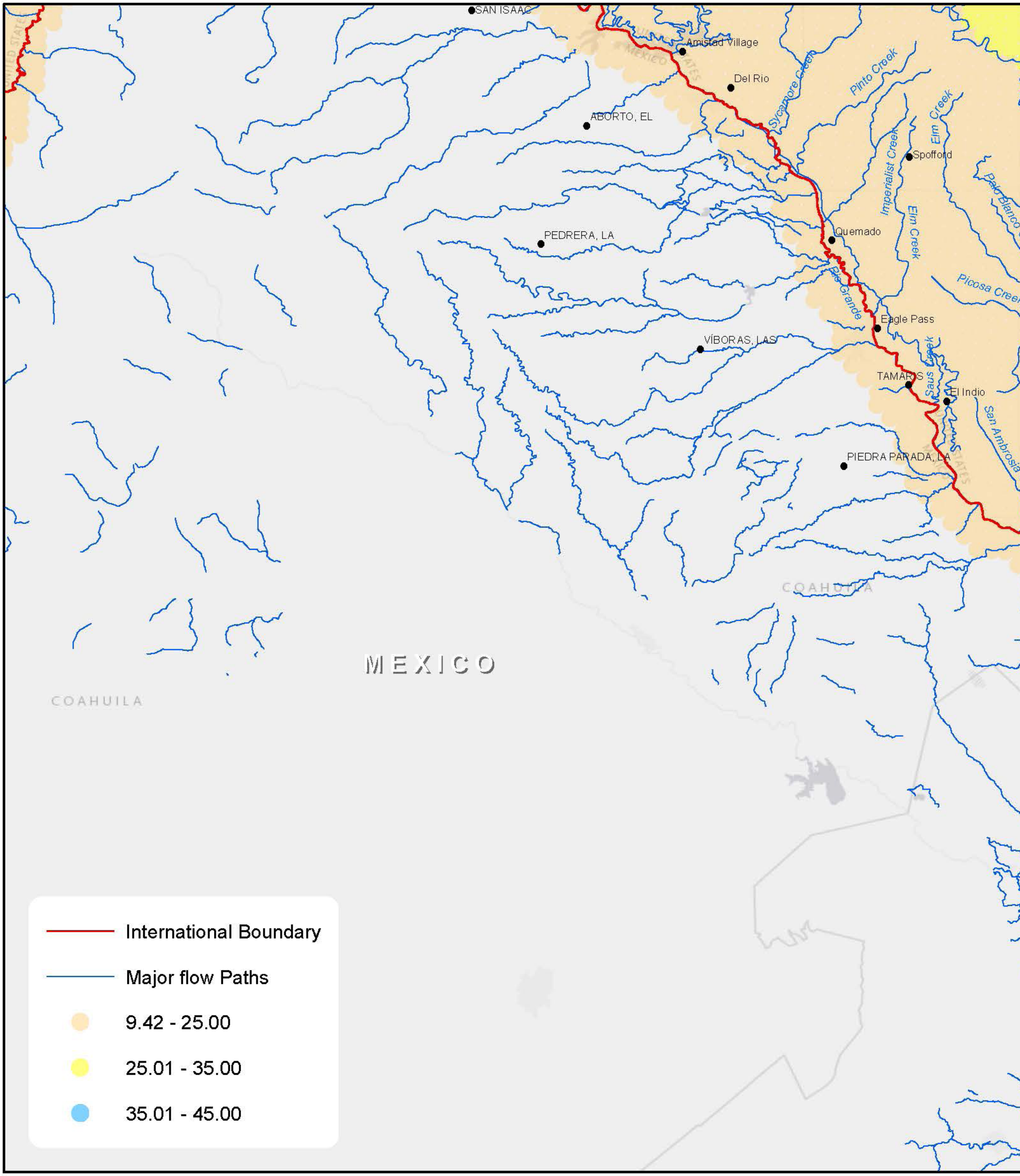

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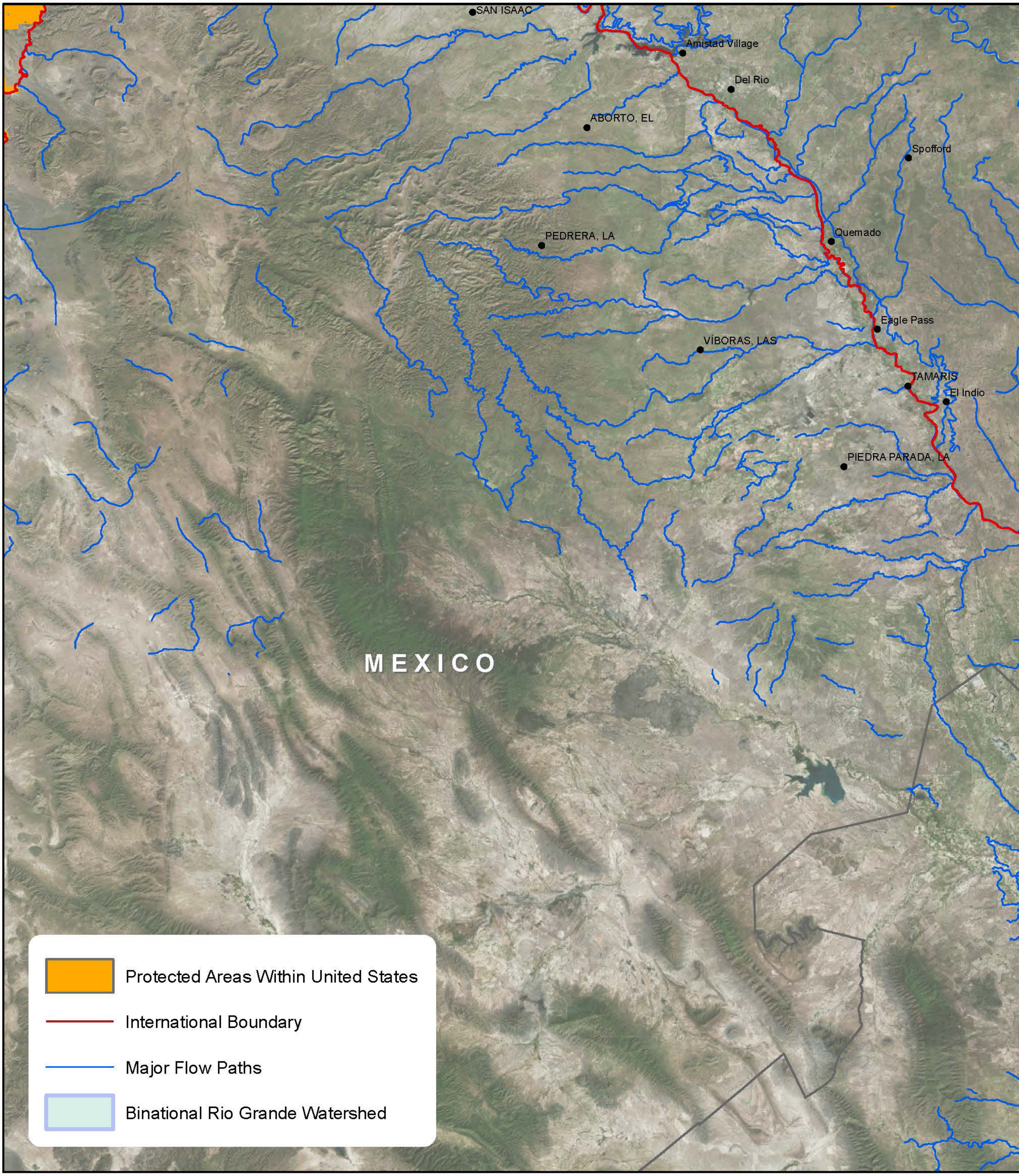

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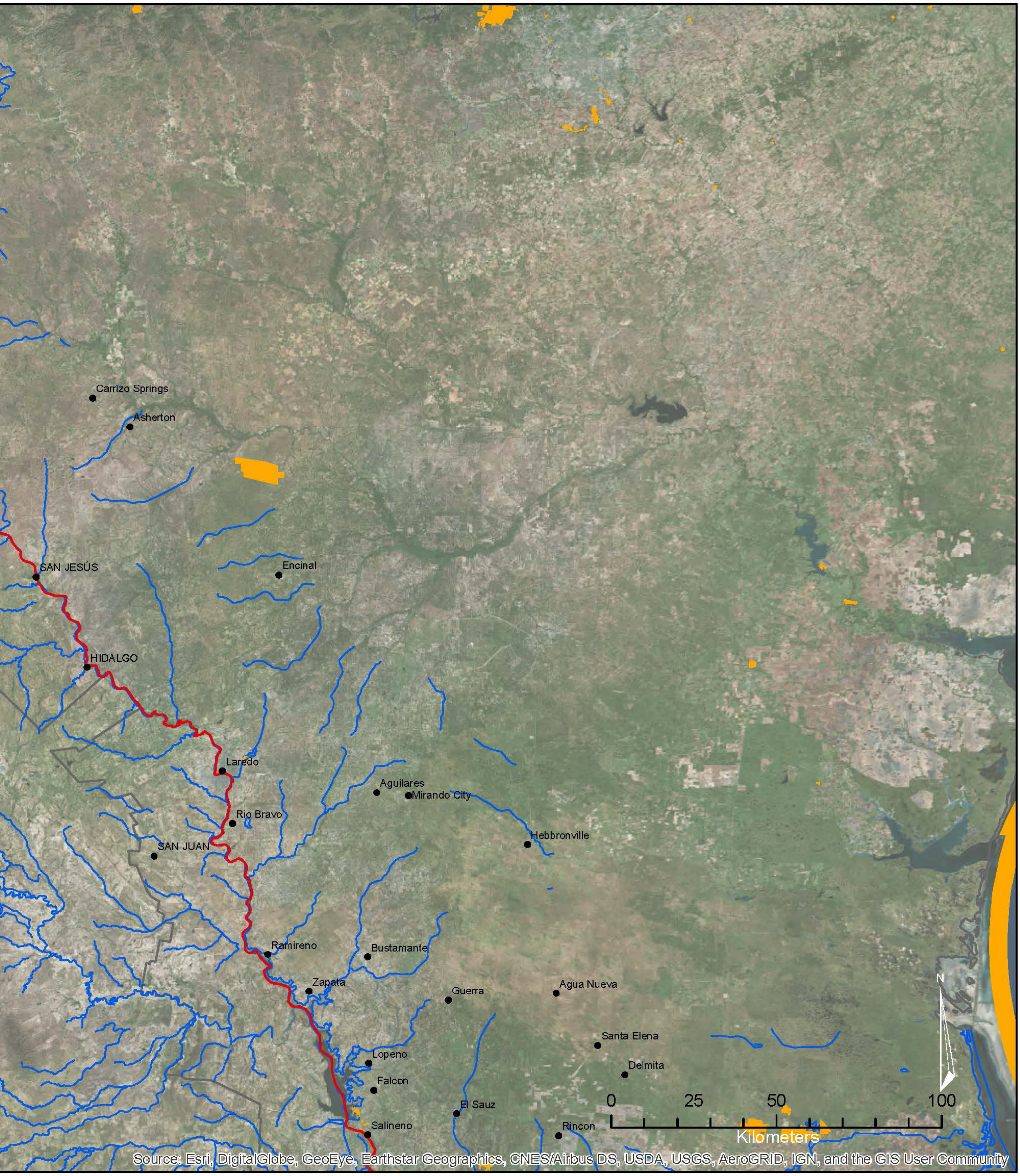

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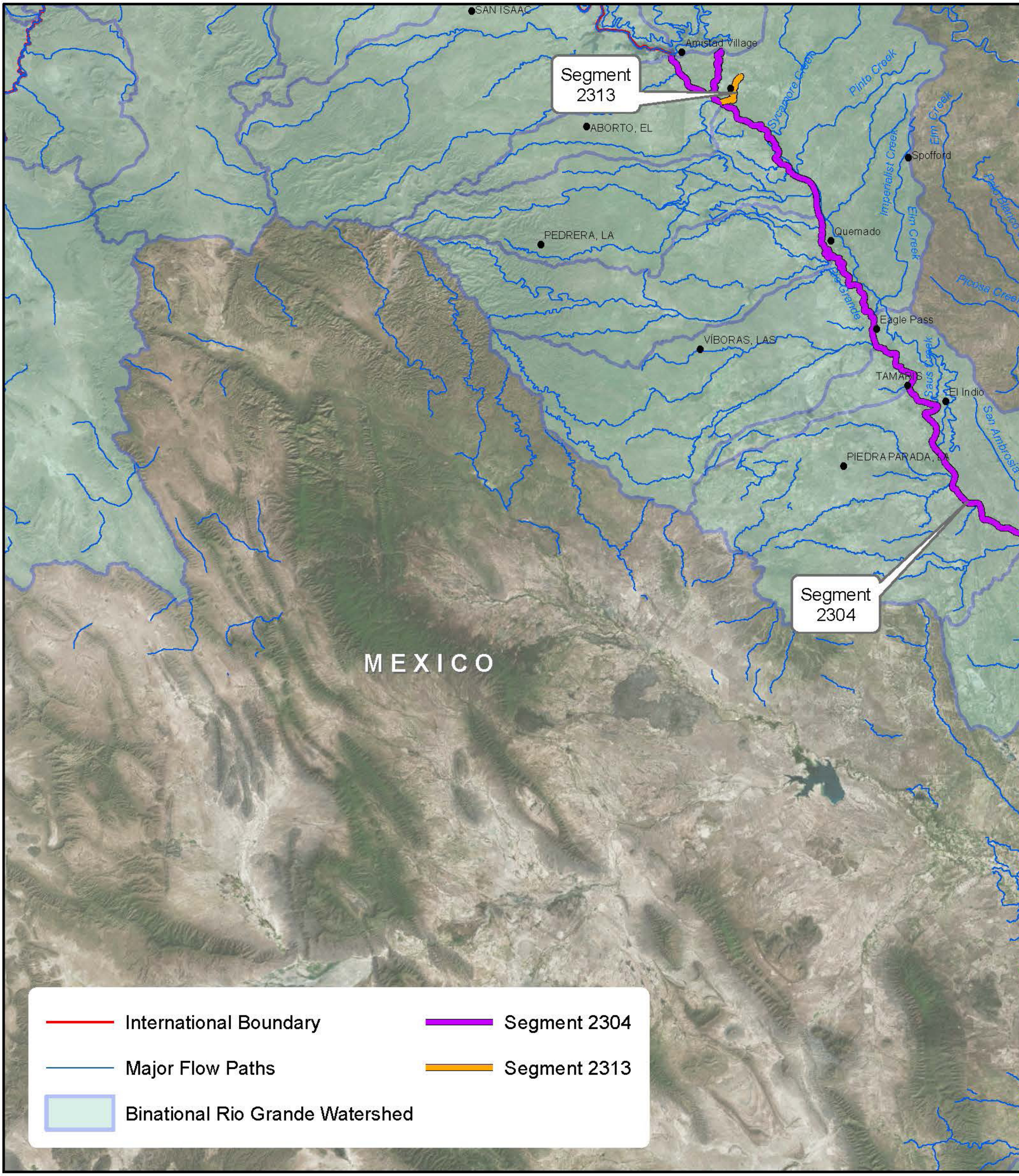

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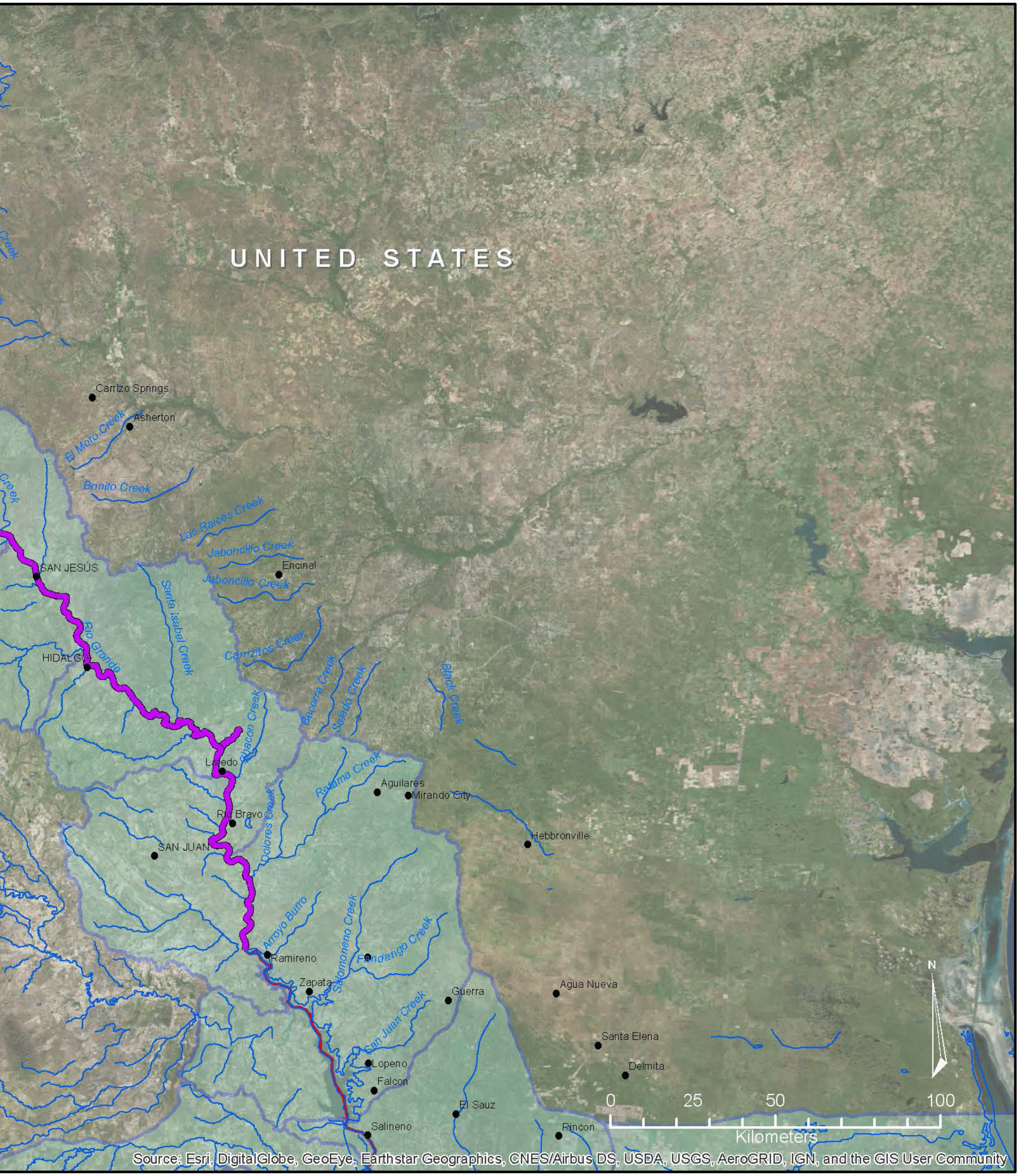

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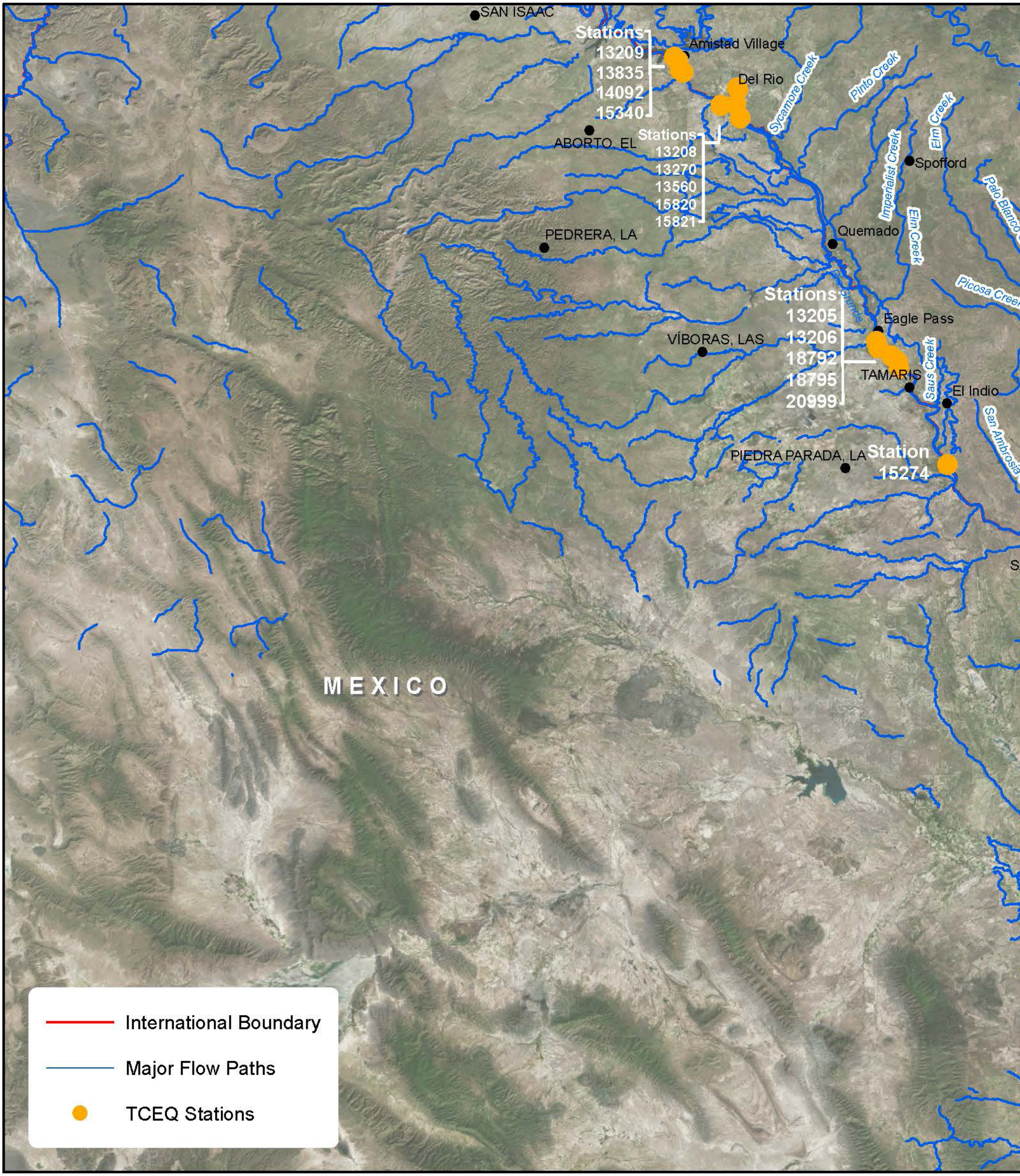

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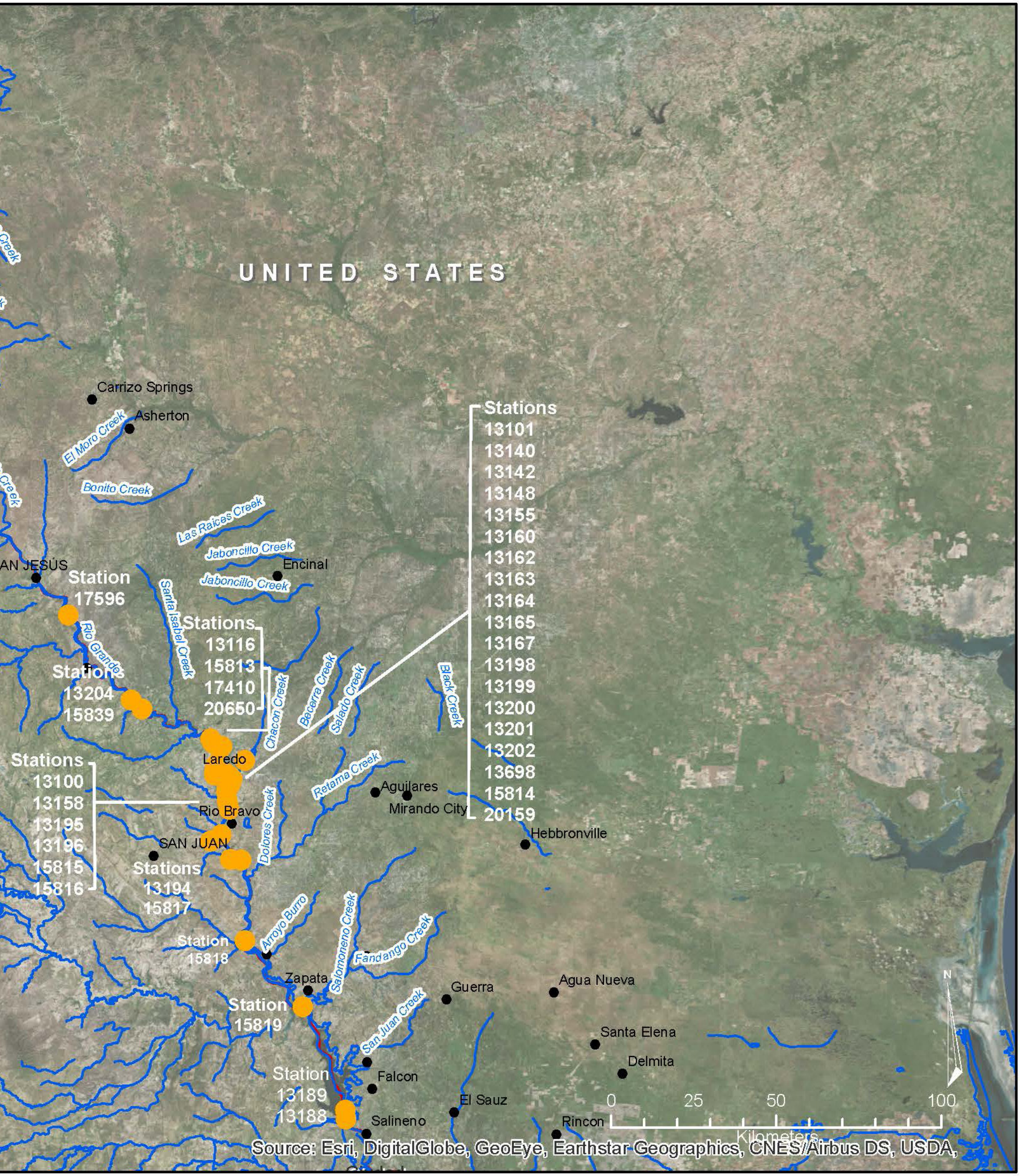

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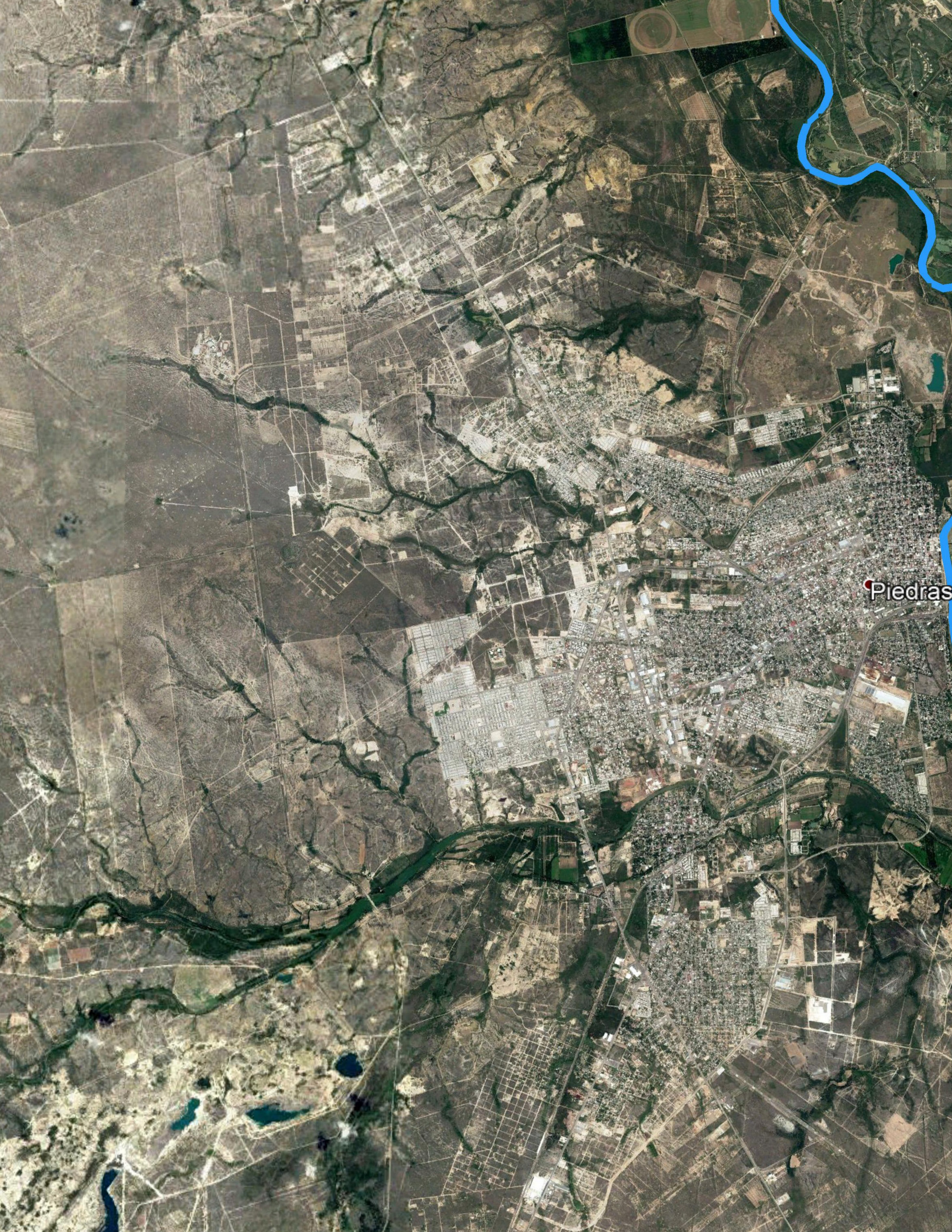
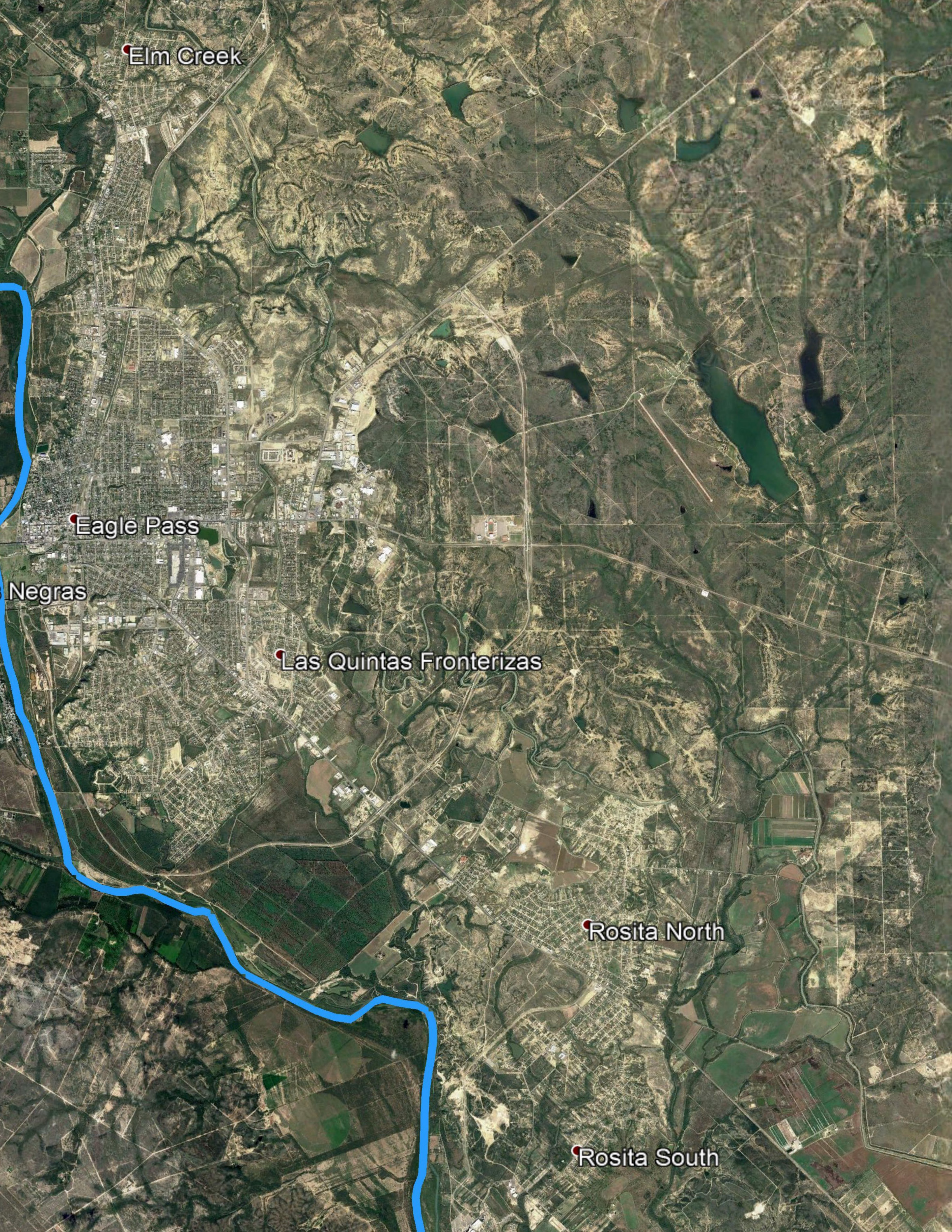
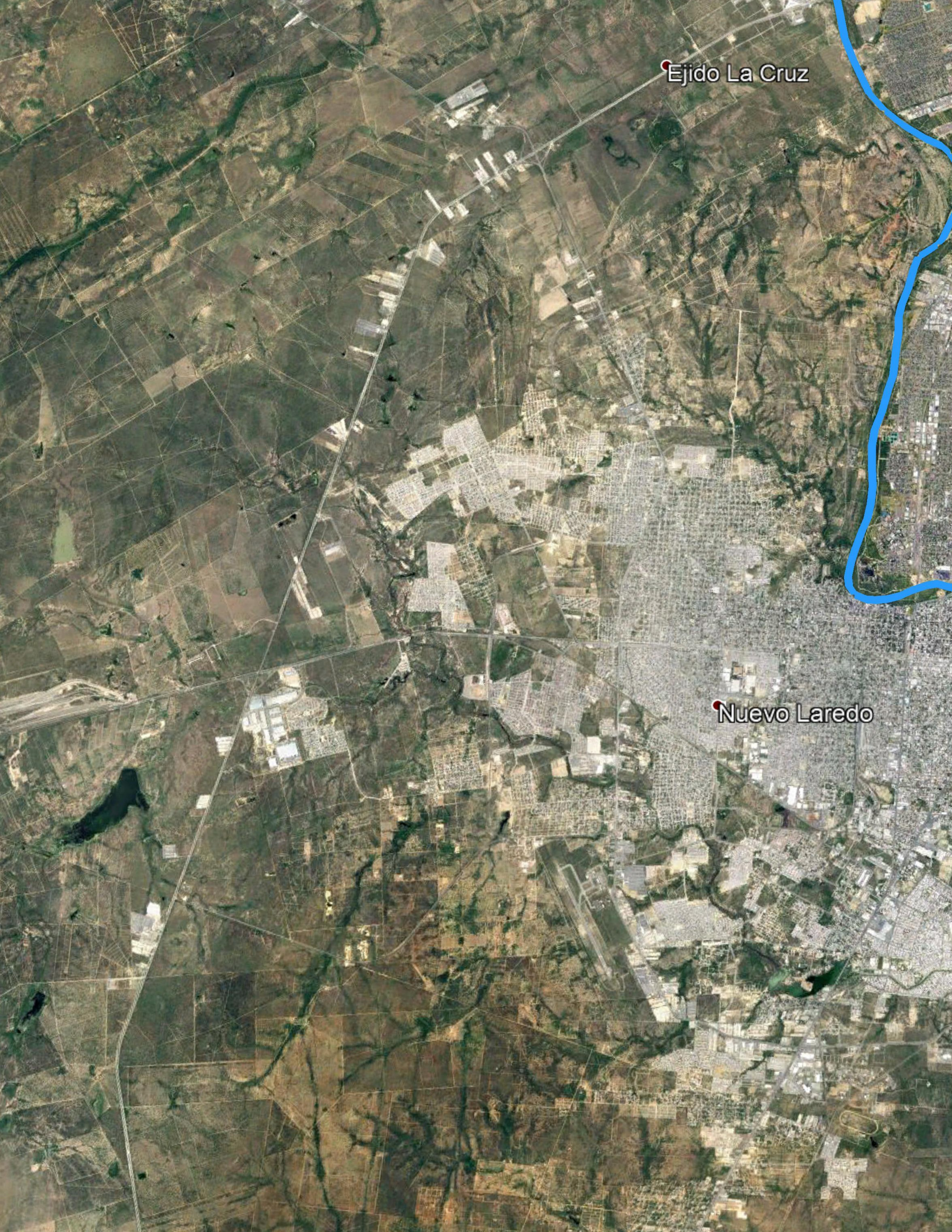
Ciene
Las Vacas

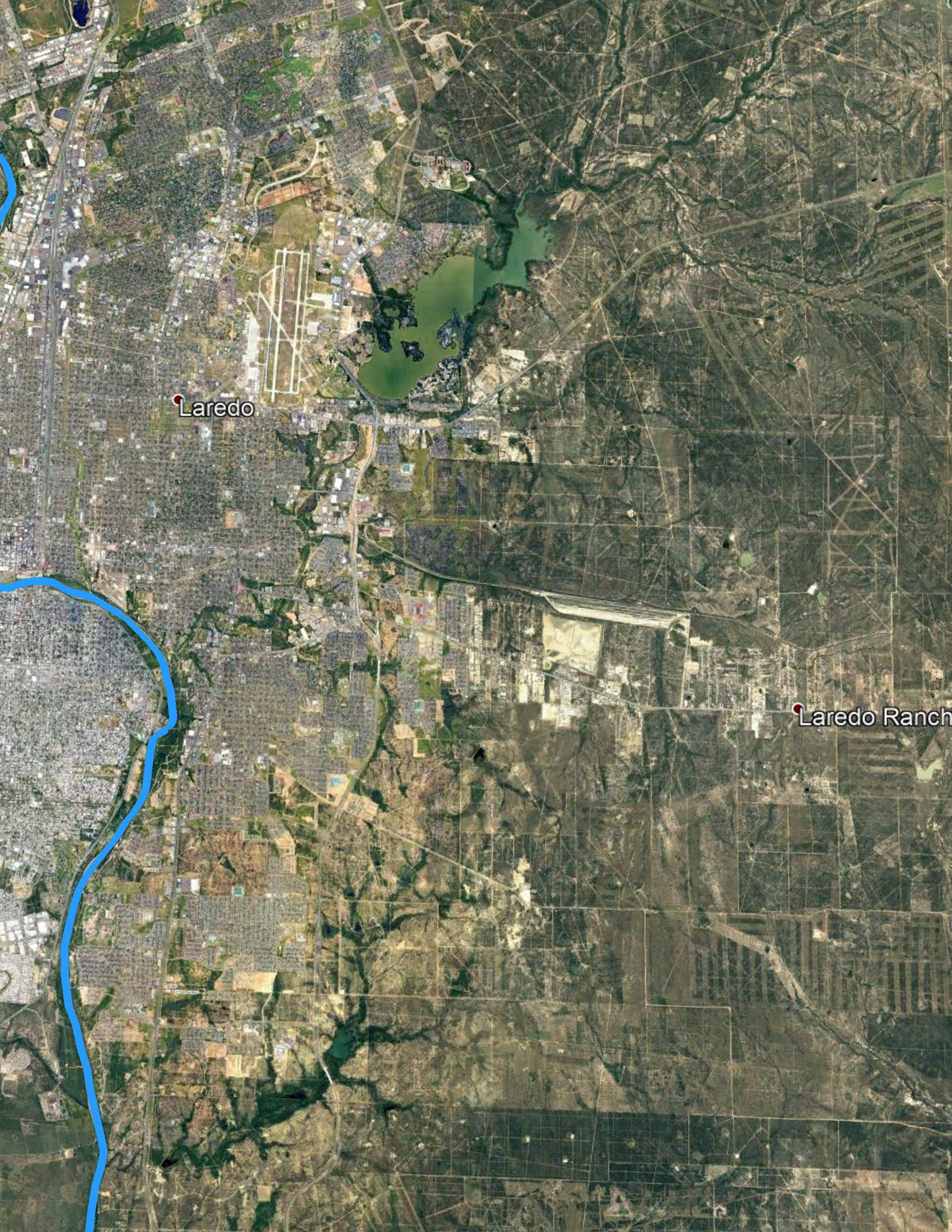

Lake View
egas Terrace
Del Rio
Val Verde Park
Laughlin AFB
Cdad. Acuña
Núm. Seis
os Novillos
Col. Calles
La Purísima


Piedras



Elm Creek
Eagle Pass
Negras
Las Quintas Fronterizas
Rosita North
Rosita South


Ejido La Cruz
Nuevo Laredo


Laredo
Laredo Ranch

MIDDLE RIO GRANDE WATER QUALITY UPDATE

Table 10 characterizes the middle sub-basin and and its associated segments by describing active stations, and providing water quality information. For questions about water quality in the Rio Grande Basin presented in this report, or for information on historical or currently inactive stations, please contact USIBWC CRP staff (contact information located on back cover).

Table 10. Statistical Analysis of Water Quality Data for the Middle Rio Grande River Sub-Basin This table describes analytical means for parameters with established water quality standards, as well as parameters for which there are screening levels (most often nutrients). Tables for the individual stations with additional statistical analysis are available in Appendix A. Values in cells represent means or geomeans (bacteria). The blue highlight indicates a statistically significant decreasing trend ($p \leq 0.1$), while the yellow indicates a significantly increasing trend ($p \leq 0.1$). Red text indicates the mean of the parameter over the period of record is above the Texas State Water Quality Standard, with the exception of dissolved oxygen, where falling below 5 mg/L would indicate impairment. An asterisk (*) indicates that the station had a sample size (n) for that parameter that is less than the samples size required for trend analysis ($n \geq 10$).

Station	pH	Dissolved Oxygen (mg/L)	Ammonia (mg/L)	Chlorophyll-a (ug/L)	Total Phosphorus (mg/L)	Bacteria (MPN/100ml)	Sulfate (mg/L)	Chloride (mg/L)	Nitrate + Nitrite (mg/L)	TDS (mg/L)
Segment 2304 | Rio Grande Below Amistad Reservoir										
15340	8.0	7.4	0.05	1.44	0.03	12	210.84	118.35	0.30	608.67*
13208	8.1	8.8	0.14	2.57	0.04	46	198.21	114.08	0.53	633.55
13560	8.1	9.7	0.24	3.61	0.07	195	181.58	108.82	0.51	587.74
20997	8.2	8.1	0.82	4.96	0.11	28	191.51	111.07	0.41	597.83
18795	8.1	7.3	0.18	8	0.14	754	169.85	99.56	0.52	591.32
20999	8.0	6.5	0.67	6.85	0.11	1489	169.81	109.84	0.65	582.17
18792	8.1	8.6	0.22	4.38	0.12	395	172.61	91.63	0.56	568.15
15274	8.1	8.1	0.09	4.41	0.10	24	170.16	31.34	0.63	538.41
17596	8.1	8.1	0.52	6.39	0.12	11	186.84	109.75	0.66	578.80
15839	.	.	.	.	.	18	.	.	.	.
20650	.	.	.	.	.	22	.	.	.	.
13202	8.1	7.9	0.21	6.39	0.10	22	189.27	115.16	1.33	612.27
13116	7.9	6.6	0.54	33.74	0.83	141	1243.55	484.73	6.95	2777.38
17410	8.1	7.8	0.30	6.15	0.11	14	183.49	111.79	1.82	609.26
15814	8.1	7.9	0.21	6.18	0.11	3845	184.03	113.65	1.28	638.42
13200	.	.	.	.	.	2201	.	.	.	.
15815	.	.	.	.	.	2601	.	.	.	.
13196	8.1*	8.4*	0.22*	.	0.25*	1028	187.71*	117.57*	0.62*	634.57*
15816	8.1	6.8	0.53*	10.67*	0.18*	954	219.33*	136.8*	1.00*	697.33*
21542	8.1*	6.4*	0.53*	11*	0.19*	1033*	218*	137.41*	1.71*	699.56*
15817	8.1	8.3	0.35	14.37	0.20	48	190.74	116	2.01	624.05
Standards and Screening Levels	6.5-9	5	0.33	14.1	0.69	126	300	200	1.95	1000
Segment 2313 | San Felipe Creek										
15820	7.6	8.3	0.05	1.40	0.03	157	23.25	20.54	1.53	277.50
15821	7.4	7.6	0.06	1.49	0.03	235	16.03	15.46	1.55	289.70
13270	8.0	8.8	0.05	1.43	0.03	257	27.48	20.98	1.41	288.20
Standards and Screening Levels	6.5-9	5	0.33	14.1	0.69	126	50	50	1.95	400

Figure 64. Water Quality Impairments and Concerns in the Middle Rio Grande Sub-Basin

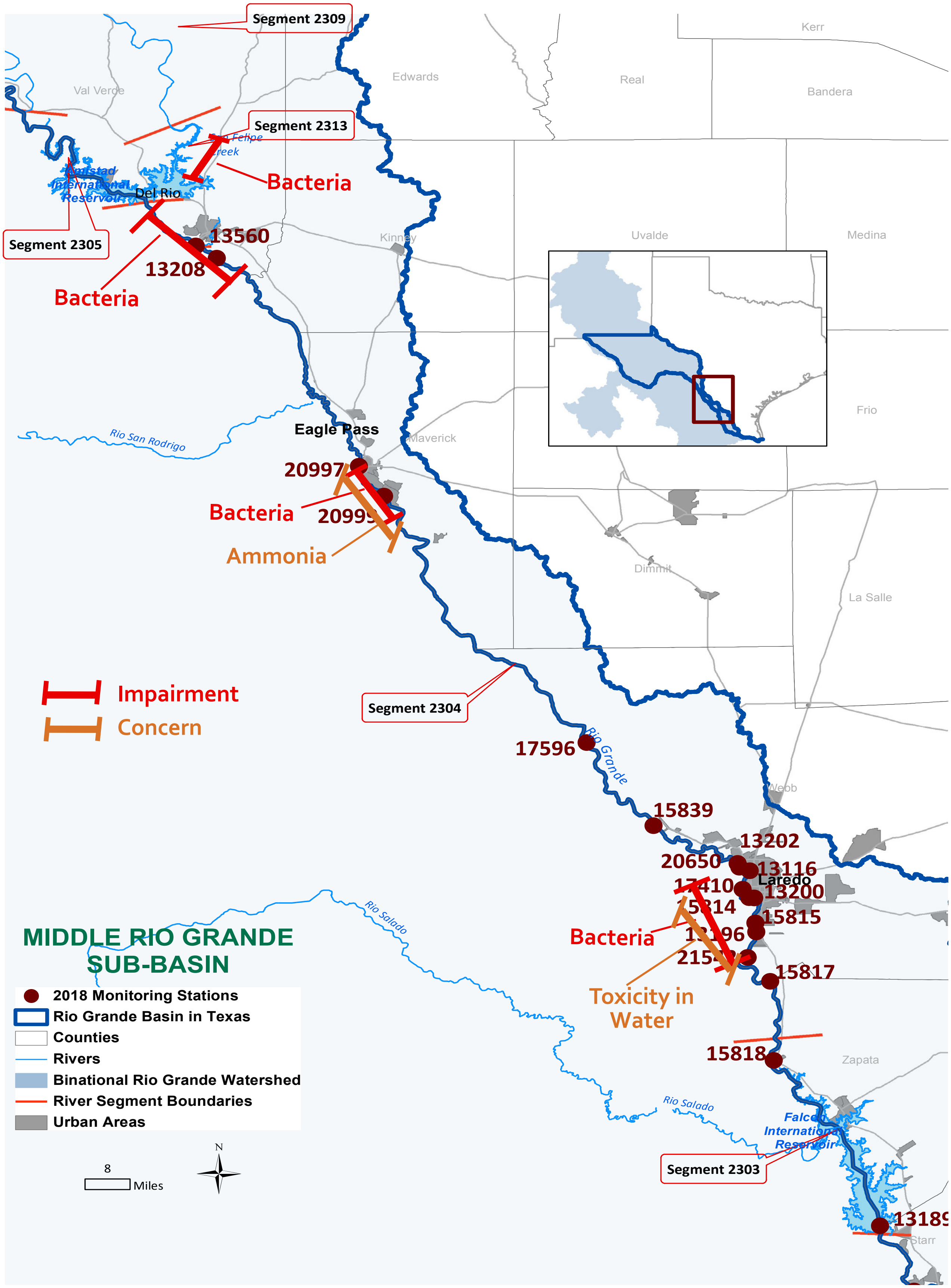


Table 11. Water Quality Review for the Middle Rio Grande Sub-Basin

Water Quality Review for the Middle Rio Grande Sub-Basin					
Segment	***Uses**	**Stations**	**Length**	**Segment Characteristics**	**Water Quality Summary**
San Felipe Creek - Segment 2313	PCR, H, PS	15820, 15821, 13270	9 mi	A high quality stream that originates in the Del Rio area. Two springs, located within the city limits, make up the San Felipe Springs, which become the San Felipe Creek.	The segment is listed as impaired for bacteria, but exhibits no concerns. This creek has a positive effect on the Rio Grande as the water quality is very high and helps to reduce some of the sediment loading in the Rio Grande as it travels downstream to other communities.
Rio Grande below Amistad Reservoir and Manadas Creek - Segments 2304 and 2304B	PCR, H, PS	21542, 15816, 15815, 15814, 20650, 13202, 17410, 15839, 17596, 20999, 20997, 13560, 13208, 13116	226 mi	This segment is defined as the Rio Grande just downstream of Amistad Reservoir to the confluence of the Arroyo Salado in Zapata County.	This area has experienced rapid urban growth during the past 10 years. The designated uses for this segment are high aquatic life use, contact recreation, general uses, fish consumption, and public water supply use with all uses being fully supported except for contact recreation at some sites due to high bacteria levels.

*For an explanation of the uses, please refer to Table 3, Designated Uses for Freshwater on page 11.

Pictured above: San felipe Creek flowing throuhg Del Rio, TX. Photo taken by USIBWC CRP staff.

Segment 2313, San Felipe Creek

Segment 2313 stretches from the confluence of the Rio Grande in Val Verde County to a point 2.5 miles (4.0 km) upstream of US 90 in Val Verde County, which runs for 9 miles (14 km). San Felipe Creek is a pristine water source that originates in the Del Rio area in Val Verde County. A series of 10 springs, collectively known as the San Felipe Springs, arise to form the headwaters of San Felipe Creek. This spring-fed stream flows through parts of Del Rio and serves as a drinking water source. San Felipe Creek, San Felipe Spring #3, and Spring #2 are the only water source for the city of Del Rio and Laughlin Air Force Base. It is also a popular recreational area. Unfortunately, over the years the recreation has taken a toll on the water quality, and in the last Integrated Report San Felipe Creek was listed as impaired for bacteria. San Felipe Creek currently has no other water quality concerns.

Segment 2313 has one Assessment Unit (AU):

2313_01, From the Rio Grande confluence to the San Felipe Springs upstream of U.S. Hwy 90

There are 3 active stations within this segment:

13270, San Felipe Creek at Guler confluence with the Rio Grande

15820, San Felipe Creek at West Springs near West Wells in Del Rio in west channel of creek 0.5 KM upstream from US90 Bridge

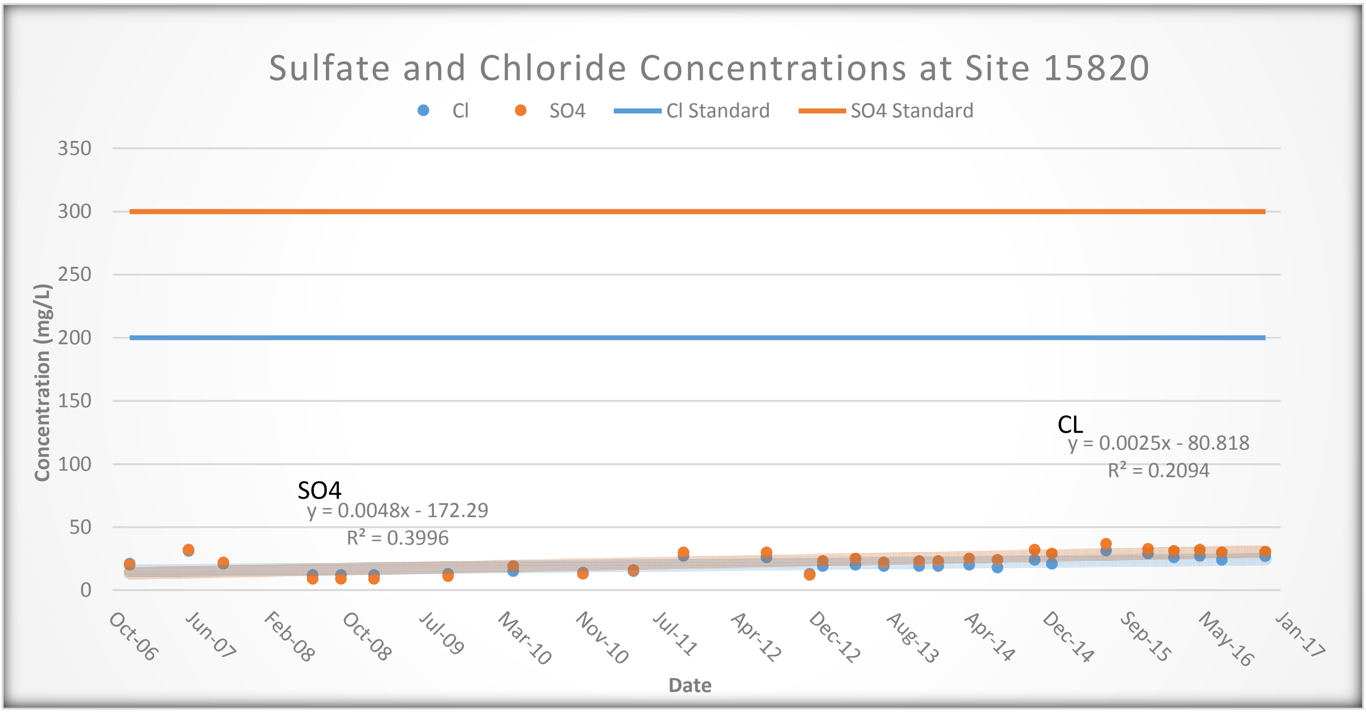
15821, San Felipe Creek at Blue Hole flood gates in park between US90 Bridge and Southern Pacific RR Bridge in Del Rio 50M downstream of US90

At Station 13270 (San Felipe Creek at Guler confluence with Rio Grande), 27 *E.coli* bacteria samples had a geomean of 257 MPN (most probable number), which is above the water quality standard of 126 MPN. The water quality data indicated that dissolved oxygen levels had an mean of 8.8 mg/L, and the mean for pH at this station during the period of record is 8.0. The mean for total dissolved solids is 288.20 mg/L. Ammonia data for this station shows a mean of 0.05 mg/L. The mean for total phosphorus is 0.03 mg/L. The mean for chlorophyll-a is 1.43 ug/L. Sulfate has a mean of 27.48 mg/L, chloride a mean of 20.98 mg/L, and nitrate+nitrite a mean of 1.41 mg/L. All parameters show no significant trends.

Pictured above: Local people enjoying a hot day at the San Felipe Springs (photo taken by USIBWC CRP staff)

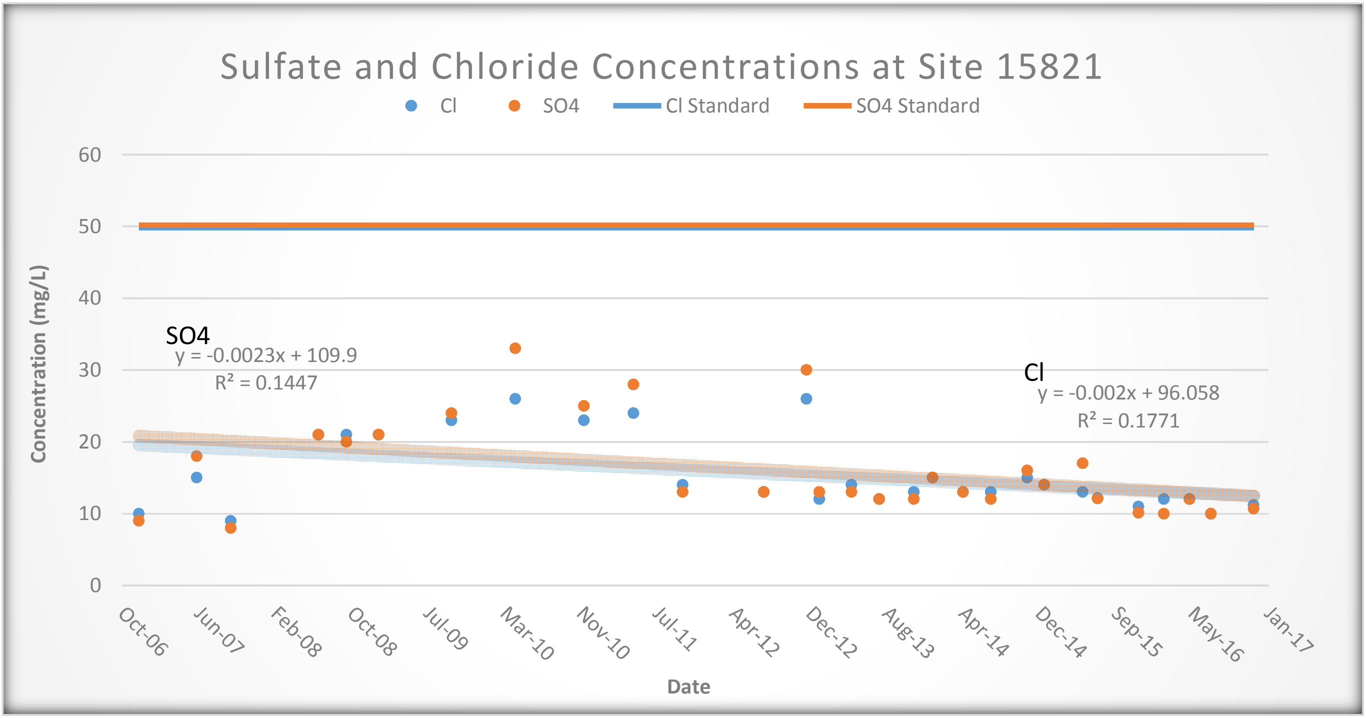
At Station 15820 (San Felipe Creek near West Wells in Del Rio), 27 *E.coli* bacteria samples had a geomean of 157 MPN (most probable number), which is above the water quality standard of 126 MPN and has no trend.The water quality data indicated that dissolved oxygen levels had an mean of 8.3 mg/L, and the mean for pH at this station during the period of record is 7.6; neither show a significant trend. The mean for total dissolved solids is 277.50 mg/L. Ammonia data for this station shows a mean of 0.05 mg/L and shows no significant trend. The mean for total phosphorus is 0.03 mg/L, and shows neither an increasing or decreasing trend. The mean for chlorophyll-a is 1.40 ug/L and shows no statistical trend. This station shows an increasing trend for sulfates, with a mean of 23.25 mg/L, and chloride, with a mean of 20.54 mg/L. Nitrate+nitrite has a mean of 1.53 mg/L and shows no significant trend. Please see graphs below.

Figure 65.



At Station 15821 (San Felipe Creek Downstream of US 90), 25 *E.coli* bacteria samples had a geomean of 235 MPN (most probable number), which is above the water quality standard of 126 MPN and shows no trend.The water quality data indicated that dissolved oxygen levels had an mean of 7.6 mg/L, and shows a decreasing trend. The mean for pH at this station is 7.4, and shows no trend. The mean for total dissolved solids is 289.70 mg/L. Ammonia data for this station shows a mean of 0.06 mg/L and shows neither an increasing or decreasing trend. The mean for total phosphorus is 0.03 mg/L, and shows neither an increasing or decreasing trend. The mean for chlorophyll-a is 1.49 ug/L and shows no statistical trend. This station shows a decreasing trend for sulfates, with a mean of 16.03 mg/L, and chloride, with a mean of 15.46 mg/L. The mean for nitrate+nitrite is 1.55 mg/L, with no significant trend. This station is downstream of Station 15820, and it it may benefit from being located in an area where the spring is not exposed to such heavy repeated recreational use. Please see the graph for this station on the following page.

Figure 66.



Segment 2304, Rio Grande Below International Amistad Reservoir and Segment 2304B, Manadas Creek

Segment 2304 is defined as the Rio Grande just downstream of Amistad Reservoir to the confluence of the Arroyo Salado in Zapata County. The segment is 226 river miles (364 km) in length. The sister cities of Del Rio, Texas/Ciudad Acuña, Coahuila, Eagle Pass, Texas/Piedras Negras, Coahuila, and Laredo, Texas/Nuevo Laredo, Tamaulipas are located in this part of the Rio Grande Basin. This area has experienced rapid urban growth during the past 10 years. The designated uses for this segment are high aquatic life use, contact recreation, general uses, fish consumption, and public water supply use with all of the uses being fully supported except for contact recreation at some sites due to high bacteria levels. Segment 2304 is impaired for bacteria since 1996. There are also concerns for ammonia and toxicity in water. Segment 2304B has concerns for bacteria, ammonia, and chlorophyll-a.

Segment 2304 has 11 assessment units, or AUs:

2304_01, From the Arroyo Salado confluence upstream to the San Idelfonso Creek confluence

2304_02, From the San Idelfonso Creek confluence upstream to International Bridge #2

2304_03, From the International Bridge #2 upstream to the City of Laredo water treatment plant intake

2304_04, From the City of Laredo water treatment plant intake upstream to the World Trade Center Bridge

2304_04, From the City of Laredo water treatment plant intake upstream to the World Trade Center Bridge

2304_05, From the World Trade Center Bridge upstream to the Columbia Bridge

2304_06, From the Columbia Bridge upstream to El Indio

2304_07, From El Indio upstream to downstream of US Hwy 277 (Eagle Pass)

2304_08, From downstream of US Hwy 277 (Eagle Pass) upstream to the Las Moras Creek confluence

2304_09, From the Las Moras Creek confluence upstream to the San Felipe Creek confluence

2304_10, From the San Felipe Creek confluence upstream to the Amistad Dam

Segment 2304B, Manadas Creek

2304B_01, From the Rio Grande confluence in Laredo to a point 1.3 km (0.81 mi) upstream of Bob Bullock Loop

There are 21 active stations within these segments:

Station 13200, Rio Grande 50 yards upstream of confluence of Zacata Creek and Rio Grande

Station 13202, Rio Grande at Laredo Water Treatment Plant pump intake

Station 13208, Rio Grande 12.8 miles (20.6 km) below Amistad Dam, 1,115 feet (340 m) upstream of U.S. 277 Bridge in Del Rio

Stations 13560, Rio Grande, 4.5 miles (7.2 km) downstream of Del Rio, Texas at Moody Ranch

Station 15814, Rio Grande at International Bridge #2 (East Bridge) in Laredo

Station 15815, Rio Grande at Masterson Road in Laredo, 6.2 miles (9.9 km) downstream of International Bridge #1

Station 15816, Rio Grande at Rio Bravo, 0.3 miles (0.5 km) downstream of the community of El Cenizo

Station 15839, Rio Grande at the Colombia Bridge

Station 17410, Rio Grande below World Trade Bridge

Station 20650, Rio Grande 115 meters south and 304 meters west from the intersection of Rancho Viejo Drive/Zebu Court and Rienda Drive in Father McNaboe City Park in Laredo

Station 20997, Rio Grande at Main Street boat ramp approximately 400 meters upstream of US 57/International Bridge in Eagle Pass

Station 20999, Rio Grande at Kickapoo Casion boat ramp South of Eagle Pass

Station 17596, Rio Grande at Apache Ranch

Station 21542, Rio Grande at El Cenizo Park 220 meters West of intersection of Cadena and Jimenez

Station 13196, Rio Grande at Pipeline Crossing 8.7 miles downstream of Laredo

Station 15274, Rio Grande east bank at IBWC weir dam 6 miles south of El Indio, 0.6 miles downstream of Cuervo Creek

Station 15340, Rio Grande 3.4 km downstream of Amistad Dam, upstream of weir dam/IBWC gage 08-4509.00

Station 15817, Rio Grande at Webb/Zapata County Line

Station 18792, Rio Grande at Kickapoo Casino 300 m south and 70 m west of Kurt Bluedog Rd at Riverside Dr south of Eagle Pass

Station 18795, Rio Grande at Kickapoo reservation 1.92 km south and 2.02 km west of RR 1021 at Maverick County Hwy 523 south of Eagle Pass

Station 13116 – Manadas Creek at FM 1472 North of Laredo

Rio Grande at International Bridge 2, looking downstream. Photo credit USIBWC CRP staff.

Rio Grande at Laredo near Zacate Creek. Photo credit USIBWC CRP staff.

Assessment Unit 2304_01 is impaired for bacteria. This AU is monitored by Stations 13196, 15816, 15817, and 21542.

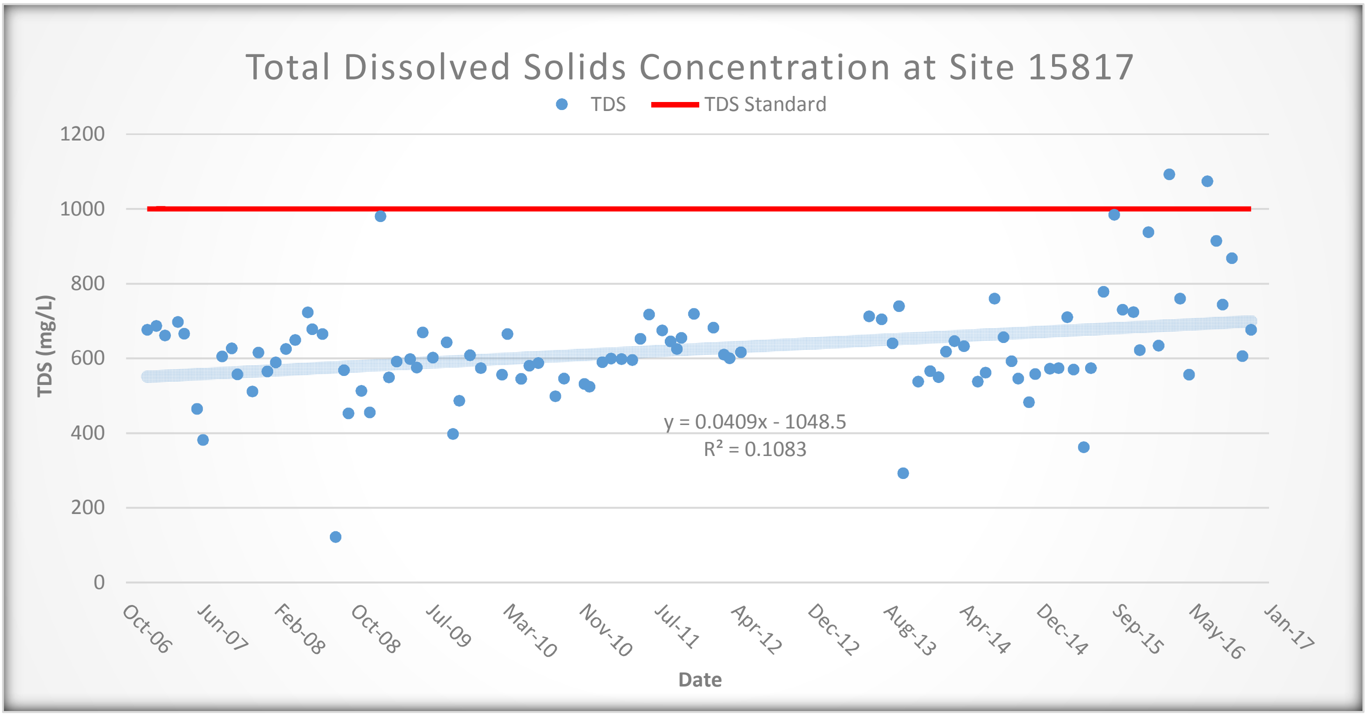
At Station 13196 (Rio Grande at Pipeline Crossing), 37 *E.coli* bacteria samples had a geomean of 1,028 MPN (most probable number), which is much higher than the water quality standard of 126 MPN. Currently the site shows a statistically increasing trend for bacteria counts. The sample size for everything other than bacteria is too small for statistically reliable data and is being provided for informational purposes only. The water quality data indicated that dissolved oxygen levels had an mean of 8.4 mg/L, and the mean for pH at this station during the period of record is 8.1. The mean for total dissolved solids is 634.57 mg/L. Ammonia data for this station shows a mean of 0.22 mg/L. The mean for total phosphorus is 0.25 mg/L. The mean for sulfate is 187.71 mg/L. The mean for chloride is 117.57 mg/L. The mean for nitrate+nitrite is 0.62 mg/L.

At Station 15816 (Rio Grande at Rio Bravo), 27 *E.coli* bacteria samples had a geomean of 954 MPN (most probable number), which is much higher than the water quality standard of 126 MPN. The water quality data indicated that dissolved oxygen levels had an mean of 6.8 mg/L, and the mean for pH at this station is 8.1; neither shows a trend. Currently the site shows no statistically significant increasing or decreasing trend for bacteria. The sample size for everything other than bacteria, pH, and dissolved oxygen are too small for statistically reliable data and is being provided for informational purposes only. Data for total dissolved solids shows a mean of 697.33 mg/L. Ammonia data for this station shows a mean of 0.53 mg/L. The mean for total phosphorus is 0.18 mg/L. The mean for chlorophyll-a is 10.67 ug/L. Sulfate has a mean of 219.33 mg/L. Chloride has a mean of 136.8 mg/L, and nitrate+nitrite has a mean of 1.00 mg/L.

Rio Grande at Rio Bravo. Photo credit USIBWC CRP staff.

At Station 15817 (Rio Grande at Webb/Zapata County Line), 112 *E.coli* bacteria samples had a geomean of 48 MPN (most probable number). Currently the site shows no statistically significant increasing or decreasing trend for bacteria counts. This station is about 12 miles below downtown Laredo/Nuevo Laredo, where serious bacteria problems exist. The water is much cleaner in this area because there is significantly less urbanization contirbuting runoff into the river. The water quality data indicated that dissolved oxygen levels had an mean of 8.3 mg/L, and is showing a slightly decreasing trend. The mean for pH at this station during the period of record is 8.1 and shows no trend. Data for total dissolved solids shows a mean of 624.05 mg/L, and shows an increasing trend. Ammonia data for this station shows a mean of 0.35 mg/L and shows neither an increasing or decreasing trend. The mean for total phosphorus is 0.20 mg/L, and shows a decreasing trend. This station also shows increasing trends for sulfate, with a mean of 190.74 mg/L, and chloride, with a mean of 116 mg/L. Nitrate+nitrite has a mean of 2.01 mg/L. The concern for toxicity in water has been carried forward in the last TCEQ Integrated Report, and more studies would need to be done to determine if this is still an issue. The graph for TDS is below, please see Appendix B .for all other graphs for this station.

Figure 67.

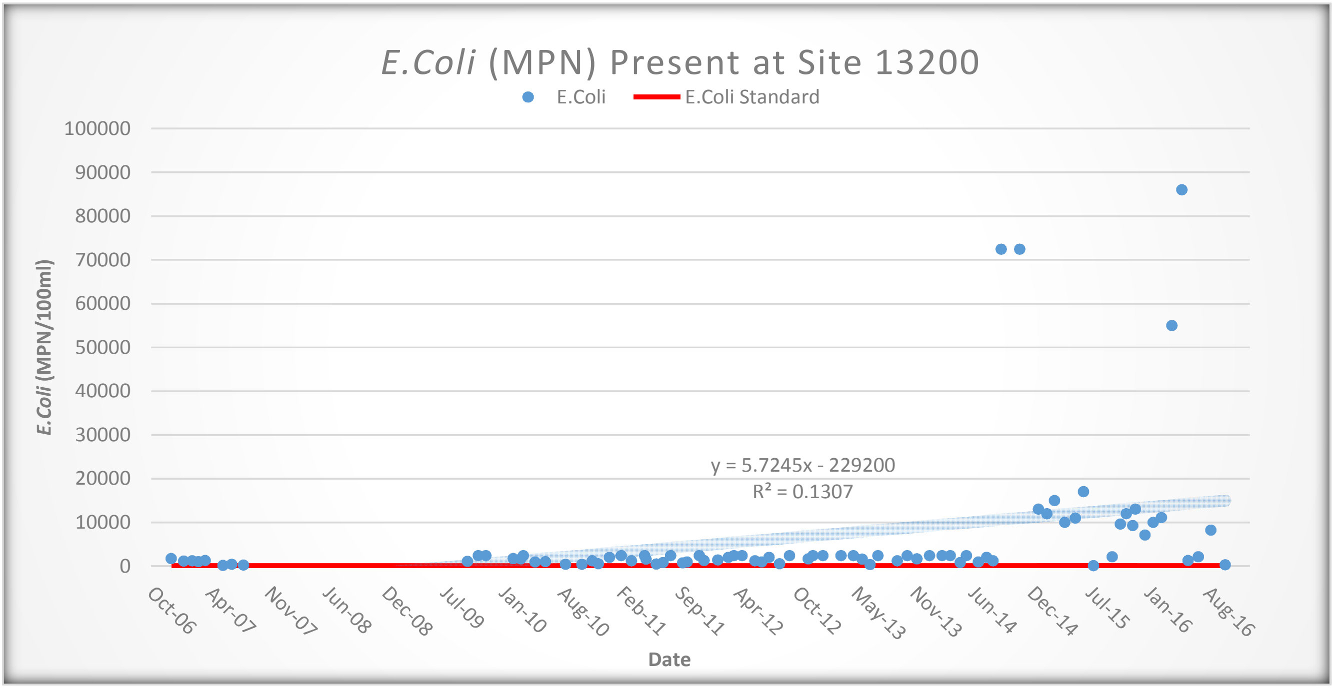


Station 21542 (Rio Grande at El Cenizo) is a relatively new station added in 2014 to address concerns about high bacteria counts in the towns of El Cenizo and Rio Bravo. The sample size was too small for statistically reliable data and the information is being provided for informational purposes only. Nine *E.coli* bacteria samples had a geomean of 1,033 MPN (most probable number), which is above the water quality standard of 126 MPN. The water quality data indicated that dissolved oxygen levels had an mean of 6.4 mg/L, and the mean for pH at this station during the period of record is 8.1. Data for total dissolved solids shows a mean of 699.56 mg/L. Ammonia data for this station shows a mean of 0.53 mg/L. The mean for total phosphorus is 0.19 mg/L. The mean for chlorophyll-a is 11 ug/L. The mean for sulfate is 218 mg/L. The mean for chloride is 137.41 mg/l, and nitrate+nitrite shows a mean of 1.71.

Assessment Unit 2304_02 is impaired for bacteria. This AU is monitored by Stations 13200 and 15815.

For Station 13200 (Rio Grande upstream of confluence with Zacate Creek), 76 *E.coli* bacteria samples had a geomean of 2,201 MPN (most probable number), which is above the water quality standard of 126 MPN. Currently the site shows a statistically increasing trend for bacteria. This station is only monitored for bacteria, and the graph is provided on the following page.

Figure 68.



At Station 15815 (Rio Grande at Masterson Road), 81 *E.coli* bacteria samples had a geomean of 2,601 MPN (most probable number), which is above the standard of 126 MPN. Currently the site does not show a statistically increasing or decreasing trend for bacteria.This station is only monitored for bacteria.

Assessment Unit 2304_03 is impaired for bacteria, and concern for toxicity in water. This AU is monitored by Station 15814.

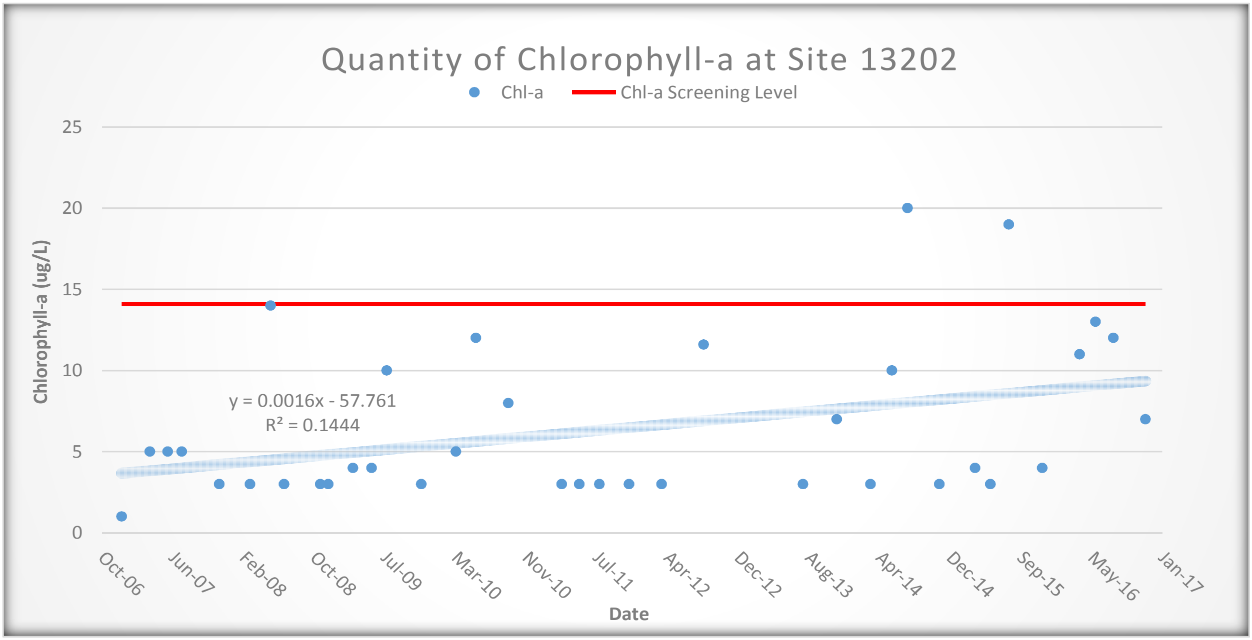
At Station 15814 (Rio Grande at International Bridge #2 in Laredo), 119 *E.coli* bacteria samples had a geomean of 3,845 MPN (most probable number), which is above the water quality standard of 126 MPN. The water quality data indicated that dissolved oxygen levels had an mean of 7.9 mg/L. The mean for pH at this station during the period of record is 8.1. Data for total dissolved solids shows a mean of 638.42 mg/L. Ammonia data for this station shows a mean of 0.21 mg/L. The mean for total phosphorus is 0.11 mg/L. The mean for sulfate is 184.03 mg/L. The mean for chloride is 113.65 mg/l, and the mean for nitrate+nitrite is 1.28 mg/L. No parameters showed significant trends.

Assessment Unit 2304_04 has no impairments, but this AU does have a concern for toxicity in water. This AU is monitored by Stations 13202 and 20650.

At Station 20650 (Rio Grande at Father McNaboe Park), 38 *E.coli* bacteria samples had a geomean of 22 MPN (most probable number). This station is in the northern part of Laredo, upstream of the area with very serious bacteria count concerns. Currently the site does not show a statistically increasing or decreasing trend for bacteria.This station is only monitored for bacteria.

At Station 13202 (Rio Grande at Laredo WTP intake), 115 *E.coli* bacteria samples had a geomean of 22 MPN (most probable number). Currently the site shows no statistically significant trend for bacteria. The water quality data indicated that dissolved oxygen levels had an mean of 7.9 mg/L, and is showing neither an increasing nor decreasing trend. The mean for pH at this station is 8.1 and shows no trend. Data for total dissolved solids shows a mean of 612.27 mg/L, and shows no significant trend. Ammonia data for this station shows a mean of 0.21 mg/L and shows neither an increasing or decreasing trend. The mean for total phosphorus is 0.10 mg/L, and also shows no significant trend. The mean for cholorphyll-a is 6.39 ug/L and does show an increasing trend. The mean for sulfate is 189.27 mg/L, with no trend. The mean for chloride is 115.16 mg/l, and also shows no trend. The mean for nitrate+nitrite is 1.33 mg/L, and also shows no significant trend. Please see graph on the following page.

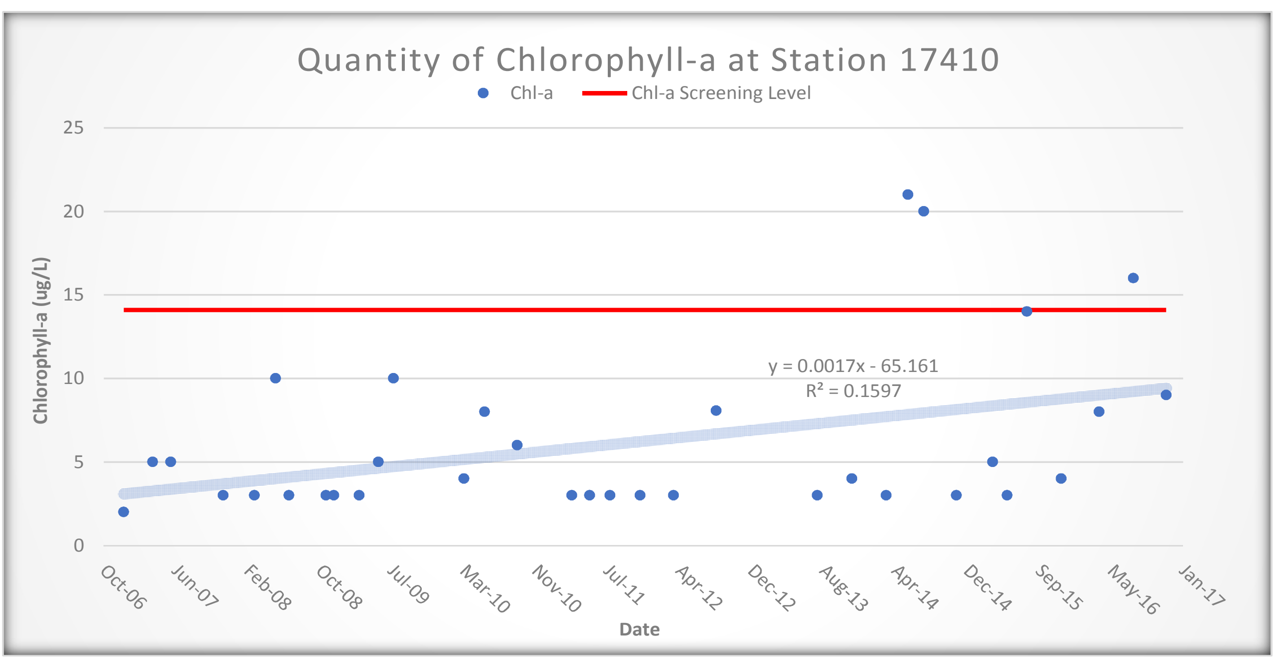
Figure 69.



Assessment Unit 2304_06 has no impairments or concerns. This AU is monitored by Stations 15274, 15839, 17410, and 17596.

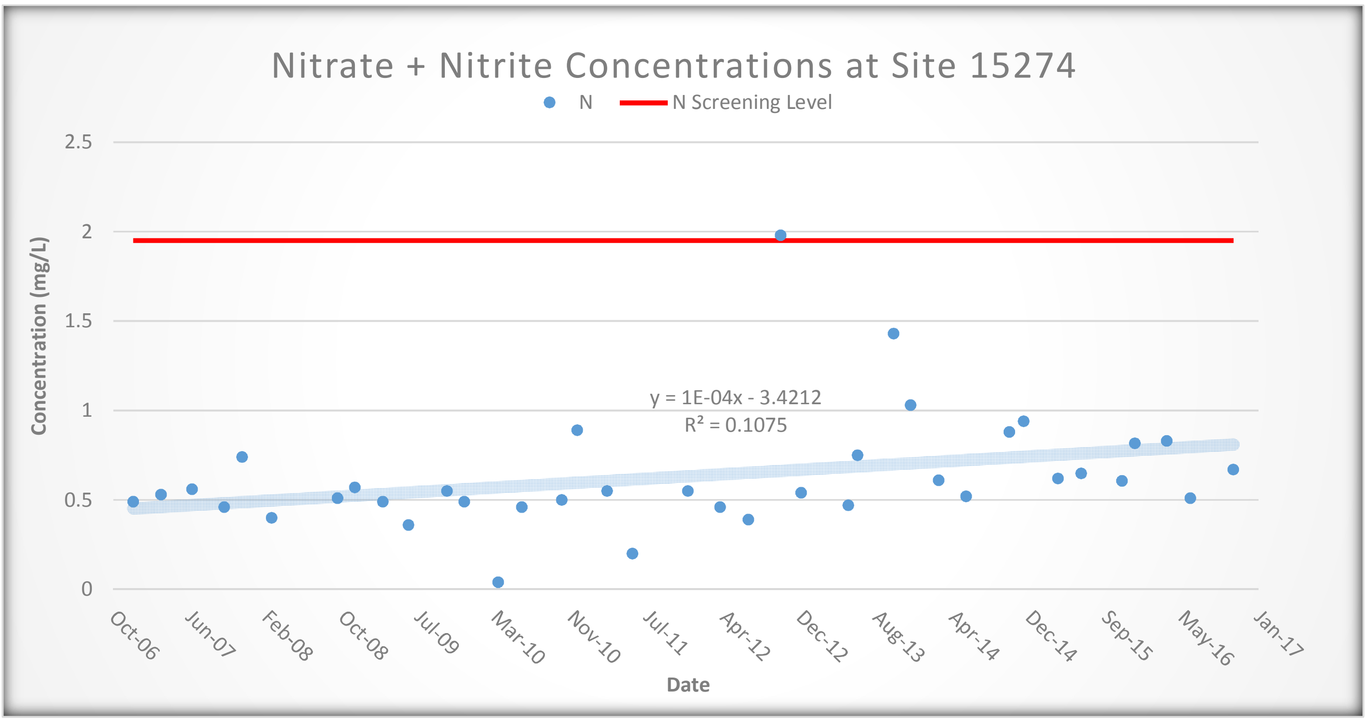
At Station 17410, 34 *E.coli* bacteria samples had a geomean of 14 MPN (most probable number).Currently the site shows no statistically significant increasing or decreasing trend for bacteria. The water quality data indicated that dissolved oxygen levels had an mean of 7.8 mg/L, and shows a decreasing trend. The mean for pH at this station is 8.1 and has no reported trend. Data for total dissolved solids shows a mean of 609.26 mg/L, and shows neither an increasing nor decreasing trend. Ammonia data for this station shows a mean of 0.30 mg/L and shows neither an increasing or decreasing trend. The mean for total phosphorus is 0.11 mg/L, and also shows neither an increasing nor decreasing trend. The mean for chlorophyll-a is 6.15 ug/L and shows an increasing trend. The mean for sulfate is 183.49 mg/L and shows no significant trend. The mean for chloride is 111.79 mg/L and shows no trend. Nitrate+nitrite, with a mean of 1.82 mg/L, also shows no trend. Please see graph below.

Figure 70.



At Station 15274 (Rio Grande at IBWC weir dam), 36 *E.coli* bacteria samples had a geomean of 24 MPN (most probable number). Currently the site shows no statistically significant increasing or decreasing trend for bacteria counts. The water quality data indicated that both dissolved oxygen and pH have means of 8.1, and both show no significant trends. Data for total dissolved solids shows a mean of 538.41 mg/L, and shows no significant trend. Ammonia data for this station shows a mean of 0.09 mg/L and shows no significant trend. The mean for total phosphorus is 0.10 mg/L, and also shows no significant trend. The mean for chlorophyll-a is 4.41 ug/L and does not show a statistical trend. The mean for sulfate is 170.16 mg/L, with no trend. The mean for chloride is 31.34 mg/L and also shows no trend. This station does show an increasing trend for nitrate+nitrite, with a mean of 0.63 mg/L. Please see graph below.

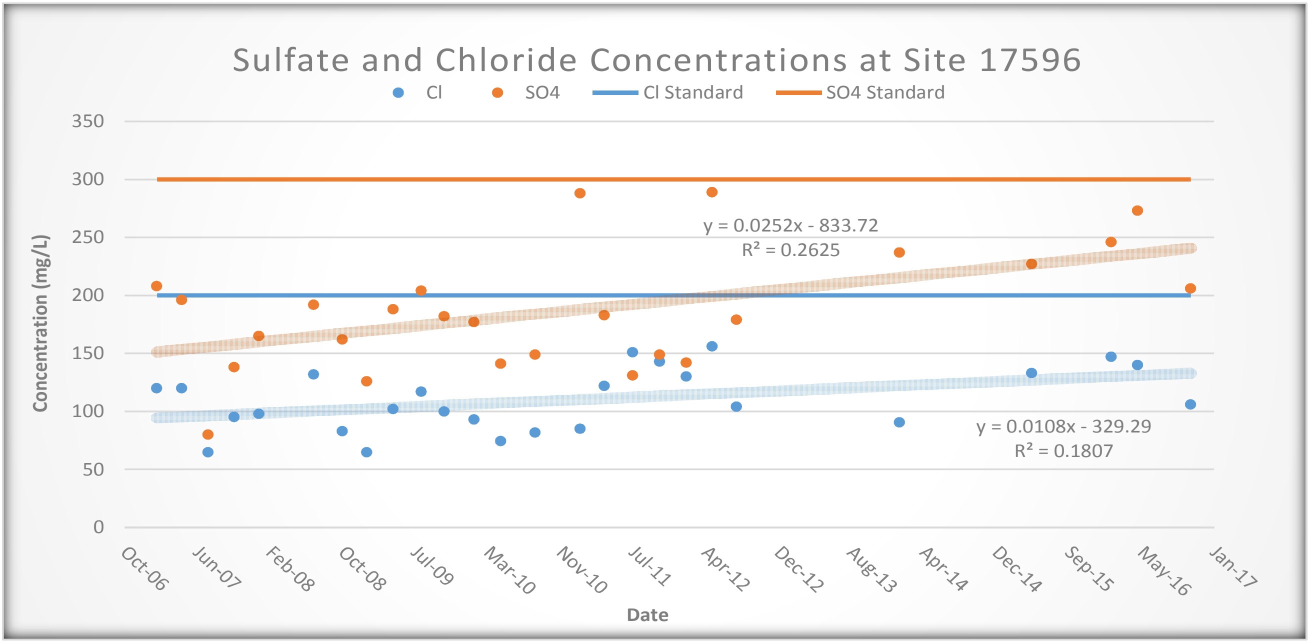
Figure 71.



At Station 15839 (Rio Grande at Colombia Bridge), 77 *E.coli* bacteria samples had a geomean of 18 MPN (most probable number). This is the most northern of the stations in the Laredo area, and is the indicator of the water quality as it enters the Laredo area. It is also about 20 miles upstream of downtown Laredo, where the high bacteria counts are seen. Currently the site does not show a statistically increasing or decreasing trend for bacteria.This station is only monitored for bacteria.

At Station 17596 (Rio Grande at Apache Ranch), 21 *E.coli* bacteria samples had a geomean of 11 MPN (most probable number). Currently the site shows no statistically significant trend for bacteria. The water quality data indicated that both dissolved oxygen and pH have means of 8.1, and both show no significant trends. Data for total dissolved solids shows a mean of 578.80 mg/L, and shows neither an increasing nor decreasing trend. Ammonia data for this station shows a mean of 0.52 mg/L and shows neither an increasing or decreasing trend. The mean for total phosphorus is 0.12 mg/L, and also shows neither an increasing nor decreasing trend. The mean for chlorophyll-a is 6.39 ug/L and does not show a statistical trend. This station does show an increasing trend for sulfate, with a mean of 186.84 mg/L, and chloride, with a mean of 109.75 mg/L. Nitrate+nitrite has a mean of 0.66 mg/L and shows no trends. Please see the graph on the following page.

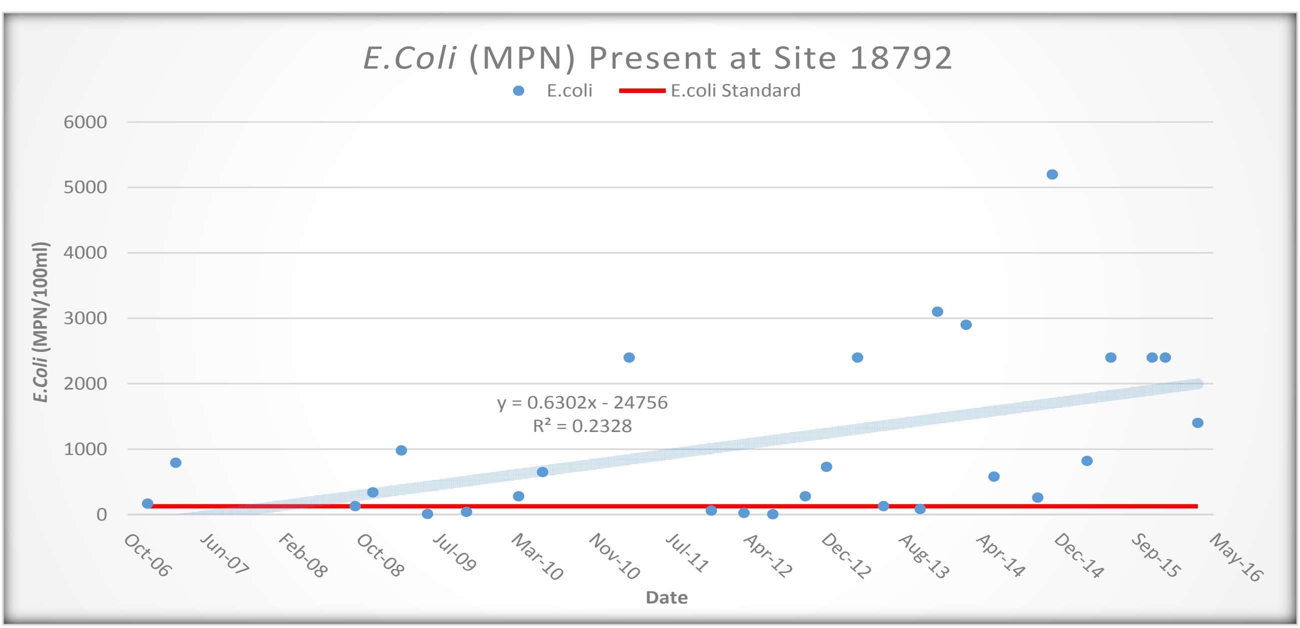
Figure 72.



Assessment Unit 2304_07 is impaired for bacteria. This AU has no parameter concerns. This AU is monitored by Stations 18792, 18795, 20997 and 20999.

At Station 18792 (Rio Grande at Kickapoo Casino South of Eagle Pass), 29 *E.coli* bacteria samples had a geomean 395 MPN (most probable number), which is above the water quality standard of 126 MPN. There is an increasing trend for bacteria. The water quality data indicated that dissolved oxygen levels had an mean of 8.6 mg/L, and shows no significant trend. The mean for pH at this station during the period of record is 8.1 and shows no trend. The mean for total phosphorus is 0.12 mg/L, and also shows neither an increasing nor decreasing trend. The mean for sulfate is 172.61 mg/L, and shows no trend. The mean for chloride is 91.63 mg/L, and also shows no trend. Data for total dissolved solids shows a mean of 568.15 mg/L, with no significant trend. Ammonia data for this station shows a mean of 0.22 mg/L and shows no trend. The mean for chlorophyll-a is 4.38 ug/L and shows no trend. The mean for nitrate+nitrite is 0.56 mg/L, and shows no trend.

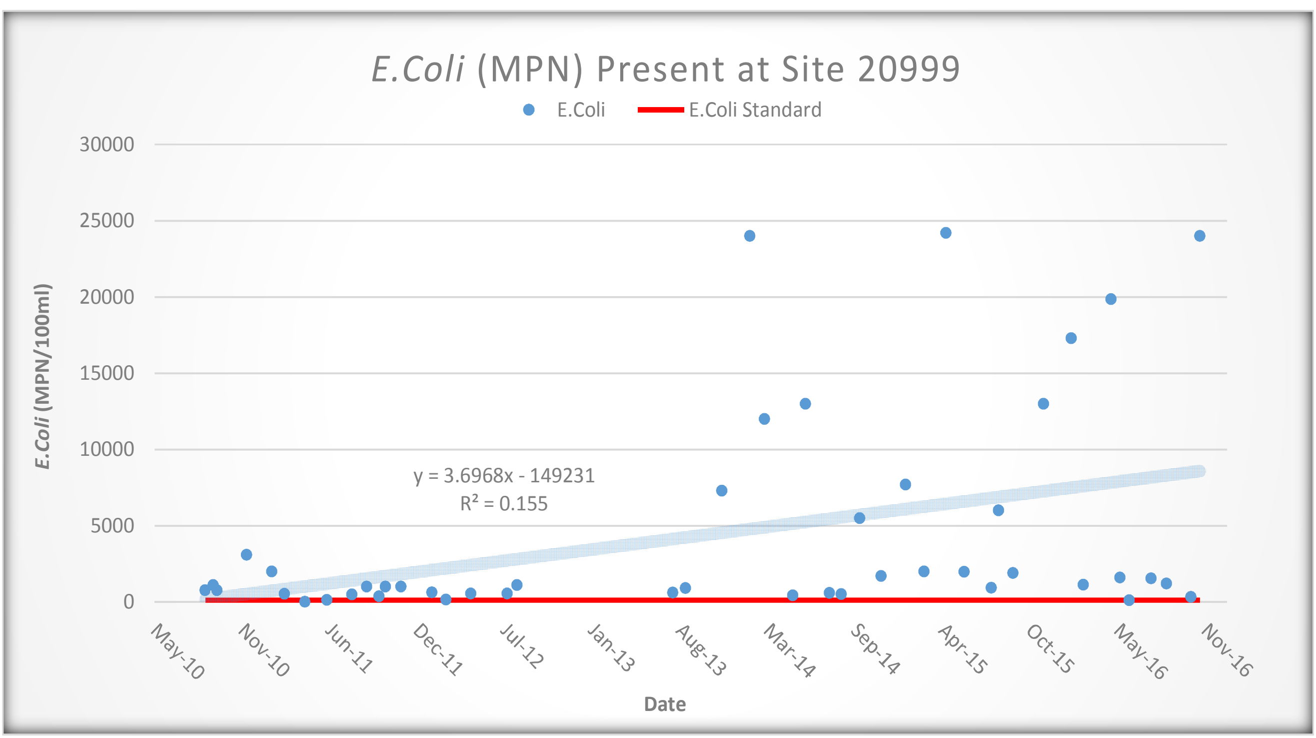
Figure 73.



At Station 18795 (Rio Grande at Kickapoo reservation south of Eagle Pass), 29 *E.coli* bacteria samples had a geomean of 754 MPN (most probable number). Currently the site shows no statistically significant for bacteria counts, although the geomean is above the water quality standard of 126 MPN. The water quality data indicated that dissolved oxygen levels had an mean of 7.3 mg/L. The mean for pH at this station during the period of record is 8.1. Data for total dissolved solids shows a mean of 591.32 mg/L. Ammonia data for this station shows a mean of 0.18 mg/L. The mean for total phosphorus is 0.14 mg/L. The mean for chlorophyll-a is 8 ug/L. The mean for sulfate is 169.85 mg/L. The mean for nitrate+nitrite is 0.52 mg/L. The mean for chloride is 99.56 mg/L. This station had data only through 2010, when a flood drastically changed the landscape and made accessibility difficult, and was replaced by Station 20999. Please see graphs for this station on the next page and in Appendix B.

At Station 20999 (Rio Grande at Kickapoo Casino Boat Ramp south of Eagle Pass), 46 *E.coli* bacteria samples had a geomean of 1,489 MPN (most probable number). Currently the site shows an increasing trend for bacteria, and the geomean is above the water quality standard of 126 MPN. The water quality data indicated that dissolved oxygen levels had an mean of 6.5 mg/L, and shows neither an increasing nor a decreasing trend. The mean for pH at this station during the period of record is 8.0 and shows an increasing trend. Data for total dissolved solids shows a mean of 582.17 mg/L, and shows an increasing trend. Ammonia data for this station shows a mean of 0.67 mg/L and shows a decreasing trend. The mean for total phosphorus is 0.11 mg/L, and shows no trend. The mean for chlorophyll-a is 6.85 ug/L and shows an increasing trend. The mean for chloride is 109.84 mg/L and also shows no trend. The mean for nitrate+nitrite is 0.65 mg/L, with no significant trend.This station does show an increasing trend for sulfate, with a mean of 169.81 mg/L. This station was established in 2010. The graph for bacteria is below, please see all other graphs for this station in Appendix B.

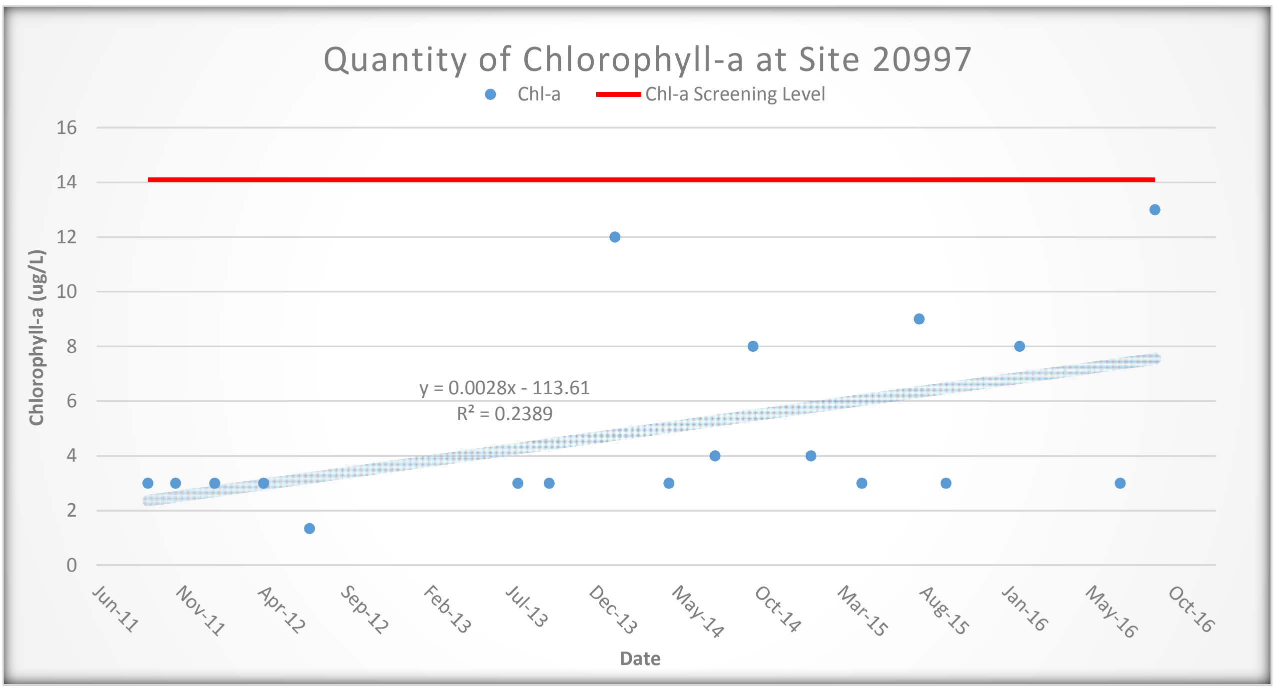
Figure 74.



Assessment Unit 2304_08 has no impairments. This AU has a concern for ammonia. This AU is monitored by Station 20997.

At Station 20997 (Rio Grande at Main St Boat Ramp Uptream of International Bridge in Eagle Pass), 18 *E.coli* bacteria samples had a geomean of 28 MPN (most probable number). Currently the site shows no statistically significant increasing or decreasing trend for bacteria counts. The water quality data indicated that dissolved oxygen levels had an mean of 8.1 mg/L, and shows neither an increasing nor a decreasing trend. The mean for pH at this station during the period of record is 8.2 and shows no trend. Data for total dissolved solids shows a mean of 597.83 mg/L, and shows neither an increasing nor decreasing trend. Ammonia data for this station shows a mean of 0.82 mg/L and shows a decreasing trend. The mean for total phosphorus is 0.11 mg/L, and shows neither an increasing nor decreasing trend. The mean for cholorphyll-a is 4.96 ug/L and shows an increasing trend. Sulfate has a mean of 191.51 mg/L, and shows no trends. Chloride has a mean of 111.07 mg/L and shows no trends. Nitrate+nitrite has a mean of 0.41 mg/L and shows no trends. This analysis was done on data from 2011-2016. Please see graphs for this station in Appendix B.

Figure 75.

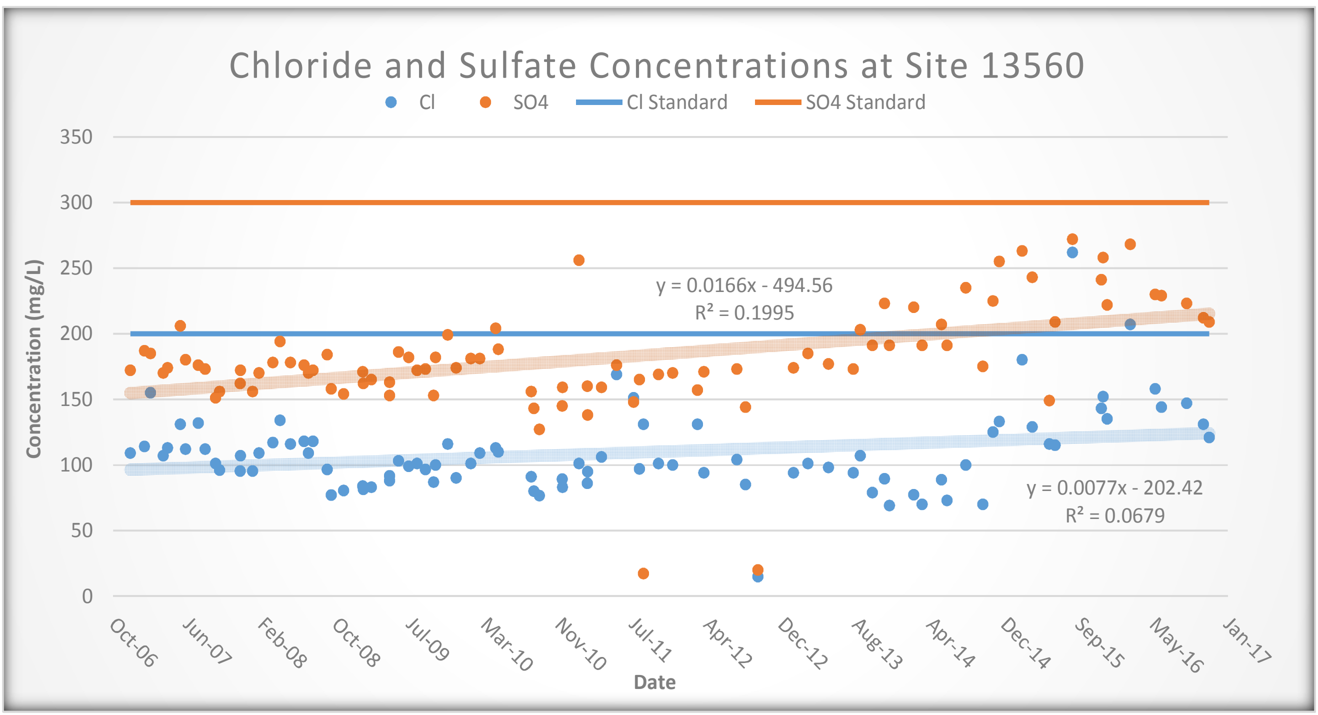


Station 20997. Photo credit USIBWC CRP staff.

Assessment Unit 2304_09 is impaired for bacteria. This AU has no parameter concerns. This AU is monitored by Station 13560.

At Station 13560 (Rio Grande downstream of Del Rio at Moody Ranch), 89 *E.coli* bacteria samples had a geomean of 195 MPN (most probable number) and is over the standard. Currently the site shows no statistically significant increasing or decreasing trend for bacteria counts. The water quality data indicated that dissolved oxygen levels had an mean of 9.7 mg/L, and shows neither an increasing nor a decreasing trend. The mean for pH at this station during the period of record is 8.1 and shows no trend. Data for total dissolved solids shows a mean of 587.74 mg/L, and shows an increasing trend. Ammonia data for this station shows a mean of 0.24 mg/L and shows neither an increasing nor decreasing trend. The mean for total phosphorus is 0.07 mg/L, and shows a decreasing trend. The mean for cholorphyll-a is 3.61 ug/L and shows neither an increasing nor decreasing trend. The mean for nitrate+nitrite is 0.51 mg/L, with no trends. This stations does show increasing trends for sulfates, with a mean of 181.58 mg/L, and chloride, with a mean of 108.82 mg/L. Please see graphs for this station below and additional graphs in Appendix B.

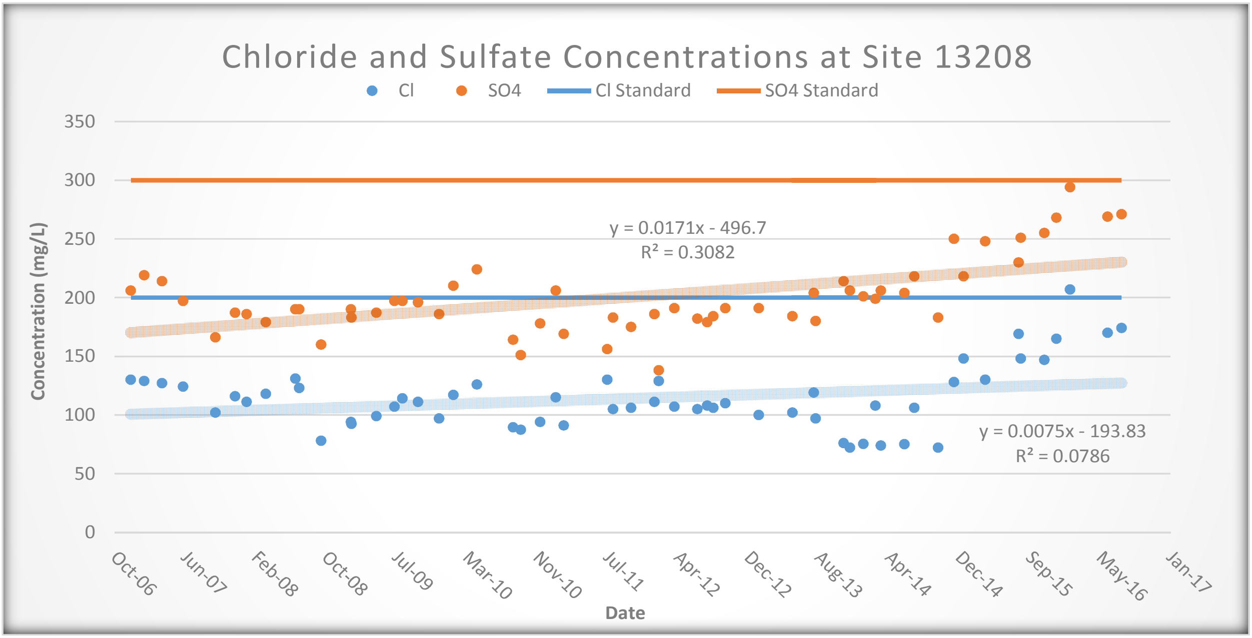
Figure 76.



Assessment Unit 2304_10 has no impairments or concerns. This AU is monitored by Stations 13208 and 15340.

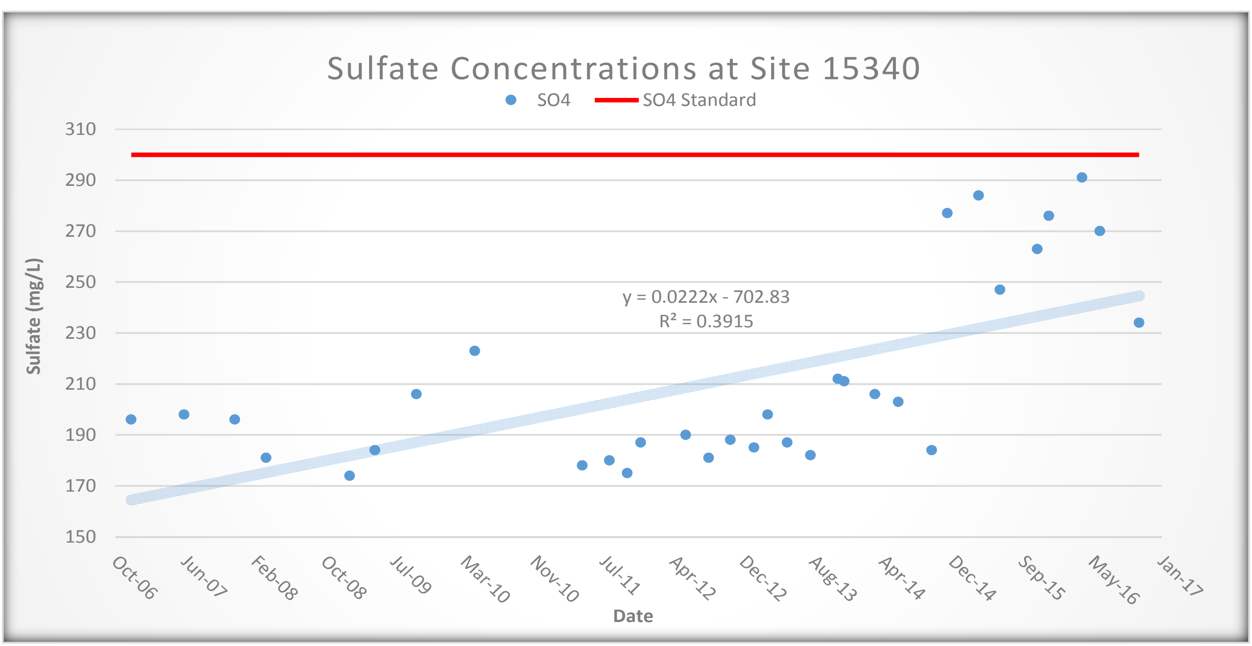
At Station 13208 (Rio Grande below Amistad Dam), 49 *E.coli* bacteria samples had a geomean of 46 MPN (most probable number). Currently the site shows no statistically significant increasing or decreasing trend for bacteria counts. The water quality data indicated that dissolved oxygen levels had an mean of 8.8 mg/L, and shows neither an increasing nor a decreasing trend. The mean for pH at this station during the period of record is 8.1 and shows no trend. Data for total dissolved solids shows a mean of 633.55 mg/L, and shows an increasing trend. Ammonia data for this station shows a mean of 0.14 mg/L and shows neither an increasing nor decreasing trend. The mean for total phosphorus is 0.04 mg/L, and also shows neither an increasing nor decreasing trend. The mean for cholorphyll-a is 2.57 ug/L and shows neither an increasing nor decreasing trend. This station does show increasing trends for sulfates, with a mean of 198.21 mg/L, and chloride, with a mean of 114.08 mg/L. Nitrate+nitrite, with a mean of 0.53 mg/L, showed no trends. Please see the graph for chloride and sulfate on the following page, and additional graphs for this station in Appendix B.

Figure 77.



At Station 15340 (Rio Grande downstream of Amistad Dam, upstream of IBWC gage), 28 *E.coli* bacteria samples had a geomean of 12 MPN (most probable number). Currently the site shows no statistically significant increasing or decreasing trend for bacteria counts. The water quality data indicated that dissolved oxygen levels had an mean of 7.4 mg/L, and shows neither an increasing nor a decreasing trend. The mean for pH at this station during the period of record is 8.0 and shows no trend. Data for total dissolved solids shows a mean of 608.67 mg/L, and shows no significant trend. Ammonia data for this station shows a mean of 0.05 mg/L and shows neither an increasing nor decreasing trend. The mean for total phosphorus is 0.03 mg/L, and also shows neither an increasing nor decreasing trend. The mean for cholorphyll-a is 1.44 ug/L and shows neither an increasing nor decreasing trend. The mean for chloride is 118.35 mg/L and shows no trends. The mean for nitrate+nitrite is 0.30 mg/L and shows no trends.This station does show increasing trends for sulfates, with a mean of 210.84 mg/L. Please see the graph below.

Figure 78.



Segment 2304B encompasses Manadas Creek. Manadas Creek is an unclassified freshwater stream in northwest Laredo, and a tributary to the Rio Grande. Data collected indicates concerns for ammonia, bacteria and chlorophyll-a. This creek is near a major highway and multiple industrial businesses, as well as directly downstream of a non-operational antimony smelter. Recent urban and industrial developments, and their associated runoff, may be contributing to the water quality concerns in this area. This segment has one Assessment Unit, 2304B_01, which has no impairments but has concerns for ammonia, bacteria, and chlorophyll-a. This AU is monitored by Station 13116.

At Station 13116, 28 *E.coli* bacteria samples had a geomean of 141 MPN (most probable number). Currently the site shows no statistically significant trend for bacteria, although the geomean is above the water quality standard of 126 MPN. The water quality data indicated that dissolved oxygen levels had an mean of 6.6 mg/L, and shows neither an increasing trend. The mean for pH at this station is 7.9 and shows a decreasing trend. Data for total dissolved solids shows a mean of 2,777.38 mg/L, and shows a decreasing trend, although it is still above the water quality standard. Ammonia data for this station shows a mean of 0.54 mg/L and shows no trend. The mean for total phosphorus is 0.83 mg/L, and also shows an increasing trend. The mean for cholorphyll-a is 33.74 ug/L and shows a decreasing trend. This station does show decreasing trends for sulfates, with a mean of 1243.55 mg/L, and chloride, with a mean of 484.73 mg/L, although the means are still above the standard. The data also shows an increasing trend nitrate+nitrite, with a mean of 6.95 mg/L. Please see the graph for TDS on the next page, and additional graphs for this station in Appendix B.

Figure 79.

Satellite Imagery of Station 13116, Manadas Creek (Google Earth map)

Figure 80.

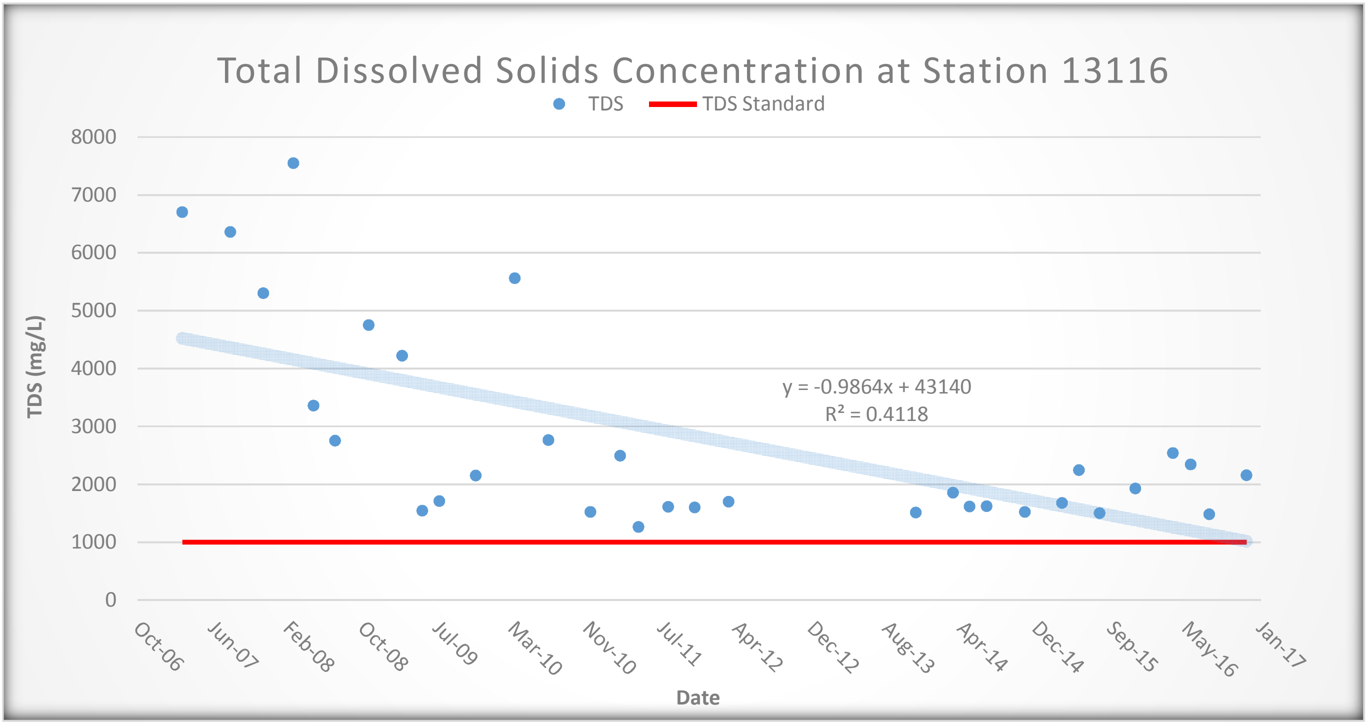
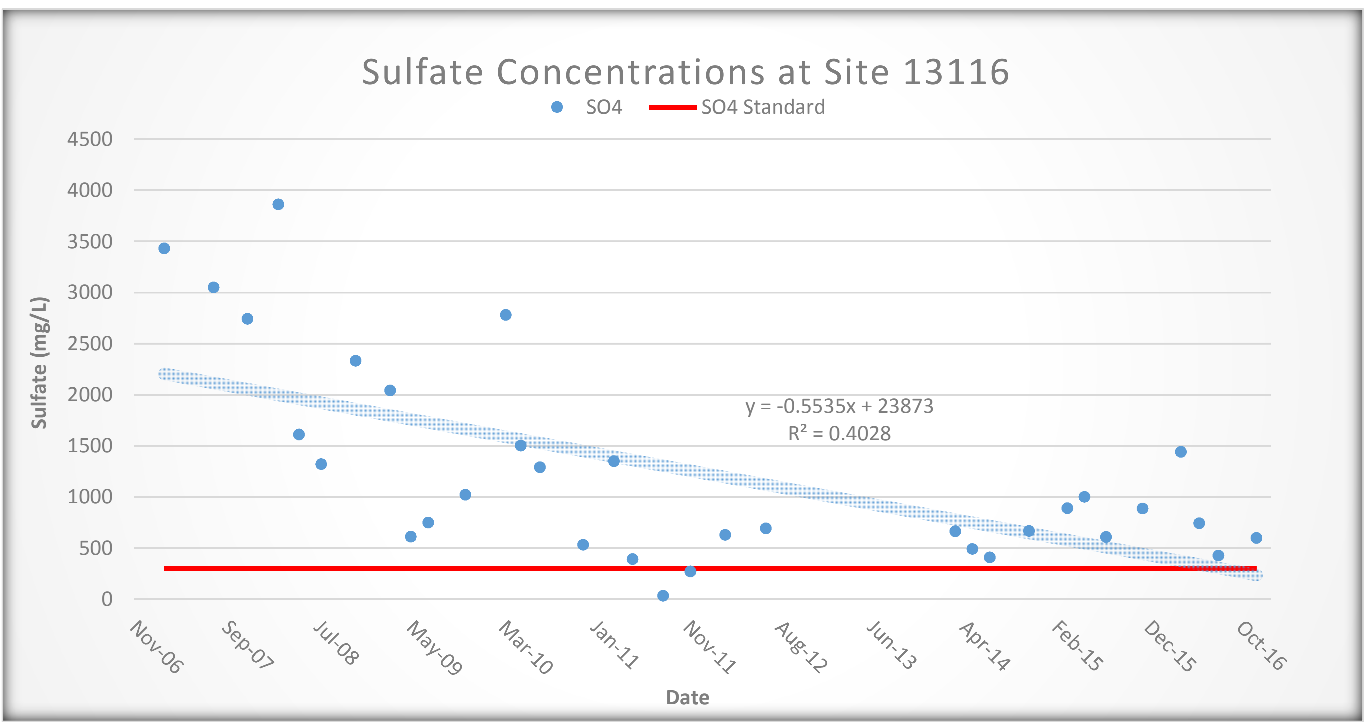


Figure 81.



Projects and Studies of Relevance to the Middle Rio Grande River Sub-basin

Bacteria Special Study- In 2011-2012, the USIBWC CRP, along with the TCEQ Laredo Field Office, the Rio Grande International Study Center, Laredo Community College and Texas A&M International University, collaborated on a special study focusing on tracking the sources of the bacterial contamination in the Laredo/ Nuevo Laredo area. The study was meant to be a two-phase project: the first phase, which took place in May and August 2011, was meant to track the sources, or at least a geographical distance, for the bacterial contamination. The first phase of the study was completed, and a final report was published that identified a 12-mile stretch of the river that has multiple discharges of concern. The USIBWC, as the binational agency responsible for the Rio Grande, has been collaborating with Mexico since 2012 to find solutions to the bacteria issues. Multiple agencies on both sides of the border have been working towards fixing or upgrading broken or aging infrastructure, and properly connecting communities to sewage systems. The two countries, through the U.S. and Mexican sections of the agency, have come to an agreement to initiate the second phase of the bacteria study to assess whether these steps have made any difference in the water quality in the area. The USIBWC CRP will be spearheading this binational effort, which is set to begin sometime in late 2018.

Mussels- The Texas Hornshell mussel has been added to the list of endangered species by the Texas Parks and Wildlife Department in 2018. This is significant in the Rio Grande Basin because the largest population of the species in found in Laredo, TX. The USIBWC provided comments during the comment solicitation period and is looking forward to participating with TCEQ's Surface water Quality Monitoring Program when they do their next assessments of the mussel community in the Laredo area, which is yet to be determined.

Land Use

San Felipe Creek has the fourth largest springs in Texas. The nine-mile stretch of segment 2313 is host to numerous recreational activities for the residents of Del Rio, Texas and a popular recreation area for visitors. There are no permitted discharges into the creek.

Segment 2304 stretches from the Amistad Reservoir to the confluence of the Arroyo Salado in Zapata County, which is about 226 miles (364 km) in length. Based on satellite imagery, there are major cities and small towns and settlements that have access to the river or tributaries to the Rio Grande on both sides of the border throughout the length of the segment. Much of the land along the Rio Grande in this segment, on both sides of the border, is privately owned and is kept in its natural condition. In the larger urban areas, such as the cities of Laredo and Nuevo Laredo, there are major industrial areas along the river, particularly in downtown Nuevo Laredo.

There are 23 permitted dischargers that discharge into Segment 2304. The permits include one for conventional water treatment, five permits for industrial wastewater treatment, one permit for a Municipal Separate Storm Sewer System (MS4), one permit for private domestic wastewater treatment, and 15 permits for public domestic wastewater treatment. Many of the discharges, permitted or not, go directly into the river, or they go to arroyos and creeks that eventually make their way into the river. This makes these discharges and small waterways major sources of water pollution, especially during storm events when the storm water runoff will push everything into the Rio Grande.

Possible negative impacts on water quality

Nonpoint sources- Runoff from urban and suburban areas of Del Rio, Texas may be a source of nonpoint source pollution to San Felipe Creek. Recreational activities from the populace may also be a major contributor to the bacterial contamination in the area. In Segment 2304, the Rio Grande is heavily impacted by the municipalities that occupy both sides of this section of the river. The sister cities of Del Rio, Texas, and Ciudad Acuña, Coahuila; Eagle Pass, Texas, and Piedras Negras, Coahuila; and Laredo, Texas and Nuevo Laredo, Tamaulipas, are located in this part of the Rio Grande Basin. The rapid growth of urban development in this section of the River is a major contributor to the degradation of water quality. Pedestrian and vehicle traffic at the ports of entry on asphalt bridges and roads can lead to water contamination from the kick-up of dust created by the traffic and polluted runoff from stormwater into the river. Historically, this area has been subjected to discharges of wastewater from both sides of the border. The untreated wastewater discharged into the Rio Grande River eventually flows into the Gulf of Mexico. This type of contamination can have repercussions on the water quality for all Texas-Mexico border cities downstream from the contamination point of origin.

Agricultural- The irrigation system in Del Rio supplies water to agricultural fields along the creek. Today the amount of water diverted from the San Felipe Creek for use in the canal system is regulated by the TCEQ. Currently the Commission set the yearly usage at 5,000 acre feet. However, the average amount of water pumped out of the San Felipe Creek into the irrigation canals is about 3,000 acre feet per year.

Segment 2304: This segment is impacted by agricultural activities. Agricultural fields near the Rio Grande may affect the Rio Grande in multiple ways. There are ranchlands in the lower part of the segment, but these have been deemed far enough from the Rio Grande to be unrelated to water quality in the river. Crop lands may cause water pollution due to the use of fertilizers, pesticides, and irrigation. The return flows from irrigation are high in nutrients, which can lead to excess algae growth, and possible decreased dissolved oxygen in the water. The use of pesticides during irrigation can lead to water contamination from runoff or remnant spray carried by wind.

Wildlife- The population of domestic ducks which reside near Highway 90 near Del Rio may be seen as a direct source of concentrated fecal pollution. High amounts of fecal contamination from wildlife may also contribute to high levels of nitrogen and phosphorus, which contribute to the growth of algae and other aquatic plants. In still waters, these plants die in the summer and the decomposition process removes oxygen in the creek waters which may directly and negatively impact fish populations as well as other aquatic inhabitants. In addition, the presence of large amount of coliform bacteria may present a health hazard to the children and adults who swim in still water areas.

Based on information from the Texas Parks and Wildlife Department (TPWD), Segment 2304 is home to a number of large and small animals that may contribute to the bacterial issues in the area. Water quality may be impacted by animals coming to graze at local watering holes. Small and large urban developments are home to many domesticated animals that possibly contribute to the bacterial concerns in the river as well. It is not uncommon to be at the river and see large numbers of cows grazing near the river, or in the river, as well as horses. It's also very common to see deer and javalinas in this region, and all of these species may contribute to bacterial contamination.

Urban Runoff- All existing and future activities can have an impact on San Felipe Creek in terms of urban runoff, potential for accidental spills, and any other source of pollution. Development along the creek has put these entities at risk in the event of a flood, but commercial development could also create other sources of pollution. The construction of conventional-style parking lots should be especially discouraged. Rainfall runoff from parking lots can introduce pollutants into the stream, therefore, provisions should be made to construct a catchment (retention pond) to process the runoff or it should be directed to extensive areas of native vegetation to filter pollutants out.

In Segment 2304, there are multiple communities along the river in this span of the basin which may contribute pollutants through urban runoff such as Del Rio, Eagle Pass, Laredo, Ciudad Acuna, Piedras Negras, Nuevo Laredo, Roma, and many other small communities bordering the river. According to a 2015 economic report on the Laredo Bridge system, the Texas comptroller department estimated over two million trucks, more than 3,600 trains hauling 400,000 rail cars, 3.5 million pedestrians and 5.2 million personal vehicles utilized the bridges crossing between Texas and Mexico for the year of 2015. The Laredo/Nuevo Laredo are is one of the largest commercial land ports in the United States, and is heavily impacted by commercial traffic on the ports of entry and roadways adjacent to the river.

Influences of Flow - San Felipe Creek is heavily influenced by rainfall that is capable of flooding, as demonstrated by the Flood of 1998. Tropical Storm Charley settled over Del Rio in 1998 and dumped over 18 inches of rain, which massively increased the flow of San Felipe Creek. The increased rainfall created floodwaters that destroyed over 200 homes along the banks of the creek. The San Felipe Creek area is still recovering from the devastation of the 1998 flood.

Segment 2304 is heavily influenced by releases from International Amistad Reservoir. The area has several heavy rain events throughout period of record. The first station below Amistad Reservoir, Station 13208, does not have immediate water quality issues, but there are water quality issues at Station 13560 which is approximately 8 river km from Station 13208. Water quality is negatively impacted by pollutants, non-point or point, as the water flows downstream. More monitoring and studies need to be done in order to determine exact sources or areas.

Stakeholders in Segment 2313

Landowners

US Fish & Wildlife Service

TX Parks and Wildlife

City of Del Rio

Laughlin Air Force Base

Devils River State Natural Area

San Felipe Springs

Val Verde Winery

TCEQ Watermaster Office

TCEQ Regional Offices

Val Verde County

Amistad Dam and Reservoir

Amistad National Recreation Area

Seminol Canyon State Park & Historic Site

San Felipe Country Club Golf Course

Stakeholders in Segment 2304

Landowners

US Fish & Wildlife Service

TX Parks and Wildlife

TX A&M International University

Sul Ross State University

TCEQ Watermaster Office, TCEQ Regional Offices

Cities of Del Rio, Eagle Pass, Laredo, and Zapata, TX

City of Laredo Health and Environmental Services

Laredo Community College

Rio Grande College

Distrito de Riego 050 Amistad Falcon

Val Verde, Kinney, Maverick, Dimmit, Webb, Zapata, and Starr Counties

Maverick County Water Control & Improvement District No. 1

Ciudad Acuña and Piedras Negras, Coahuila Nuevo Laredo, Tamaulipas

Recommendations

The USIBWC CRP will continue routine monitoring at current levels in 2019. The program will continue to monitor and look for water quality issues in this area, particularly for improvement in the areas with severe bacteria concerns. In Del Rio at San Felipe Springs, rainfall runoff from parking lots can introduce pollutants into the stream, therefore, provisions should be made to construct a catchment (retention pond) to process the runoff or it should be directed to extensive areas of native vegetation to filter pollutants out.

The USIBWC CRP should use its unique position within the agency to assist and provide guidance on water quality improvement projects in the Laredo/Nuevo Laredo area. The second phase of the bacteria special study should move forward, and the collaborating entities that participated in the first phase should be invited to assist again. Work should continue with the local city governments, who have been very involved and seem to be genuinely interested in improving water quality. This is one of the most monitored areas in the Rio Grande Basin, and the USIBWC CRP does not think additional monitoring is needed, but rather a more focused approach to deal with the water quality issues currently at hand; this includes additional special studies, working with local, state and federal governments, and more environmental education.

The Lower Rio Grande Basin

The Lower Rio Grande Sub-basin stretches from below International Falcon Dam to its confluence with the Gulf of Mexico (see Figure 36). This 280-mile (451-km) stretch of the Rio Grande runs through Starr, Hidalgo, and Cameron counties of Texas, and forms the border between those counties and the Mexican State of Tamaulipas. Population centers along the Lower Rio Grande have grown tremendously in the past 10 years. Agriculture, trade, services, manufacturing, and hydrocarbon production are the primary economic activities in this region. Major cities in the sub-basin include McAllen, Harlingen, and Brownsville, Texas, in the U.S., and Matamoros and Reynosa, Tamaulipas, in Mexico. Drinking water requirements in the Lower Rio Grande Sub-basin depend entirely on the Rio Grande. Anticipated increases in municipal and industrial demands resulting from rapid population growth will further strain a limited resource already taxed by previous drought conditions and high agricultural use.

The Lower Rio Grande Sub-basin occupies the southeastern portion of the South Texas Brush Country region. There are two major aquifers that lie beneath a major portion of this region, the Carrizo-Wilcox and Gulf Coast Aquifers. Groundwater in the area is brackish, requiring construction of a desalinization plant and the possible construction of additional plants in the future. Studies are being conducted on the desalinization of groundwater and ocean water to supplement drinking water supplies in the Lower Rio Grande Valley due, in part, to the high salinity in the water in this region. Currently, research is also being done on potential water storage solutions, such as construction of a weir near Brownsville. Most agricultural and urban discharges do not enter the Rio Grande in this reach, as they are diverted to canals that ultimately empty into the Gulf of Mexico; however, excessive flows that exceed the capacity of the canals can be routed to the Rio Grande.

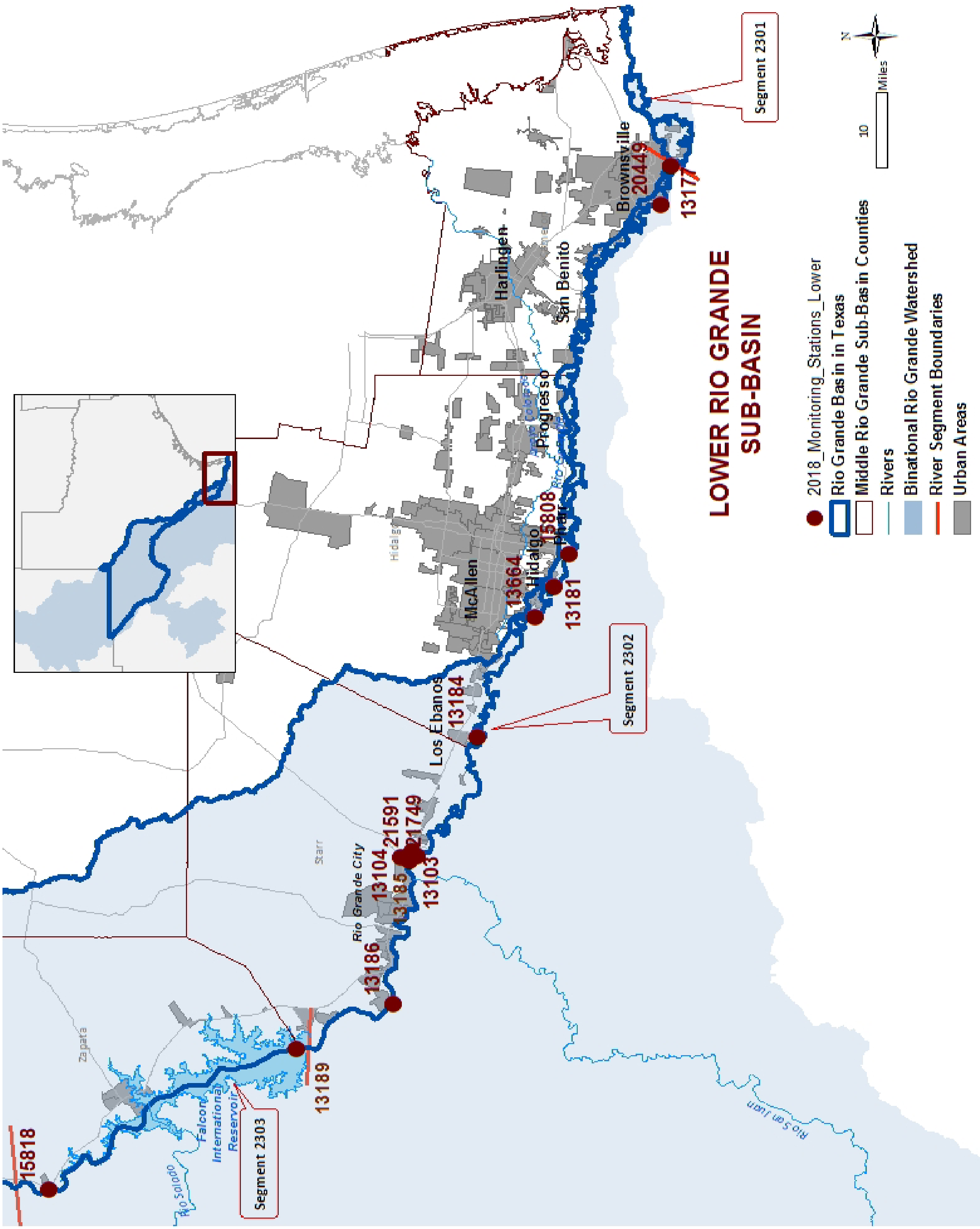
The USIBWC has multiple dams along this stretch of the river: Falcon Dam, Anzalduas Dam, and Retamal Dam. Falcon Dam and Reservoir serve for conservation purposes, and water is released during scheduled water releases to both countries, as well as during severe weather-related occurrences (hurricanes, tropical storms) that require large amounts of water to be carefully released to prevent flooding of the urban areas downstream. Anzalduas and Retamal dams are diversion dams for water accounting purposes, but both can also be used for emergency flooding situations as well. The Lower Rio Grande Valley also has an emergency floodway that is meant to divert flood waters from the Rio Grande to the Gulf of Mexico during flood events, which was last used in 2010 during Hurricane Alex.

The USIBWC CRP has 4 partners in the Lower Rio Grande: the USIBWC Falcon Dam Field Office, USIBWC Mercedes Field Office, Brownsville Public Utilities Board, and the University of Texas Rio Grande Valley-Edinburg. There are 21 stations monitored in three segments (2303, 2302, 2301), providing field, flow, and water quality data for the program. Each segment will be discussed in more detail.

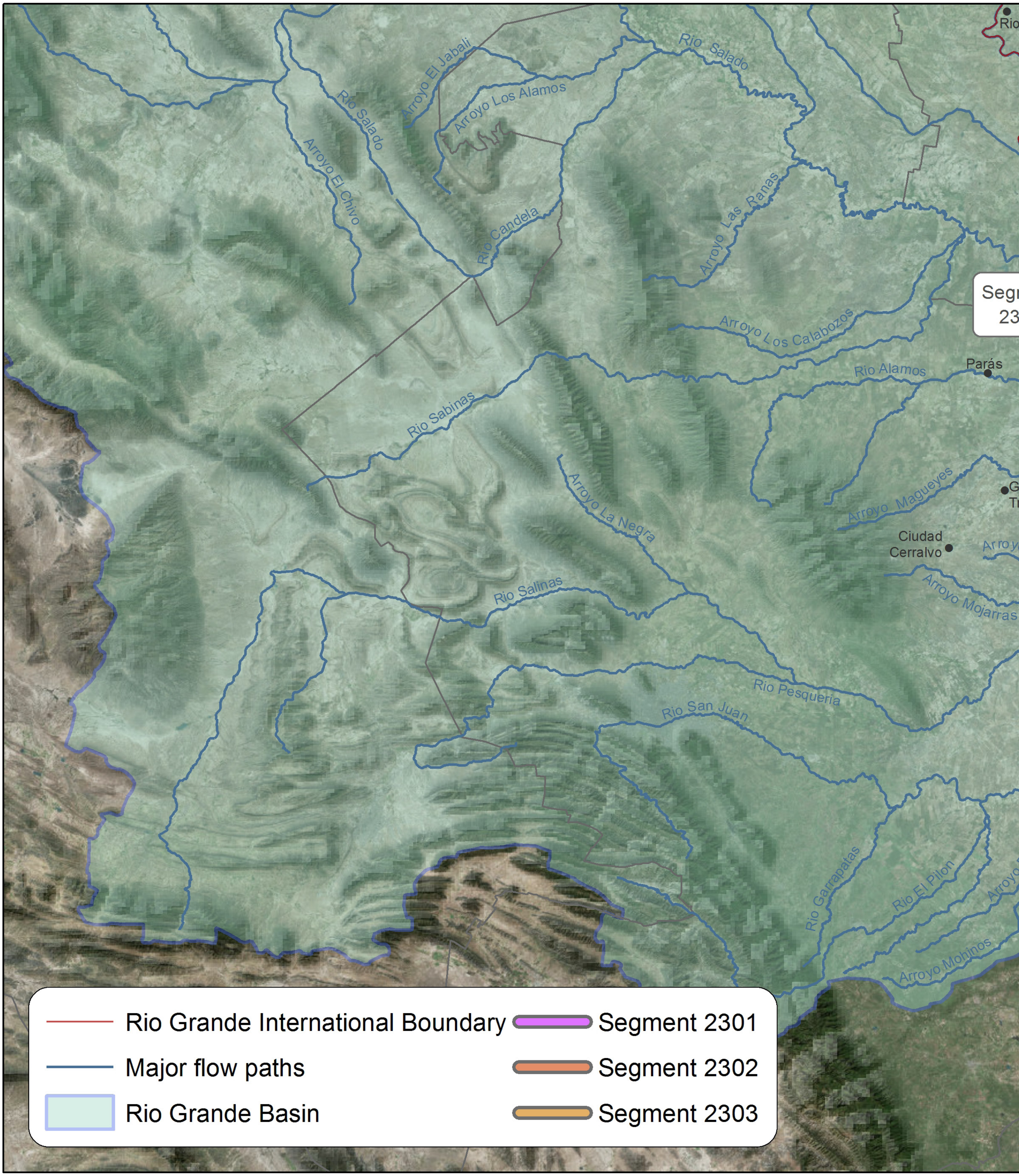
Pictured at left: Rio Grande at Los Ebanos, Station 13184
Photo credits: USIBWC CRP staff

Pictured: UTRGV- Edinburg students at Station 13104

Figure 82. Map of the Lower Rio Grande Basin in Texas



TCEQ Segments, General Topography, Major Flowpaths



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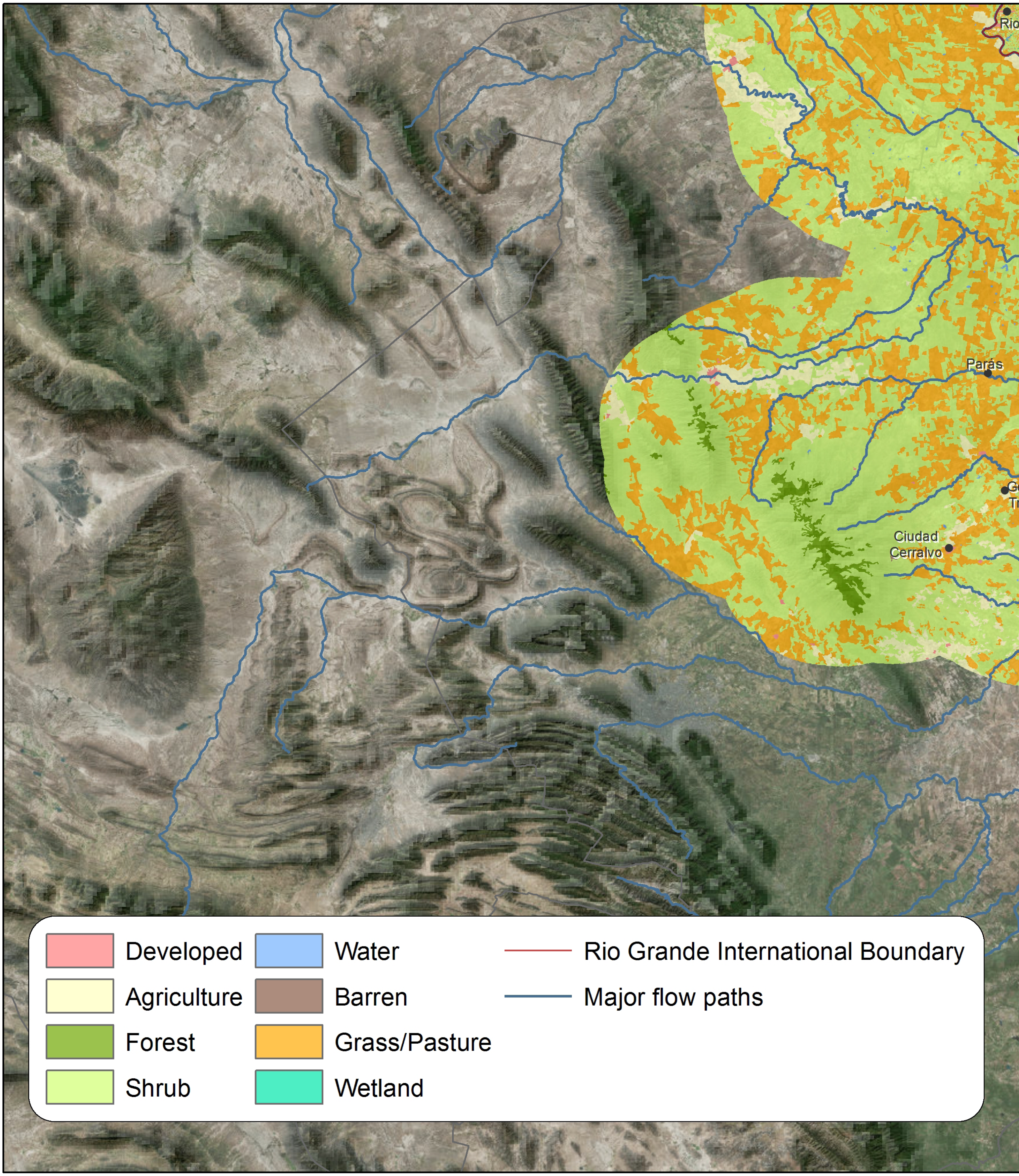

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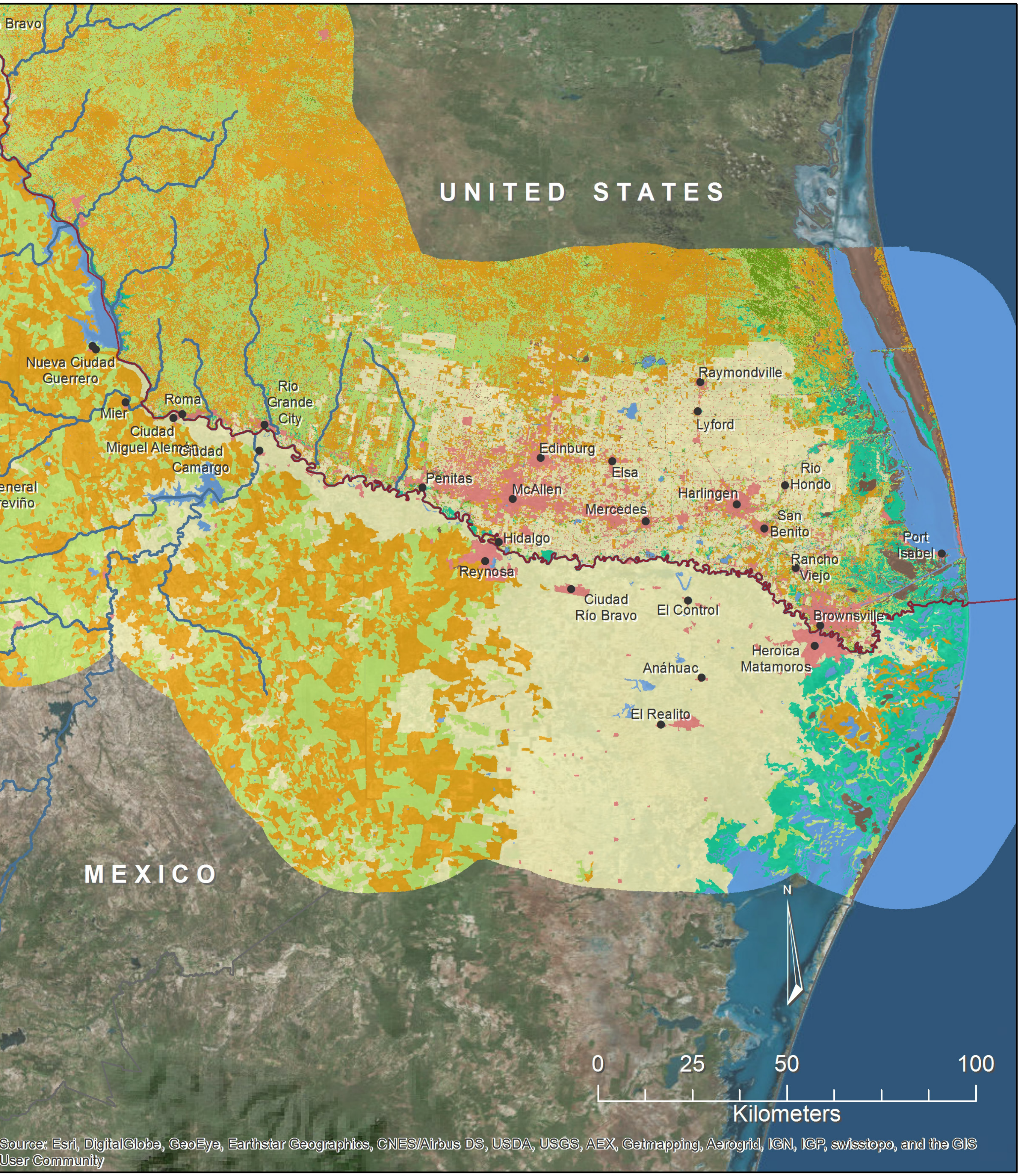

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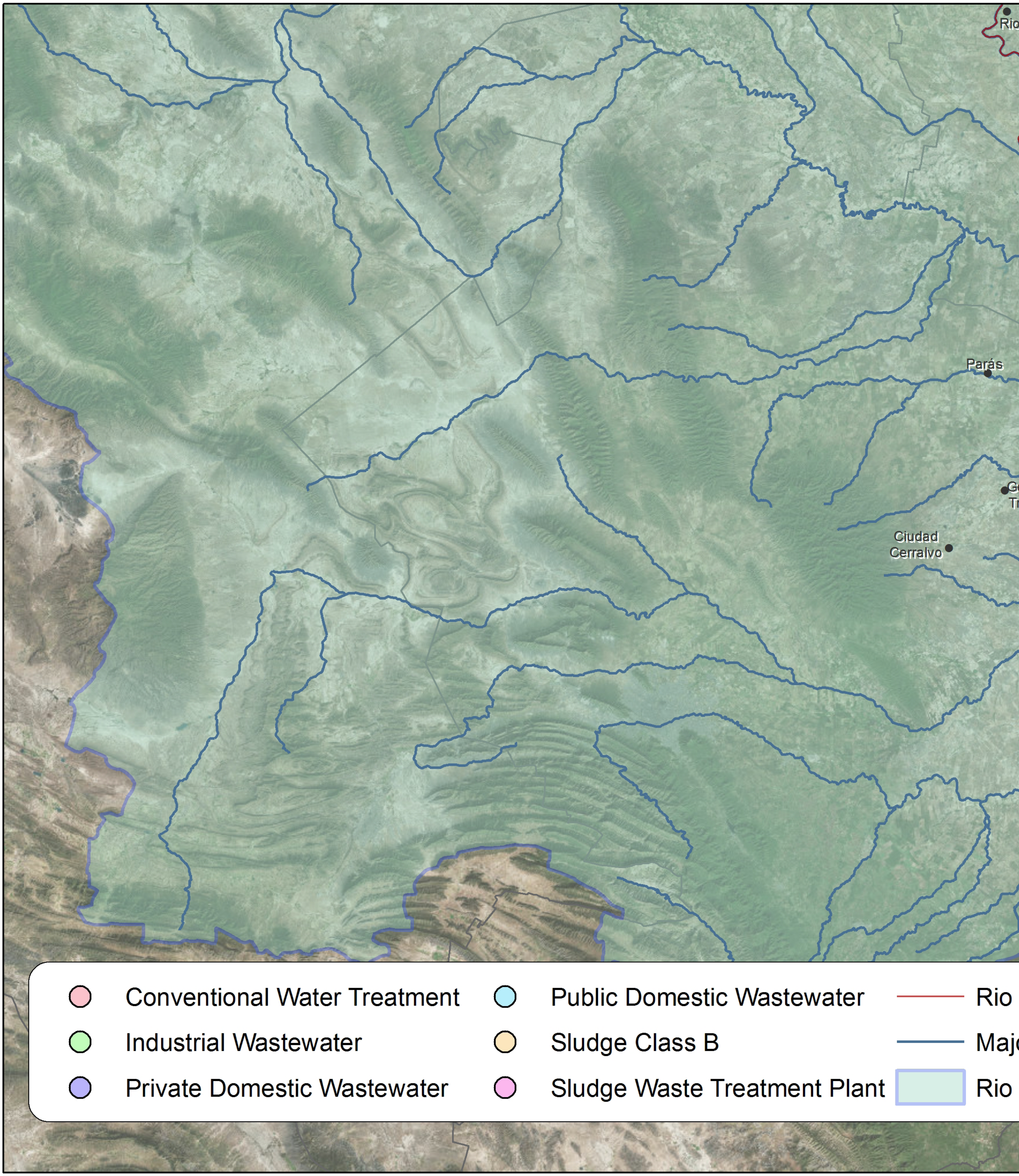

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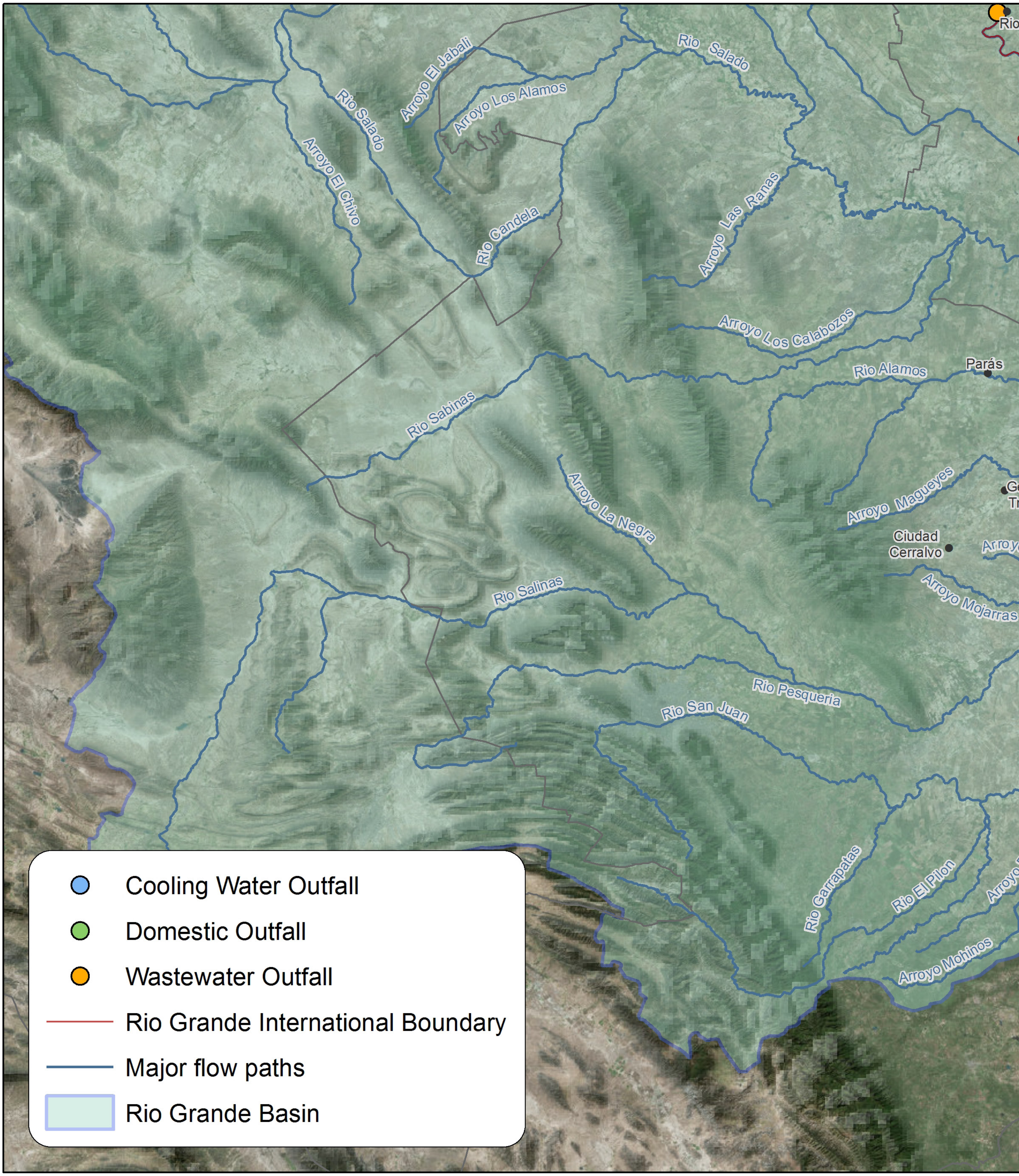

Major flow paths downloaded from the University of
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Rio Grande Valley, United States

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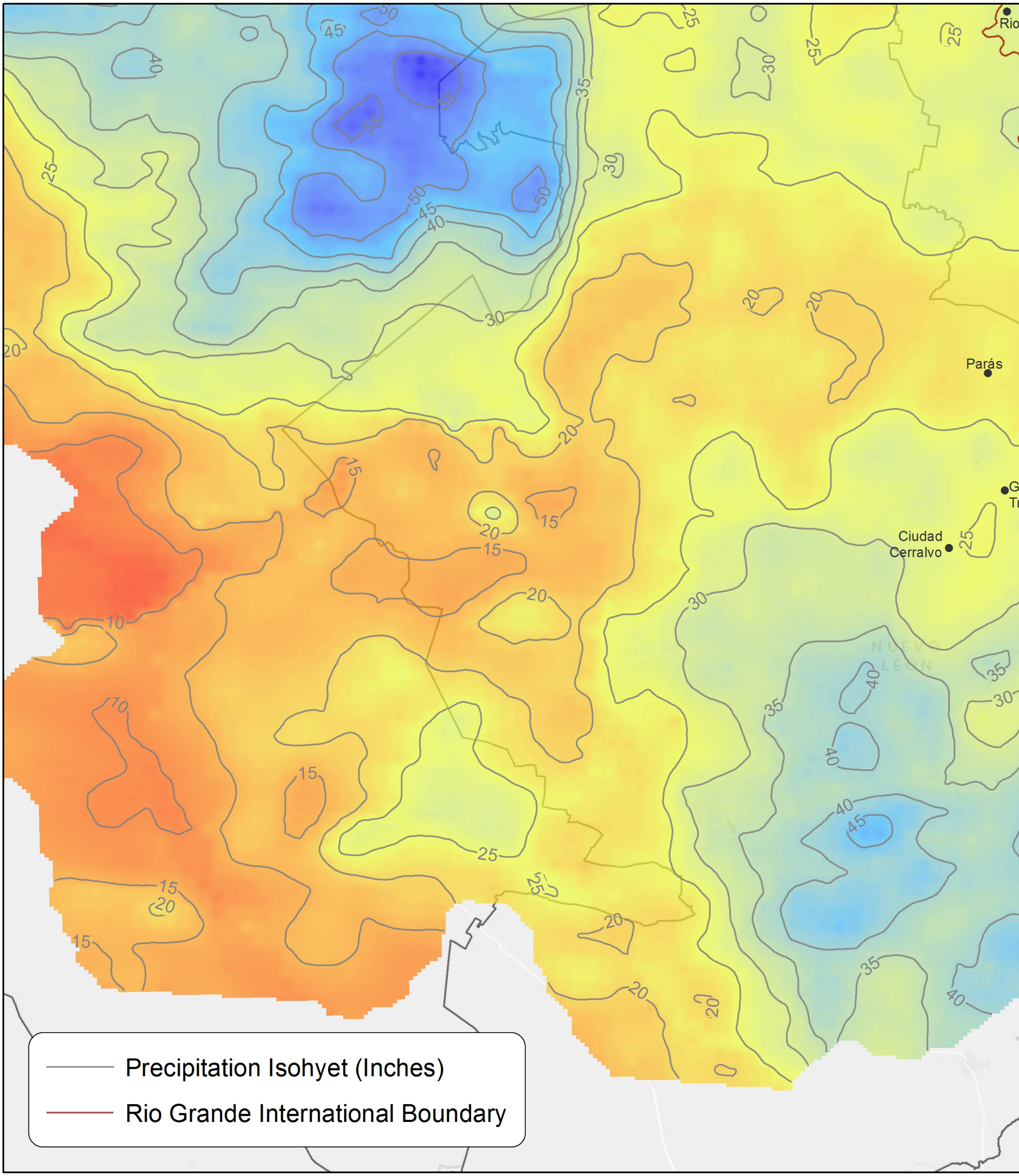

Precipitation values interpolated from data dow
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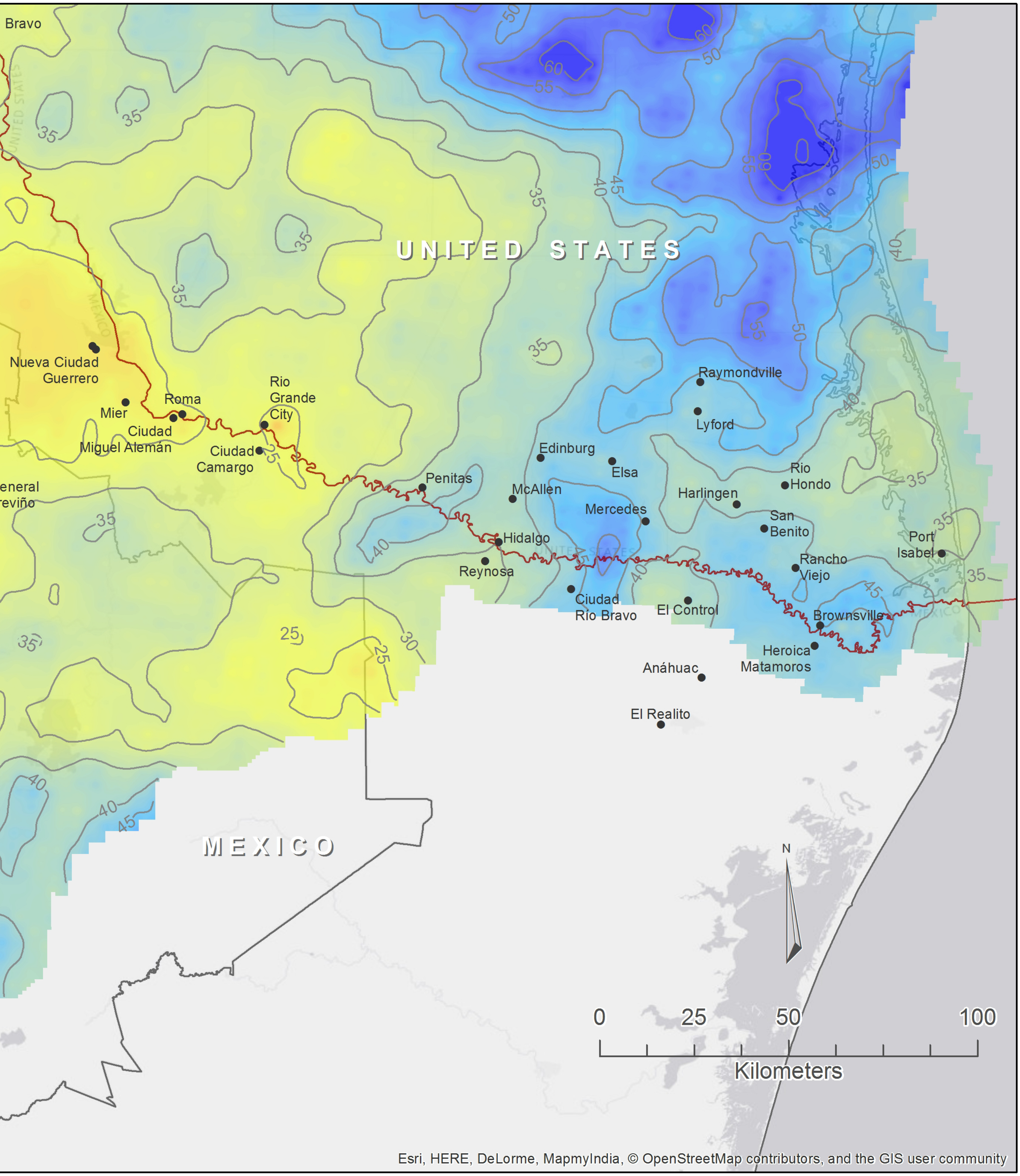

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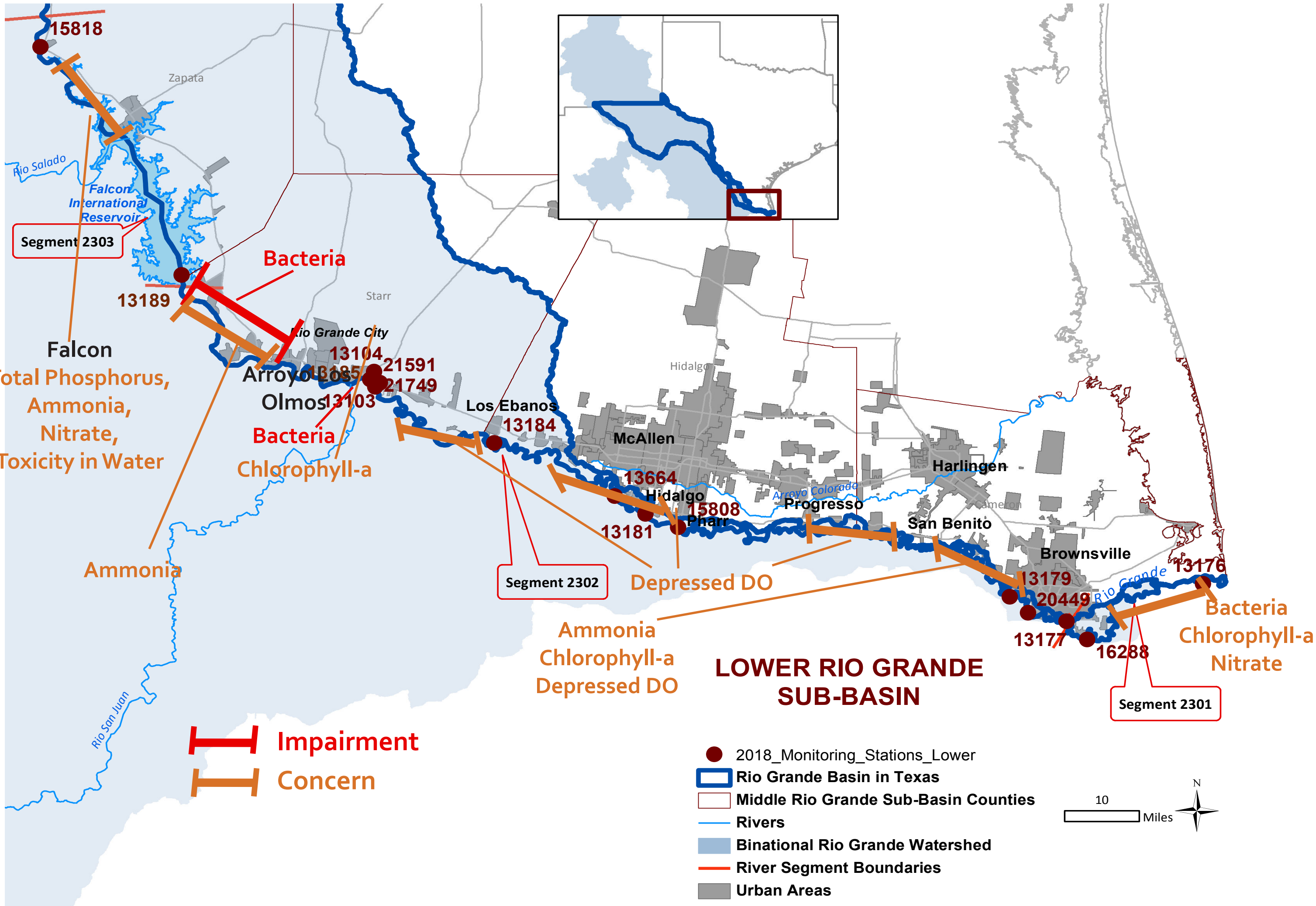
Table 13 characterizes the lower sub-basin and its associated segments, lists currently active stations, and provides other general information. For questions on this table, or historical or currently inactive stations, please contact USIBWC CRP staff.

Table 12. Statistical Analysis of Water Quality Data for the Lower Rio Grande River Sub-Basin This table describes analytical means for parameters with established water quality standards, as well as parameters for which there are screening levels (most often nutrients). Tables for the individual stations with additional statistical analysis are available in Appendix A. Values in cells represent means or geomeans (bacteria). The blue highlight indicates a statistically significant decreasing trend ($p \le 0.1$), while the yellow indicates a significantly increasing trend ($p \le 0.1$). Red text indicates the mean of the parameter over the period of record is above the Texas State Water Quality Standard, with the exception of dissolved oxygen, where falling below 5 mg/L would indicate impairment. An asterisk (*) indicates that the station had a sample size (n) for that parameter that is less than the samples size required for trend analysis ($n \ge 10$).

Station	pH	Dissolved Oxygen (mg/L)	Ammonia (mg/L)	Chlorophyll-a (ug/L)	Total Phosphorus (mg/L)	Bacteria (MPN/100ml)	Sulfate (mg/L)	Chloride (mg/L)	Nitrate + Nitrite (mg/L)	TDS (mg/L)
Segment 2303 | International Falcon Reservoir										
15818	8.0	7.9	0.18	9.70	0.24	38	185.59	114.21	3.95	604.77
13189	8.3	8.7	0.42	17.85	0.07	6	199.21	115.83	0.10	615.12
Standards and Screening Levels	6.5-9	5	0.11	26.7	0.2	126	300	200	0.37	1000
Segment 2302 | Rio Grande Below Falcon Reservoir										
13186	8.0	8.4	0.33	10.64	0.07	27	194.97	117.13	12	612.90
13185	8.0	8.1	0.85	11.17	0.15	145	218.81	140.06	0.41	694.15
13104	7.3*	4.2*	0.10*	151*	0.18*	9200*	746.80*	1190.60*	0.29*	3198*
13103	7.9	5.2	0.65	45.60*	0.14	745	583.42*	1534*	1.75	3948.18
21591	7.9*	6.2*	0.10*	18.33*	0.06*	310*	281.67*	236.33*	0.09*	1064.67*
21749	8.0*	7.1*	0.10*	3.33*	0.05*	71*	241*	132*	0.12*	783.33*
13184	8.0	6.2	0.22	12.02	0.08	32	231.53	148.97	0.37	764.04
20698	8.2*	5.2*	0.16*	14.67*	0.18*	10*	365*	619.33*	8.51*	1786.67*
21012	7.9*	10.1	0.06	16.92	0.07*	28*	264.90	150.50	0.14	.
13664	8.0	6.8	0.24	14.38	0.08	18	264.17	188.14	0.50	807.93
13181	7.8	6.6	0.24	14.52	0.08	89	270.94	181.46	0.56	826.25
15808	7.9	6.3	0.50	15.21	0.11	181	272.49	185.63	0.58	825.44
13180	7.8*	5.4*	.	.	.	183*	.	.	.	.
17247	7.9	8.6	0.24	46.43	0.26	50	353.43	806.09	0.67	796.54
10249	8.0	10.1	0.17	49.25	0.26	24	282.22	194.90	0.52	885.20
13179	8.0	7.0	0.45	39.24	0.17	12	252.39	195.35	0.48	855.17
20449	.	.	0.15	.	.	31	.	.	.	1021.05
13178	8.0	7.8	0.48	40.26	0.14	31	267.04	212.33	0.60	918.95
13177	7.9	6.3	0.27	37.71	0.20	178	280.01	203.44	0.94	905.08
Standards and Screening Levels	6.5-9	5	0.33	14.1	0.69	126	350	270	1.95	880
Segment 2301 | Rio Grande Tidal										
16288	8.0	8.2	0.28	32.82	0.32	154*	296.26	236.62	1.58	992.86
13176	8.2	7.8	0.40	55.60	0.24	41	326.83	619.76	0.57	1711.90
Standards and Screening Levels	6.5-9	5	0.46	21	0.66	35	na	na	1.1	na

Figure . Water Quality Impairments and Concerns in the Lower Rio Grande Sub- Basin



Station 13185. Photo Credit USIBWC CRP Staff.

Table 13. Water Quality Review for the Lower Rio Grande Sub-Basin

Water Quality Review for the Lower Rio Grande Sub-Basin					
Segment	*Uses	Stations	Length	Segment Characteristics	Water Quality Summary
2303- International Falcon Reservoir	H, PS, FC, PCR	15818, 13189	131 mi	Falcon Reservoir is used for recreation, water supply, and hydroelectric power generation.	No impairments; however, there is a concern for toxicity of the water near Zapata, likely from municipal effluent.
2302 - Rio Grande Below Falcon Reservoir	H, PS, GU, FC, PCR	13186, 13185, 13184, 13664, 13181, 15808, 17247, 10249, 13179, 13178, 20449, 13177, 21012, 21749, 21591	231 mi	This segment is classified as a freshwater stream. Extends from Falcon Dam to below Brownsville and includes Anzalduas Dam and most of the Lower Rio Grande Valley (LRGV).	The majority of this segment has no impairments, but there are consistently **high bacteria** counts around urban areas such as Brownsville, Rio Grande City, and McAllen/Hidalgo, impairing the segment for contact recreation. There are increased sulfate levels, indicating potential wastewater influences that can adversely affect the public water supply. The entire segment has a concern for fish consumption due to elevated **mercury** in fish. Colonias without wastewater infrastructure as well as urban runoff may contribute to the bacteria and DO issues.
2302A - Arroyo Los Olmos	L	13103, 13104	25 mi	This is an unclassified water body. It is an intermittent stream with pools, and limited aquatic life.	This segment is impaired for **bacteria**, with exact source unknown. It may be due to urban runoff and other nonpoint source pollution during rain events.
2301 - Rio Grande Tidal	E, GU, FC, PCR	16288, 13176	49 mi	This is classified as a tidal stream. It extends from the confluence of the Rio Grande with the Gulf of Mexico to a point 6.7 miles downstream of the International Bridge in Brownsville, Cameron County.	This is classified as a tidal stream due to the proximity to the Gulf of Mexico. There are no impairments but closer to the Gulf there are high **chlorophyll-a** levels. The bacteria indicator is Enterococcus, and data shows a concern for **bacteria**.

*For an explanation of the uses, please refer to Table 3, Designated Uses for Freshwater on page 11

Aerial photo taken of Falson Dam during flood water releases due to Hurricane Alex in 2010. Photo credit USIBWC.

Segment 2303, International Falcon Reservoir

Segment 2303 begins at Falcon Dam in Starr County and continues to the confluence of the Arroyo Salado (Mexico) in Zapata County, up to normal pool elevation of 301.1 feet (impounds Rio Grande). It includes the length of International Falcon Reservoir and is approximately 131 square miles in area. There are currently no impairments in this segment, but there are numerous concerns for near non-attainment of water quality standards and/or based on screening levels for ammonia, nitrate, total phosphorus, and toxicity in water. All of the water quality concerns are located in 2301_02.

Segment 2303 has four assessment units, or AUs:

2303_01, Area around International Monument XIV

2301_02, Area around Zapata WTP Intake

2301_03, Area around International Monument 1

2301_04, Remainder of Segment

There are two active stations within this segment:

15818, Falcon Reservoir at San Ygnacio WTP Intake west of US 83 Intersection with FM 3169
13189, Falcon Lake at International Boundary Monument I

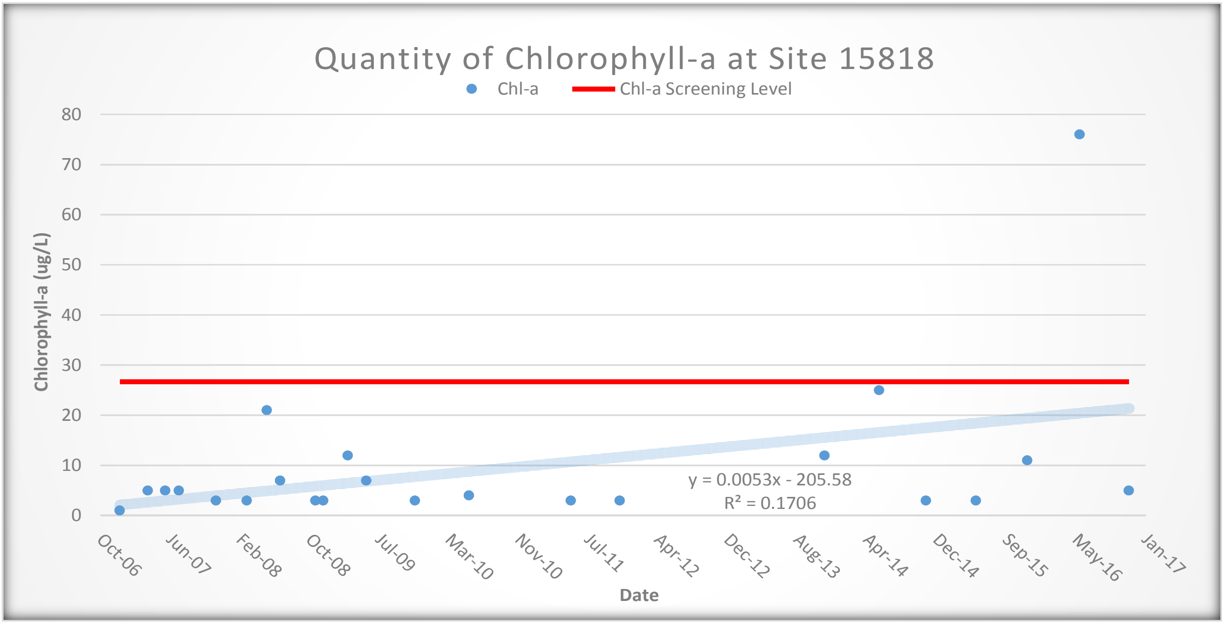
Assessment Unit 2303_01 has no impairments or concerns, and does not have monitoring stations.

Assessment Unit 2303_02 has concerns for ammonia, nitrate, total phosphorus and toxicity in water. This AU is monitored by Station 15818.

At Station 15818 (Falcon Reservoir at San Ygnacio), 24 *E.coli* bacteria samples had a geomean of 38 MPN. The geomean for this site shows no significant trend for high bacteria, but individual grab samples in the later part of the period of record have been increasing, which is likely due to the increasing population and recreation in the area. The data indicated that the mean for dissolved oxygen levels is 7.9 mg/L, and shows no trend. The mean for pH is 8.0, and also shows no trend. The water quality data for total dissolved solids shows a mean of 604.77 mg/L, and shows no significant trend. Ammonia data for this station has a mean of 0.18 mg/L and shows neither an increasing or decreasing trend. The mean for total phosphorus is 0.24 mg/L, and shows neither an increasing or decreasing trend. The mean for chlorophyll-a is 9.70 ug/L and is increasing. The mean for sulfate is 185.59 mg/L, with no significant trend. The mean for chloride is 114.21 mg/L, and the mean for nitrate+nitrite is 3.95 mg/L; neither parameter shows any significant trends. The concern for toxicity in water has been carried forward in the last TCEQ Integrated Report, and more studies would need to be done to determine if this is still an issue. Please see the graph for this station on the following page.

Picture taken below Falcon Dam, during releases of flood water in 2010 resulting from Hurricane Alex. Photo taken by USIBWC staff.

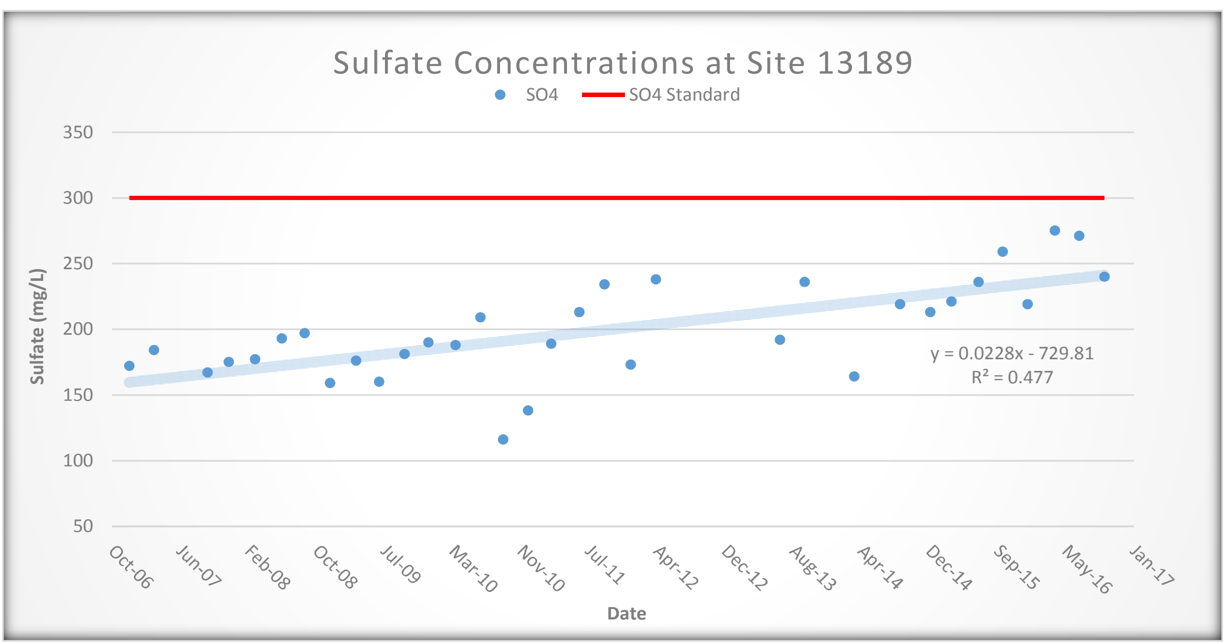
Figure 90.



Assessment Unit 2303_03 has no water quality impairments or concerns. This AU is monitored by Station 13189.

At Station 13189 (Falcon Lake at Monument 1), 30 *E.coli* bacteria samples had a geomean of 6 MPN. There is no statistically significant trend for bacteria. The water quality data indicates that dissolved oxygen levels had a mean of 8.7 mg/L, and pH shows a mean of 8.3; neither shows a significant trend. Analysis of total dissolved solids shows a mean of 615.12 mg/L and is neither an increasing or decreasing trend. Ammonia data shows a mean of 0.42 mg/L and shows no significant trend. The mean for total phosphorus is 0.07 mg/L, and also shows neither an increasing or decreasing trend. The mean for chlorophyll-a is 17.85 ug/L, with no significant statistical trend. This station does have an increasing trend for sulfate, with a mean of 199.21 mg/L. The mean for chloride is 115.83 mg/L, and the mean for nitrate+nitrite is 0.10 mg/L, with neither showing a significant trend. The concern for toxicity in water has been carried forward in the last TCEQ Integrated Report, and more studies would need to be done to determine if this is still an issue. Please see the graph for this station below.

Figure 91.



Segment 2302, Rio Grande Below Falcon Reservoir and 2302A, Arroyo los Olmos

Segment 2302 is described from a point 10.8 km (6.7 miles) downstream of the International Bridge in Cameron County to Falcon Dam in Starr County. It is the segment located just below International Falcon Reservoir, stretching to the tidal segment of the Rio Grande and is approximately 231.5 miles long. Based on statistical analysis of 10 years of water quality data for the stations in Segment 2302 and the station in Segment 2302A, water quality is being negatively affected as we proceed downstream. The bacteria counts and other data are within standard limits at many of the stations, but in the area surrounding station 13103, which is one of the sites furthest downstream, the bacteria problems are a serious concern. This segment also has issues with salinity, and farmers and irrigators have concerns that the water is not suitable for irrigation use. Although the area is not yet impaired for Total Dissolved Solids (TDS), the salinity over time has been increasing steadily. Possible sources of this salinity are described further in this report. Both Segment 2302 and 2302A are currently impaired for bacteria. There are numerous concerns for near non-attainment of water quality standards and/or based on screening levels in this area for ammonia, chlorophyll-a, and dissolved oxygen.

Segment 2302 has seven Assessment Units, or AUs, and 2302A has one:

2302_01, From El Jardin Pump Station upstream to the Rancho Viejo Floodway

2302_02, From the Rancho Viejo Floodway upstream to the Progresso Int'l Bridge (FM 1015)

2302_03, From the Progresso Int'l Bridge (FM 1015) upstream to the McAllen Int'l Bridge (US Hwy 281)

2302_04, From the McAllen Int'l Bridge (US Hwy 281) upstream to Anzalduas Dam

2302_05, From Anzalduas Dam upstream to the Los Ebanos Ferry Crossing

2302_06, From the Los Ebanos Ferry Crossing upstream to the Arroyo los Olmos confluence

2302_07, From the Arroyo los Olmos confluence upstream to the Falcon Dam

Segment 2302A, Arroyo los Olmos

2302A_01 From Rio Grande confluence at Rio Grande City to El Sauz in Starr County

There are 19 stations within these segments:

10249, Rio Grande River 285 meters south and 30 meters west from the intersection of FM Road 813/Cantu Road and Avilia Road 6.3 KM downstream from San Benito pumping station

13103, Los Olmos Creek at US 83/East 2nd Street south of Rio Grande City

13104, Arroyo los Olmos at SH 755 NW of Rio Grande City

17247, Rio Grande River 100 M upstream of FM 1015 at Progresso, Texas

21012, Rio Grande River off Sherbach RD/Airfield RD 1.05 KM south and 340 meters east from the intersection of Shuerbach RD and Military RD south of Mission Cams 792

13186, Rio Grande River 4.1 km downstream of the confluence with Rio Alamo near Fronton, TX

13185, Rio Grande River at Fort Ringgold 1.6 km downstream of Rio Grande City

21749, Rio Grande approx 380 meters downstream of confluence with Los Olmos Creek

21591, Arroyo Los Olmos 400 m upstream of confluence with Rio Grande near Rio Grande City

13184, Rio Grande River at FM 886 near Los Ebanos

13664, Rio Grande River 0.8 km downstream of Anzalduas Dam and 16.4 km upstream from Hidalgo, TX

13181, Rio Grande River at Hwy 281/International Blvd in Hidalgo

15808, Rio Grande River 300m upstream of the Pharr International Bridge/US 281 east of Hidalgo, TX

13179, Rio Grande River at River Bend Golf Course Boat Ramp west of Brownsville

20449, Rio Grande River at Brownsville PUB Water Treatment Plant Number 1 Intake between WTP Reservoir and Rio Grande Levee 910 m and 335 m south to the intersection of West Elizabeth Street and South Military Road

13177, Rio Grande River at El Jardin Pump Station located 350m west of intersection of Monsees Road and Calle Milpa Verde

13178, Rio Grande International Bridge on US 77 at Brownsville

13180, Rio Grande downstream of El Anhelo Drain south of Las Milpas

20698, Old Rio Grande Meander La Parido Banco Number 144 Boat Ramp in Bentsen Rio Grande State Park 787 m west and 780 m south from the intersection of Military Road and FM 2062/ South Bentsen Palm Drive/Bentsen State Park Rd 43/Bentsen Palm Drive/Bentsen-Rio Grande Valley State Park

Station 13103, Arroyo Los Olmos

Assessment unit 2302_01 (From El Jardin Pump Station Upstream to the Rancho Viejo Floodway) was delisted for bacteria in the 2014 Integrated report. This indicates that water quality improved enough in this area that the data collected during that assessment period fully supported water quality standards for bacteria, and is a major improvement for this area. Part of the improvement is attributed to the Matamoros Wastewater Treatment Plant that went online in 2008; we have been monitoring a steady decrease since 2008. However, this AU has other water quality concerns. Over the years, routine monitoring has shown concerns for Ammonia, chlorophyll-a and depressed dissolved oxygen. Assessment unit 2302_01 is monitored by Stations 13177, 13179, 13178 and 20449.

At Station 13177 (Rio Grande at El Jardin Pump Station), 65 *E.coli* bacteria samples had a geomean of 178 MPN, which is above the standard but shows no trend. The water quality data indicated that dissolved oxygen had a mean of 6.3 mg/L, and shows a decreasing trend. Analysis of water quality data for pH shows a mean of 7.9, with no significant trend. Data for total dissolved solids shows a mean of 905.08 mg/L, which is above the standard and shows an increasing trend. Ammonia data has a mean of 0.27 mg/L, and total phosphorus data has a mean of 0.2 mg/L, with phosphorus showing a decreasing trend. Analysis of chlorophyll-a data showed a mean of 37.71 ug/L, and is increasing. This station also shows an increasing trend for sulfate, with a mean of 280.01 mg/L, and chloride with a mean of 203.44 mg/L. Nitrate+nitrite has a mean of 0.94 mg/L and shows a decreasing trend. Some graphs are provided below, please see all graphs for this station in Appendix B.

Figure 92.

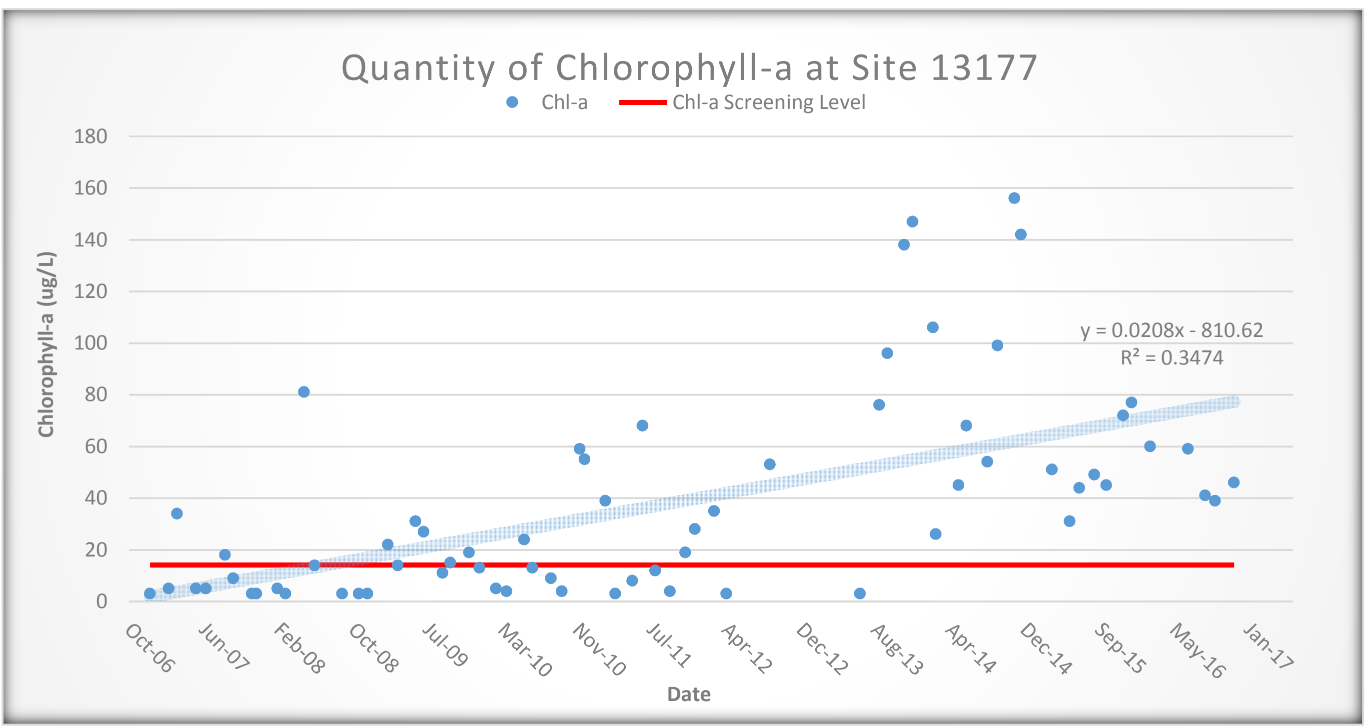
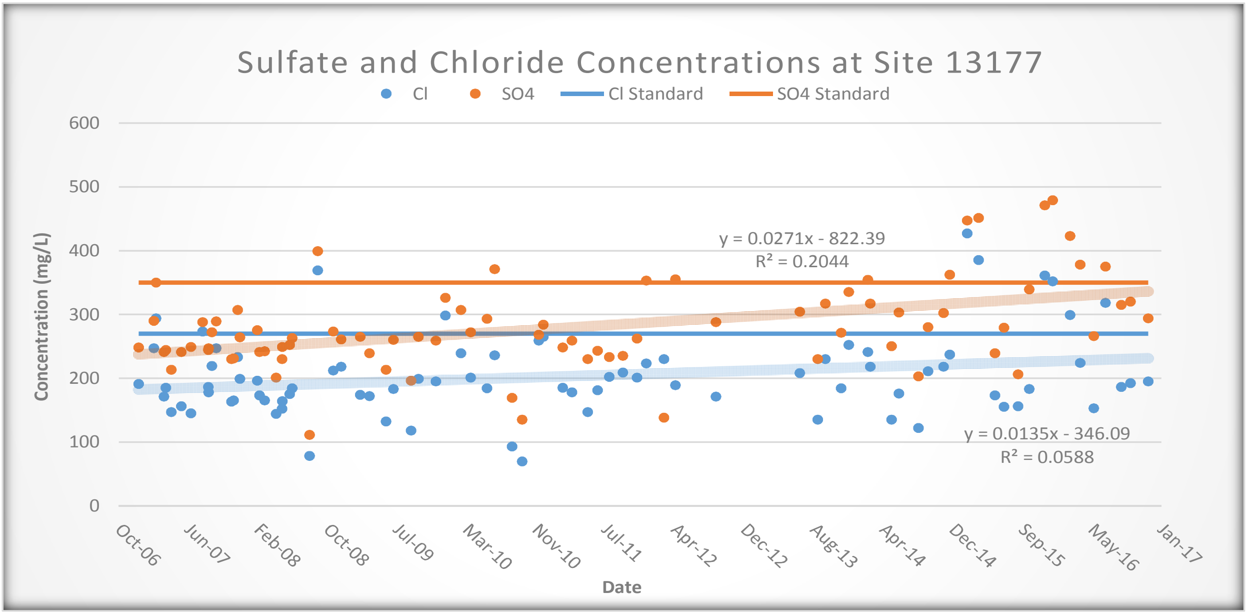
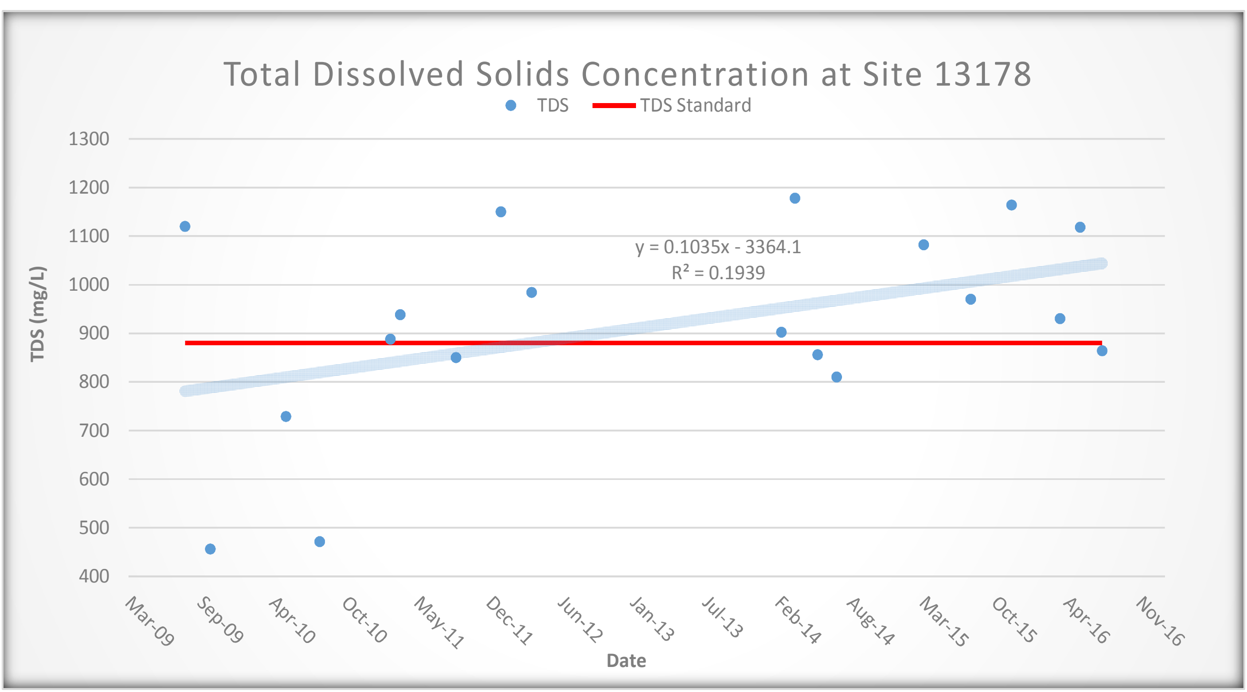


Figure 93.



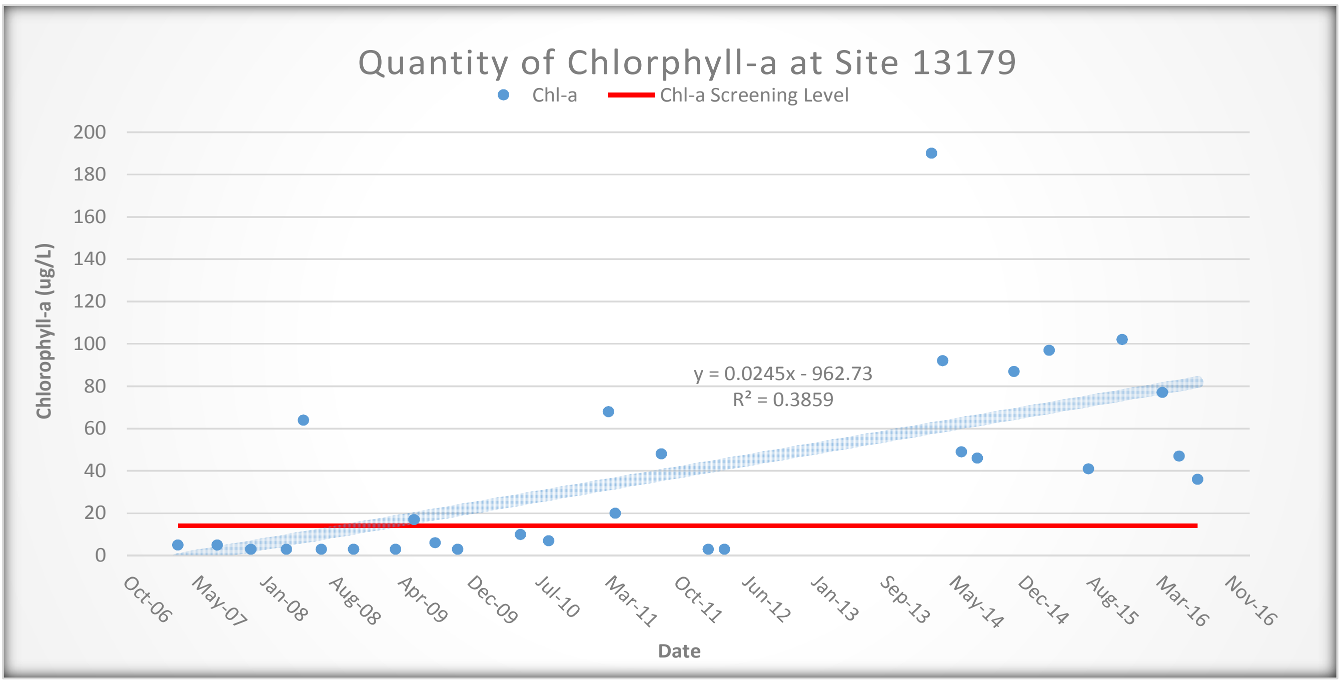
At Station 13178 (Rio Grande at International Bridge in Brownsville), 16 *E.coli* bacteria samples had a geomean of 31 MPN. The trend analysis for bacteria water quality data at this station shows no significant trend at this time, but grab samples show bacteria counts that are steadily increasing over time. The water quality data indicated that dissolved oxygen had a mean of 7.8 mg/L, with an increasing trend. Analysis of water quality data for pH shows a mean of 8.0, and no trends. Data for total dissolved solids shows a mean of 918.95 mg/L, which is over the standard and is increasing over the period of record. Ammonia data shows a mean of 0.48 mg/L, and total phosphorus data shows a mean of 0.14 mg/L, both of which show no significant trend. Analysis of chlorophyll-a data for this station showed a mean of 40.26 ug/L, and has an increasing trend over the period of record. Sulfate has a mean of 267.04 mg/L, and chloride has a mean of 212.33 mg/L, neither of which shows any trend. The mean for nitrate+nitrite is 0.60 mg/L, and also shows no trend. The TDS graph is provided below, please see all graphs for this station in Appendix B.

Figure 94.



At Station 13179 (Rio Grande River at River Bend Golf Course Boat Ramp west of Brownsville), 23 *E.coli* bacteria samples had a geomean of 12 MPN. The trend analysis for bacteria water quality data at this station shows no significant trends at this time, but grab samples show bacteria counts that are steadily increasing. Data for pH shows a mean of 8.0, and the mean for dissolved oxygen is 7.0 mg/L; both of these parameters show increasing trends. Data for total dissolved solids shows a mean of 855.17 mg/L and no significant trend over the period of record. Ammonia data shows a mean of 0.45 mg/L, and total phosphorus data shows a mean of 0.17 mg/L; ammonia shows neither an increasing nor decreasing trend, but total phosphorus is slightly decreasing. Analysis of chlorophyll-a data for this station showed a mean of 39.24 ug/L, and is increasing. Sulfate has a mean of 252.39 mg/L, and chloride has a mean off 195.35 mg/L; neither shows a significant trend. Nitrate+nitrite has a mean of 0.48 mg/L and also shows no significant trend. Please see graph below for this station, and additional graphs in Appendix B.

Figure 95.

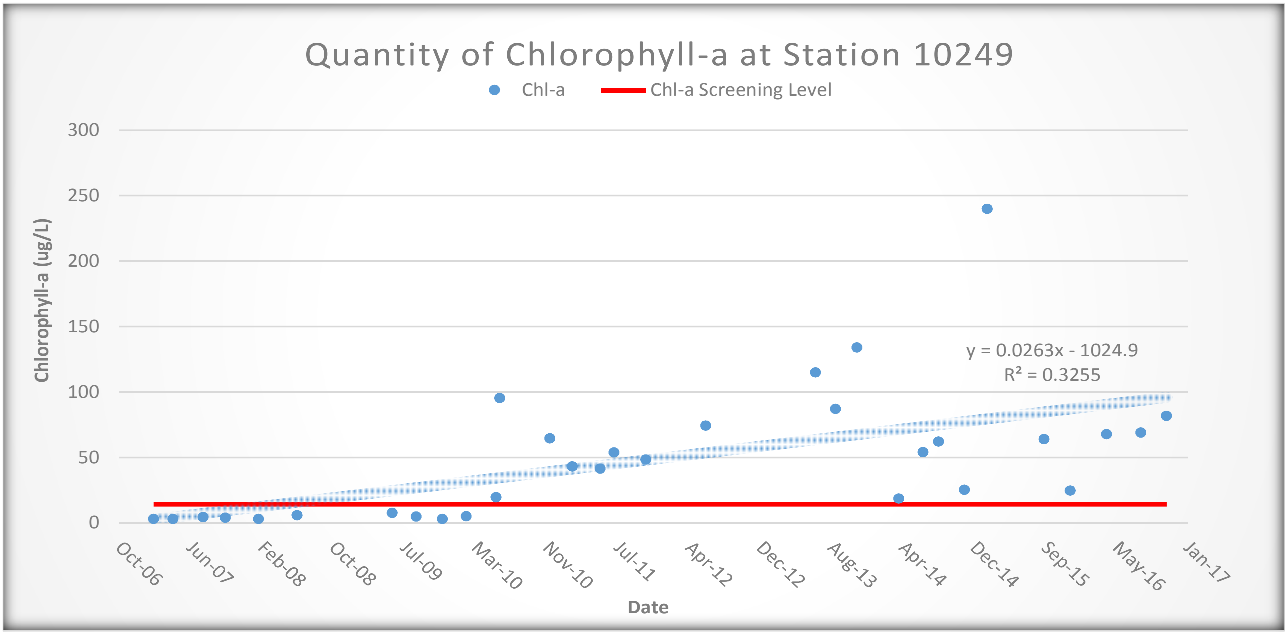


At Station 20449 (Rio Grande at BPUB Treatment Plant 1), 96 *E. coli* bacteria samples had a geomean of 31 MPN and the trend for this site is neither increasing nor decreasing. There is no dissolved oxygen or pH recorded at this site. Total dissolved solids data shows a mean of 1,021.05 mg/L , and there is no significant trend. Ammonia data shows a mean of 0.15 mg/L with no significant trend. Total phosphorus, sulfate, nitrate+nitrite, chloride, and chlorophyll-a are not analyzed at this station.

Assessment unit 2302_02 currently has no impairments. However, over the years, routine monitoring has shown concerns for chlorophyll-a. Assessment unit 2302_02 is monitored by Station 10249.

At Station 10249 (Rio Grande downstream of San benito pumping station), 27 *E.coli* bacteria samples had a geomean of 24 MPN. The site shows neither an increasing nor decreasing trend for bacteria. The water quality data indicated that dissolved oxygen mean was 10.1 mg/L, and grab samples are showing an increasing trend in some of the more recent sampling events. The mean for pH is 8.0 and shows an increasing trend. Total dissolved solids data shows a mean of 885.20 mg/L, which is above the standard but shows no trend. The data for ammonia shows a mean of 0.17 mg/L, and shows a decreasing trend. The data for total phosphorus shows a mean of 0.26 mg/L and does not show a significant trend. The chlorophyll-a data shows a mean of 49.25 ug/L, which is high and is increasing for this station. Sulfate, with a mean of 282.22 mg/L, chloride, with a mean of 194.90 mg/L, and nitrate+nitrite, with a mean of 0.52 mg/L, show no significant trends. Please see the graph for chlorophyll-a on the next page, and additional graphs for this station in Appendix B.

Figure 96.



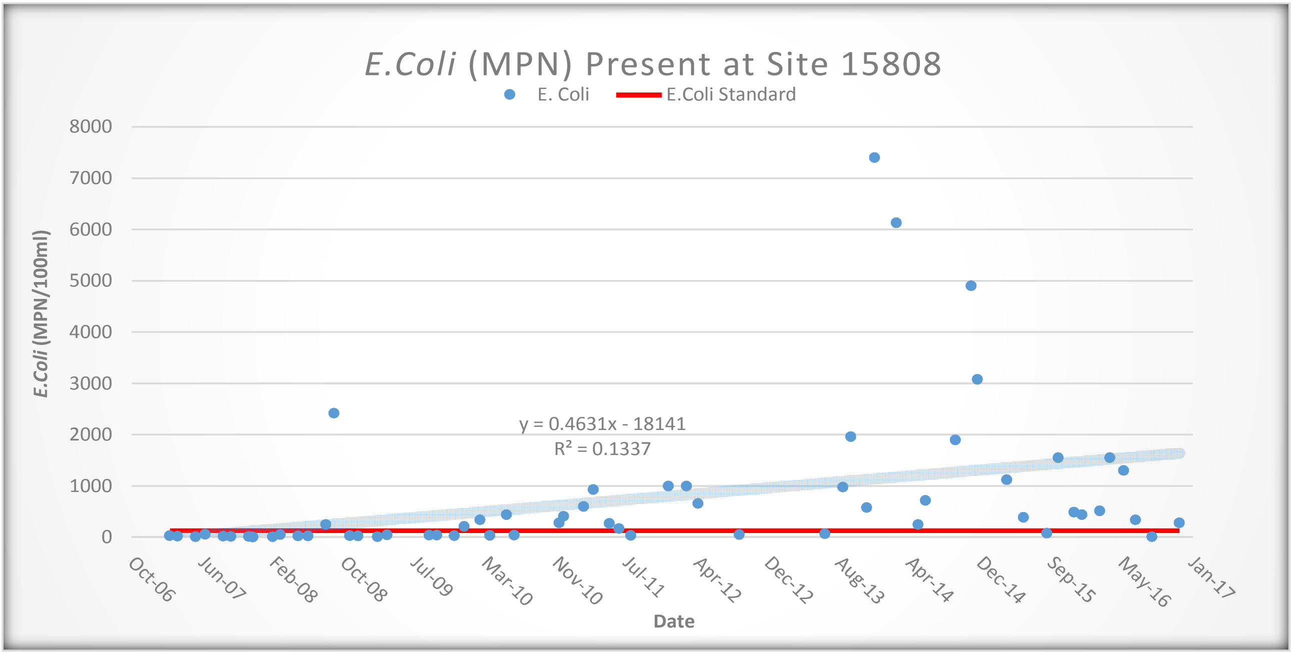
Assessment unit 2302_03 currently has no impairments. This AU has a water quality concern for depressed dissolved oxygen. Assessment unit 2302_03 is monitored by Stations 13180, 15808, and 17247.

Station 13180 (Rio Grande downstream of El Anhelo Drain south of Las Milpas) did not have enough sampling events at this station to consider the results for these parameters statistically relevant, and the data provided is for informational purposes only. At Station 13180, 7 *E.coli* bacteria samples had a geomean of 183 MPN, which is above the standard. The water quality data indicated that dissolved oxygen had a mean of 5.4 mg/L. Analysis of water quality data for pH shows a mean of 7.8. No other parameters were analysed at this station for the period of record.

At Station 15808 (Rio Grande Upstream of Pharr International Bridge), 60 *E.coli* bacteria samples had a geomean of 181 MPN and is above the standard. The trend analysis for bacteria water quality data at this station is increasing over the period of record. The water quality data indicated that dissolved oxygen had a mean of 6.3 mg/L. Analysis of water quality data for pH shows a mean of 7.9. Neither pH nor DO showed any significant trends. Data for total dissolved solids shows a mean of 825.44 mg/L and shows no trend. Ammonia data shows a mean of 0.50 mg/L, and total phosphorus data shows a mean of 0.11 mg/L, both of which show neither an increasing nor decreasing trend. Analysis of chlorophyll-a data for this station showed a mean of 15.21 ug/L, and is increasing over the period of record. The mean for sulfate is 272.49 mg/L and shows an increasing trend. The mean for chloride is 185.63 mg/L, and the mean for nitrate+nitrite is 0.58 mg/L, and neither parameter shows a significant trend. A graph for bacteria is on the next page, please see Appendix B for additional graphs.

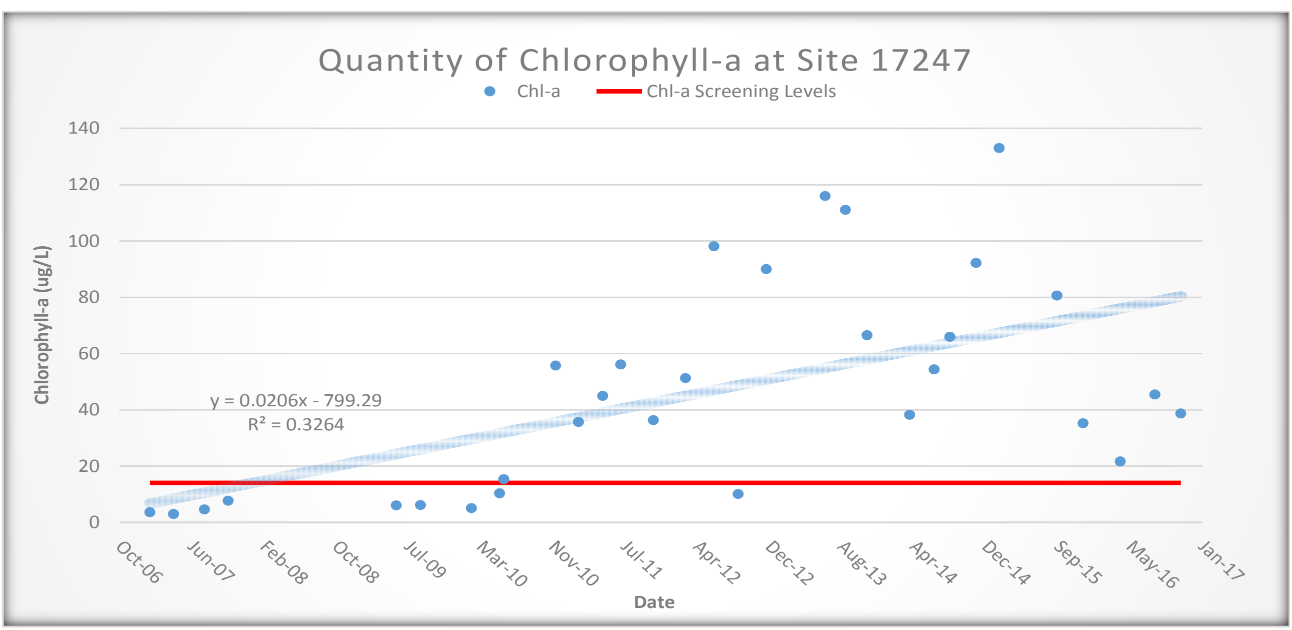
Rio Grande at El jardin Pump. Photo credit USIBWC CRP staff.

Figure 97.



At Station 17247 (Rio Grande River 100 M upstream of FM 1015 at Progresso, Texas), 25 *E.coli* bacteria samples had a geomean of 50 MPN. The analysis for bacteria water quality data at this station shows no trend over the period of record. The water quality data indicated that dissolved oxygen had a mean of 8.6 mg/L, and pH shows a mean of 7.9; both parameters show increasing trends. Data for total dissolved solids shows a mean of 796.54 mg/L and is neither increasing nor decreasing over the period of record. Ammonia data shows a mean of 0.24 mg/L, and shows a slightly decreasing trend. Total phosphorus data shows a mean of 0.26 mg/L, and shows no significant trend. Analysis of chlorophyll-a data showed a mean of 46.43 ug/L, which is high and is increasing. Sulfate has a mean of 353.43 mg/L, which is above the standard but shows no trend. Chloride has a mean of 806.09 mg/L, which is above the standard but also shows no trend. Nitrate+nitrite has a mean of 0.67 mg/L and shows no trends. Please see the graph for this station below, and Appendix B for additional graphs for this site.

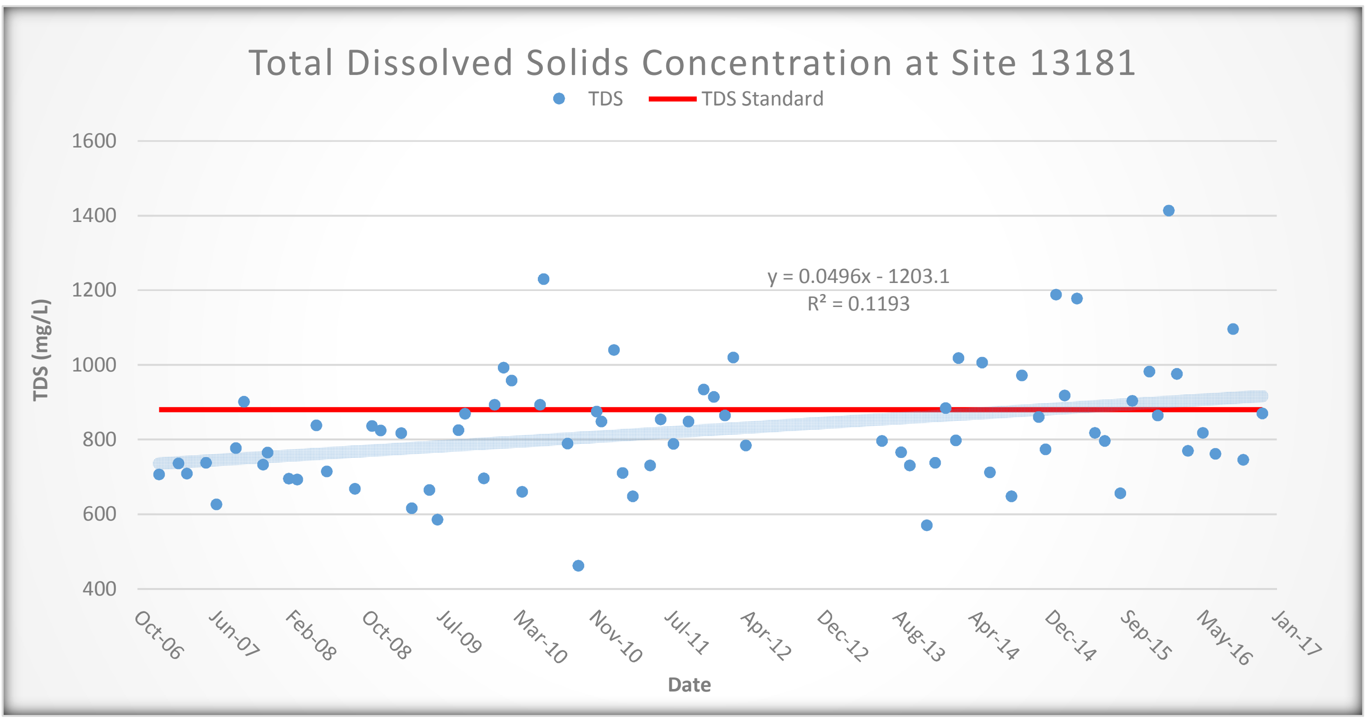
Figure 98.



Assessment unit 2302_04 currently has no impairments. This AU has a water quality concern for depressed dissolved oxygen. Assessment unit 2302_04 is monitored by Stations 13181 and 13664.

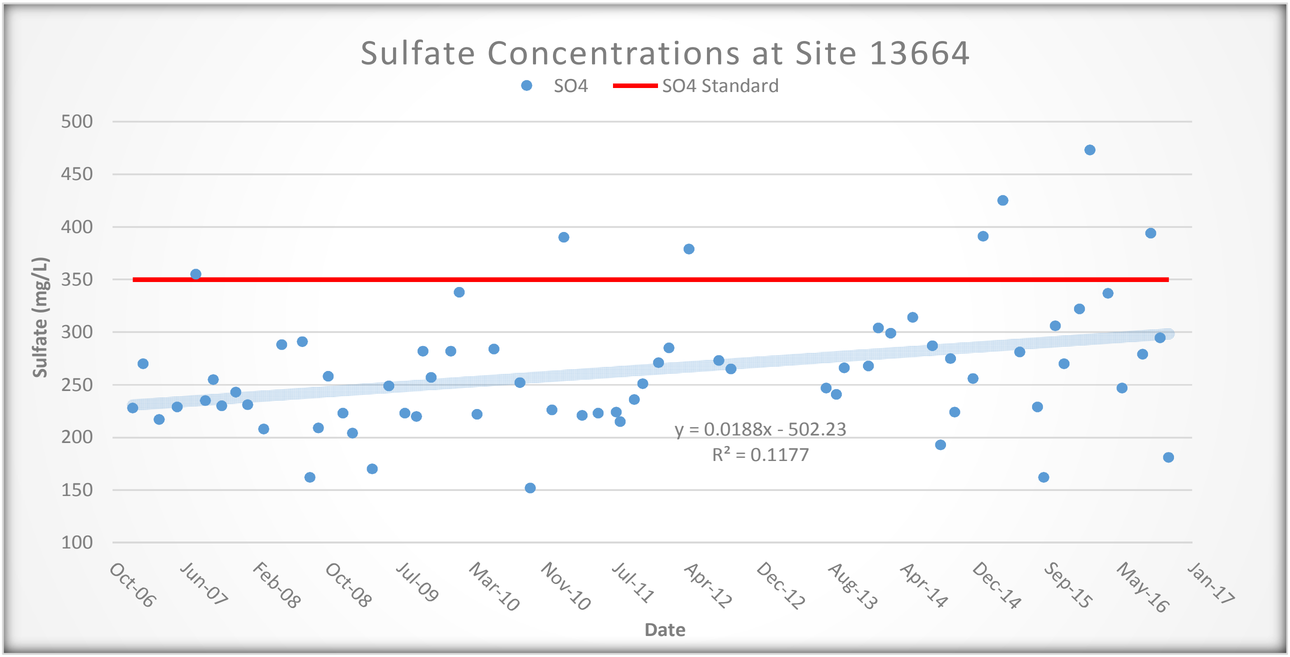
At Station 13181 (Rio Grande River at Hwy 281/International Blvd in Hidalgo), 70 *E.coli* bacteria samples had a geomean of 89 MPN. Bacteria shows no significant trend over the period of record. The water quality data indicated that dissolved oxygen had a mean of 6.6 mg/L, and pH shows a mean of 7.8; neither parameter shows trends. Data for total dissolved solids shows a mean of 826.25 mg/L and is increasing over the period of record. Ammonia data shows a mean of 0.24 mg/L, and total phosphorus data shows a mean of 0.08 mg/L; neither parameter shows an increasing nor decreasing trend. Analysis of chlorophyll-a data for this station showed a mean of 14.52 ug/L, and is increasing over the period of record. This station also has an increasing trend for sulfate, with a mean of 270.94 mg/L. The mean for chloride is 181.46 mg/L, and shows no trend. The mean for nitrate+nitrite is 0.56 mg/L, and also shows no trend. The graph for TDS is below, please see Appendix B for additional graphs for this site.

Figure 99.



At Station 13664 (Rio Grande downstream of Anzalduas Dam), 53 *E.coli* bacteria samples had a geomean of 18 MPN. The trend analysis for bacteria water quality data at this station is neither increasing nor decreasing. The water quality data indicated that dissolved oxygen had a mean of 6.8 mg/L, and shows a decreasing trend. Analysis of water quality data for pH shows a mean of 8.0, with no significant trend. Data for total dissolved solids shows a mean of 807.93 mg/L and is neither decreasing nor increasing. Ammonia data shows a mean of 0.24 mg/L, and total phosphorus data shows a mean of 0.08 mg/L; neither parameter shows an increasing nor decreasing trend. Analysis of chlorophyll-a data for this station showed a mean of 14.38 ug/L, and is increasing. Sulfate has a mean of 264.17 mg/L, and shows an increasing trend. Chloride has a mean of 188.14 mg/L, and shows no trends. Nitrate+nitrite has a mean of 0.50 mg/L and also shows no trends. A graph of the trend for sulfate is shown on the next page, and see additional graphs for this station in Appendix B.

Figure 100.



Assessment unit 2302_05 currently has no impairments. This AU currently has no water quality concerns. Assessment unit 2302_05 is monitored by Station 21012 and 20698.

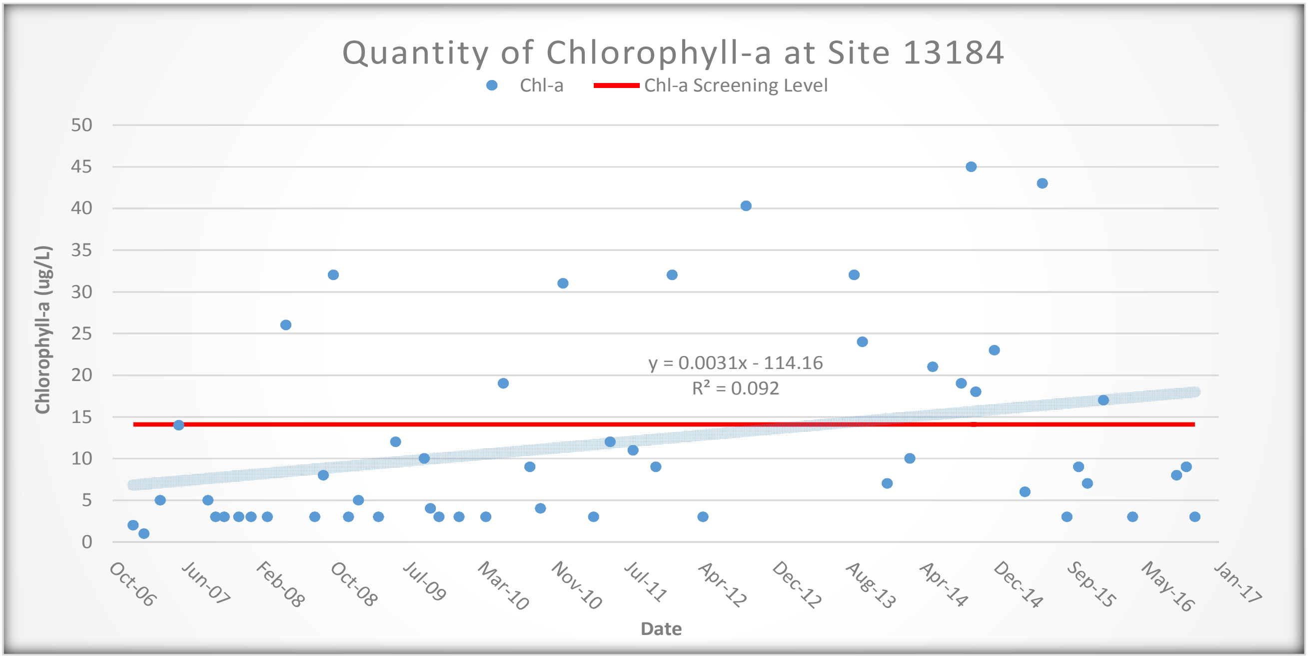
For Station 21012 (Rio Grande South of Mission CAMS 792), there were not enough sampling events at this station to consider the results for these parameters statistically relevant. This data is provided for informational purposes only. At Station 21012, eight *E.coli* bacteria samples had a geomean of 28 MPN. Total phosphorus data shows a mean of 0.07 mg/L. Analysis of water quality data for pH shows a mean of 7.9. The following parameters had adequate sample size for trend analysis. The water quality data indicated that dissolved oxygen had a mean of 10.1 mg/L. Total dissolved solids is not analyzed at this station. Ammonia data shows a mean of 0.06 mg/L. Analysis of Chlorophyll-a data for this station showed a mean of 16.92 ug/L. The mean for sulfate is 264.90 mg/L. The mean for chloride is 150.50 mg/L. The mean for nitrate+nitrite is 0.14 mg/L. There are no trends for any parameters with adequate sample size.

For Station 20698 (Old Rio Grande Meander, Bentsen-Rio Grande Valley State Park), there were not enough sampling events at this station to consider the results for all parameters statistically relevant. Results are provided for informational purposes only. Three *E.coli* bacteria samples had a geomean of 10 MPN. Total phosphorus data shows a mean of 0.18 mg/L. Analysis of water quality data for pH shows a mean of 8.2. The water quality data indicated that dissolved oxygen had a mean of 5.2 mg/L. Total dissolved solids had a mean of 1786.67 mg/L, which is above the standard. Ammonia data shows a mean of 0.16 mg/L. Analysis of chlorophyll-a data for this station showed a mean of 14.67 ug/L. The mean for sulfate is 365 mg/L, which is above the standard. The mean for chloride is 619.33 mg/L, and is above the standard. The mean for nitrate+nitrite is 8.51 mg/L.

Assessment unit 2302_06 currently has no impairments. This AU currently has a water quality concern for depressed dissolved oxygen. Assessment unit 2302_06 is monitored by Station 13184.

At Station 13184 (Rio Grande near Los Ebanos), 39 *E.coli* bacteria samples had a geomean of 32 MPN.The water quality data indicated that dissolved oxygen had a mean of 6.2 mg/L, and pH shows a mean of 8.0; neither parameter shows any trends. Data for total dissolved solids shows a mean of 764.04 mg/L and no significant trend. Ammonia data shows a mean of 0.22 mg/L, and total phosphorus data shows a mean of 0.08 mg/L; neither parameter shows an increasing nor decreasing trend. Sulfate shows a mean of 231.53 mg/L, and nitrate+nitrite shows a mean of 0.37 mg/L; neither parameter shows a significant trend. Analysis of chlorophyll-a data for this station showed a mean of 12.02 ug/L, and is increasing. The mean for chloride is 148.97 mg/L and shows no trend. Please see the graph for this station on the next page.

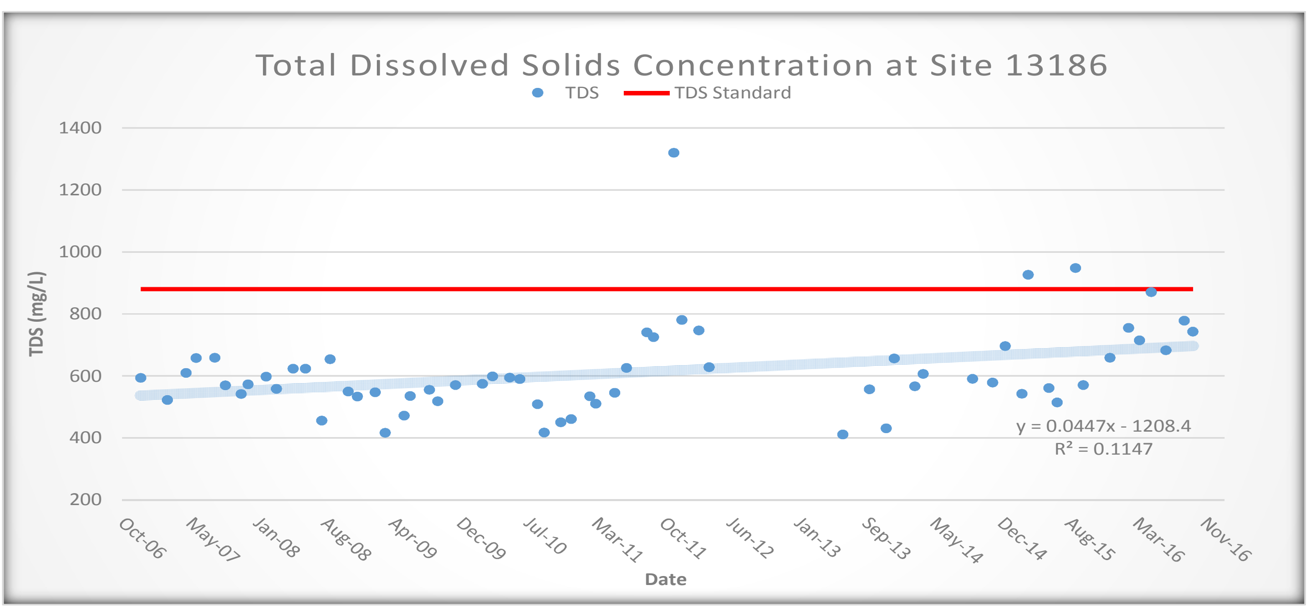
Figure 101.



Assessment unit 2302_07, from the Arroyo Los Olmos confluence upstream to Falcon Dam, is currently impairmented for bacteria. This AU also has a water quality concerns for ammonia. Assessment unit 2302_07 is monitored by Stations13185, 13186, and 13188.

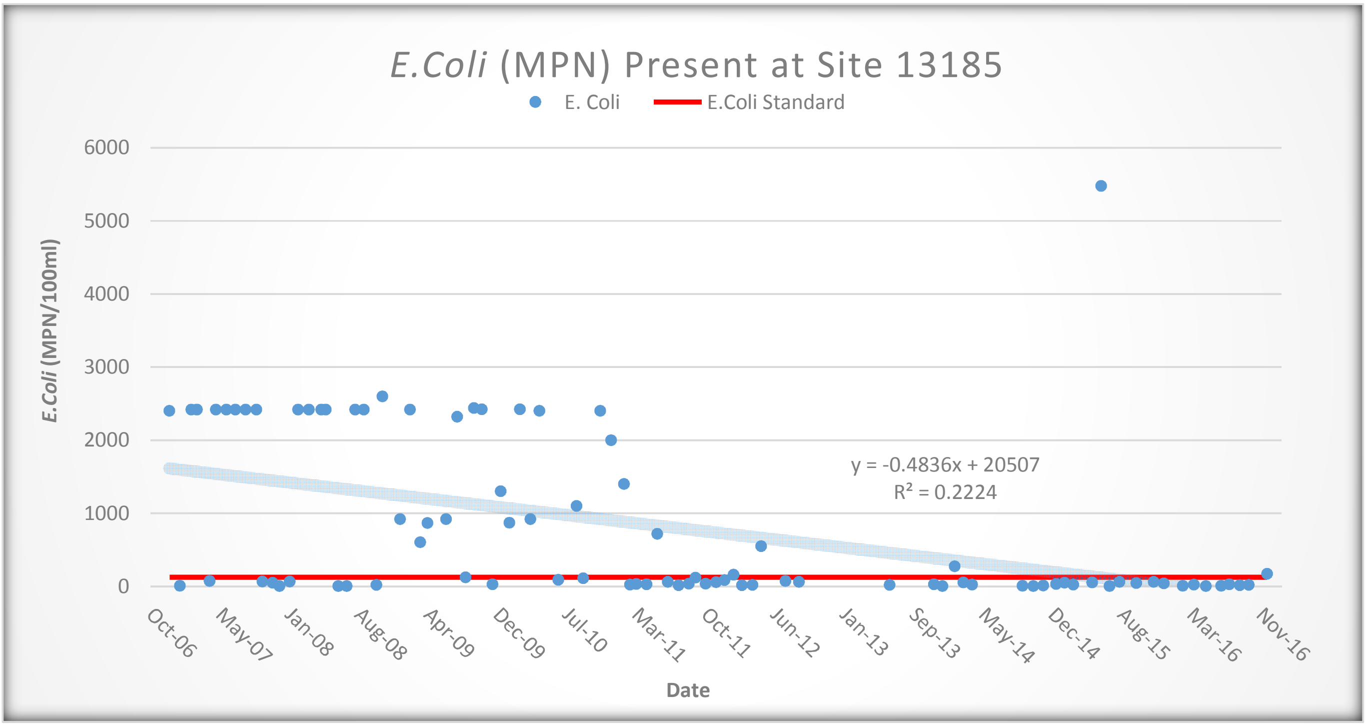
At Station 13186 (Rio Grande near Fronton, TX), 59 *E.coli* bacteria samples had a geomean of 27 MPN. The analysis for bacteria water quality data at this station shows no significant trends, but grab samples show bacteria counts that are steadily increasing. The water quality data indicated that dissolved oxygen had a mean of 8.4 mg/L, and pH shows a mean of 8.0; neither parameters shows any trends. Data for total dissolved solids shows a mean of 612.90 mg/L and an increasing trend. Ammonia data shows a mean of 0.33 mg/L, and total phosphorus data shows a mean of 0.07 mg/L, both of which show neither an increasing nor decreasing trend. Sulfate shows a mean of 194.97 mg/L, and chloride shows a mean of 117.13 mg/L; both show increasing trends. Analysis of chlorophyll-a data for this stations showed a mean of 10.64 ug/L, and nitrate+nitrite has a mean of 12 mg/L; neither is decreasing nor increasing. Please see graph below and additional graphs for this site in Appendix B.

Figure 102.



At Station 13185 (Rio Grande at Ft. Ringgold), 89 *E.coli* bacteria samples had a geomean of 145 MPN. The trend for this site is steadily decreasing, indicating an improvement of water quality around this station, but is still above the water quality standard of 126 MPN. The water quality data indicated that dissolved oxygen levels had a mean of 8.1 mg/L,and pH shows a mean of 8.0; neither parameter shows a significant trend. Total dissolved solids data shows a mean of 694.15 mg/L and is increasing. Ammonia data shows a mean of 0.85 mg/L, with no trends. Total phosphorus shows a mean of 0.15 mg/L and is decreasing. The chlorophyll-a data shows a mean of 11.17 ug/L and does not show a statistically significant trend. Sulfate has a mean of 218.81 mg/L, and shows an increasing trend. Chloride has a mean of 140.06 mg/L, and also shows an increasing trend. Nitrate+nitrite has a mean of 0.41 mg/L, and shows no significant trend. Please see graph below and additional graphs in Appendix B.

Figure 103.



Assessment unit 2302A, Arroyo Los Olmos, is currently impaired for bacteria. AU 2302A_01 has a water quality concern for chlorophyll-a. Assessment unit 2302A_01 is monitored by Stations 13103, 13104, 21591, and 21749.

Station 13103 (Los Olmos Creek at US 83/East 2nd Street south of Rio Grande City) has not flowed consistently since the drought began in 2010, and usually flows only during rain events or during irrigation season. At this station, 11 *E.coli* bacteria samples had a geomean of 745 MPN, which is above the standard but has no trend. The water quality data indicated that dissolved oxygen mean was 5.2 mg/L. The mean for pH is 7.9. Neither pH nor DO show any significant trend. Total dissolved solids data shows a mean of 3,948.18, which is above the standard but shows no trend. The data for ammonia shows a mean of 0.65 mg/L, and shows a decreasing trend. Nitrate+nitrite has a mean of 1.75 mg/L and shows no significant trend. The data for total phosphorus shows a mean of 0.14 mg/L and does not indicate an increasing or decreasing trend. The following parameters did nothave adequate sample size for analysis.The chlorophyll-a data shows a mean of 45.60 ug/L. Sulfate shows a mean of 583.42 mg/L, which is above the standard. The mean for chloride is 1,534 mg/L.

Station 13104 (Arroyo los Olmos at SH 755 NW of Rio Grande City), was recently added back into the monitoring schedule after no monitoring for several years. This station also usually has no measureable flow during non-irrigation months. Although it did not meet the minimum number of events, the data is being provided for informational purposes. Station 13104 had three *E.coli* bacteria samples with a geomean of 9,200 MPN, which is above the water quality standard of 126 MPN. The water quality data indicated that dissolved oxygen mean was 4.2 mg/L, which is below the standard. The mean for pH is 7.3. Total dissolved solids data shows a mean of 3,198 mg/L, which is above the standard. The data for ammonia shows a mean of 0.1 mg/L, and the data for total phosphorus shows a mean of 0.18 mg/L. The chlorophyll-a data shows a mean of 151 ug/L, which is very high, but not surprising, since this site usually has no measureable flow. Sulfate has a mean of 746.80 mg/L, which is above the standard. Chloride has a mean of 1,190.60 mg/L, which is also above the standard. The mean for nitrate+nitrite is 0.29 mg/L.

Station 21591 (Arroyo Los Olmos 400 m upstream of confluence with Rio Grande near Rio Grande City) is a new station. Although it did not meet the minimum number of events, the data available is being provided for informational purposes. Station 21591 had three samples with a geomean for *E.coli* bacteria samples of 310 MPN. The water quality data indicated that dissolved oxygen mean was 6.2 mg/L. The mean for pH is 7.9. Total dissolved solids data shows a mean of 1064.67 mg/L, which is above the standard. The data for ammonia shows a mean of 0.1 mg/L, and the data for total phosphorus shows a mean of 0.06 mg/L. The chlorophyll-a data shows a mean of 18.33 ug/L. Sulfate has a mean of 281.67 mg/L. Chloride has a mean of 236.33 mg/L. Nitrate+nitrite has a mean of 0.09 mg/L.

Station 21749 (Rio Grande approx 380 meters downstream of confluence with Los Olmos Creek) is also a new station. Although it did not meet the minimum number of events, the data is being provided for informational purposes. Station 21749 had three *E.coli* bacteria samples with a geomean of 71 MPN. The water quality data indicated that dissolved oxygen mean was 7.1 mg/L. The mean for pH is 8.0. Total dissolved solids data shows a mean of 783.33 mg/L. The data for ammonia shows a mean of 0.1 mg/L, and the data for total phosphorus shows a mean of 0.05 mg/L. The chlorophyll-a data shows a mean of 3.33 ug/L. Sulfate has a mean of 241 mg/L, chloride a mean of 132 mg/L, and nitrate+nitrite a mean of 0.12 mg/L.

This map, made on 01/11/2018, shows the water of the Rio Grande reaching the mouth and flowing into the Gulf of Mexico.

Segment 2301, Rio Grande Tidal

Segment 2301 is from the confluence with the Gulf of Mexico in Cameron County to a point 10.8 km (6.7 miles) downstream of the International Bridge in Cameron County and is approximately 48.31 miles long. The segment is classified as a tidal stream. In the 2014 Intergrated Report, Segment 2301 does not have any impairments at this time, but does have concerns for bacteria, chlorophyll-a, and nitrate.

Segment 2301 has two assessment units, or AUs:

2301_01, From the mouth of the Rio Grande (lower segment boundary) to a point 71.7 km (44.6 mi) upstream

2301_02, From a point 71.7 km (44.6 mi) upstream of the mouth of the Rio Grande to the upper segment boundary 10.8 km (6.7 mi) downstream of the International Bridge

There are two stations currently being monitored within this segment:

16288, Rio Grande River at Sabal Palm Sanctuary 370 meters south and 310 meters east from the intersection of Dakota Ave and Sabal Palm Grove Road

13176, Rio Grande River Tidal at the end of Quicksilver Ave 375 meters south from the intersection of Boca Chica Blvd and Quicksilver Ave

Assessment Unit 2301_01, which includes Station 13176, has a concern for chlorophyll-a.

At Station 13176 (Rio Grande at Boca Chica), 7 *Enterococcus* bacteria samples had a geomean of 41 MPN, which is above the standard, and shows no trend. This station collects *Enterococcus* due to its proximity to the Gulf, but because *Enterococcus* has a short holding time for analysis, it has proven difficult to analyze samples. The analysis showed that dissolved oxygen had a mean of 7.8 mg/L, and pH shows a mean of 8.2. Neither shows a significant trend. Total dissolved solids shows a mean of 1,711.90 mg/L, which is normal considering this station's proximity to the Gulf of Mexico. Data for ammonia shows a mean of 0.40 mg/L, and shows no significant trend. Total phosphorus shows a mean of 0.24 mg/L and shows a decreasing trend. The chlorophyll-a data shows a mean of 55.60 ug/L and is not decreasing nor increasing over time. The mean for sulfate is 326.83 mg/L, and shows no significant trend. The mean for chloride is 619.76 mg/L, and also shows no significant trend. The mean for nitrate+nitrite is 0.57 mg/L, with no significant trend. Please see graphs in Appendix B.

Assessment Unit 2301_02, which includes Station 16288, has no impairments, but has concerns for bacteria and nitrate.

This station had previously been monitored by the Sabal Palm Audubon Sanctuary, but they dropped out of the program in 2012, which resulted in a bit of a gap for sample collection. It was eventually picked up by UTRGV- Brownsville in 2014. At Station 16288 (Rio Grande at Sabal Palm Sanctuary), 12 *Enterococcus* bacteria water quality samples had a geomean of 154 MPN, which is above the standard but shows no trend. This station collects *Enterococcus* due to its proximity to the Gulf, but because *Enterococcus* has a short holding time for analysis, it has proven difficult to collect samples. The water quality data indicates that dissolved oxygen had a mean of 8.2 mg/L and the trend remains constant (no increase/decrease). Data for pH shows a mean of 8.0, with no trend. Total dissolved solids shows a mean of 992.86 mg/L and also remains constant, with no increase or decrease. The ammonia data shows a mean of 0.28 mg/L and total phosphorus has a mean of 0.32 mg/L, with total phosphorus showing a decreasing trend. The data for chlorophyll-a has a mean 32.82 ug/L, and is increasing over time. Sulfate shows a mean of 296.26 mg/L, and has no significant trend. Chloride has a mean of 236.62 mg/L, and shows an increasing trend. Nitrate+nitrite has a mean of 1.58 mg/L, and has no significant trend. Please see graphs for this station on the next page and in Appendix B.

Figure 104.

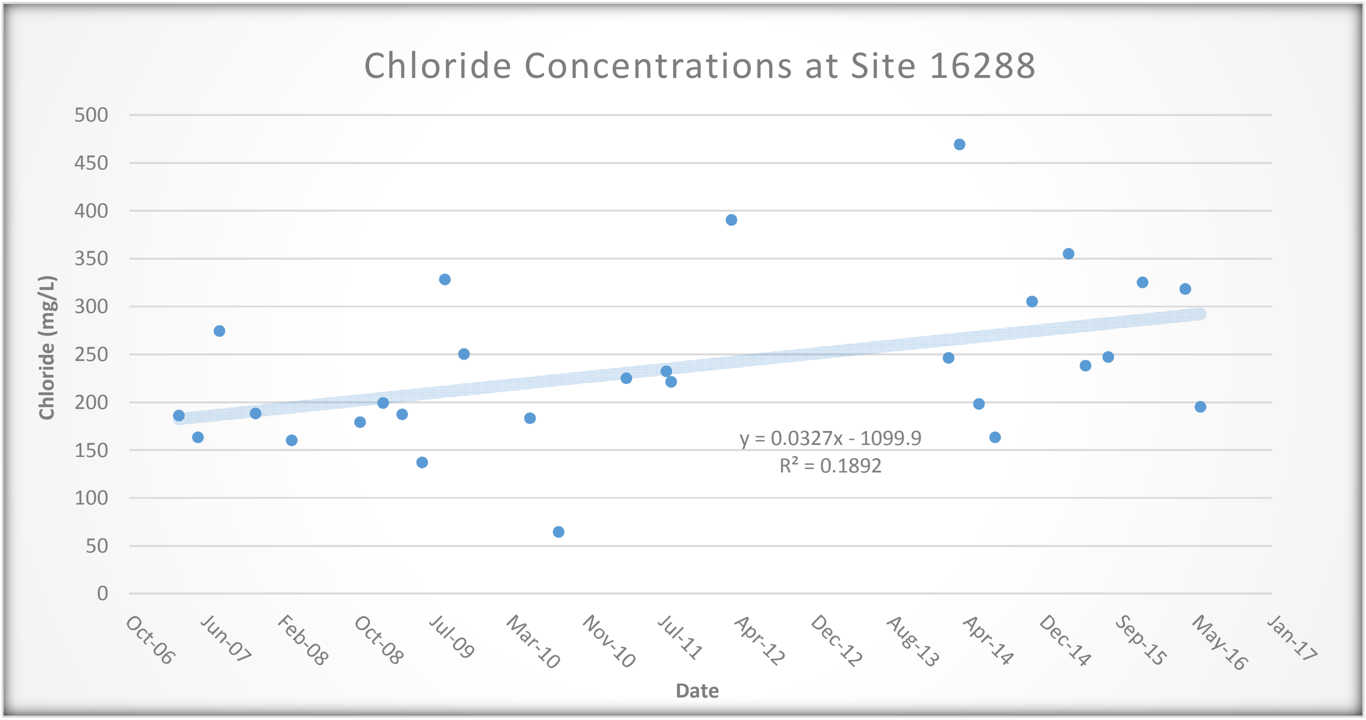
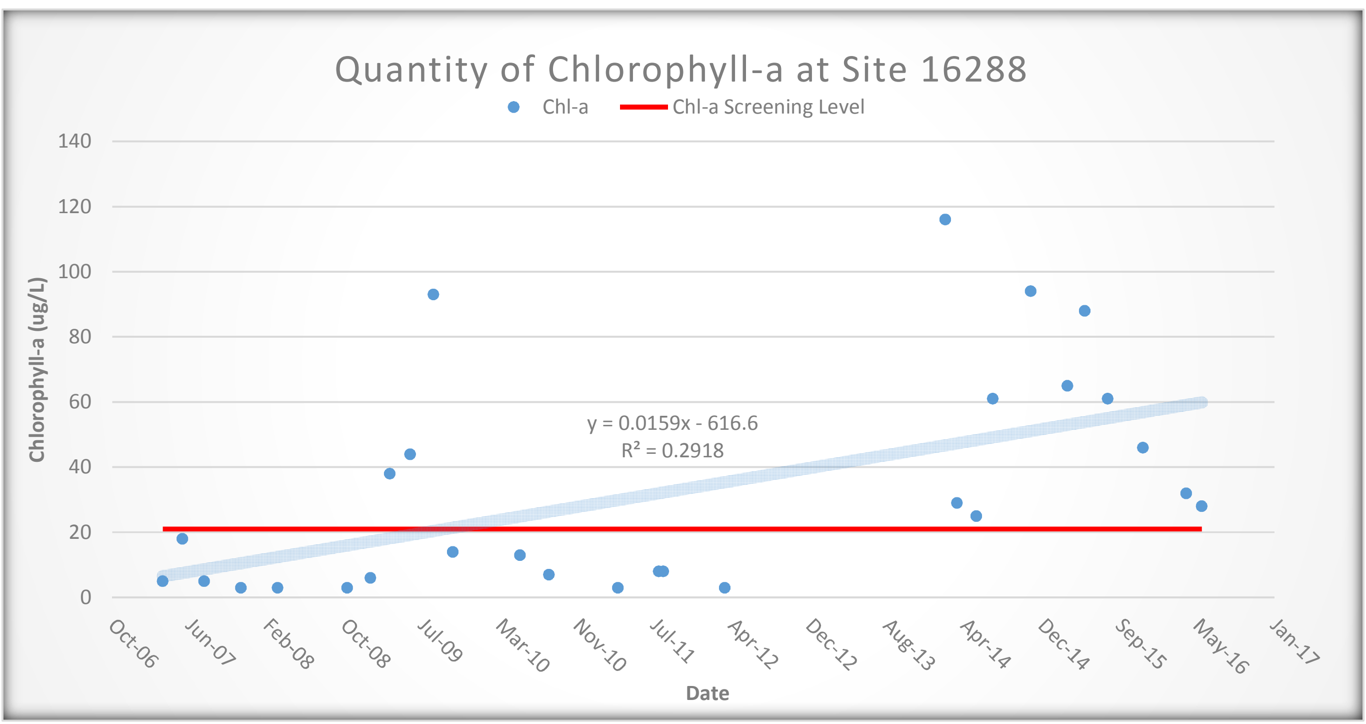


Figure 105.



Lower Rio Grande Water Quality Initiative

The Lower Rio Grande, from Falcon International Reservoir to the reach where the river enters the Gulf of Mexico (here-after termed Lower Rio Grande/Rio Bravo) has experienced persistently high bacteria and increasing salinity levels. The goal of the Lower Rio Grande Water Quality Initiative is to identify feasible options for the prevention and control of pollution. These measures will result in the restoration, conservation, and improvement of water quality in the Lower Rio Grande/Rio Bravo River through a bi-national facilitated process that includes Federal, State, and local agencies on both sides of the border. The information gathered during the project will be used to populate a hydrologic model of the Lower Rio Grande/Rio Bravo, which will be coordinated on both sides of the border through multiple agencies and participants. This model can then be used to optimize pollution prevention solutions so the most efficient course of action can be taken, and may even be used to do similar projects in other parts of the basin. The ultimate goal of this project is to establish a model and strategy that can be applied throughout the rest of the basin.

This pilot project was an opportunity for both countries to meet and agree on what the issues were in this region, and how we were going to address them. This group has held several bi-national meetings over the course of seven years to discuss the scope and focus of this project. Discussions covered topics such as parameters of interest, laboratory methodology, sampling techniques and sampling equipment, as well as establishing the criteria for the water models and what data was needed. The study included a detailed reconnaissance survey of four areas of the river to identify all potential discharges in December 2013. Baseline data was collected in 2014. Planning continued throughout 2015, which included 3 binational sampling events in March, August and November of 2015, and an additional binational monitoring event in March 2016. Field data, bacteria samples, metals and other parameters were collected by the participants on both sides of the border.

At present, the project is entering its last phases. The water quality data has been analyzed and the conceptual water models have been designed with that data, and are currently being reviewed. At this time the teams are getting ready for the preparation of the final report and models, which may be ready by the end of 2018. For more information on this project, please contact Clean Rivers Program staff at the IBWC. A map of the project sites is provided on the next page for reference.

Pictured, Left: One of the binational sampling teams, November 2015.
Pictured, right: Salinity profile team, August 2015.

Land Use

Segment 2303: Based on satellite imagery, the land along the river directly upstream and downstream of Falcon Reservoir is largely unpopulated and undisturbed. There are small urban developments on both sides of the border, but the rest of the land looks to be undisturbed. The area immediately around the reservoir is popular for recreational activities (boating, fishing, swimming), with large settlements of homes on or near the shorelines. The land use of areas past the urban settlements, in the surrounding territory, is rural and largely consists of uninhabited ranchland.

There are two permitted dischargers into Segment 2303, Zapata County Water Works Wastewater Treatment Plant and Zapata County Chihuahua Wastewater Treatment Plant. Zapata County Water Works Wastewater Treatment Plant's permit is for the discharge of treated public domestic wastewater, and they are allowed to discharge up to 0.0175 million gallons per day (MGP) into Arroyo Miguel, which goes into International Falcon Reservoir.

Segment 2302: Based on satellite imagery, there is land at the beginning of the segment that is undeveloped, but proceeding downstream there are small and large urban developments on both sides of the border in this area. The Lower Rio Grande Valley is heavily influenced by agriculture, and a large part of the lands near the river are agricultural crop lands. There are several large industrial buildings on the Mexican side of the border. This area has ports of entry as well, which see heavy traffic, commercial and private, on a daily basis.

There are 16 permitted dischargers that discharge into Segment 2302. The permits include one for conventional water treatment, one permit for industrial wastewater treatment, two permits for private domestic wastewater treatment, and eight permits for public domestic wastewater treatment.

Segment 2301: Based on satellite imagery, there are small and large urban developments on both sides of the border in this area. There are very small developments dotting the land that follows the river throughout the entire segment on both sides of the border, and may presumably be colonias, or communities with access to little or no wastewater infrastructure and poor sanitary conditions. A large portion of the lands near the river on both sides of the border are wetlands, with agricultural lands right before that (see Binational Landcover map on p. 35-36).

There is one permitted discharger that discharges into Segment 2301. The permit belongs to the Brownsville Public Utilities Board (BPUB), which discharges treated public domestic wastewater. The BPUB facility, the Southside Wastewater Treatment Facility, is located at 2800 East University Boulevard, in southeast Brownsville, in Cameron County, Texas. It discharges 12.8 MGD of treated wastewater from Southside Wastewater Treatment Facility directly to Rio Grande Tidal in Segment 2301.

Figure 106.

Small town of San Ygnacio on the right hand side, near Station 15818. MX side on the left side shows

no development.

Figure 107.

Pictured: Map showing International Falcon Reservoir

Figure 108.

Map shows a large industrial area on the Mexican side of the river, no U.S. city across.

Figure 109.

Map shows the city of Roma on the upper side of the Rio Grande, and the city of Migeul Aleman in Mexico on the underside of the river.

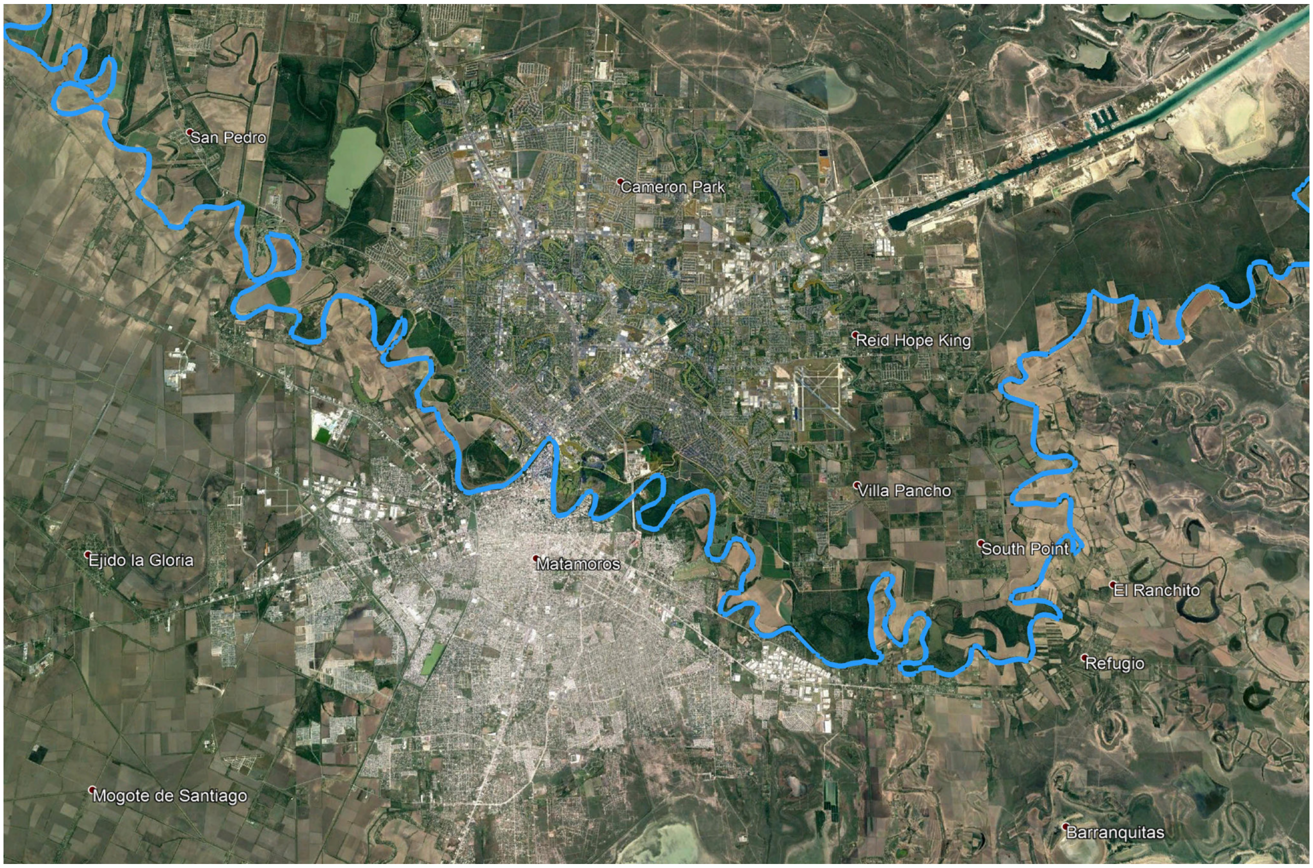
Figure 110.

Map: Rio Grande City, TX on the upper side of the Rio Grande. Under side is undeveloped rural land or farmland in MX.

Figure 111.

Map shows McAllen, TX on the upper right side of the river, and the city of Reynosa in Mexico on the lower left.

Figure 112.



Map of Brownsville, TX on the upper side of the map, above the river. The large urban area south of the river, to the bottom left, is Matamoros, Tamaulipas, Mexico.

Possible negative impacts on water quality

Nonpoint sources- Segment 2303 consists of the water of the Rio Grande in Falcon Reservoir and contributing flows from the Rio Salado in Mexico. However, the section of the river that flows into Falcon Reservoir is flowing downstream from the Laredo/Nuevo Laredo area, which has serious bacteria impairments. There are several small urban developments located all the way around the reservoir, which may contribute to bacteria introduction into the reservoir. The reservoir, being an impounded water source, does not flow, and this could contribute to lack of aeration and the buildup and break down of organic materials. Water fowl and horses and cattle from nearby ranchlands may further contribute to bacteria in the water, but the extent of any impact on the reservoir from wildlife is currently unknown.

In Segments 2302 and 2301, the Rio Grande is heavily impacted not only by small and large urban developments on both sides of the border, but also by the lower-income communities that have limited or no access to sewer systems. These areas are more likely to have aging infrastructure, inadequate sewer connections, leaky and/or old septic tanks or no infrastructure at all, and facilities that are too small for the communities they serve, which can contribute to the bacteria problems in the area. The populations in the McAllen, Harlingen and Brownsville areas have doubled in the past ten years, and this places a heavy strain on the treatment facilities in these communities. Water fowl and livestock from nearby ranchlands may further contribute to bacteria in the water, but the extent of any impact on the water quality from those activities is currently unknown.

Agricultural- In Segment 2303, there are private ranchlands in the surrounding areas, but farming takes place downstream of the reservoir and has little to no impact here. The ranchlands have goats, cattle and horses, as these are frequently seen grazing along the river near San Ygnacio. Farming practices would need to be investigated further in this area as the acreage covered by agricultural lands and the impact agriculture may have on water quality in this region is unknown.

Segments 2302 and 2301 are heavily impacted by the agricultural industry, and the majority of the land is crop land. This can easily be verified through satellite imagery. There are some private ranchlands in the surrounding areas that have livestock. Agricultural return flows may contribute to high salinity in the water being returned to the river, and may also have a negative impact on the bacteria counts. It is important to note that return flows are received from both the U.S. and Mexico, and both may be contributing to the problem. Agricultural return flows are also high in nutrients, which can contribute to algal blooms. Livestock that are allowed to graze near the river can also be a contributing source of bacteria.

Wildlife- Access to the river at the stations in this segment is relatively easy, though the landscape was drastically changed by the flooding caused by Hurricane Alex in 2010. The area is popular for migratory birds and sees heavy bird activity, which may contribute to the bacteria issues in this area. There are also horses and cattle grazing in and around the river, and the area has problems with feral hogs. Javalinas and other small wildlife are also common and could be small contributors to bacteria problems. The reservoir sees water fowl year-round, and some cattle and horses may come to graze and drink in the remote edges of the water line. There is also livestock grazing around the river from private ranches. Other small wildlife are also common and could be small contributors to bacteria problems. The area in Segments 2302 and 2301 has wildlife refuges and preserves, and several protected areas.

Urban Runoff- Falcon Reservoir is impacted by runoff from the multiple communities around the shorelines, as well as by boat ramps and roads coming off the main highways. In Segment 2302, Google Earth maps show that the main roads in many towns, such as El Cenizo and Rio Bravo, go directly to the river, and many of the town's small recreation areas (parks, popular fishing spots) are along the river and directly accessible by the main road. There are multiple communities along the river in this span of the basin. Roma, Rio Grande City, Mercedes, McAllen, Weslaco, La Joya, Harlingen and Brownsville, along with many other cities, border the river until it reaches the Gulf on the U.S. side, while numerous towns and cities border the river on the Mexican side as well. Google Earth maps show multiple roads in every one of these cities that go directly to the river. Pollution related to trash from recreation are also problems. These segments are impacted by runoff from the multiple communities around the shorelines and adjacent to the river, as well as by boat ramps and roads coming off the main highways. Ports of Entry at each city are also major contributors of pollution to the Rio Grande water quality, especially during heavy rain events, as these see heavy pedestrian, private and commercial vehicle traffic on a daily basis.

Influences of Flow - Segment 2303 mainly encompasses Falcon Reservoir, which has no flow. However, Station 15818, located just as the river is entering the Reservoir, is influenced by flows coming from upstream. Directly upstream is Laredo/Nuevo Laredo, Rio Bravo, and El Cenizo, all of which have documented severely elevated bacteria counts. This may be influencing the bacteria counts at the station, contributing to the increasing trend for high bacteria counts, and may be negatively impacting the quality of the water going into the Reservoir.

Segment 2302 is heavily influenced by releases from Falcon Reservoir, but this area also sees several rain events throughout the year. Since the first station below Falcon Reservoir, 13186, does not have any immediate water quality issues (though the assessment unit itself is impaired for bacteria), it appears that the impacts to the water quality are coming from other sources as the water flows downstream.

Segment 2301 is heavily influenced by weather in the Gulf region, and the region sees several rain events throughout the year. This is the furthest downstream segment of the basin, and is receiving water from the upstream segments that are impaired. Because the segment is so close to the Gulf, the area is affected by tidal influences, from the tide back flowing and mixing with the river water, and well as by storm surges from tropical storms and hurricanes. These factors, combined with the increasing salinity of the water as it flows downstream from further up the river basin, all contribute to the salinity in this area. The agricultural return flows may also have an impact on the water quality, although there are currently no impairments or concerns for high salinity.

Stakeholders in Segment 2303

Landowners

TCEQ Watermaster Office

US Fish & Wildlife Service

TCEQ Regional Offices

TX Parks and Wildlife

City of Laredo, TX

Webb and Zapata Counties

Border cities and towns on MX side

Nuevo Laredo, MX

Distrito de Riego 050 Amistad Falcon

Towns of Rio Bravo, El Cenizo, San Ygnacio, TX, U.S. side

Stakeholders in Segment 2302

Landowners

US Fish & Wildlife Service

TX Parks and Wildlife

UTRGV- Edinburg

Starr, Willacy, Hidalgo, Cameron Counties

Cameron County Water Improvement District No. 10 and 16

Cameron County irrigation District No. 2 and 6

Donna irrigation District- Hidalgo County No. 1

Hidalgo and Cameron County Irrigation District No. 9

Hidalgo County Irrigation District No. 1, 2, 6, 13, 16, 19

Hidalgo County Water Control and Improvement District No. 18

Hidalgo County Water Improvement District No. 3, 5

Hidalgo County Municipal Utility District No. 1

Cities of Zapata, Roma, McAllen, La Feria, Pharr, Mercedes, Weslaco, Edinburg, Mission, Rio Grande City

La Feria Irrigation District- Cameron County No. 3

Santa Maria Irrigation District- Cameron County No. 4

United Irrigation District of Hidalgo County

Valley Acres Water District

Valley Municipal Utility District No. 2

TCEQ Watermaster Office

TCEQ Regional Offices

TX A&M Kingsville

Cuarta Unidad del Distrito de Riego 026 Bajo Rio San Juan, Distrito de Riego 025 Bajo Rio Bravo

Valley Acres Water District

Valley Municipal Utility District No. 2

TCEQ Watermaster Office

TCEQ Regional Offices

TX A&M Kingsville

Cuarta Unidad del Distrito de Riego 026 Bajo Rio San Juan, Distrito de Riego 025 Bajo Rio Bravo

Stakeholders in Segment 2301

Landowners

US Fish & Wildlife Service

TX Parks and Wildlife

Matamoros and other cities in Tamaulipas, MX

Adams Garden Irrigation District No. 19

TCEQ Watermaster Office, TCEQ Regional Offices

Brownsville irrigation District

Cities of Harlingen, La Joya, Brownsville, TX

University of Texas Rio Grande Valley

Harlingen Irrigation District- Cameron County No. 1

Cuarta Unidad del Distrito de Riego 026 Bajo Rio San Juan, Distrito de Riego 025 Bajo Rio Bravo

Recommendations

The USIBWC CRP will continue routine monitoring at current levels in 2019. The program is currently a participant in the Lower Rio Grande Water Quality Initiative, a pilot binational project that aims to look at bacteria and salinity in the Lower Rio Grande Sub-Basin and establish protocols to try and implement a binational watershed protection plan. More information on this project can be obtained by contacting USIBWC CRP staff. The final report from this project will be very useful in identifying sources of water pollution and increased salinity that will help the USIBWC CRP determine what additional resources are needed in this area to deal with the issues. This area would benefit from collaborative work to establish guidelines to deal with salinity, and to come up with possible solutions to the issue of bacteria. The Initiative mentioned above is a step in the right direction, but there is still much that needs to be done.

2018 Basin Sumary Report Conclusions and Recommendations

Sampling stations within the Rio Grande Basin show both increasing and declining parameter concentration trends. The table depicts the percent of stations within each sub-basin that show increasing or decreasing trends. Bacteria levels are of particular concern throughout the entire basin, as they typically show an increasing trend and multiple stations are already above the standard.

Table 14. Percent of Sites in Each Sub-Basin Showing Trends

Sub-basin	pH	Dissolved Oxygen (mg/L)	Ammonia (mg/L)	Chlorophyll-a (ug/L)	Total Phosphorus (mg/L)	Bacteria (MPN/100ml)	Sulfate (mg/L)	Chloride (mg/L)	Nitrate + Nitrite (mg/L)	TDS (mg/L)
Upper Rio Grande										
Percent Increasing	5.4	2.7	3.6	9.7	10.3	9.1	17.2	17.2	3.6	3.6
Percent Decreasing	8.1	8.1	3.6	6.5	6.9	0	6.9	17.2	14.3	17.9
Middle Rio Grande										
Percent Increasing	5	5	0	26.3	5	12.5	35	25	10	20
Percent Decreasing	5	15	10	5.3	10	0	10	10	0	5
Pecos										
Percent Increasing	0	0	0	0	0	0	5.9	5.9	0	0.0
Percent Decreasing	7.7	0	0	7.7	5.9	9.1	0	0	17.6	0
Lower Rio Grande										
Percent Increasing	13.6	18.2	0	52.4	0	4.3	33.3	19.0	0	28.6
Percent Decreasing	0	9.1	13.6	0	23.8	4.3	0	0	4.8	0

We see many of the same issues throughout the Rio Grande Basin: illegal dumping, aging and/or inadequate wastewater treament plants, highly saline agricultural returns, and population growth that has far exceeded projections. These issues are not just on one side of the border, but are mirrored by both countries. In order to address these issues, a collaborative and adaptive management approach must be utilized and embraced by resource management agencies in the United States and Mexico.

The Upper Rio Grande Sub-Basin would benefit from a collaborative watershed protection plan in the Texas/New Mexico area, which may set the example for other border communities and foster the desire for these communities to work together towards a common goal. Additionally, infrastructure updates to New Mexico wastewater treatment plants are overdue and would greatly improve water quality.

The Pecos River Sub-Basin would benefit greatly from additional partners who can assist with monitoring, and an updated watershed protection plan to continue looking at the salinity issues in the area.

The Middle Rio Grande Sub-Basin needs additional intensive monitoring in order to improve the bacteria issues in some areas, which are a serious public health concern. There is a high level of contact recreation in this part of the basin, which may be having a detrimental effect on the water quality. This area of the basin does see a high level of binational collaboration, but many of the entities lack the financial means to make the costly changes required. The entities in this reach need to focus their efforts to pool the resources they have and address the concerns with high bacteria levels.

The Lower Rio Grande Sub-Basin will benefit greatly from the conclusion of the Lower Rio Grande Water Quality Initiative, as will the rest of the basin. This novel binational approach that deals with salinity and bacteria issues will not only identify possible sources of solution, but also identify what additional resources are needed to make this binational watershed protection plan successful.

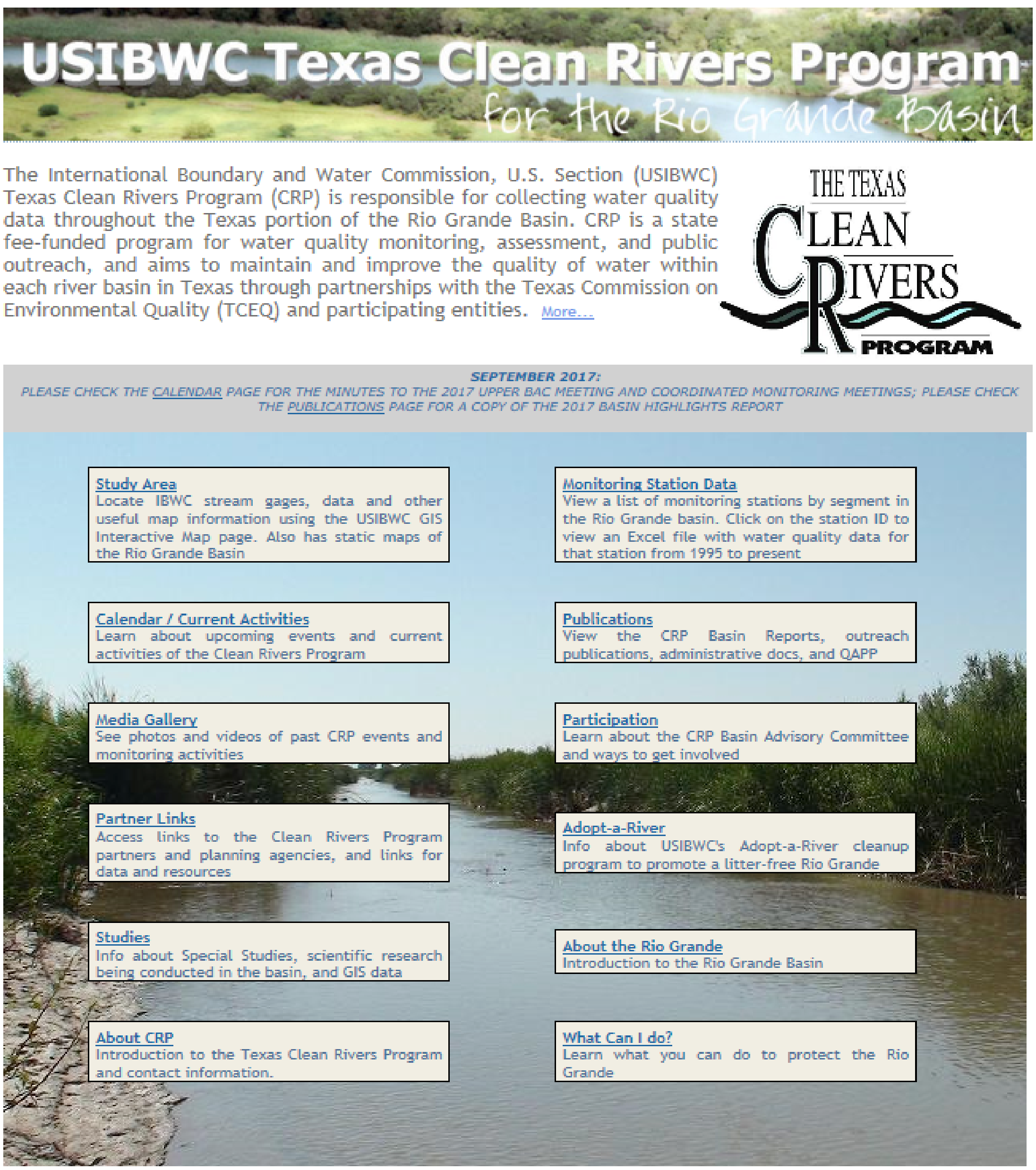
The novel approach seen in the Lower Rio Grande Sub- Basin involved multiple levels of government collaboration on both sides of the border, focusing on the water quality issues at hand in that region while working towards the improvement of water quality in the Rio Grande. This mindset is the answer to many, if not all, of the issues along the international border.

CRP Website and References

USIBWC CRP Website
http://www.ibwc.gov/CRP/index.htm

The USIBWC CRP maintains a website with a wealth of information for the public:

- **About CRP:** An introduction to the Rio Grande Basin
- **Contact Information:** Contacts for the USIBWC CRP and program information
- **Study Area:** Contains maps of the Rio Grande Basin and of the monitoring locations
- **Monitoring Station Data:** USIBWC CRP and TCEQ water quality data in Excel files by station; information about quality assurance, parameters, and standards.
- **Other Information:** A calendar provides information on upcoming meetings and activities. There are links to studies and publications about the Rio Grande Watershed and the USIBWC Adopt-a-River program. Partner links provide resources for monitoring partners, links to other planning agencies, and links to environmental groups and resources for the Rio Grande.
- **Media Gallery:** Photo albums and videos about monitoring, research, geography, wildlife, and outreach. Our video gallery now includes a number of videos, the most recent being about water quality in the Rio Grande.



Additional Resources and Links:

TSWQS: https://www.tceq.texas.gov/waterquality/standards/2014standards.html

SWQM: http://www.tceq.texas.gov/waterquality/monitoring

2014 Texas Integrated Report: https://www.tceq.texas.gov/waterquality/assessment

Coordinated Monitoring Schedule: http://cms.lcra.org/

EPA Recreational WQ Criteria: http://water.epa.gov/scitech/swguidance/standards/criteria/health/recreation/

The Disappearing Rio Grande http://riogrande.texastribune.org/

TPWD Kills and Spills team: https://tpwd.texas.gov/landwater/water/environconcerns/kills_and_spills/

Water Resources: http://www.twdb.texas.gov/waterplanning

RGISC: http://rgisc.org/

Paso del Norte Watershed Council http://smiley.nmsu.edu/pdnwc/

USIBWC website: http://www.ibwc.gov/home.html

References:

Pecos Watershed Protection Plan. http://pecosbasin.tamu.edu.

https://tshaonline.org/handbook/online/articles/rnp02

https://www.tceq.texas.gov/waterquality/assessment

https://www.tceq.texas.gov/assets/public/permitting/watersup- ply/water_rights/pecos_coalition_factsheet.pdf

Miyamoto S., F. Yuan, S. Anand. 2006. *Influences of Tributaries on Salinity of Amistad International Reservoir. Texas Water resources Institute.* TR- 292.

Picture of Independence Creek, https://rebeccastuch.com/2014/03/12/independence-creek-preserve-texas/comment-page-1/

https://www.tceq.texas.gov/permitting/compacts/pecos.html

Picture of Devils River, http://kut.org/post/devils-river-land-deal-tpwd-table-now

Picture of Kayakers, Devils River, TPWD. https://tpwd.texas.gov/state-parks/devils-river

Picture of Devils River. http://marfapublicradio.org/blog/nature-notes/texas-most-pristine-river-unlocking-the-mysteries-of-the-devils-river/

Picture of Red Bluff Dam, courtesy of the National Weather Service. https://www.weather.gov/lub/events-2014-20140921-rain

Picture of red Bluff Reservoir, courtesy of Sandra Mireles, https://hubpages.com/travel/West-Texas-Lakes

Picture of Pecos River, Wikipedia. https://wikivisually.com/wiki/Category:Rivers_of_New_Mexico

USIBWC GIS Department, maps for the Upper, Middle, Lower, and Pecos sub-basin. USIBWC GIS Department, maps for the Upper, Middle, Lower, and Pecos sub-basin.

http://twri.tamu.edu/docs/education/2008/em102.pdf

https://en.wikipedia.org/wiki/Pecos_River

https://www.tceq.texas.gov/permitting/compacts/pecos.html

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The preparation of this report was financed through grants from and in cooperation with the Texas Commission on Environmental Quality

Appendix A
Statistical Analysis

(*) indicates samples size <10
(**) indicates trend was influenced by resolution changes in analysis (lowering LOQs)
(***) indicates trend not reported due to data not collected through 2016

Upper Rio Grande Sub-Basin Stations

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13272						
pH (S.U.)	153	8.0	6.6 - 9	-1.550	0.123	none
Dissolved Oxygen (mg/L)	134	9.2	4.7 - 18.5	0.538	0.592	none
Specific Conductivity (S/cm)	150	2722	707 - 9650	**4.198**	**0**	**+**
Ammonia (mg/L)	137	0.50	0.02 - 5.05	**4.502**	**0**	**+**
Chlorophyll-a (ug/L)	133	17.16	2 - 66	1.311	0.192	none
Total Phosphorus (mg/L)	141	0.65	0.02 - 8.6	**3.902**	**0**	**+**
E.Coli (#/100ml)	130	339	1 - 8200	**2.225**	**0.028**	**+**
Sulfates (mg/L)	141	475.91	10 - 1670	**4.453**	**0**	**+**
Chloride (mg/L)	141	368.04	17.8 - 1420	**5.001**	**0**	**+**
Nitrate + Nitrite (mg/L)	130	1.07	0 - 13.1	1.445	0.151	none
TDS (mg/L)	117	1544.58	11 - 4570	**4.041**	**0**	**+**

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13274						
pH (S.U.)	7	8.4	8 - 8.6	*	*	*
Dissolved Oxygen (mg/L)	10	8.5	6.6 - 11.4	**-2.457**	**0.036**	**-**
Specific Conductivity (S/cm)	10	871	359 - 1390	-1.753	0.118	none
Ammonia (mg/L)	7	0.17	0.1 - 0.56	*	*	*
Chlorophyll-a (ug/L)	7	14.71	3 - 35	*	*	*
Total Phosphorus (mg/L)	7	0.31	0.06 - 0.54	*	*	*
E.Coli (#/100ml)	5	444	62 - 6900	*	*	*
Sulfates (mg/L)	7	156.71	113 - 264	*	*	*
Chloride (mg/L)	7	108.83	62 - 161	*	*	*
Nitrate + Nitrite (mg/L)	8	2.15	0.25 - 14.2	*	*	*
TDS (mg/L)	7	616.29	508 - 836	*	*	*

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13275						
pH (S.U.)	11	8.4	8.2 - 8.6	-0.151	0.883	none
Dissolved Oxygen (mg/L)	17	8.0	6.6 - 9.8	-1.348	0.196	none
Specific Conductivity (S/cm)	18	828	321 - 1530	-0.747	0.466	none
Ammonia (mg/L)	15	0.37	0.1 - 2.24	-1.462	0.166	none
Chlorophyll-a (ug/L)	14	15.71	3 - 48	**2.061**	**0.060**	**+**
Total Phosphorus (mg/L)	15	0.24	0.05 - 0.42	1.724	0.107	none
E.Coli (#/100ml)	15	90	26 - 890	-0.153	0.881	none
Sulfates (mg/L)	16	138.82	52 - 308	-0.777	0.449	none
Chloride (mg/L)	16	103.72	18.3 - 250	-0.948	0.358	none
Nitrate + Nitrite (mg/L)	15	2.16	0.12 - 21.5	-0.700	0.495	none
TDS (mg/L)	16	556.31	174 - 1110	-0.531	0.603	none

Upper Rio Grande Sub-Basin Stations

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13276						
pH (S.U.)	42	8.3	7.6 - 8.8	0.658	0.514	none
Dissolved Oxygen (mg/L)	43	8.0	4.6 - 13.8	-1.338	0.188	none
Specific Conductivity (S/cm)	48	1087	296 - 6770	-1.614	0.113	none
Ammonia (mg/L)	39	0.24	0.02 - 2.56	-0.540	0.592	none
Chlorophyll-a (ug/L)	39	19.23	2.8 - 68.3	-1.842	0.073	none
Total Phosphorus (mg/L)	41	0.28	0.06 - 0.86	**2.064**	**0.046**	**+**
E.Coli (#/100ml)	41	74	20 - 460	0.671	0.506	none
Sulfates (mg/L)	41	164.45	84 - 355	**-2.410**	**0.021**	**-**
Chloride (mg/L)	42	100.19	41 - 241	-1.250	0.218	none
Nitrate + Nitrite (mg/L)	41	1.37	0.0957 - 22.8	-0.433	0.667	none
TDS (mg/L)	30	599.37	377 - 1140	-1.262	0.217	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
15089						
pH (S.U.)	22	8.0	6.6 - 8.7	0.341	0.736	none
Dissolved Oxygen (mg/L)	26	9.0	5.2 - 13.5	-1.808	0.083	none
Specific Conductivity (S/cm)	29	2264	925 - 3450	0.435	0.667	none
Ammonia (mg/L)	14	0.49	0.1 - 2.2	-0.694	0.500	none
Chlorophyll-a (ug/L)	15	14.67	3 - 40	**2.626**	**0.020**	**+**
Total Phosphorus (mg/L)	14	0.77	0.162 - 2.79	0.373	0.715	none
E.Coli (#/100ml)	23	414	31 - 25000	0.865	0.400	none
Sulfates (mg/L)	15	360.53	132 - 847	0.143	0.888	none
Chloride (mg/L)	15	324.49	80.3 - 703	-0.294	0.773	none
Nitrate + Nitrite (mg/L)	14	9.95	0.49 - 30.6	**-3.895**	**0.002**	**-**
TDS (mg/L)	15	1222.87	280 - 2066	-1.311	0.211	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
17040						
pH (S.U.)	52	8.1	6.7 - 9.2	-1.352	0.182	none
Dissolved Oxygen (mg/L)	58	8.4	2.4 - 16.3	-0.971	0.336	none
Specific Conductivity (S/cm)	59	1330	361 - 5400	**2.305**	**0.025**	**+**
Ammonia (mg/L)	26	2.71	0.05 - 24.9	1.213	0.236	none
Chlorophyll-a (ug/L)	26	17.50	3 - 68	1.507	0.144	none
Total Phosphorus (mg/L)	26	1.07	0.0508 - 6.56	-0.616	0.543	none
E.Coli (#/100ml)	34	290	28 - 24000	1.716	0.096	none
Sulfates (mg/L)	27	210.67	102 - 382	0.256	0.800	none
Chloride (mg/L)	27	191	62.5 - 390	0.128	0.899	none
Nitrate + Nitrite (mg/L)	26	4.78	0.09 - 22.8	-0.924	0.365	none
TDS (mg/L)	25	819.68	460 - 1400	0.051	0.960	none

Upper Rio Grande Sub-Basin Stations

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
14465						
pH (S.U.)	31	8.2	7.3 - 9	-1.056	0.300	none
Dissolved Oxygen (mg/L)	29	9.5	2.5 - 13.7	1.263	0.217	none
Specific Conductivity (S/cm)	28	2062	778 - 4780	1.174	0.251	none
Ammonia (mg/L)	20	0.73	0.02 - 5.6	1.681	0.109	none
Chlorophyll-a (ug/L)	20	13.50	4 - 46	-0.241	0.812	none
Total Phosphorus (mg/L)	21	229.22	0.2 - 4780	0.329	0.746	none
E.Coli (#/100ml)	22	82	1 - 2420	-0.830	0.416	none
Sulfates (mg/L)	20	308.30	118 - 484	1.147	0.266	none
Chloride (mg/L)	20	267.91	56.6 - 413	**2.508**	**0.021**	**+**
Nitrate + Nitrite (mg/L)	19	5.37	0.42 - 15	**3.239**	**0.005**	**+**
TDS (mg/L)	21	1156.93	7.5 - 2840	1.637	0.117	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
15528						
pH (S.U.)	18	8.4	7.8 - 9.5	-1.595	0.129	none
Dissolved Oxygen (mg/L)	15	8.7	5.1 - 13.7	-1.125	0.279	none
Specific Conductivity (S/cm)	16	1641	357 - 3730	1.038	0.317	none
Ammonia (mg/L)	15	0.57	0.02 - 2.4	1.725	0.106	none
Chlorophyll-a (ug/L)	16	32.06	2 - 180	**2.491**	**0.025**	**+**
Total Phosphorus (mg/L)	16	0.50	0.2 - 1.4	**2.126**	**0.050**	**+**
E.Coli (#/100ml)	16	1230	16 - 2420	0.377	0.712	none
Sulfates (mg/L)	15	289.99	37.4 - 670	1.276	0.223	none
Chloride (mg/L)	16	225.41	24.4 - 525	1.310	0.210	none
Nitrate + Nitrite (mg/L)	16	2.10	0.1 - 11.13	**2.621**	**0.019**	**+**
TDS (mg/L)	16	1026.75	252 - 2080	1.227	0.239	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
15529						
pH (S.U.)	14	8.4	7.8 - 9.4	0.168	0.869	none
Dissolved Oxygen (mg/L)	12	8.9	5.6 - 14.2	-0.459	0.655	none
Specific Conductivity (S/cm)	13	1539	421 - 3777	0.549	0.594	none
Ammonia (mg/L)	12	0.52	0.02 - 1.7	1.097	0.296	none
Chlorophyll-a (ug/L)	12	27.67	2 - 160	1.513	0.158	none
Total Phosphorus (mg/L)	12	0.46	0.2 - 1.4	**2.397**	**0.035**	**+**
E.Coli (#/100ml)	12	1439	280 - 2420	-0.862	0.409	none
Sulfates (mg/L)	12	285.52	76.2 - 616	0.581	0.573	none
Chloride (mg/L)	12	211.23	35.9 - 503	0.775	0.455	none
Nitrate + Nitrite (mg/L)	11	2.49	0.05 - 12	**3.092**	**0.011**	**+**
TDS (mg/L)	12	971.33	246 - 1990	0.703	0.497	none

Upper Rio Grande Sub-Basin Stations

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13230						
pH (S.U.)	112	8.1	6.9 - 10.2	1.417	0.159	none
Dissolved Oxygen (mg/L)	107	8.2	4.7 - 13.8	-0.371	0.711	none
Specific Conductivity (S/cm)	108	2727	900 - 5410	**-3.104**	**0.002**	**-**
Ammonia (mg/L)	104	0.18	0.02 - 3.36	-0.519	0.605	none
Chlorophyll-a (ug/L)	100	46.47	1.88 - 260	**-2.686**	**0.008**	**-**
Total Phosphorus (mg/L)	104	0.40	0.02 - 6.95	-1.544	0.126	none
E.Coli (#/100ml)	97	93	7.3 - 5400	**2.031**	**0.045**	**+**
Sulfates (mg/L)	109	599.67	6 - 1620	-0.726	0.469	none
Chloride (mg/L)	107	451.47	5 - 1200	**-5.279**	**0**	**-**
Nitrate + Nitrite (mg/L)	104	1.01	0.04 - 35.6	**-2.190**	**0.031**	**-**
TDS (mg/L)	83	1847.42	564 - 4010	**-3.621**	**0.001**	**-**

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13232						
pH (S.U.)	14	7.9	7.4 - 8.7	-1.734	0.107	none
Dissolved Oxygen (mg/L)	12	8.8	5.4 - 13.9	**-2.281**	**0.043**	**-**
Specific Conductivity (S/cm)	14	3394	2270 - 5320	-0.211	0.836	none
Ammonia (mg/L)	14	2.54	0.05 - 11.8	-0.157	0.877	none
Chlorophyll-a (ug/L)	10	57.38	11.1 - 248	**-2.356**	**0.043**	**-**
Total Phosphorus (mg/L)	14	1.18	0.32 - 3.05	-0.625	0.542	none
E.Coli (#/100ml)	10	203	10 - 200000	0.884	0.403	none
Sulfates (mg/L)	15	561.93	74 - 1000	0.884	0.391	none
Chloride (mg/L)	15	660.40	112 - 1230	0.641	0.532	none
Nitrate + Nitrite (mg/L)	15	1.58	0.05 - 4.76	1.223	0.241	none
TDS (mg/L)	16	5353.13	1450 - 50300	-1.568	0.138	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
15704						
pH (S.U.)	43	8.1	6.5 - 10	**-3.601**	**0.001**	**-**
Dissolved Oxygen (mg/L)	40	8.8	3.8 - 13.6	**-2.196**	**0.034**	**-**
Specific Conductivity (S/cm)	43	1612	20 - 2450	0.779	0.441	none
Ammonia (mg/L)	43	0.74	0.05 - 4.6	1.946	0.058	none
Chlorophyll-a (ug/L)	39	22.93	3 - 93	-1.825	0.076	none
Total Phosphorus (mg/L)	41	1.01	0.06 - 5.15	**2.002**	**0.052**	**+**
E.Coli (#/100ml)	31	366	10 - 2400	1.299	0.204	none
Sulfates (mg/L)	45	289.49	114 - 540	0.528	0.600	none
Chloride (mg/L)	45	259.97	61 - 481	1.646	0.107	none
Nitrate + Nitrite (mg/L)	40	3.46	0.04 - 23.6	0.610	0.545	none
TDS (mg/L)	35	1063.49	560 - 1480	0.537	0.595	none

Upper Rio Grande Sub-Basin Stations

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
15795						
pH (S.U.)	39	8.1	6.9 - 9.1	**-2.305**	**0**	**-**
Dissolved Oxygen (mg/L)	37	9.2	2.4 - 13.6	-1.435	0.160	none
Specific Conductivity (S/cm)	42	2016	664 - 3970	-1.081	0.286	none
Ammonia (mg/L)	28	1.96	0.04 - 25.90	0.566	0.576	none
Chlorophyll-a (ug/L)	28	36.52	3 - 178	0.725	0.475	none
Total Phosphorus (mg/L)	34	1.02	0.24 - 4.70	1.235	0.226	none
E.Coli (#/100ml)	24	720	26 - 240000	-0.004	0.997	none
Sulfates (mg/L)	34	365.64	64.80 - 741	-1.434	0.161	none
Chloride (mg/L)	35	325.20	10 - 832	0.038	0.970	none
Nitrate + Nitrite (mg/L)	29	1.54	0.04 - 7.48	0.153	0.879	none
TDS (mg/L)	27	1428.48	472 - 2822	-0.229	0.821	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
16272						
pH (S.U.)	39	8.0	6.6 - 9	**-3.195**	**0**	**-**
Dissolved Oxygen (mg/L)	33	7.7	1.6 - 11.8	-1.422	0.165	none
Specific Conductivity (S/cm)	39	1624	699 - 2760	**2.406**	**0.021**	**+**
Ammonia (mg/L)	42	0.88	0.05 - 12.9	1.857	0.071	none
Chlorophyll-a (ug/L)	38	18.04	3 - 133	0.314	0.755	none
Total Phosphorus (mg/L)	37	1.13	0.33 - 4.19	1.177	0.247	none
E.Coli (#/100ml)	31	203	10 - 3100	**2.486**	**0.019**	**+**
Sulfates (mg/L)	43	274.67	120 - 495	1.064	0.294	none
Chloride (mg/L)	43	255.22	58.5 - 433	**2.145**	**0.038**	**+**
Nitrate + Nitrite (mg/L)	42	2.91	0.04 - 17.5	**3.809**	**0**	**+**
TDS (mg/L)	31	995.45	534 - 1350	-1.048	0.303	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
17407						
pH (S.U.)	4	7.8	7.6 - 8	*	*	*
Dissolved Oxygen (mg/L)	4	6.1	3.2 - 9.9	*	*	*
Specific Conductivity (S/cm)	3	3239	798 - 4580	*	*	*
Ammonia (mg/L)	4	4.92	0.1 - 17.9	*	*	*
Chlorophyll-a (ug/L)	1	24	.	*	*	*
Total Phosphorus (mg/L)	4	0.21	0.131 - 0.408	*	*	*
E.Coli (#/100ml)	1	180	.	*	*	*
Sulfates (mg/L)	4	480.25	232 - 822	*	*	*
Chloride (mg/L)	4	591.03	48.1 - 1150	*	*	*
Nitrate + Nitrite (mg/L)	4	1.46	0.05 - 3.94	*	*	*
TDS (mg/L)	3	1261.67	565 - 2480	*	*	*

Upper Rio Grande Sub-Basin Stations

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
20648						
pH (S.U.)	6	7.9	6 - 8.5	*	*	*
Dissolved Oxygen (mg/L)	5	10.7	7.4 - 13.5	*	*	*
Specific Conductivity (S/cm)	7	3804	2760 - 4750	*	*	*
Ammonia (mg/L)	8	0.80	0.1 - 2.49	*	*	*
Chlorophyll-a (ug/L)	2	37.50	28 - 47	*	*	*
Total Phosphorus (mg/L)	8	0.58	0.06 - 1.21	*	*	*
E.Coli (#/100ml)	4	8	1 - 90.9	*	*	*
Sulfates (mg/L)	8	539.75	78 - 865	*	*	*
Chloride (mg/L)	8	652.64	42.1 - 1020	*	*	*
Nitrate + Nitrite (mg/L)	8	1.30	0.05 - 4.5	*	*	*
TDS (mg/L)	8	2000.50	314 - 2750	*	*	*

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13223						
pH (S.U.)	18	8.1	7.7 - 8.3	0.090	0.930	none
Dissolved Oxygen (mg/L)	19	8.1	5.8 - 11.3	0.046	0.964	none
Specific Conductivity (S/cm)	21	1174	252 - 1800	-1.774	0.092	none
Ammonia (mg/L)	14	0.06	0.05 - 0.1	**-2.677**	**0.019**	**-**
Chlorophyll-a (ug/L)	13	11.64	1.85 - 39.5	-0.211	0.837	none
Total Phosphorus (mg/L)	16	2.31	0.02 - 10.9	-0.170	0.867	none
E.Coli (#/100ml)	15	56	4.1 - 1300	0.615	0.549	none
Sulfates (mg/L)	15	291.60	119 - 489	-0.833	0.392	none
Chloride (mg/L)	15	83.11	11 - 199	-0.059	0.954	none
Nitrate + Nitrite (mg/L)	15	0.90	0.52 - 1.66	0.536	0.601	none
TDS (mg/L)	6	782.50	9 - 1180	-1.583	0.174	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13225						
pH (S.U.)	31	8.1	7.3 - 9.4	0.995	0.327	none
Dissolved Oxygen (mg/L)	29	8.0	2.3 - 12.4	0.919	0.366	none
Specific Conductivity (S/cm)	31	1527	39 - 3260	-1.773	0.087	none
Ammonia (mg/L)	26	0.05	0.02 - 0.06	-1.292	0.208	none
Chlorophyll-a (ug/L)	22	9.61	1.19 - 26	-0.366	0.718	none
Total Phosphorus (mg/L)	27	0.80	0.02 - 9.23	-0.789	0.437	none
E.Coli (#/100ml)	18	35	2 - 2400	-0.533	0.601	none
Sulfates (mg/L)	26	432.23	134 - 744	-1.208	0.238	none
Chloride (mg/L)	25	136.90	15 - 379	**-2.326**	**0.029**	**-**
Nitrate + Nitrite (mg/L)	29	0.35	0.01 - 1.23	-0.045	0.964	none
TDS (mg/L)	8	1248	464 - 1560	1.077	0.317	none

Upper Rio Grande Sub-Basin Stations

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13228						
pH (S.U.)	89	8.0	6.2 - 9.6	0.849	0.398	none
Dissolved Oxygen (mg/L)	86	9.2	4.2 - 17.2	-1.112	0.269	none
Specific Conductivity (S/cm)	90	2365	615 - 5580	**-3.072**	**0.003**	-
Ammonia (mg/L)	91	0.22	0.01 - 2.52	-0.415	0.679	none
Chlorophyll-a (ug/L)	83	25.41	1.06 - 255	**-2.920**	**0.005**	-
Total Phosphorus (mg/L)	92	0.36	0.02 - 5	0.371	0.712	none
E.Coli (#/100ml)	62	29	1 - 2400	-0.718	0.476	none
Sulfates (mg/L)	94	698.43	196 - 1300	-1.260	0.211	none
Chloride (mg/L)	94	314.87	25 - 715	**-4.389**	**0**	-
Nitrate + Nitrite (mg/L)	90	0.65	0.04 - 25.3	0.180	0.858	none
TDS (mg/L)	71	1700	809 - 2460	**-2.770**	**0.007**	-

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13229						
pH (S.U.)	113	8.0	7.3 - 8.8	0.231	0.818	none
Dissolved Oxygen (mg/L)	108	8.8	5.2 - 14.5	1.206	0.230	none
Specific Conductivity (S/cm)	108	2533	357 - 5830	-1.515	0.133	none
Ammonia (mg/L)	107	0.18	0.02 - 2.8	-0.651	0.516	none
Chlorophyll-a (ug/L)	101	42.43	1.25 - 205	-1.730	0.087	none
Total Phosphorus (mg/L)	107	0.31	0.02 - 6.84	-0.351	0.726	none
E.Coli (#/100ml)	94	65	2 - 2400	-1.303	0.196	none
Sulfates (mg/L)	110	719.44	73.8 - 2443	-0.268	0.789	none
Chloride (mg/L)	109	313.63	15.9 - 829	**-4.480**	**0**	-
Nitrate + Nitrite (mg/L)	105	0.57	0.04 - 3.34	**-2.693**	**0.008**	-
TDS (mg/L)	85	1772.14	298 - 2800	**-2.162**	**0.033**	-

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
16730						
pH (S.U.)	54	7.8	6.9 - 8.6	-0.003	0.998	none
Dissolved Oxygen (mg/L)	55	8.0	5.1 - 13.3	-0.135	0.893	none
Specific Conductivity (S/cm)	60	1981	475 - 3920	**-2.929**	**0.005**	-
Ammonia (mg/L)	59	0.28	0.02 - 4.76	-0.071	0.944	none
Chlorophyll-a (ug/L)	52	19.38	2 - 225	-1.597	0.116	none
Total Phosphorus (mg/L)	58	0.38	0.05 - 6.15	-0.350	0.727	none
E.Coli (#/100ml)	41	21	1 - 2910	-0.017	0.986	none
Sulfates (mg/L)	59	548.91	39.8 - 896	**-2.064**	**0.043**	-
Chloride (mg/L)	59	235.63	12.2 - 505	**-3.336**	**0.001**	-
Nitrate + Nitrite (mg/L)	57	0.97	0.04 - 24.3	0.651	0.518	none
TDS (mg/L)	57	1344.46	120 - 2300	**-2.182**	**0.033**	-

Upper Rio Grande Sub-Basin Stations

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
16862						
pH (S.U.)	15	8.1	7.3 - 8.5	0.823	0.424	none
Dissolved Oxygen (mg/L)	14	7.8	6.3 - 11.7	-0.238	0.816	none
Specific Conductivity (S/cm)	16	2691	1390 - 5540	-0.161	0.784	none
Ammonia (mg/L)	14	0.27	0.1 - 2.24	-0.844	0.414	none
Chlorophyll-a (ug/L)	13	36.15	3 - 217	0.430	0.675	none
Total Phosphorus (mg/L)	14	0.14	0.05 - 0.403	**-2.590**	**0.022**	**-**
E.Coli (#/100ml)	13	9	1 - 180	-1.564	0.146	none
Sulfates (mg/L)	14	771.51	38.2 - 1391	**2.132**	**0.053**	**+**
Chloride (mg/L)	14	348.16	67.2 - 800	-0.505	0.622	none
Nitrate + Nitrite (mg/L)	14	0.65	0.04 - 3.45	-1.137	0.276	none
TDS (mg/L)	14	1761.50	791 - 2354	1.277	0.224	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
17000						
pH (S.U.)	77	7.9	7 - 8.5	-0.434	0.666	none
Dissolved Oxygen (mg/L)	75	8.2	5.9 - 13.2	-0.109	0.913	none
Specific Conductivity (S/cm)	76	2602	477 - 4100	-1.558	0.123	none
E.Coli (#/100ml)	68	112	5 - 2419.2	-0.860	0.393	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
17001						
pH (S.U.)	76	7.9	7.2 - 8.5	-0.782	0.437	none
Dissolved Oxygen (mg/L)	75	8.0	5.6 - 13.6	-0.557	0.579	none
Specific Conductivity (S/cm)	76	2592	513 - 4060	-1.298	0.198	none
E.Coli (#/100ml)	66	97	1 - 2400	2.335	0.023	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
18441						
pH (S.U.)	15	8.2	7.4 - 8.9	1.297	0.216	none
Dissolved Oxygen (mg/L)	14	8.1	5.3 - 12.9	0.042	0.967	none
Specific Conductivity (S/cm)	19	2633	1130 - 6220	-0.223	0.827	none
Ammonia (mg/L)	14	0.21	0.1 - 1.4	-0.927	0.371	none
Chlorophyll-a (ug/L)	13	36.92	3 - 188	-0.127	0.901	none
Total Phosphorus (mg/L)	14	0.14	0.05 - 0.458	**-2.108**	**0.055**	**-**
E.Coli (#/100ml)	12	14	1 - 488	0.298	0.772	none
Sulfates (mg/L)	14	734.57	161 - 1423	0.854	0.409	none
Chloride (mg/L)	14	324.15	53.3 - 700	-0.955	0.357	none
Nitrate + Nitrite (mg/L)	14	0.61	0.04 - 2.96	-0.842	0.415	none
TDS (mg/L)	14	1622.36	408 - 2346	0.204	0.841	none

Upper Rio Grande Sub-Basin Stations

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
20623						
pH (S.U.)	3	8.0	7.8 - 8.1	*	*	*
Dissolved Oxygen (mg/L)	3	7.9	6.1 - 9	*	*	*
Specific Conductivity (S/cm)	3	1883	1220 - 2600	*	*	*

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
20625						
pH (S.U.)	5	8.0	7.5 - 8.3	*	*	*
Dissolved Oxygen (mg/L)	5	7.7	6 - 9.3	*	*	*
Specific Conductivity (S/cm)	5	1510	902 - 2440	*	*	*

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
20631						
pH (S.U.)	3	8.2	8 - 8.3	*	*	*
Dissolved Oxygen (mg/L)	3	8.4	7.4 - 9.5	*	*	*
Specific Conductivity (S/cm)	3	1150	991 - 1320	*	*	*

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13108						
pH (S.U.)	7	8.0	7.3 - 8.5	*	*	*
Dissolved Oxygen (mg/L)	6	8.1	5.6 - 11.9	*	*	*
Specific Conductivity (S/cm)	7	2234	1340 - 3960	*	*	*
Total Phosphorus (mg/L)	7	0.46	0.12 - 0.85	*	*	*
Sulfates (mg/L)	7	587.43	365 - 1030	*	*	*
Chloride (mg/L)	7	271.67	92.9 - 588	*	*	*
TDS (mg/L)	7	1571.14	919 - 2850	*	*	*

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13240						
pH (S.U.)	8	8.1	7.5 - 8.6	*	*	*
Dissolved Oxygen (mg/L)	8	9.0	7.3 - 11.5	*	*	*
Specific Conductivity (S/cm)	8	3114	1900 - 4420	*	*	*
Ammonia (mg/L)	1	0.05	.	*	*	*
Chlorophyll-a (ug/L)	1	3.00	.	*	*	*
Total Phosphorus (mg/L)	8	0.01	0.004 - 0.06	*	*	*
E.Coli (#/100ml)	1	5	.	*	*	*
Sulfates (mg/L)	8	418.63	234 - 621	*	*	*
Chloride (mg/L)	8	746.88	368 - 1240	*	*	*
Nitrate + Nitrite (mg/L)	1	0.92	.	*	*	*
TDS (mg/L)	8	1993.75	1200 - 2780	*	*	*

Upper Rio Grande Sub-Basin Stations

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13835						
pH (S.U.)	34	8.2	7.1 - 8.5	**3.101**	**0.004**	**+**
Dissolved Oxygen (mg/L)	32	8.3	4.9 - 10.7	1.941	0.061	none
Specific Conductivity (S/cm)	37	1001	519 - 1300	**2.600**	**0.014**	**+**
Ammonia (mg/L)	30	0.05	0.02 - 0.05	**	**	**
Chlorophyll-a (ug/L)	34	2.54	0.61 - 4.44	**	**	**
Total Phosphorus (mg/L)	34	0.03	0.02 - 0.06	**	**	**
E.Coli (#/100ml)	31	2	1 - 10	-1.796	0.083	none
Sulfates (mg/L)	34	211	160 - 375	**4.067**	**0**	**+**
Chloride (mg/L)	34	117.44	71 - 227	1.807	0.080	none
Nitrate + Nitrite (mg/L)	37	0.25	0.04 - 0.87	0.563	0.577	none
TDS (mg/L)	11	588.64	523 - 652	-0.318	0.757	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
15892						
pH (S.U.)	31	8.2	7.5 - 8.5	**3.496**	**0.001**	**+**
Dissolved Oxygen (mg/L)	30	7.9	2.3 - 10.9	**2.088**	**0.046**	**+**
Specific Conductivity (S/cm)	32	1095	609 - 1700	**3.487**	**0.002**	**+**
Ammonia (mg/L)	30	0.05	0.02 - 0.19	-0.077	0.939	none
Chlorophyll-a (ug/L)	30	4.01	1.12 - 15.3	-1.251	0.221	none
Total Phosphorus (mg/L)	32	0.04	0.02 - 0.06	**	**	**
E.Coli (#/100ml)	29	2	1 - 16	-0.723	0.476	none
Sulfates (mg/L)	32	230.56	106 - 340	**5.048**	**0**	**+**
Chloride (mg/L)	32	127.69	31 - 276	**2.044**	**0.050**	**+**
Nitrate + Nitrite (mg/L)	32	0.39	0.04 - 1.56	1.245	0.222	none
TDS (mg/L)	13	618.46	406 - 740	-0.701	0.497	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
15893						
pH (S.U.)	38	8.2	7.7 - 8.5	1.254	0.218	none
Dissolved Oxygen (mg/L)	36	8.6	4.8 - 12.2	0.750	0.458	none
Specific Conductivity (S/cm)	37	745	461 - 1089	**3.125**	**0.004**	**+**
Ammonia (mg/L)	36	0.05	0.02 - 0.11	-1.421	0.165	none
Chlorophyll-a (ug/L)	35	5.25	1.03 - 18.3	1.300	0.203	none
Total Phosphorus (mg/L)	37	0.05	0.02 - 0.71	0.667	0.509	none
E.Coli (#/100ml)	32	2	1 - 64	-1.624	0.115	none
Sulfates (mg/L)	37	120.70	46 - 206	**3.983**	**0**	**+**
Chloride (mg/L)	36	69.98	36 - 126	**2.677**	**0.011**	**+**
Nitrate + Nitrite (mg/L)	38	0.44	0.09 - 1.05	-1.438	0.159	none
TDS (mg/L)	22	469	280 - 612	**3.595**	**0.002**	**+**

Upper Rio Grande Sub-Basin Stations

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
16379						
pH (S.U.)	20	8.2	7.8 - 8.5	1.112	0.280	none
Dissolved Oxygen (mg/L)	21	8.6	4.6 - 11	0.336	0.74	none
Specific Conductivity (S/cm)	20	2490	1620 - 5060	**2.446**	**0.025**	**+**
Ammonia (mg/L)	20	0.07	0.02 - 0.19	0.459	0.652	none
Chlorophyll-a (ug/L)	21	11.40	3 - 38.1	1.424	0.170	none
Total Phosphorus (mg/L)	18	0.06	0.02 - 0.24	0.425	0.676	none
E.Coli (#/100ml)	21	5	1 - 920	0.633	0.534	none
Sulfates (mg/L)	20	340.45	227 - 802	1.222	0.237	none
Chloride (mg/L)	20	465.45	140 - 1330	**2.387**	**0.028**	**+**
Nitrate + Nitrite (mg/L)	21	0.51	0.031 - 1.99	-1.216	0.238	none
TDS (mg/L)	10	1198.40	764 - 1580	-1.669	0.129	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13237						
pH (S.U.)	40	8.2	7.5 - 8.5	1.578	0.123	none
Dissolved Oxygen (mg/L)	39	9.4	7.1 - 11.7	-0.136	0.983	none
Specific Conductivity (S/cm)	39	393	201 - 512	-1.307	0.199	none
Ammonia (mg/L)	37	0.05	0.02 - 0.06	**	**	**
Chlorophyll-a (ug/L)	35	1.79	0.2 - 3	**	**	**
Total Phosphorus (mg/L)	40	0.04	0.02 - 0.06	**	**	**
E.Coli (#/100ml)	33	5	1 - 187	-1.984	0.056	none
Sulfates (mg/L)	40	8.46	7 - 12	-1.767	0.085	none
Chloride (mg/L)	40	14.42	10 - 17	0.991	0.328	none
Nitrate + Nitrite (mg/L)	37	1.01	0.59 - 1.52	**-2.983**	**0.006**	**-**
TDS (mg/L)	34	235.18	186 - 292	**-2.264**	**0.030**	**-**

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13239						
pH (S.U.)	36	7.8	7.2 - 8.1	0.141	0.889	none
Dissolved Oxygen (mg/L)	35	8.8	6.8 - 11.8	-1.852	0.073	none
Specific Conductivity (S/cm)	37	447	385 - 486	1.270	0.212	none
Ammonia (mg/L)	36	0.05	0.02 - 0.06	**	**	**
Chlorophyll-a (ug/L)	31	2.06	0.39 - 8.36	**	**	**
Total Phosphorus (mg/L)	35	0.04	0.02 - 0.0619	**	**	**
E.Coli (#/100ml)	31	15	1 - 104	-0.723	0.475	none
Sulfates (mg/L)	37	9.14	7 - 13	-1.322	0.195	none
Chloride (mg/L)	36	15.43	9 - 17	1.069	0.293	none
Nitrate + Nitrite (mg/L)	36	1.22	0.2 - 1.71	0.516	0.609	none
TDS (mg/L)	32	263.50	229 - 300	0.028	0.978	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
14942						
pH (S.U.)	38	7.9	7.3 - 8.1	1.573	0.124	none
Dissolved Oxygen (mg/L)	37	8.3	6.5 - 10.7	**-3.149**	**0.003**	**-**
Specific Conductivity (S/cm)	37	472	396 - 501	**2.945**	**0.006**	**+**
Ammonia (mg/L)	37	0.05	0.02 - 0.05	**	**	**
Chlorophyll-a (ug/L)	33	2.16	0.33 - 18	-1.672	0.104	none
Total Phosphorus (mg/L)	36	0.04	0.02 - 0.0757	**	**	**
E.Coli (#/100ml)	36	19	1 - 142	-1.580	0.123	none
Sulfates (mg/L)	38	7.89	5 - 13	-0.526	0.602	none
Chloride (mg/L)	38	14.96	7 - 17	1.669	0.104	none
Nitrate + Nitrite (mg/L)	37	1.54	0.789 - 1.89	-1.271	0.212	none
TDS (mg/L)	31	276.55	224 - 310	1.882	0.070	none

Pecos River Sub-Basin Stations

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13109						
pH (S.U.)	143	8.1	7.9 - 8.4	3.526	0.001	+
Dissolved Oxygen (mg/L)	144	8.8	6.5 - 11.5	-1.009	0.315	none
Specific Conductivity (S/cm)	144	1000	688 - 1419	**4.281**	**0**	**+**
Ammonia (mg/L)	40	0.05	0.02 - 0.08	-1.485	0.146	
Chlorophyll-a (ug/L)	39	1.72	0.2 - 3.01	**	**	**
Total Phosphorus (mg/L)	40	0.04	0.02 - 0.06	**	**	**
E.Coli (#/100ml)	37	12	1 - 120	**-2.138**	**0.040**	**-**
Sulfates (mg/L)	40	149.21	34.5 - 180	0.001	0.999	none
Chloride (mg/L)	40	101.41	23.4 - 123	0.060	0.952	none
Nitrate + Nitrite (mg/L)	40	1.01	0.47 - 8.29	1.424	0.162	none
TDS (mg/L)	18	618.28	498 - 710	-0.301	0.767	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13246						
pH (S.U.)	7	8.0	7.9 - 8	*	*	*
Dissolved Oxygen (mg/L)	7	7.8	6.8 - 9.5	*	*	*
Specific Conductivity (S/cm)	7	5476	3300 - 6680	*	*	*
Ammonia (mg/L)	7	0.05	.	*	*	*
Chlorophyll-a (ug/L)	7	6.80	3 - 19.8	*	*	*
Total Phosphorus (mg/L)	7	0.06	0.04 - 0.06	*	*	*
E.Coli (#/100ml)	7	25	4 - 74	*	*	*
Sulfates (mg/L)	7	799.71	417 - 997	*	*	*
Chloride (mg/L)	7	1306	680 - 1690	*	*	*
Nitrate + Nitrite (mg/L)	7	0.67	0.38 - 1.02	*	*	*
TDS (mg/L)	7	3532.86	1930 - 4540	*	*	*

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13248						
pH (S.U.)	15	7.9	7.8 - 8.1	-0.244	0.811	none
Dissolved Oxygen (mg/L)	15	7.7	5.6 - 10.1	-0.605	0.555	none
Specific Conductivity (S/cm)	15	9259	5200 - 12900	**3.152**	**0.008**	**+**
Ammonia (mg/L)	8	0.10	.	*	*	*
Chlorophyll-a (ug/L)	8	17.13	4 - 40	*	*	*
Total Phosphorus (mg/L)	8	0.05	.	*	*	*
Sulfates (mg/L)	8	1324.75	704 - 1732	*	*	*
Chloride (mg/L)	7	2382.57	1621 - 3401	*	*	*
Nitrate + Nitrite (mg/L)	8	0.21	0.04 - 0.48	*	*	*
TDS (mg/L)	7	6157.71	3478 - 7680	*	*	*

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
14163						
pH (S.U.)	15	7.9	7.8 - 8.1	0.696	0.498	none
Dissolved Oxygen (mg/L)	15	7.9	6.7 - 10.2	-0.113	0.912	none
Specific Conductivity (S/cm)	15	7569	3190 - 10500	**2.397**	**0.032**	**+**
Ammonia (mg/L)	8	0.10	.	*	*	*
Chlorophyll-a (ug/L)	8	13.25	3 - 25	*	*	*
Total Phosphorus (mg/L)	8	0.05	.	*	*	*
E.Coli (#/100ml)	2	46	33 - 63	*	*	*
Sulfates (mg/L)	8	1055.38	425 - 1689	*	*	*
Chloride (mg/L)	7	1832.57	812 - 3022	*	*	*
Nitrate + Nitrite (mg/L)	8	0.36	0.17 - 0.51	*	*	*
TDS (mg/L)	8	7840.75	2404 - 28912	*	*	*

Pecos River Sub-Basin Stations

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
18801						
pH (S.U.)	36	8.0	7.8 - 8.2	0.622	0.538	none
Dissolved Oxygen (mg/L)	36	8.8	7.2 - 11.4	-0.259	0.797	none
Specific Conductivity (S/cm)	36	5369	2540 - 8990	0.910	0.369	none
Ammonia (mg/L)	33	0.05	0.02 - 0.171	-0.280	0.781	none
Chlorophyll-a (ug/L)	32	5.89	0.48 - 35.4	1.735	0.093	none
Total Phosphorus (mg/L)	29	0.04	0.02 - 0.0969	-0.765	0.451	none
E.Coli (#/100ml)	29	33	5 - 430	1.877	0.071	none
Sulfates (mg/L)	33	823.88	368 - 1720	1.128	0.268	none
Chloride (mg/L)	33	1293.24	539 - 2360	0.791	0.435	none
Nitrate + Nitrite (mg/L)	33	0.48	0.0498 - 1.07	**-3.681**	**0.001**	**-**
TDS (mg/L)	11	3689.09	2470 - 4720	-0.654	0.528	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13249						
pH (S.U.)	40	7.8	7.4 - 8.1	**-2.283**	**0.028**	**-**
Dissolved Oxygen (mg/L)	40	8.1	5.3 - 10.3	-0.876	0.386	none
Specific Conductivity (S/cm)	40	11581	4930 - 17400	-0.304	0.763	none
Ammonia (mg/L)	33	0.07	0.02 - 0.47	0.655	0.517	none
Chlorophyll-a (ug/L)	28	12.69	0.907 - 71.4	1.051	0.303	none
Total Phosphorus (mg/L)	30	0.04	0.02 - 0.08	**-2.241**	**0.033**	**-**
Sulfates (mg/L)	33	1915.85	683 - 3040	0.114	0.910	none
Chloride (mg/L)	33	3261.82	1210 - 5240	-0.437	0.665	none
Nitrate + Nitrite (mg/L)	32	0.39	0.02 - 0.88	**-2.003**	**0.054**	**-**
TDS (mg/L)	11	8828.18	6020 - 11900	1.103	0.296	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13257						
pH (S.U.)	59	8.0	7.3 - 8.8	-1.103	0.274	none
Dissolved Oxygen (mg/L)	59	7.6	1.5 - 11.7	-0.371	0.712	none
Specific Conductivity (S/cm)	58	20771	6980 - 39000	-0.338	0.736	none
Ammonia (mg/L)	56	0.10	0.02 - 1.21	1.124	0.266	none
Chlorophyll-a (ug/L)	35	14.04	1.47 - 89.4	-0.283	0.779	none
Total Phosphorus (mg/L)	56	0.04	0.02 - 0.09	**	**	**
Enterococci (#/100ml)	7	51	16 - 130	*	*	*
Sulfates (mg/L)	59	4093.56	1570 - 11700	1.772	0.082	none
Chloride (mg/L)	54	6390	2080 - 16500	1.402	0.167	none
Nitrate + Nitrite (mg/L)	53	0.06	0.02 - 0.51	1.903	0.063	none
TDS (mg/L)	35	12996.40	5940 - 20700	0.400	0.692	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13258						
Ammonia (mg/L)	26	0.09	0.036 - 0.52	1.493	0.148	none
Total Phosphorus (mg/L)	22	0.06	0.03 - 0.09	-0.586	0.564	none
Sulfates (mg/L)	27	2836.70	881 - 4700	-0.362	0.720	none
Chloride (mg/L)	25	4406.40	1180 - 6280	0.252	0.803	none
Nitrate + Nitrite (mg/L)	17	0.06	0.04 - 0.13	0.126	0.901	none
TDS (mg/L)	25	11070.40	3240 - 15700	0.667	0.511	none

Pecos River Sub-Basin Stations

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13259						
Ammonia (mg/L)	26	0.07	0.05 - 0.27	0.422	0.677	none
Total Phosphorus (mg/L)	23	0.06	0.03 - 0.08	**	**	**
Sulfates (mg/L)	26	2502.85	764 - 3050	-0.161	0.873	none
Chloride (mg/L)	23	3940	2000 - 4900	2.196	0.039	***
Nitrate + Nitrite (mg/L)	18	0.04	.	.	.	none
TDS (mg/L)	24	9650	2810 - 12700	0.341	0.736	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13260						
pH (S.U.)	65	7.7	6.8 - 8.3	-0.546	0.587	none
Dissolved Oxygen (mg/L)	65	8.4	1.9 - 13.1	-1.382	0.172	none
Specific Conductivity (S/cm)	65	18731	6450 - 36400	**2.694**	**0.009**	**+**
Ammonia (mg/L)	53	0.12	0.02 - 0.46	-0.432	0.667	none
Chlorophyll-a (ug/L)	35	12.55	1.31 - 42	0.774	0.444	none
Total Phosphorus (mg/L)	50	0.05	0.02 - 0.21	-0.373	0.710	none
Enterococci (#/100ml)	5	23	11 - 82	*	*	*
Sulfates (mg/L)	56	3065.71	1340 - 8450	**2.876**	**0.006**	**+**
Chloride (mg/L)	51	5006.67	1400 - 14200	**2.783**	**0.008**	**+**
Nitrate + Nitrite (mg/L)	50	0.07	0.02 - 1.11	1.631	0.109	none
TDS (mg/L)	30	9749.67	5800 - 12700	2.031	0.051	***

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13261						
Ammonia (mg/L)	26	0.06	0.05 - 0.21	0.733	0.470	none
Total Phosphorus (mg/L)	23	0.06	0.04 - 0.13	-0.648	0.524	none
Sulfates (mg/L)	26	2215.04	781 - 2660	-0.654	0.519	none
Chloride (mg/L)	24	2886.25	670 - 3780	0.656	0.518	none
Nitrate + Nitrite (mg/L)	19	0.04	.	.	.	none
TDS (mg/L)	25	7830.80	2710 - 9670	0.037	0.971	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13265						
pH (S.U.)	54	7.9	7 - 9.3	0.354	0.725	none
Dissolved Oxygen (mg/L)	55	8.3	2 - 12.7	-1.047	0.300	none
Specific Conductivity (S/cm)	55	11473	5770 - 22100	-1.282	0.206	none
Ammonia (mg/L)	36	0.14	0.05 - 0.53	-0.504	0.617	none
Chlorophyll-a (ug/L)	35	21.21	1.92 - 72.4	**-2.050**	**0.048**	**-**
Total Phosphorus (mg/L)	33	0.04	0.02 - 0.08	**	**	**
Enterococci (#/100ml)	6	27	4 - 260	*	*	*
Sulfates (mg/L)	35	2494.29	1350 - 8750	0.574	0.570	none
Chloride (mg/L)	36	3253.06	1260 - 11300	0.329	0.744	none
Nitrate + Nitrite (mg/L)	37	0.08	0.02 - 0.67	1.750	0.089	none
TDS (mg/L)	18	7447.78	6060 - 8500	-0.514	0.614	none

Pecos River Sub-Basin Stations

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
15114						
pH (S.U.)	34	7.9	7.6 - 8.2	1.592	0.121	none
Dissolved Oxygen (mg/L)	34	8.7	6.2 - 11.3	0.057	0.955	none
Specific Conductivity (S/cm)	34	13409	5380 - 26200	0.345	0.731	none
Ammonia (mg/L)	8	0.06	0.05 - 0.09	*	*	*
Chlorophyll-a (ug/L)	9	9.98	3 - 37.5	*	*	*
Total Phosphorus (mg/L)	9	0.05	0.02 - 0.07	*	*	*
Enterococci (#/100ml)	5	52	8 - 170	*	*	*
Sulfates (mg/L)	9	2304.44	1500 - 2950	*	*	*
Chloride (mg/L)	9	4168.89	3310 - 4950	*	*	*
Nitrate + Nitrite (mg/L)	9	0.27	0.04 - 0.42	*	*	*
TDS (mg/L)	9	9787.78	7170 - 11400	*	*	*

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
20399						
Ammonia (mg/L)	25	0.09	0.044 - 0.65	0.552	0.586	none
Total Phosphorus (mg/L)	21	0.06	0.02 - 0.14	-1.542	0.139	none
Sulfates (mg/L)	26	3115.77	1360 - 4960	-0.304	0.763	none
Chloride (mg/L)	23	4913.48	2060 - 7220	0.073	0.943	none
Nitrate + Nitrite (mg/L)	17	0.04	0.04 - 0.08	-0.996	0.334	none
TDS (mg/L)	24	12247.92	5390 - 17500	0.191	0.851	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
20558						
pH (S.U.)	13	7.0	6.3 - 7.9	-1.922	0.079	none
Dissolved Oxygen (mg/L)	12	5.8	1.6 - 12.4	-0.483	0.639	none
Specific Conductivity (S/cm)	12	722	651 - 809	-0.956	0.362	none
Ammonia (mg/L)	14	0.64	0.1 - 2.8	0.009	0.993	none
Chlorophyll-a (ug/L)	13	100.79	3 - 1120	0.022	0.982	none
Total Phosphorus (mg/L)	14	0.09	0.05 - 0.19	-0.706	0.493	none
E.Coli (#/100ml)	14	32	1 - 270	0.623	0.545	none
Sulfates (mg/L)	14	47.87	23.8 - 175	-0.400	0.695	none
Chloride (mg/L)	14	29.71	20.7 - 44	0.076	0.941	none
Nitrate + Nitrite (mg/L)	13	0.65	0.04 - 1.71	-2.251	0.044	***
TDS (mg/L)	13	449.54	410 - 550	-0.526	0.608	none

Pecos River Sub-Basin Stations

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13267						
pH (S.U.)	20	8.0	7.3 - 8.4	0.760	0.457	none
Dissolved Oxygen (mg/L)	20	7.5	4.3 - 9.7	-0.193	0.849	none
Specific Conductivity (S/cm)	25	11063	5310 - 18600	-1.286	0.211	none
Ammonia (mg/L)	18	0.06	0.02 - 0.18	-1.221	0.239	none
Chlorophyll-a (ug/L)	17	22.59	11.6 - 59.1	-1.487	0.156	none
Total Phosphorus (mg/L)	15	0.05	0.02 - 0.12	-1.056	0.309	none
Enterococci (#/100ml)	3	6	4 - 8	*	*	*
Sulfates (mg/L)	19	2277.89	1230 - 4880	-0.128	0.900	none
Chloride (mg/L)	19	2812.11	1090 - 5990	-0.458	0.652	none
Nitrate + Nitrite (mg/L)	18	0.04	0.02 - 0.04	-1.209	0.243	none
TDS (mg/L)	9	7378.89	6360 - 8410	*	*	*

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13269						
pH (S.U.)	19	8.1	7.8 - 8.5	0.842	0.411	none
Dissolved Oxygen (mg/L)	19	8.2	4.6 - 11.6	-0.048	0.962	none
Specific Conductivity (S/cm)	19	10326	4850 - 18800	-0.021	0.983	none
Ammonia (mg/L)	18	0.08	0.02 - 0.28	-0.111	0.913	none
Chlorophyll-a (ug/L)	17	31.06	9.56 - 50.5	-0.511	0.617	none
Total Phosphorus (mg/L)	17	0.06	0.02 - 0.12	-1.902	0.075	none
Enterococci (#/100ml)	3	29	9 - 57	*	*	*
Sulfates (mg/L)	19	1933.68	1100 - 3450	0.584	0.566	none
Chloride (mg/L)	19	2606.63	933 - 5690	-0.041	0.968	none
Nitrate + Nitrite (mg/L)	18	0.08	0.0269 - 0.49	**-2.356**	**0.031**	**-**
TDS (mg/L)	11	6256.36	3280 - 8160	0.979	0.351	none

Middle Rio Grande Sub-Basin Stations

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13116						
pH (S.U.)	35	7.9	7.4 - 8.5	**-2.448**	**0.020**	**-**
Dissolved Oxygen (mg/L)	37	6.6	3.8 - 11.3	**2.968**	**0.005**	**+**
Specific Conductivity (S/cm)	37	3153	433 - 8410	**-2.081**	**0.045**	**-**
Ammonia (mg/L)	34	0.54	0.037 - 8.4	-0.434	0.667	none
Chlorophyll-a (ug/L)	33	33.74	3 - 252	**-2.557**	**0.016**	**-**
Total Phosphorus (mg/L)	33	0.83	0.05 - 2.71	**2.751**	**0.010**	**+**
E.Coli (#/100ml)	28	141	10 - 3700	-0.621	0.540	none
Sulfates (mg/L)	33	1243.55	32 - 3860	**-4.572**	**0**	**-**
Chloride (mg/L)	33	484.73	197 - 1110	**-4.806**	**0**	**-**
Nitrate + Nitrite (mg/L)	28	6.95	0.04 - 23.8	**3.988**	**0**	**+**
TDS (mg/L)	32	2777.38	1260 - 7550	**-4.583**	**0**	**-**

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13196						
pH (S.U.)	7	8.1	7.8 - 8.2	*	*	*
Dissolved Oxygen (mg/L)	7	8.4	6.4 - 14	*	*	*
Specific Conductivity (S/cm)	22	974	777 - 1080	-2.000	0.060	***
Ammonia (mg/L)	7	0.22	0.01 - 0.72	*	*	*
Total Phosphorus (mg/L)	7	0.25	0.1 - 0.52	*	*	*
E.Coli (#/100ml)	37	1028	109 - 2419	2.513	0.017	***
Sulfates (mg/L)	7	187.71	162 - 218	*	*	*
Chloride (mg/L)	7	117.57	103 - 127	*	*	*
Nitrate + Nitrite (mg/L)	7	0.62	0.39 - 1.45	*	*	*
TDS (mg/L)	7	634.57	579 - 681	*	*	*

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13200						
Specific Conductivity (S/cm)	76	1004	554 - 1980	**2.795**	**0.007**	**+**
E.Coli (#/100ml)	83	2201	100 - 86000	**3.489**	**0.001**	**+**

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13202						
pH (S.U.)	40	8.1	7.6 - 8.7	0.323	0.748	none
Dissolved Oxygen (mg/L)	41	7.9	5.8 - 11	-2.994	0.005	none
Specific Conductivity (S/cm)	111	197	536 - 1340	**2.601**	**0.011**	**+**
Ammonia (mg/L)	36	0.21	0.025 - 1.4	0.122	0.904	none
Chlorophyll-a (ug/L)	37	6.39	1 - 20	**2.431**	**0.02**	**+**
Total Phosphorus (mg/L)	35	0.10	0.05 - 0.335	-1.232	0.226	none
E.Coli (#/100ml)	115	22	1 - 1900	-0.470	0.639	none
Sulfates (mg/L)	37	189.27	117 - 300	1.596	0.119	none
Chloride (mg/L)	37	115.16	56.2 - 218	1.760	0.087	none
Nitrate + Nitrite (mg/L)	34	1.33	0.04 - 18.4	-0.430	0.670	none
TDS (mg/L)	37	612.27	289 - 1000	1.545	0.131	none

Middle Rio Grande Sub-Basin Stations

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13208						
pH (S.U.)	56	8.1	7.5 - 9.7	0.785	0.436	none
Dissolved Oxygen (mg/L)	55	8.8	3.2 - 12.8	-0.069	0.945	none
Specific Conductivity (S/cm)	61	996	790 - 1280	**4.681**	**0**	**+**
Ammonia (mg/L)	52	0.14	0.02 - 2.8	-0.175	0.862	none
Chlorophyll-a (ug/L)	50	2.57	0.46 - 8	-1.464	0.150	none
Total Phosphorus (mg/L)	56	0.04	0.02 - 0.094	**	**	**
E.Coli (#/100ml)	49	46	2 - 2400	1.891	0.065	none
Sulfates (mg/L)	58	198.21	55 - 294	**4.149**	**0**	**+**
Chloride (mg/L)	57	114.08	72 - 207	**2.166**	**0.035**	**+**
Nitrate + Nitrite (mg/L)	53	0.53	0.05 - 9.75	-0.184	0.855	none
TDS (mg/L)	31	633.55	490 - 872	**3.236**	**0.003**	**+**

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
13560						
pH (S.U.)	93	8.1	6.9 - 9.9	1.018	0.311	none
Dissolved Oxygen (mg/L)	84	9.7	4.8 - 16.6	1.530	0.130	none
Specific Conductivity (S/cm)	89	951	751 - 1290	**5.443**	**0**	**+**
Ammonia (mg/L)	90	0.24	0.031 - 3.36	0.541	0.590	none
Chlorophyll-a (ug/L)	92	3.61	0.62 - 40	-1.268	0.208	none
Total Phosphorus (mg/L)	87	0.07	0.02 - 0.261	**-2.458**	**0.016**	**-**
E.Coli (#/100ml)	89	195	5 - 24000	0.702	0.485	none
Sulfates (mg/L)	92	181.58	17.3 - 272	**4.730**	**0**	**+**
Chloride (mg/L)	91	108.82	15 - 262	**2.547**	**0.586**	**+**
Nitrate + Nitrite (mg/L)	88	0.51	0.04 - 5.89	-0.835	0.406	none
TDS (mg/L)	68	587.74	459 - 826	**2.891**	**0.005**	**+**

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
15274						
pH (S.U.)	38	8.1	7.8 - 8.4	0.070	0.945	none
Dissolved Oxygen (mg/L)	37	8.1	5.5 - 10.8	-1.137	0.263	none
Specific Conductivity (S/cm)	38	916	665 - 1150	1.035	0.308	none
Ammonia (mg/L)	39	0.09	0.041 - 0.74	-0.775	0.443	none
Chlorophyll-a (ug/L)	38	4.41	0.78 - 21.7	1.800	0.08	none
Total Phosphorus (mg/L)	38	0.10	0.03 - 0.25	-0.089	0.930	none
E.Coli (#/100ml)	36	24	1 - 2400	1.854	0.072	none
Sulfates (mg/L)	38	170.16	102 - 240	1.669	0.104	none
Chloride (mg/L)	38	31.34	48 - 131	0.090	0.929	none
Nitrate + Nitrite (mg/L)	38	0.63	0.04 - 1.98	**2.082**	**0.044**	**+**
TDS (mg/L)	17	538.41	390 - 616	-1.498	0.154	none

Middle Rio Grande Sub-Basin Stations

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
15340						
pH (S.U.)	30	8.0	7.4 - 8.3	-0.919	0.366	none
Dissolved Oxygen (mg/L)	30	7.4	1.5 - 11.7	-0.708	0.485	none
Specific Conductivity (S/cm)	32	1036	847 - 1330	**3.041**	**0.005**	**+**
Ammonia (mg/L)	29	0.05	0.02 - 0.24	1.107	0.278	none
Chlorophyll-a (ug/L)	32	1.44	0.28 - 3	**	**	**
Total Phosphorus (mg/L)	32	0.03	0.02 - 0.06	**	**	**
E.Coli (#/100ml)	28	12	1 - 3400	-1.184	0.247	none
Sulfates (mg/L)	32	210.84	174 - 291	**4.393**	**0**	**+**
Chloride (mg/L)	31	118.35	74 - 186	1.544	0.133	none
Nitrate + Nitrite (mg/L)	32	0.30	0.04 - 0.76	0.613	0.545	none
TDS (mg/L)	9	608.67	508 - 700	*	*	*

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
15814						
pH (S.U.)	40	8.1	7.5 - 8.5	-0.213	0.832	none
Dissolved Oxygen (mg/L)	40	7.9	5.7 - 11	0.136	0.892	none
Specific Conductivity (S/cm)	114	911	103 - 1320	0.564	0.574	none
Ammonia (mg/L)	36	0.21	0.04 - 1.4	-0.253	0.801	none
Chlorophyll-a (ug/L)	36	6.18	2 - 18	-0.139	0.890	none
Total Phosphorus (mg/L)	35	0.11	0.05 - 0.3	-0.565	0.576	none
E.Coli (#/100ml)	119	3845	5 - 93000	0.796	0.427	none
Sulfates (mg/L)	37	184.03	114 - 294	-0.725	0.473	none
Chloride (mg/L)	37	113.65	57.4 - 219	0.377	0.709	none
Nitrate + Nitrite (mg/L)	35	1.28	0.04 - 18.4	-0.083	0.935	none
TDS (mg/L)	36	638.42	358 - 1500	-0.218	0.828	none

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
15815						
Specific Conductivity (S/cm)	73	918	533 - 1360	1.812	0.074	none
E.Coli (#/100ml)	81	2601	18 - 91000	**3.753**	**0**	**+**

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
15816						
pH (S.U.)	10	8.1	7.7 - 8.5	0.529	0.610	none
Dissolved Oxygen (mg/L)	10	6.8	4.2 - 10.9	0	1	none
Specific Conductivity (S/cm)	19	991	787 - 1370	1.523	0.146	none
Ammonia (mg/L)	9	0.53	0.1 - 1	*	*	*
Chlorophyll-a (ug/L)	9	10.67	3 - 32	*	*	*
Total Phosphorus (mg/L)	9	0.18	0.05 - 0.37	*	*	*
E.Coli (#/100ml)	27	954	50 - 20000	1.599	0.122	none
Sulfates (mg/L)	9	219.33	145 - 280	*	*	*
Chloride (mg/L)	8	136.80	89.4 - 188	*	*	*
Nitrate + Nitrite (mg/L)	9	1.00	0.46 - 1.66	*	*	*
TDS (mg/L)	9	697.33	554 - 1032	*	*	*

Middle Rio Grande Sub-Basin Stations

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
15817						
pH (S.U.)	113	8.1	7.2 - 9.1	0.846	0.399	none
Dissolved Oxygen (mg/L)	114	8.3	3 - 12.9	**-2.362**	**0.020**	**-**
Specific Conductivity (S/cm)	115	952	337 - 1560	**2.539**	**0.012**	**+**
Ammonia (mg/L)	98	0.35	0.05 - 3.36	0.099	0.921	none
Chlorophyll-a (ug/L)	102	14.37	1 - 96	**4.859**	**0**	**+**
Total Phosphorus (mg/L)	100	0.20	0.05 - 0.591	**-3.138**	**0.002**	**-**
E.Coli (#/100ml)	112	48	1 - 11000	1.167	0.246	none
Sulfates (mg/L)	104	190.74	17.1 - 308	**2.818**	**0.006**	**+**
Chloride (mg/L)	104	116	53.3 - 224	**3.399**	**0.001**	**+**
Nitrate + Nitrite (mg/L)	100	2.01	0.022 - 30.2	-0.073	0.942	none
TDS (mg/L)	101	624.05	122 - 1092	**3.468**	**0.001**	**+**

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
15839						
Specific Conductivity (S/cm)	70	894	94 - 1307	**2.280**	**0.026**	**+**
E.Coli (#/100ml)	77	18	1 - 2600	1.227	0.224	none

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
17410						
pH (S.U.)	37	8.1	7.2 - 8.5	0.756	0.454	none
Dissolved Oxygen (mg/L)	38	7.8	5.2 - 11.3	**-2.846**	**0.007**	**-**
Specific Conductivity (S/cm)	37	890	530 - 1130	0.686	0.497	none
Ammonia (mg/L)	34	0.30	0.027 - 2.24	0.078	0.938	none
Chlorophyll-a (ug/L)	34	6.15	2 - 21	**2.467**	**0.019**	**+**
Total Phosphorus (mg/L)	34	0.11	0.05 - 0.519	-0.865	0.393	none
E.Coli (#/100ml)	34	14	2 - 921	0.926	0.361	none
Sulfates (mg/L)	35	183.49	113 - 306	1.342	0.189	none
Chloride (mg/L)	35	111.79	56.8 - 215	1.129	0.267	none
Nitrate + Nitrite (mg/L)	33	1.82	0.04 - 20.1	0.661	0.513	none
TDS (mg/L)	34	609.26	366 - 1500	0.437	0.665	none

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
17596						
pH (S.U.)	28	8.1	6.6 - 8.9	1.046	0.305	none
Dissolved Oxygen (mg/L)	22	8.1	5.3 - 17.1	1.754	0.096	none
Specific Conductivity (S/cm)	30	904	480 - 1250	**2.825**	**0.009**	**+**
Ammonia (mg/L)	26	0.52	0.03 - 5.6	0.405	0.689	none
Chlorophyll-a (ug/L)	24	6.39	3 - 33	1.573	0.129	none
Total Phosphorus (mg/L)	25	0.12	0.05 - 0.53	-0.553	0.585	none
E.Coli (#/100ml)	21	11	3 - 120	1.880	0.076	none
Sulfates (mg/L)	26	186.84	79.9 - 289	**2.923**	**0.007**	**+**
Chloride (mg/L)	26	109.75	64.8 - 156	**2.301**	**0.030**	**+**
Nitrate + Nitrite (mg/L)	23	0.66	0.04 - 6.42	0.233	0.818	none
TDS (mg/L)	25	578.80	365 - 748	1.330	0.196	none

Middle Rio Grande Sub-Basin Stations

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
18792						
pH (S.U.)	32	8.1	7.9 - 8.5	-0.555	0.583	none
Dissolved Oxygen (mg/L)	31	8.6	6.1 - 12.5	-0.953	0.348	none
Specific Conductivity (S/cm)	32	906	375 - 1130	-0.837	0.409	none
Ammonia (mg/L)	31	0.22	0.05 - 0.45	0.947	0.351	none
Chlorophyll-a (ug/L)	31	4.38	0.56 - 19.40	-0.488	0.629	none
Total Phosphorus (mg/L)	30	0.12	0.06 - 0.25	1.306	0.202	none
E.Coli (#/100ml)	28	395	5 - 5200	**2.809**	**0.009**	**+**
Sulfates (mg/L)	31	172.61	117 - 221	0.279	0.783	none
Chloride (mg/L)	30	91.63	50 - 126	-1.289	0.208	none
Nitrate + Nitrite (mg/L)	32	0.56	0.14 - 1.86	1.640	0.111	none
TDS (mg/L)	13	568.15	436 - 350	-0.240	0.815	none

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
18795						
pH (S.U.)	29	8.1	7.5 - 8.6	-1.393	0.175	none
Dissolved Oxygen (mg/L)	25	7.3	4.3 - 11.6	-1.629	0.116	none
Specific Conductivity (S/cm)	24	894	665 - 1030	0.683	0.502	none
Ammonia (mg/L)	27	0.18	0.07 - 0.379	-0.449	0.657	none
Chlorophyll-a (ug/L)	27	8	3 - 37	0.551	0.587	none
Total Phosphorus (mg/L)	27	0.14	0.056 - 0.35	0.321	0.751	none
E.Coli (#/100ml)	29	754	2 - 24000	0.872	0.391	none
Sulfates (mg/L)	28	169.85	72.6 - 253	-0.702	0.489	none
Chloride (mg/L)	28	99.56	33.3 - 156	-2.656	0.013	***
Nitrate + Nitrite (mg/L)	26	0.52	0.077 - 3.86	-1.717	0.098	none
TDS (mg/L)	28	591.32	343 - 1500	-2.484	0.019	***

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
20650						
Specific Conductivity (S/cm)	73	909	499 - 1310	**2.328**	**0.023**	**+**
E.Coli (#/100ml)	78	22	1 - 1800	1.248	0.216	none

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
20997						
pH (S.U.)	18	8.2	7.2 - 8.8	0.110	0.914	none
Dissolved Oxygen (mg/L)	18	8.1	4.7 - 12.8	-0.020	0.984	none
Specific Conductivity (S/cm)	22	919	532 - 1240	1.100	0.284	none
Ammonia (mg/L)	16	0.82	0.05 - 9.52	**-2.129**	**0.050**	**-**
Chlorophyll-a (ug/L)	18	4.96	1.34 - 13	**2.24**	**0.039**	**+**
Total Phosphorus (mg/L)	16	0.11	0.03 - 0.701	-1.955	0.069	none
E.Coli (#/100ml)	18	28	6 - 1000	-0.122	0.905	none
Sulfates (mg/L)	19	191.51	67.6 - 277	1.298	0.211	none
Chloride (mg/L)	18	111.07	42.3 - 183	0.335	0.741	none
Nitrate + Nitrite (mg/L)	16	0.41	0.05 - 1.09	-0.813	0.429	none
TDS (mg/L)	18	597.83	326 - 826	1.552	0.139	none

Middle Rio Grande Sub-Basin Stations

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
20999						
pH (S.U.)	49	8.0	6.8 - 9.8	**2.315**	**0.025**	**+**
Dissolved Oxygen (mg/L)	45	6.5	3.9 - 10.5	-0.804	0.425	none
Specific Conductivity (S/cm)	53	923	560 - 1270	**3.303**	**0.002**	**+**
Ammonia (mg/L)	44	0.67	0.1 - 6.08	**-3.136**	**0.003**	**-**
Chlorophyll-a (ug/L)	47	6.85	0.86 - 85	**2.140**	**0.038**	**+**
Total Phosphorus (mg/L)	44	0.11	0.05 - 0.654	-0.221	0.826	none
E.Coli (#/100ml)	46	1489	25 - 24196	**2.841**	**0.007**	**+**
Sulfates (mg/L)	48	169.81	0.1 - 279	**3.185**	**0.003**	**+**
Chloride (mg/L)	48	109.84	0.15 - 297	1.199	0.237	none
Nitrate + Nitrite (mg/L)	45	0.65	0.05 - 4.92	-1.207	0.234	none
TDS (mg/L)	42	582.17	342 - 834	**3.285**	**0.002**	**+**

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
21542						
pH (S.U.)	9	8.1	7.7 - 8.5	*	*	*
Dissolved Oxygen (mg/L)	9	6.4	2.7 - 10.2	*	*	*
Specific Conductivity (S/cm)	9	1031	803 - 1320	*	*	*
Ammonia (mg/L)	9	0.53	0.2 - 1	*	*	*
Chlorophyll-a (ug/L)	9	11	3 - 39	*	*	*
Total Phosphorus (mg/L)	9	0.19	0.05 - 0.36	*	*	*
E.Coli (#/100ml)	9	1033	84 - 17000	*	*	*
Sulfates (mg/L)	9	218	144 - 264	*	*	*
Chloride (mg/L)	8	137.41	89.3 - 194	*	*	*
Nitrate + Nitrite (mg/L)	9	1.71	0.56 - 5.9	*	*	*
TDS (mg/L)	9	699.56	538 - 1000	*	*	*

Middle Rio Grande Sub-Basin Stations

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
13270						
pH (S.U.)	29	8.0	7.8 - 8.1	0.640	0.528	none
Dissolved Oxygen (mg/L)	29	8.8	7.7 - 9.7	0.494	0.625	none
Specific Conductivity (S/cm)	28	512	441 - 940	-1.265	0.217	none
Ammonia (mg/L)	27	0.05	0.02 - 0.05	**	**	**
Chlorophyll-a (ug/L)	27	1.43	0.19 - 3	**	**	**
Total Phosphorus (mg/L)	28	0.03	0.02 - 0.06	**	**	**
E.Coli (#/100ml)	27	257	19 - 2800	0.066	0.948	none
Sulfates (mg/L)	29	27.48	13 - 188	0.282	0.780	none
Chloride (mg/L)	29	20.98	9 - 107	0.016	0.987	none
Nitrate + Nitrite (mg/L)	28	1.41	0.21 - 1.69	-1.046	0.305	none
TDS (mg/L)	10	288.20	268 - 330	0.703	0.500	none

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
15820						
pH (S.U.)	29	7.6	7 - 7.9	1.535	0.136	none
Dissolved Oxygen (mg/L)	29	8.3	6.5 - 9.5	0.949	0.351	none
Specific Conductivity (S/cm)	29	525	448 - 588	**3.459**	**0.002**	**+**
Ammonia (mg/L)	29	0.05	0.02 - 0.05	**	**	**
Chlorophyll-a (ug/L)	26	1.40	0.2 - 3	**	**	**
Total Phosphorus (mg/L)	29	0.03	0.02 - 0.06	**	**	**
E.Coli (#/100ml)	27	157	0.9 - 2400	-0.307	0.762	none
Sulfates (mg/L)	28	23.25	9 - 36.8	**4.160**	**0**	**+**
Chloride (mg/L)	28	20.54	12 - 31.3	**2.624**	**0.014**	**+**
Nitrate + Nitrite (mg/L)	29	1.53	1.34 - 1.79	-1.225	0.231	none
TDS (mg/L)	10	277.50	250 - 330	-3.166	0.011	***

Station/Parameter	N	Mean	Range	T-Score	p-value	Trend
15821						
pH (S.U.)	29	7.4	7.1 - 7.6	-1.993	0.056	none
Dissolved Oxygen (mg/L)	29	7.6	6.4 - 8.8	**-2.362**	**0.025**	**-**
Specific Conductivity (S/cm)	29	478	434 - 593	**-2.688**	**0.012**	**-**
Ammonia (mg/L)	29	0.06	0.02 - 0.55	-1.990	0.056	none
Chlorophyll-a (ug/L)	26	1.49	0.16 - 6.14	**	**	**
Total Phosphorus (mg/L)	29	0.03	0.02 - 0.08	**	**	**
E.Coli (#/100ml)	25	235	0.9 - 870	1.060	0.300	none
Sulfates (mg/L)	29	16.03	8 - 33	**-2.136**	**0.042**	**-**
Chloride (mg/L)	29	15.46	9 - 26	**-2.412**	**0.023**	**-**
Nitrate + Nitrite (mg/L)	28	1.55	1.29 - 1.91	-0.414	0.682	none
TDS (mg/L)	10	289.70	260 - 312	2.524	0.033	***

Lower Rio Grande Sub-Basin Stations

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
13189						
pH (S.U.)	31	8.3	6.9 - 9.7	-0.231	0.819	none
Dissolved Oxygen (mg/L)	30	8.7	5 - 13.9	-1.142	0.263	none
Specific Conductivity (S/cm)	34	947	580 - 1180	1.235	0.226	none
Ammonia (mg/L)	33	0.42	0.022 - 7.84	-0.158	0.875	none
Chlorophyll-a (ug/L)	33	17.85	2 - 45	1.487	0.147	none
Total Phosphorus (mg/L)	33	0.07	0.025 - 0.425	0.155	0.878	none
E.Coli (#/100ml)	30	6	1 - 77.1	0.104	0.918	none
Sulfates (mg/L)	33	199.21	116 - 275	**5.000**	**0**	**+**
Chloride (mg/L)	34	115.83	47.5 - 199	0.726	0.473	none
Nitrate + Nitrite (mg/L)	31	0.10	0.04 - 0.608	0.418	0.679	none
TDS (mg/L)	33	615.12	443 - 874	1.640	0.111	none

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
15818						
pH (S.U.)	24	8.0	7.5 - 8.5	1.655	0.112	none
Dissolved Oxygen (mg/L)	24	7.9	5.3 - 11.8	0.331	0.744	none
Specific Conductivity (S/cm)	25	971	581 - 2010	0.601	0.553	none
Ammonia (mg/L)	23	0.18	0.044 - 1.12	0.806	0.429	none
Chlorophyll-a (ug/L)	23	9.70	1 - 76	**2.079**	**0.050**	**+**
Total Phosphorus (mg/L)	22	0.24	0.05 - 0.821	-1.132	0.270	none
E.Coli (#/100ml)	23	38	2 - 1990	1.379	0.182	none
Sulfates (mg/L)	22	185.59	116 - 234	-0.725	0.476	none
Chloride (mg/L)	22	114.21	59.5 - 162	-0.298	0.769	none
Nitrate + Nitrite (mg/L)	21	3.95	0.05 - 38.3	0.913	0.372	none
TDS (mg/L)	22	604.77	332 - 888	0.242	0.811	none

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
10249						
pH (S.U.)	33	8.0	7.2 - 8.6	**3.334**	**0.002**	**+**
Dissolved Oxygen (mg/L)	33	10.1	6.5 - 16.7	**2.647**	**0.013**	**+**
Specific Conductivity (S/cm)	34	1478	1150 - 2730	0.971	0.339	none
Ammonia (mg/L)	31	0.17	0.02 - 1.79	**-2.397**	**0.023**	**-**
Chlorophyll-a (ug/L)	31	49.25	3 - 240	**3.741**	**0.001**	**+**
Total Phosphorus (mg/L)	30	0.26	0.07 - 0.788	-0.564	0.577	none
E.Coli (#/100ml)	27	24	1 - 1000	0.548	0.588	none
Sulfates (mg/L)	32	282.22	202 - 440	1.703	0.099	none
Chloride (mg/L)	31	194.90	104 - 424	0.366	0.717	none
Nitrate + Nitrite (mg/L)	32	0.52	0.02 - 4.53	-0.444	0.660	none
TDS (mg/L)	15	885.20	748 - 1220	-0.036	0.972	none

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
13103						
pH (S.U.)	11	7.9	7.4 - 8.6	-1.423	0.185	none
Dissolved Oxygen (mg/L)	12	5.2	1.9 - 9.9	-1.789	0.101	none
Specific Conductivity (S/cm)	12	2692	540 - 9370	0.363	0.724	none
Ammonia (mg/L)	11	0.65	0.1 - 3.36	**-2.752**	**0.020**	**-**
Chlorophyll-a (ug/L)	5	45.60	3 - 156	0.340	0.751	none
Total Phosphorus (mg/L)	11	0.14	0.06 - 0.349	-0.576	0.577	none
E.Coli (#/100ml)	11	745	150 - 4500	0.089	0.931	none
Sulfates (mg/L)	5	583.42	99.1 - 2080	-1.807	0.145	none
Chloride (mg/L)	5	1534	225 - 5200	-1.707	0.163	none
Nitrate + Nitrite (mg/L)	11	1.75	0.05 - 8.72	-1.927	0.083	none
TDS (mg/L)	11	3948.18	218 - 10200	-0.443	0.667	none

Lower Rio Grande Sub-Basin Stations

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
13104						
pH (S.U.)	2	7.3	.	*	*	*
Dissolved Oxygen (mg/L)	2	4.2	3.1 - 5.2	*	*	*
Specific Conductivity (S/cm)	2	735	479 - 992	*	*	*
Ammonia (mg/L)	2	0.10	.	*	*	*
Chlorophyll-a (ug/L)	2	151	11 - 291	*	*	*
Total Phosphorus (mg/L)	2	0.18	0.11 - 0.25	*	*	*
E.Coli (#/100ml)	1	9200	.	*	*	*
Sulfates (mg/L)	2	746.80	27.6 - 1466	*	*	*
Chloride (mg/L)	2	1190.60	45.2 - 2336	*	*	*
Nitrate + Nitrite (mg/L)	2	0.29	0.19 - 0.38	*	*	*
TDS (mg/L)	2	3198	304 - 6092	*	*	*

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
13177						
pH (S.U.)	115	7.9	6.8 - 8.8	-0.099	0.921	none
Dissolved Oxygen (mg/L)	113	6.3	3 - 10.5	**-2.657**	**0.009**	**-**
Specific Conductivity (S/cm)	93	1416	653 - 2070	**2.242**	**0.027**	**+**
Ammonia (mg/L)	78	0.27	0.01 - 2.24	-0.535	0.594	none
Chlorophyll-a (ug/L)	68	37.71	3 - 156	**5.928**	**0**	**+**
Total Phosphorus (mg/L)	81	0.2	0.05 - 0.52	**-6.607**	**0**	**-**
E.Coli (#/100ml)	65	178	9 - 19863	1.032	0.306	none
Sulfates (mg/L)	84	280.01	111 - 479	**4.590**	**0**	**+**
Chloride (mg/L)	84	203.44	69.5 - 427	**2.264**	**0.026**	**+**
Nitrate + Nitrite (mg/L)	76	0.94	0.04 - 11.8	**-2.766**	**0.007**	**-**
TDS (mg/L)	78	905.08	471 - 1320	**2.398**	**0.019**	**+**

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
13178						
pH (S.U.)	14	8.0	7.3 - 8.6	1.011	0.331	none
Dissolved Oxygen (mg/L)	12	7.8	3.4 - 13.3	**2.729**	**0.020**	**+**
Specific Conductivity (S/cm)	13	1713	1200 - 3740	-0.778	0.453	none
Ammonia (mg/L)	19	0.48	0.1 - 3.92	-1.308	0.207	none
Chlorophyll-a (ug/L)	19	40.26	3 - 155	**2.924**	**0.009**	**+**
Total Phosphorus (mg/L)	19	0.14	0.05 - 0.304	-1.234	0.233	none
E.Coli (#/100ml)	16	31	3 - 2220	0.836	0.417	none
Sulfates (mg/L)	19	267.04	29 - 444	1.892	0.075	none
Chloride (mg/L)	18	212.33	61.9 - 362	1.312	0.207	none
Nitrate + Nitrite (mg/L)	19	0.60	0.04 - 3.35	-1.761	0.095	none
TDS (mg/L)	19	918.95	456 - 1178	**2.022**	**0.058**	**+**

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
13179						
pH (S.U.)	24	8.0	7.2 - 8.6	**2.034**	**0.054**	**+**
Dissolved Oxygen (mg/L)	17	7.0	3.6 - 12.2	**2.498**	**0.024**	**+**
Specific Conductivity (S/cm)	23	1507	739 - 2850	1.093	0.287	none
Ammonia (mg/L)	30	0.45	0.1 - 7	-0.418	0.679	none
Chlorophyll-a (ug/L)	29	39.24	3 - 190	**4.119**	**0**	**+**
Total Phosphorus (mg/L)	28	0.17	0.05 - 0.51	**-3.383**	**0.002**	**-**
E.Coli (#/100ml)	23	12	1 - 68	-1.282	0.214	none
Sulfates (mg/L)	29	252.39	27 - 414	0.883	0.385	none
Chloride (mg/L)	29	195.35	39.3 - 354	0.757	0.455	none
Nitrate + Nitrite (mg/L)	29	0.48	0.04 - 2.22	-1.674	0.105	none
TDS (mg/L)	30	855.17	449 - 1288	1.906	0.067	none

Lower Rio Grande Sub-Basin Stations

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
13180						
pH (S.U.)	7	7.8	7.26 - 8.3	*	*	*
Dissolved Oxygen (mg/L)	7	5.4	3.18 - 7.9	*	*	*
Specific Conductivity (S/cm)	7	1237	847 - 1720	*	*	*
E.Coli (#/100ml)	7	183	7 - 2419.6	*	*	*

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
13181						
pH (S.U.)	85	7.8	5.4 - 9	-1.861	0.066	none
Dissolved Oxygen (mg/L)	84	6.6	2.4 - 14.2	0.098	0.922	none
Specific Conductivity (S/cm)	86	1290	787 - 2040	**2.456**	**0.016**	**+**
Ammonia (mg/L)	74	0.24	0.028 - 2.52	-0.409	0.684	none
Chlorophyll-a (ug/L)	76	14.52	2 - 96	**2.443**	**0.017**	**+**
Total Phosphorus (mg/L)	74	0.08	0.02 - 0.39	-1.317	0.192	none
E.Coli (#/100ml)	70	89	10 - 2420	-1.189	0.239	none
Sulfates (mg/L)	77	270.94	144 - 548	**4.252**	**0**	**+**
Chloride (mg/L)	77	181.46	73.5 - 378	1.764	0.082	none
Nitrate + Nitrite (mg/L)	72	0.56	0.04 - 6.06	-0.998	0.322	none
TDS (mg/L)	76	826.25	462 - 1414	**3.166**	**0.002**	**+**

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
13184						
pH (S.U.)	59	8.0	5.91 - 9.40	1.032	0.307	none
Dissolved Oxygen (mg/L)	57	6.2	1.50 - 9.50	0.891	0.377	none
Specific Conductivity (S/cm)	60	1145	513 - 1670	0.676	0.502	none
Ammonia (mg/L)	53	0.22	0.03 - 3.08	-0.116	0.908	none
Chlorophyll-a (ug/L)	53	12.02	1 - 45	**2.273**	**0.027**	**+**
Total Phosphorus (mg/L)	52	0.08	0.05 - 0.27	-1.950	0.057	none
E.Coli (#/100ml)	39	32	4 - 1733	0.950	0.348	none
Sulfates (mg/L)	54	231.53	87.5 - 442	1.912	0.061	none
Chloride (mg/L)	54	148.97	54.80 - 388	0.531	0.598	none
Nitrate + Nitrite (mg/L)	50	0.37	0.04 - 4.08	-0.406	0.686	none
TDS (mg/L)	53	764.04	356 - 1960	0.375	0.709	none

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
13185						
pH (S.U.)	96	8.0	7.2 - 9.7	-0.310	0.757	none
Dissolved Oxygen (mg/L)	87	8.1	4.2 - 18.6	1.503	0.136	none
Specific Conductivity (S/cm)	100	1068	479 - 1460	**4.264**	**0**	**+**
Ammonia (mg/L)	96	0.85	0.05 - 8.4	-1.634	0.106	none
Chlorophyll-a (ug/L)	94	11.17	1 - 76.6	0.792	0.43	none
Total Phosphorus (mg/L)	94	0.15	0.05 - 0.565	**-3.830**	**0**	**-**
E.Coli (#/100ml)	89	145	2 - 5475	**-4.988**	**3.09E-06**	**-**
Sulfates (mg/L)	96	218.81	22.7 - 353	**5.482**	**0**	**+**
Chloride (mg/L)	96	140.06	41 - 293	**3.686**	**0**	**+**
Nitrate + Nitrite (mg/L)	91	0.41	0.04 - 5.05	-0.993	0.323	none
TDS (mg/L)	94	694.15	274 - 1990	**2.112**	**0.037**	**+**

Lower Rio Grande Sub-Basin Stations

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
13186						
pH (S.U.)	62	8.0	7 - 9.1	-0.252	0.802	none
Dissolved Oxygen (mg/L)	57	8.4	4.3 - 16.6	1.915	0.061	none
Specific Conductivity (S/cm)	67	965	651 - 1440	**2.092**	**0.040**	**+**
Ammonia (mg/L)	64	0.33	0.035 - 4.48	-0.091	0.928	none
Chlorophyll-a (ug/L)	64	10.64	2 - 108	-0.486	0.629	none
Total Phosphorus (mg/L)	62	0.07	0.032 - 0.372	0.160	0.873	none
E.Coli (#/100ml)	59	27	1 - 240	-0.761	0.450	none
Sulfates (mg/L)	64	194.97	22.2 - 340	**3.731**	**0**	**+**
Chloride (mg/L)	65	117.13	49.2 - 304	**2.545**	**0.013**	**+**
Nitrate + Nitrite (mg/L)	31	12	0.04 - 722	-0.739	0.463	none
TDS (mg/L)	63	612.90	410 - 1320	**2.811**	**0.007**	**+**

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
13644						
pH (S.U.)	75	8.0	6.2 - 9	-0.479	0.633	none
Dissolved Oxygen (mg/L)	73	6.8	3.8 - 16.6	**-2.254**	**0.027**	**-**
Specific Conductivity (S/cm)	76	1280	789 - 2090	1.626	0.108	none
Ammonia (mg/L)	68	0.24	0.027 - 5.04	-0.299	0.766	none
Chlorophyll-a (ug/L)	68	14.38	3 - 71	**2.166**	**0.034**	**+**
Total Phosphorus (mg/L)	66	0.08	0.034 - 0.42	-1.785	0.079	none
E.Coli (#/100ml)	53	18	1 - 2100	0.838	0.406	none
Sulfates (mg/L)	70	264.17	152 - 473	**3.012**	**0.004**	**+**
Chloride (mg/L)	70	188.14	74.1 - 919	0.365	0.717	none
Nitrate + Nitrite (mg/L)	65	0.50	0.04 - 7.19	-0.318	0.751	none
TDS (mg/L)	67	807.93	108 - 1448	0.905	0.369	none

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
15808						
pH (S.U.)	76	7.9	6.1 - 8.8	-1.990	0.050	none
Dissolved Oxygen (mg/L)	75	6.3	2.1 - 13.2	0.062	0.950	none
Specific Conductivity (S/cm)	77	1319	922 - 1870	**2.857**	**0.006**	**+**
Ammonia (mg/L)	67	0.50	0.042 - 8.96	0.636	0.527	none
Chlorophyll-a (ug/L)	68	15.21	1 - 69	**3.048**	**0.003**	**+**
Total Phosphorus (mg/L)	66	0.11	0.037 - 0.61	0.623	0.536	none
E.Coli (#/100ml)	60	181	6.3 - 7400	**2.992**	**0.004**	**+**
Sulfates (mg/L)	69	272.49	141 - 489	**4.253**	**0**	**+**
Chloride (mg/L)	68	185.63	106 - 380	1.653	0.103	none
Nitrate + Nitrite (mg/L)	64	0.58	0.04 - 8.03	-0.859	0.394	none
TDS (mg/L)	68	825.44	554 - 1192	**2.740**	**0.008**	**+**

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
17247						
pH (S.U.)	33	7.9	7.3 - 8.4	**3.609**	**0.001**	**+**
Dissolved Oxygen (mg/L)	32	8.6	2 - 15	**3.866**	**0.001**	**+**
Specific Conductivity (S/cm)	34	1525	1080 - 4290	0.594	0.557	none
Ammonia (mg/L)	31	0.24	0.026 - 1.64	**-2.537**	**0.017**	**-**
Chlorophyll-a (ug/L)	31	46.43	3 - 133	**3.749**	**0.001**	**+**
Total Phosphorus (mg/L)	31	0.26	0.06 - 2.01	-0.572	0.572	none
E.Coli (#/100ml)	25	50	1 - 1700	-0.069	0.946	none
Sulfates (mg/L)	35	353.43	198 - 2570	1.345	0.187	none
Chloride (mg/L)	34	806.09	122 - 20800	0.945	0.351	none
Nitrate + Nitrite (mg/L)	30	0.67	0.04 - 8.3	0.076	0.940	none
TDS (mg/L)	13	796.54	566 - 1040	-1.881	0.084	none

Lower Rio Grande Sub-Basin Stations

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
20449						
Ammonia (mg/L)	89	0.15	0.04 - 0.98	0.031	0.975	none
E.Coli (#/100ml)	96	31	3 - 2400	0.744	0.459	none
TDS (mg/L)	89	1021.05	9.3 - 7800	0.389	0.698	none

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
20698						
pH (S.U.)	2	8.2	8.1 - 8.3	*	*	*
Dissolved Oxygen (mg/L)	2	5.2	5.1 - 5.3	*	*	*
Specific Conductivity (S/cm)	2	1320	1280 - 1360	*	*	*
Ammonia (mg/L)	3	0.16	0.1 - 0.28	*	*	*
Chlorophyll-a (ug/L)	3	14.67	3 - 28	*	*	*
Total Phosphorus (mg/L)	3	0.18	0.06 - 0.408	*	*	*
E.Coli (#/100ml)	3	10	4 - 33	*	*	*
Sulfates (mg/L)	3	365	138 - 795	*	*	*
Chloride (mg/L)	3	619.33	216 - 1410	*	*	*
Nitrate + Nitrite (mg/L)	3	8.51	0.051 - 24.6	*	*	*
TDS (mg/L)	3	1786.67	790 - 3680	*	*	*

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
21012						
pH (S.U.)	9	7.9	7.5 - 8.4	**3.908**	**0.004**	**+**
Dissolved Oxygen (mg/L)	10	10.1	6.6 - 14.5	0.463	0.654	none
Specific Conductivity (S/cm)	9	1420	1170 - 2190	**-5.129**	**0.001**	**-**
Ammonia (mg/L)	10	0.06	0.0471 - 0.1	-0.638	0.539	none
Chlorophyll-a (ug/L)	10	16.92	8.8 - 27.47	-1.732	0.119	none
Total Phosphorus (mg/L)	9	0.07	0.02 - 0.14	-0.602	0.564	none
E.Coli (#/100ml)	8	28	3 - 350	-0.512	0.627	none
Sulfates (mg/L)	10	264.90	161 - 376	1.309	0.223	none
Chloride (mg/L)	10	150.50	91 - 229	0.971	0.357	none
Nitrate + Nitrite (mg/L)	10	0.14	0.0229 - 0.32	-0.801	0.444	none

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
21591						
pH (S.U.)	3	7.9	7.8 - 8.1	*	*	*
Dissolved Oxygen (mg/L)	3	6.2	4.9 - 7.8	*	*	*
Specific Conductivity (S/cm)	3	1613	1210 - 2020	*	*	*
Ammonia (mg/L)	3	0.1	.	*	*	*
Chlorophyll-a (ug/L)	3	18.33	16 - 21	*	*	*
Total Phosphorus (mg/L)	3	0.06	0.05 - 0.08	*	*	*
E.Coli (#/100ml)	1	310	.	*	*	*
Sulfates (mg/L)	3	281.67	257 - 310	*	*	*
Chloride (mg/L)	3	236.33	135 - 343	*	*	*
Nitrate + Nitrite (mg/L)	3	0.09	0.05 - 0.15	*	*	*
TDS (mg/L)	3	1064.67	774 - 1388	*	*	*

Lower Rio Grande Sub-Basin Stations

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
21749						
pH (S.U.)	3	8.0	7.9 - 8.3	*	*	*
Dissolved Oxygen (mg/L)	3	7.1	6.4 - 8.3	*	*	*
Specific Conductivity (S/cm)	3	1160	1100 - 1220	*	*	*
Ammonia (mg/L)	3	0.1	.	*	*	*
Chlorophyll-a (ug/L)	3	3.33	3 - 4	*	*	*
Total Phosphorus (mg/L)	3	0.05	.	*	*	*
E.Coli (#/100ml)	3	71	37 - 100	*	*	*
Sulfates (mg/L)	3	241	222 - 272	*	*	*
Chloride (mg/L)	3	132	131 - 133	*	*	*
Nitrate + Nitrite (mg/L)	3	0.12	0.07 - 0.18	*	*	*
TDS (mg/L)	3	783.33	696 - 906	*	*	*

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
13176						
pH (S.U.)	21	8.2	6.7 - 8.8	1.931	0.068	none
Dissolved Oxygen (mg/L)	15	7.8	1.4 - 12.5	-0.125	0.902	none
Specific Conductivity (S/cm)	19	2864	1060 - 8940	0.534	0.600	none
Ammonia (mg/L)	29	0.40	0.026 - 7.1	-0.279	0.782	none
Chlorophyll-a (ug/L)	30	55.60	3 - 288	1.789	0.084	none
Total Phosphorus (mg/L)	28	0.24	0.05 - 0.776	**-3.080**	**0.005**	**-**
E.Coli (3/2007-8/2011)(#/100ml)	7	50	2 - 730	0.750	0.487	none
Enterococci (2/2014-7/2016)(#/100ml)	10	41	4 - 140	0.638	0.541	none
Sulfates (mg/L)	28	326.83	29 - 641	1.393	0.175	none
Chloride (mg/L)	28	619.76	73.2 - 2789	1.039	0.308	none
Nitrate + Nitrite (mg/L)	28	0.57	0.04 - 3.44	-0.567	0.575	none
TDS (mg/L)	29	1711.90	456 - 7004	1.334	0.193	none

Station/Parameter	N	Average	Range	T-Score	p-value	Trend
16288						
pH (S.U.)	22	8.0	6.43 - 10.20	0.190	0.851	none
Dissolved Oxygen (mg/L)	21	8.2	3.3 - 14.4	1.628	0.119	none
Specific Conductivity (S/cm)	22	1536	741 - 2750	1.812	0.085	none
Ammonia (mg/L)	28	0.28	0.10 - 1.96	0.072	0.943	none
Chlorophyll-a (ug/L)	28	32.82	3 - 116	**3.273**	**0.003**	**+**
Total Phosphorus (mg/L)	28	0.32	0.05 - 1.36	**-2.401**	**0.024**	**-**
E.Coli (3/2007-8/2011) (#/100ml)	12	189	30 - 770.1	**-2.982**	**0.014**	**-**
Enterococci (2/2014-5/2016)(#/100ml)	8	154	12 - 2420	-1.004	0.354	none
Sulfates (mg/L)	28	296.26	28.4 - 664	1.441	0.161	none
Chloride (mg/L)	28	236.62	64.4 - 469	**2.463**	**0.020**	**+**
Nitrate + Nitrite (mg/L)	28	1.58	0.05 - 13.9	-1.721	0.097	none
TDS (mg/L)	28	992.86	483 - 1880	1.775	0.087	none

Appendix B
Water Quality Trend Analysis Graphs

Figure 113. Station 13176, Phosphorus

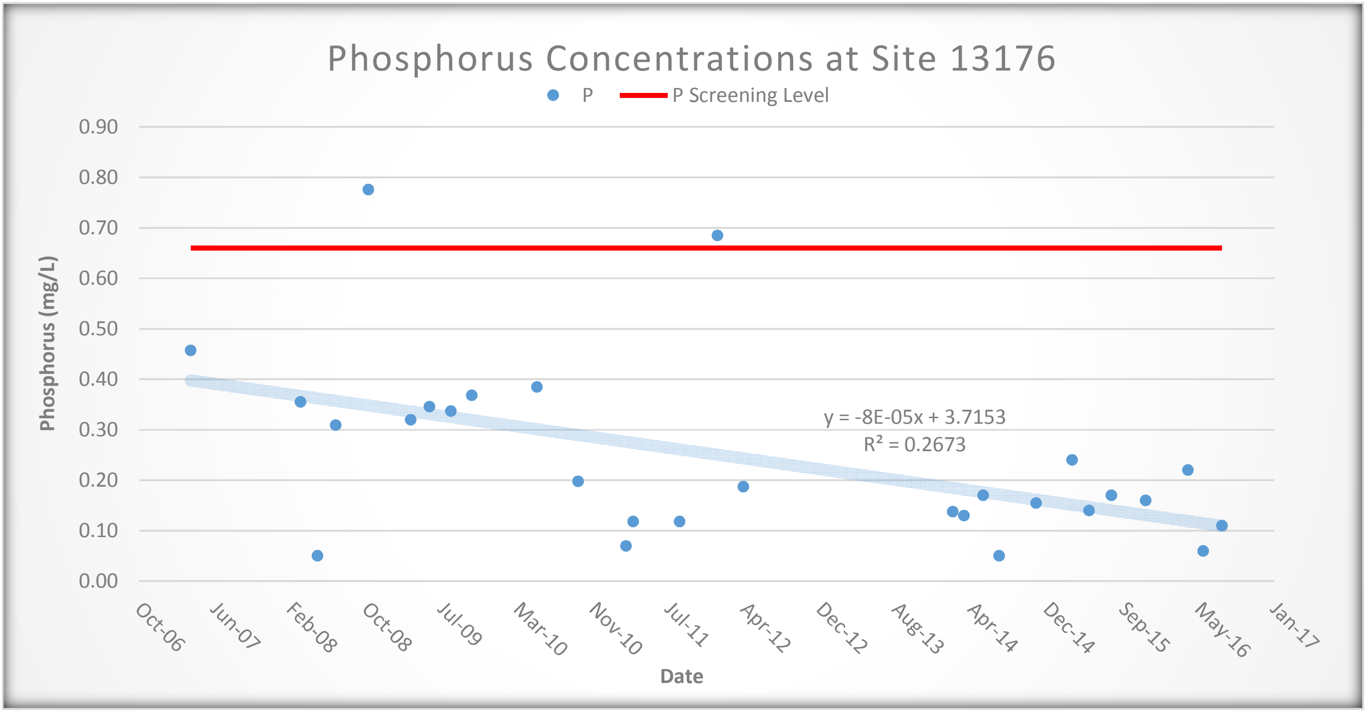

Figure 114. Station 16288, Chlorophyll-a

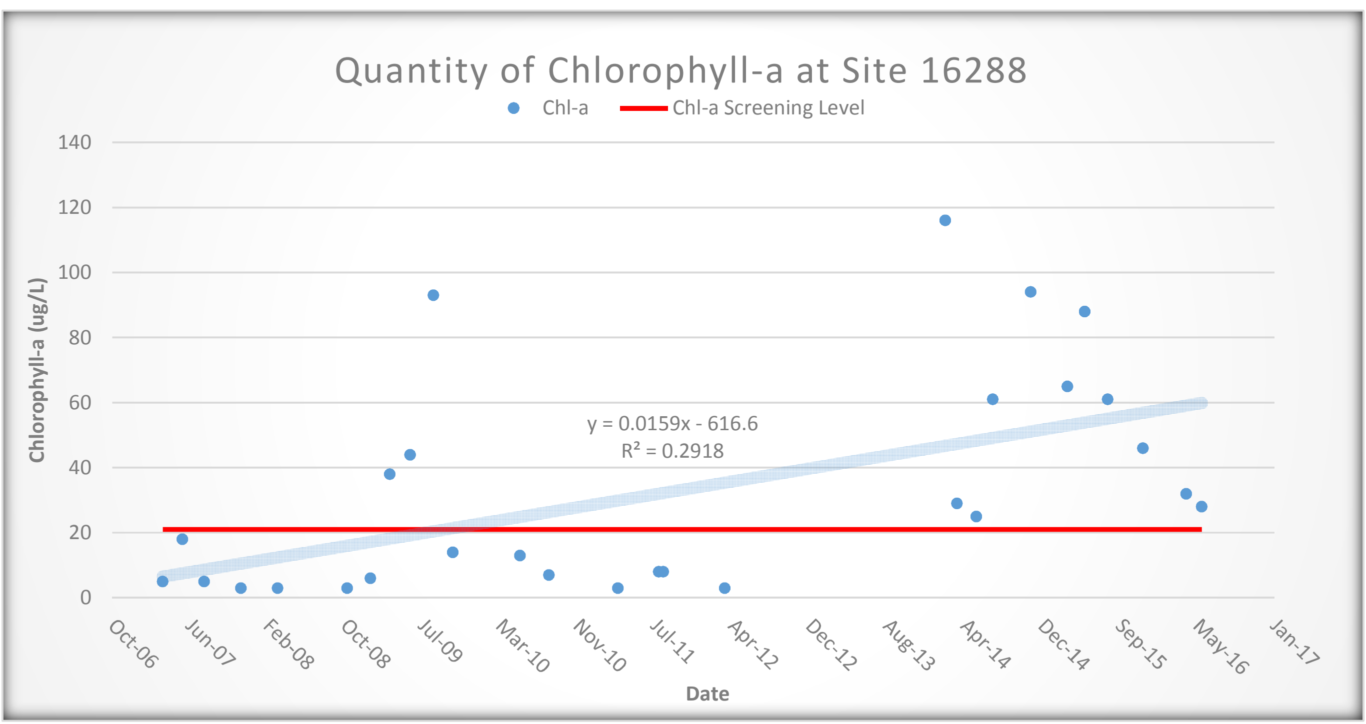

Figure 115. Station 16288, Phosphorus

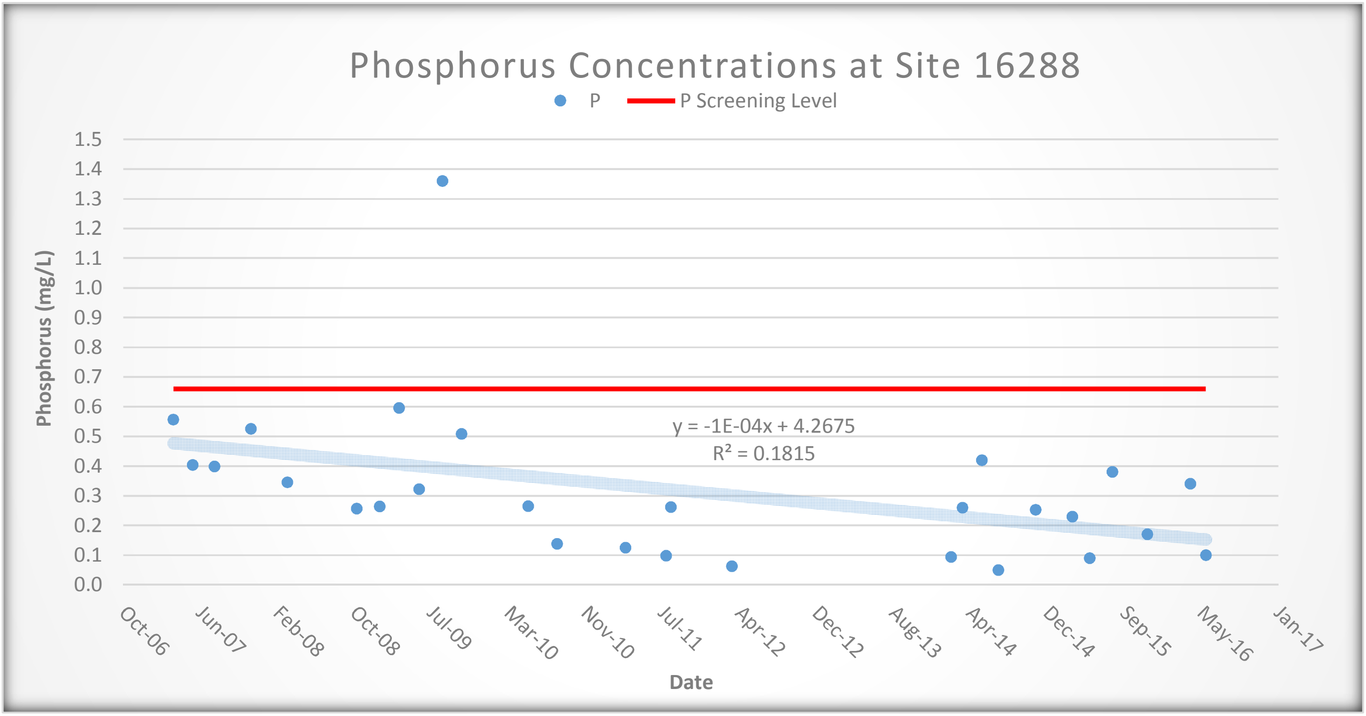

Figure 116. Station 13177, Chlorophyll-a

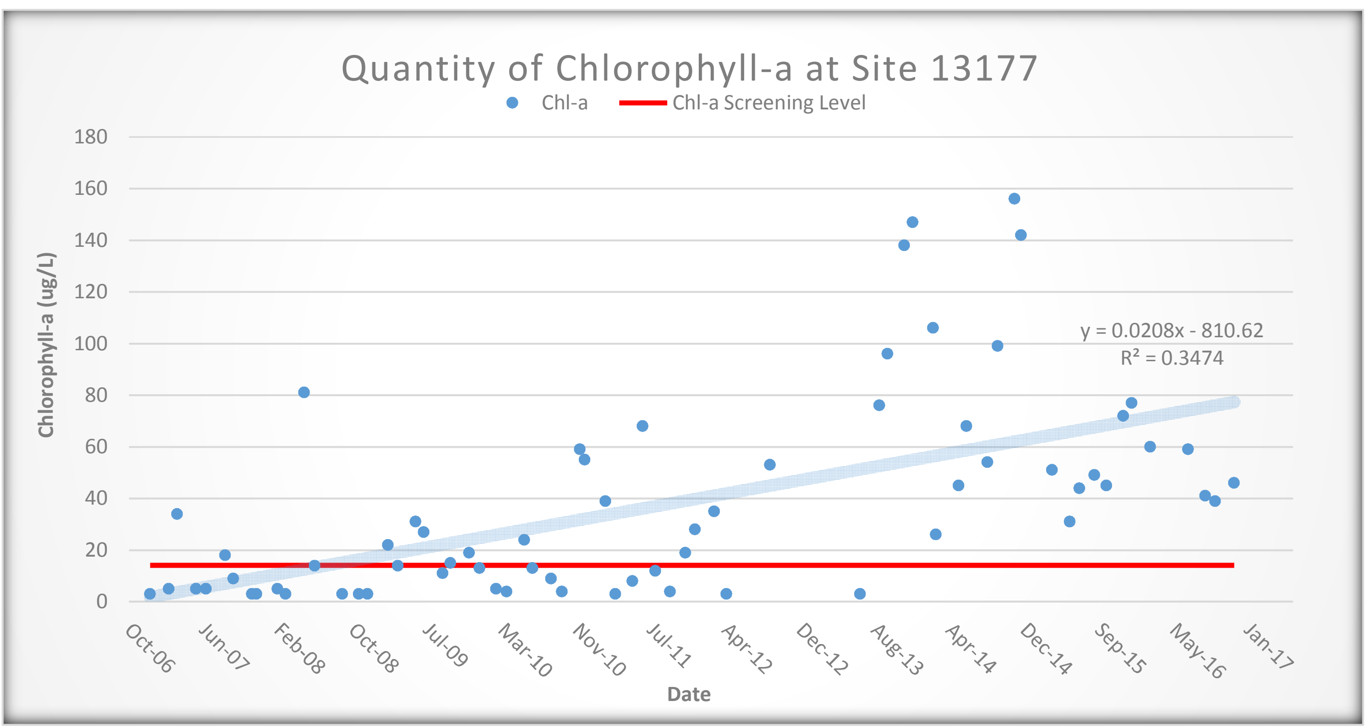

Figure 117. Station 13177, TDS

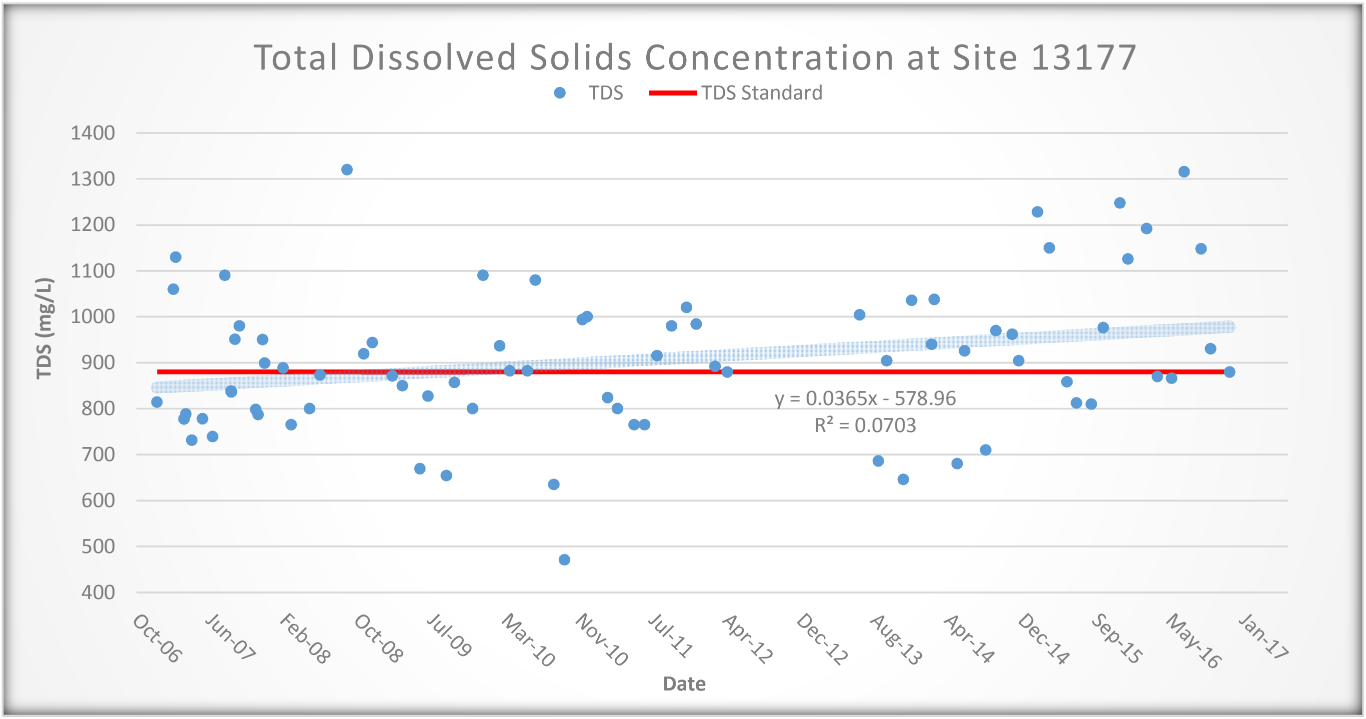

Figure 118. Station 13177, Phosphorus

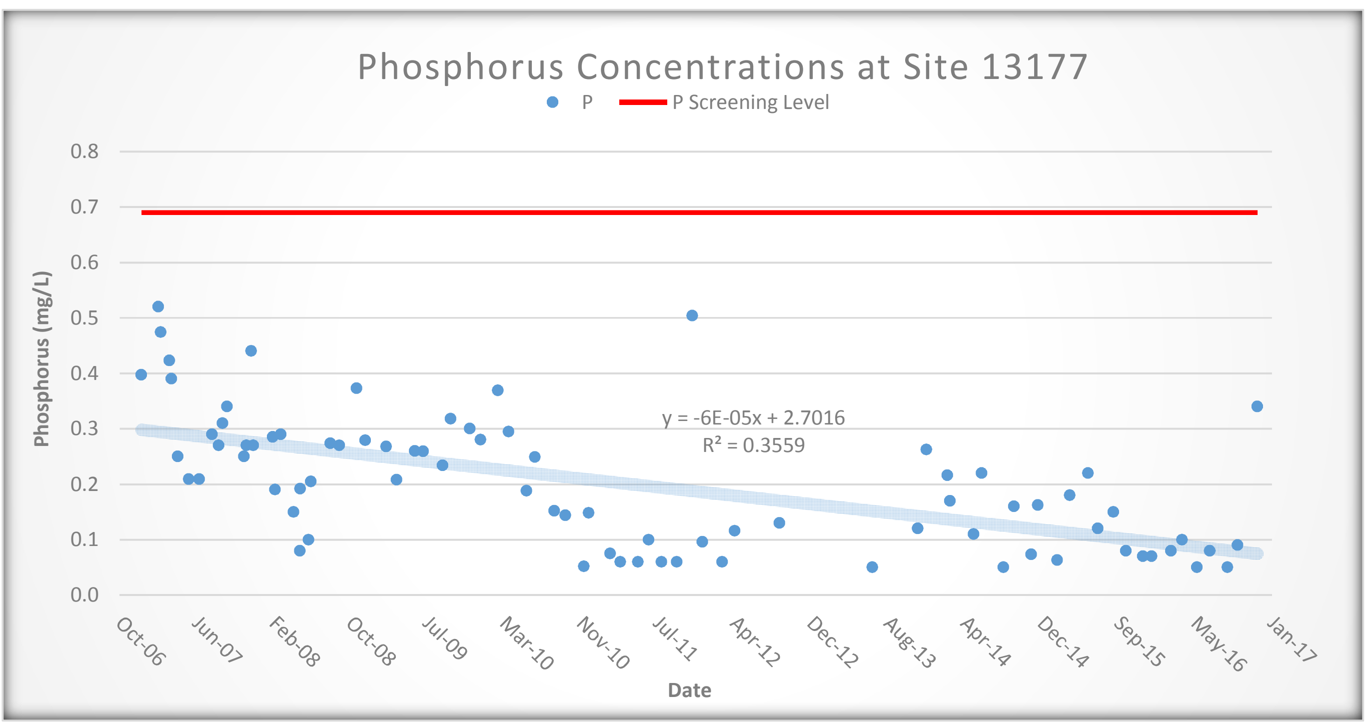

Figure 119. Station 13177, Sulfate and Chloride

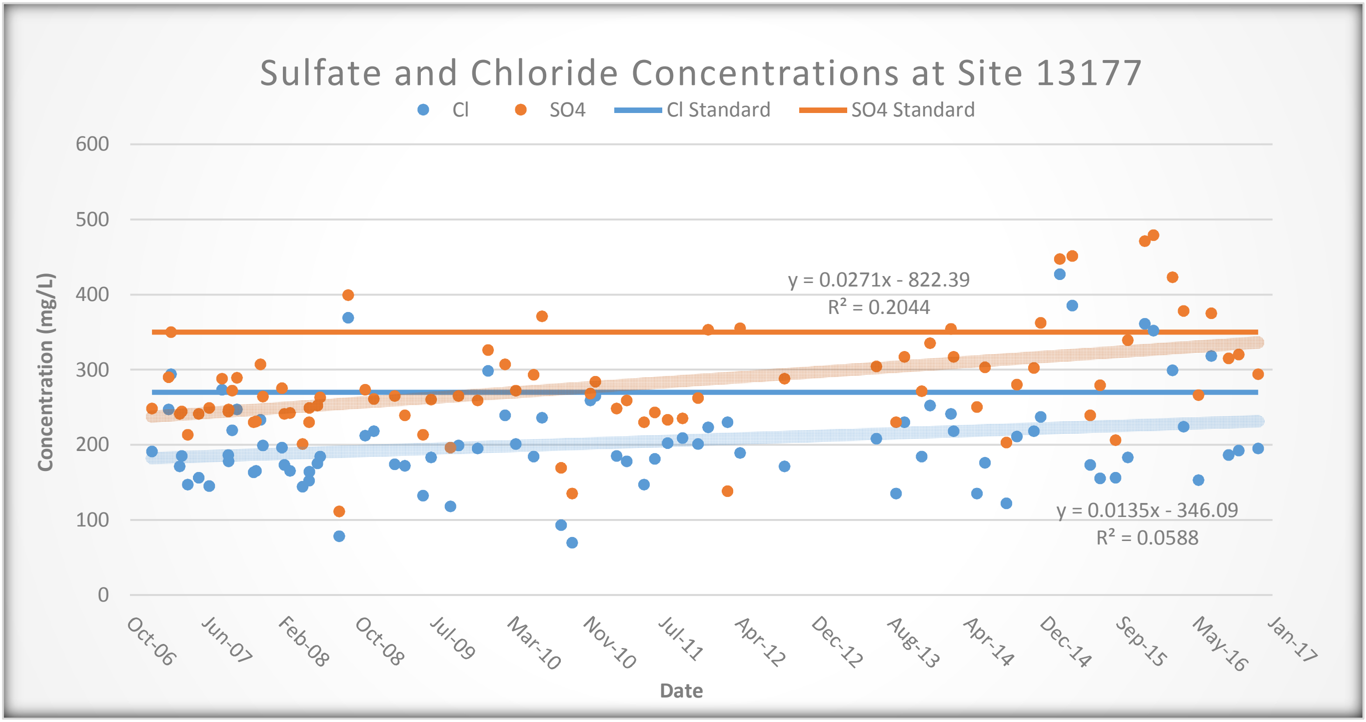

Figure 120. Station 13177, Nitrate+Nitrite

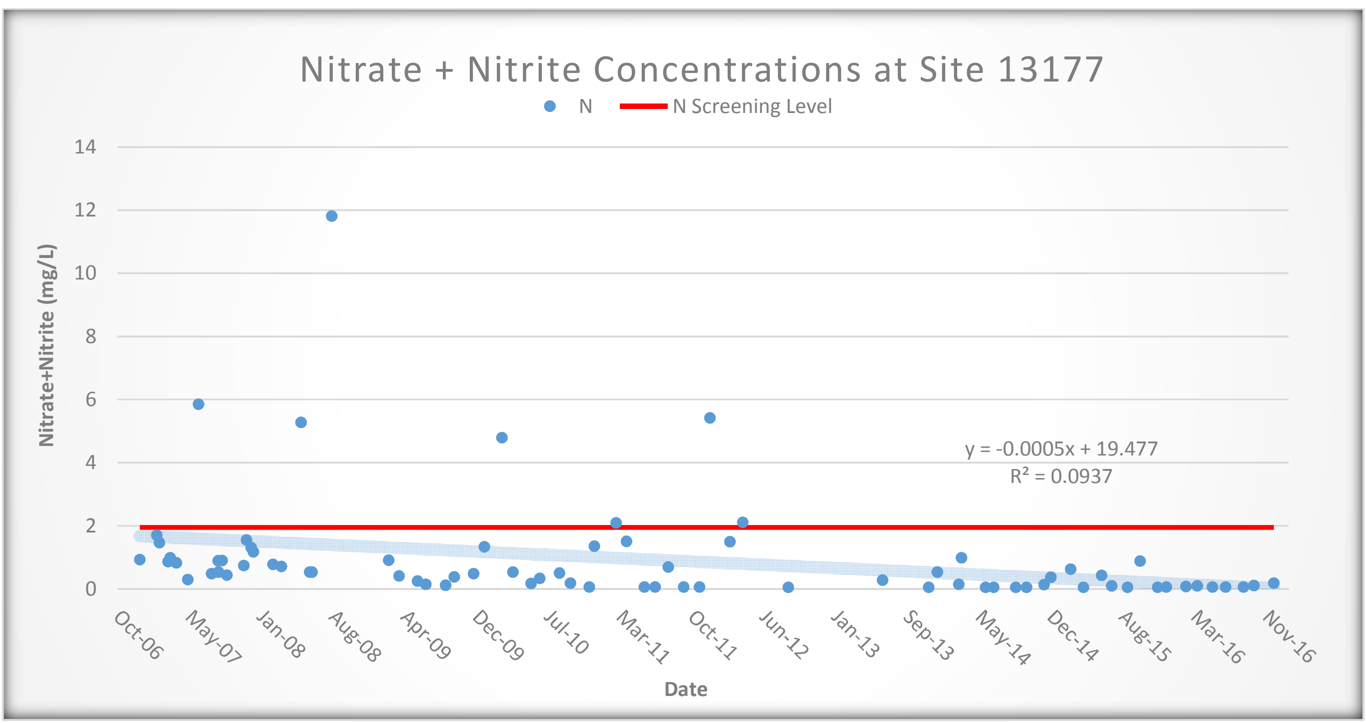

Figure 121. Station 13178, TDS

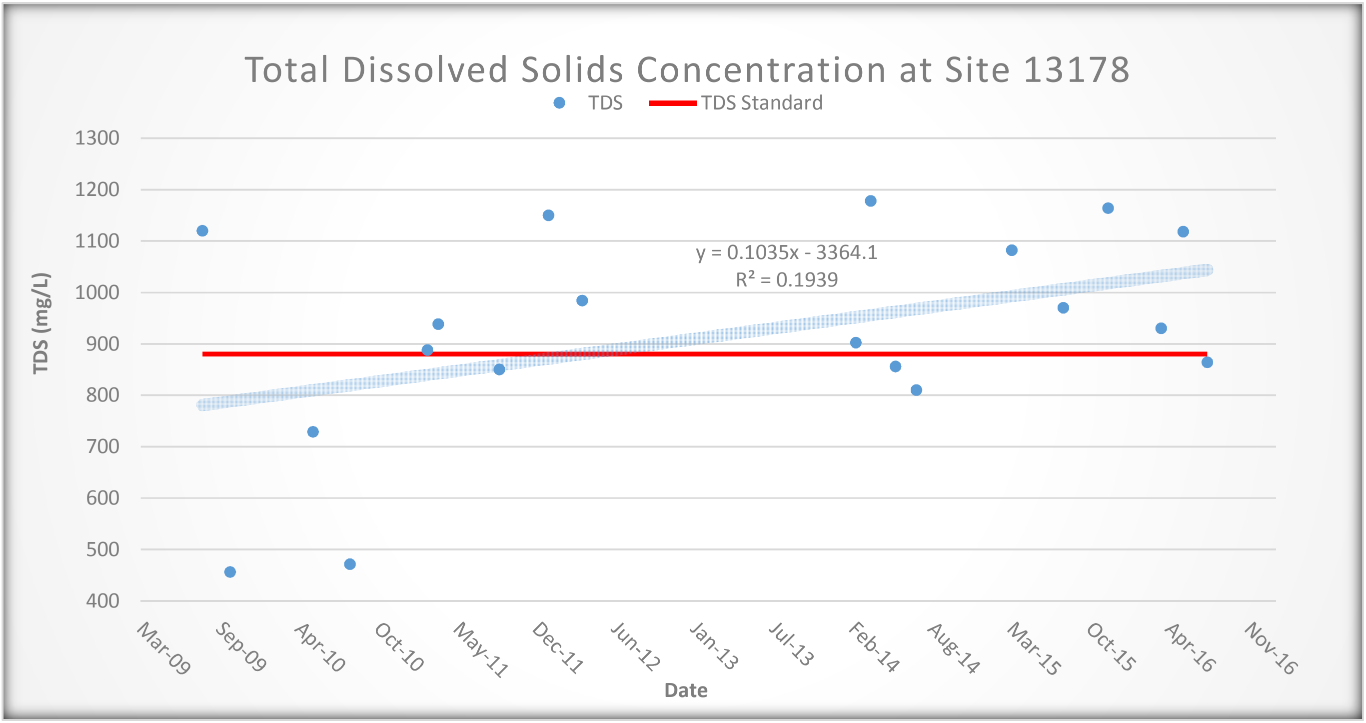

Figure 122. Station 13178, Chlorophyll-a

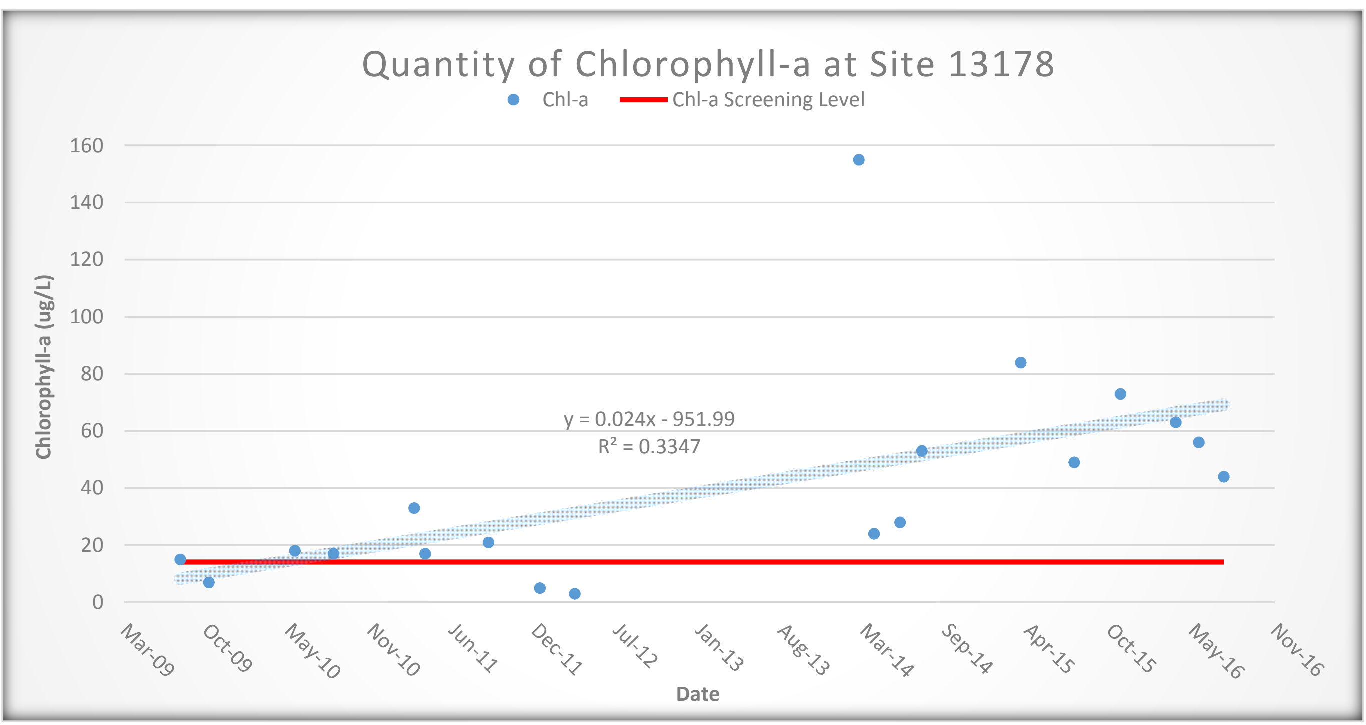

Figure 123. Station 13179, Chlorophyll-a

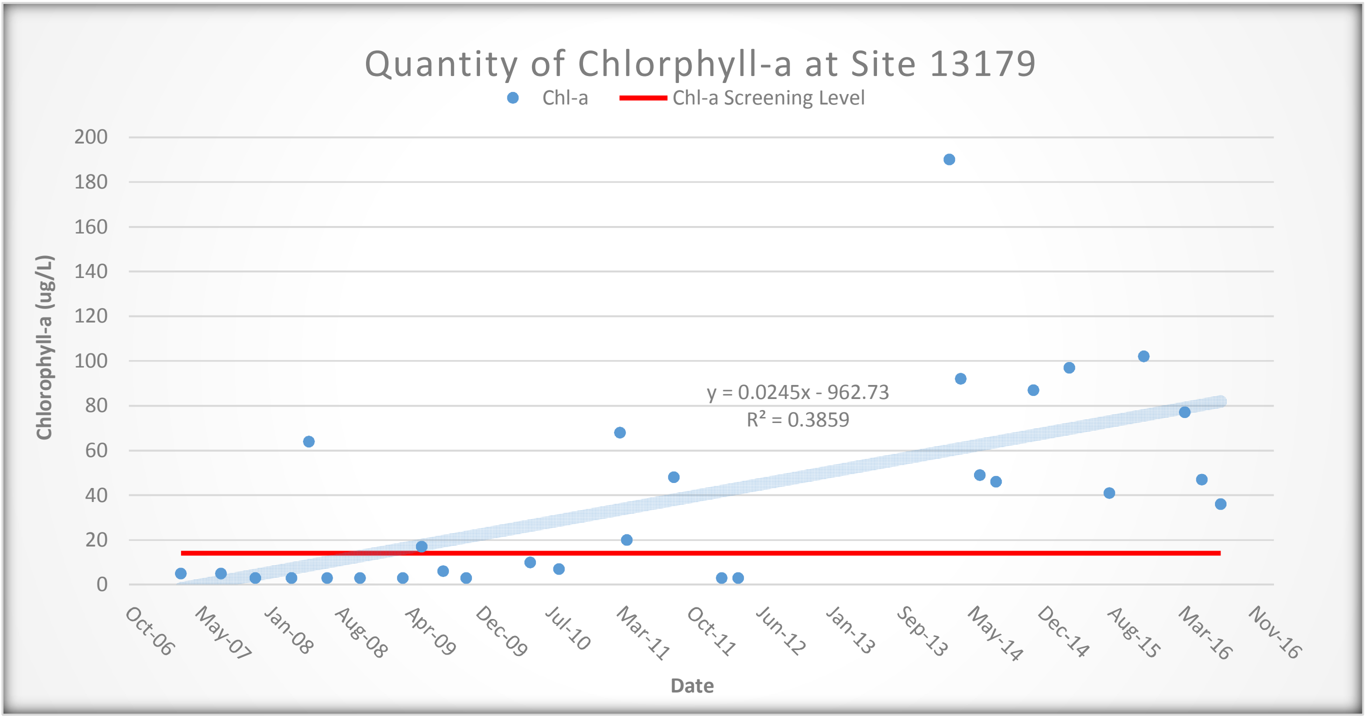

Figure 124. Station 13179, Phosphorus

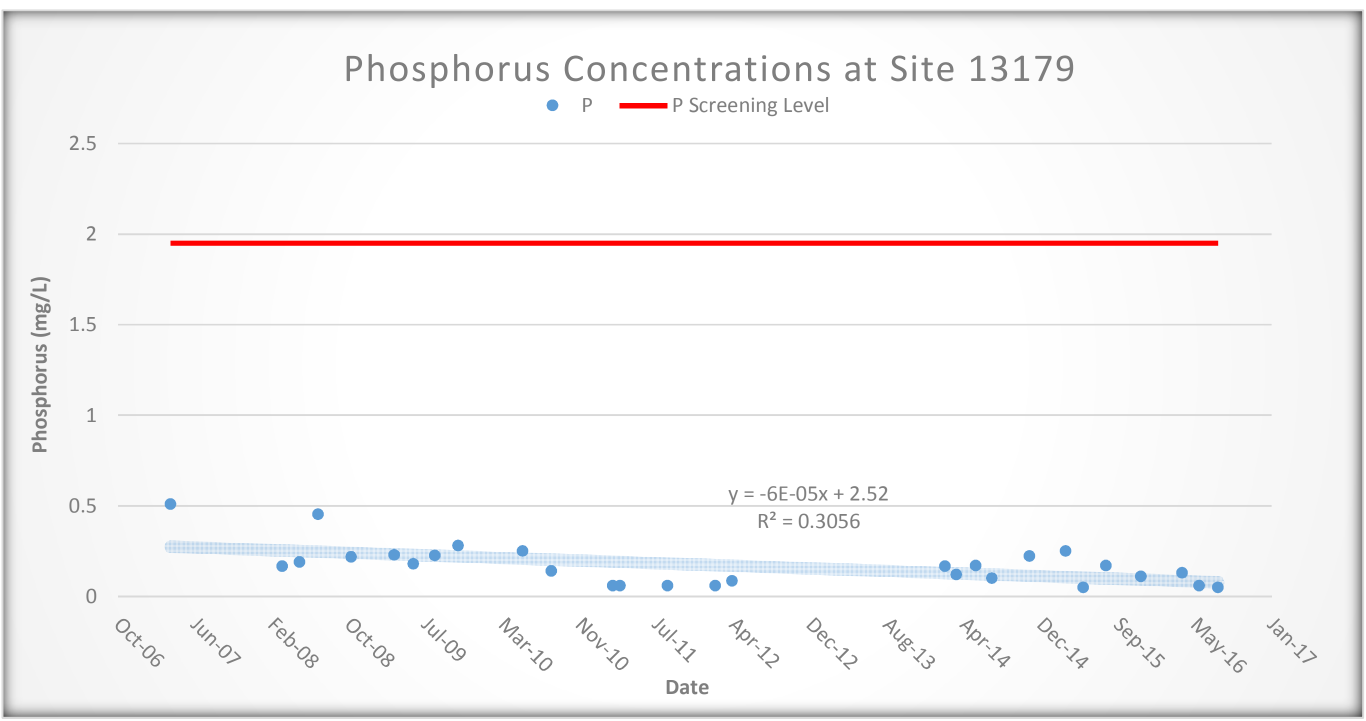

Figure 125. Station 15808, TDS

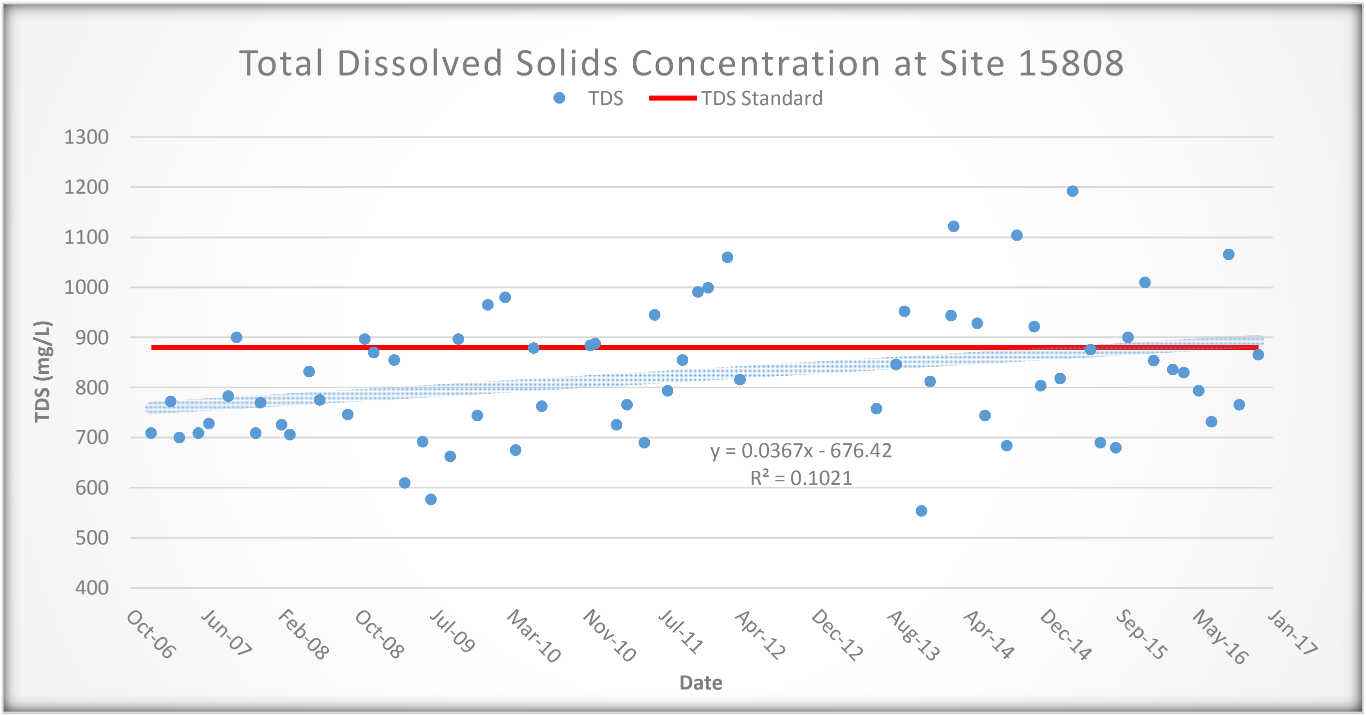

Figure 126. Station 15808, Chlorophyll-a

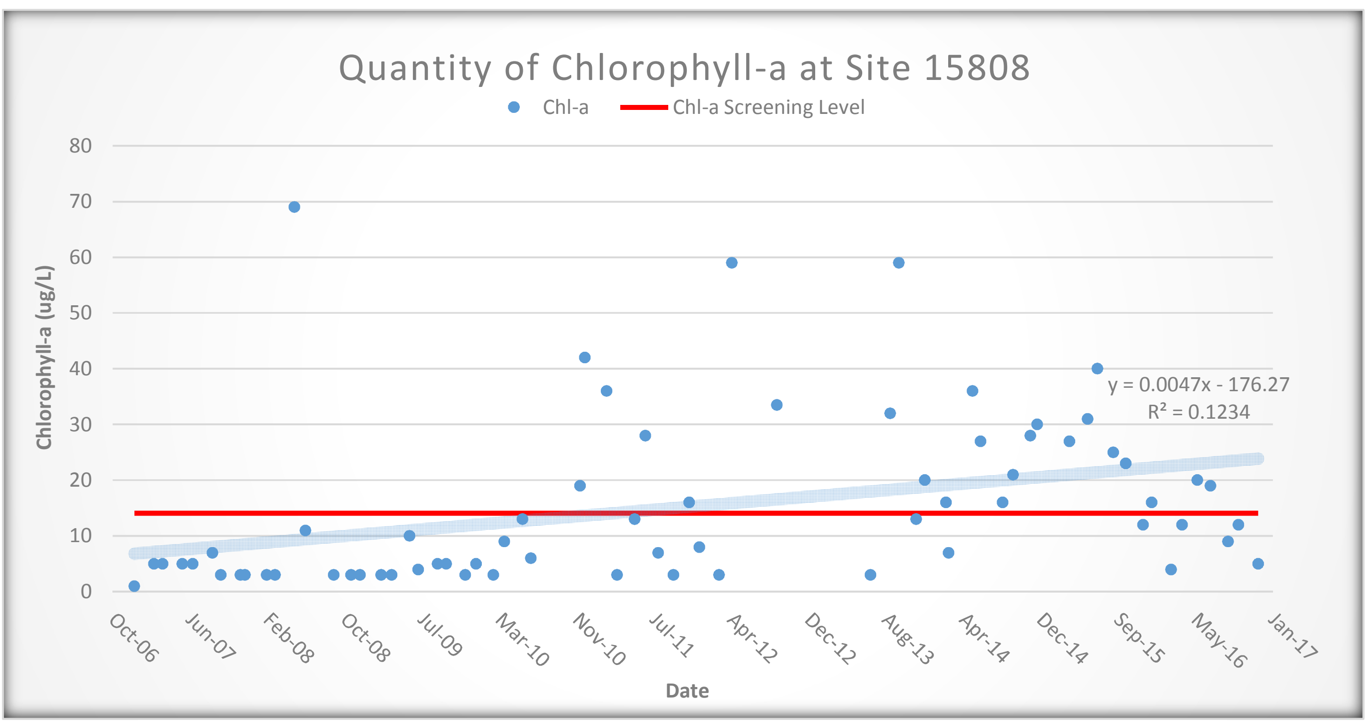

Figure 127. Station 15808, Sulfate

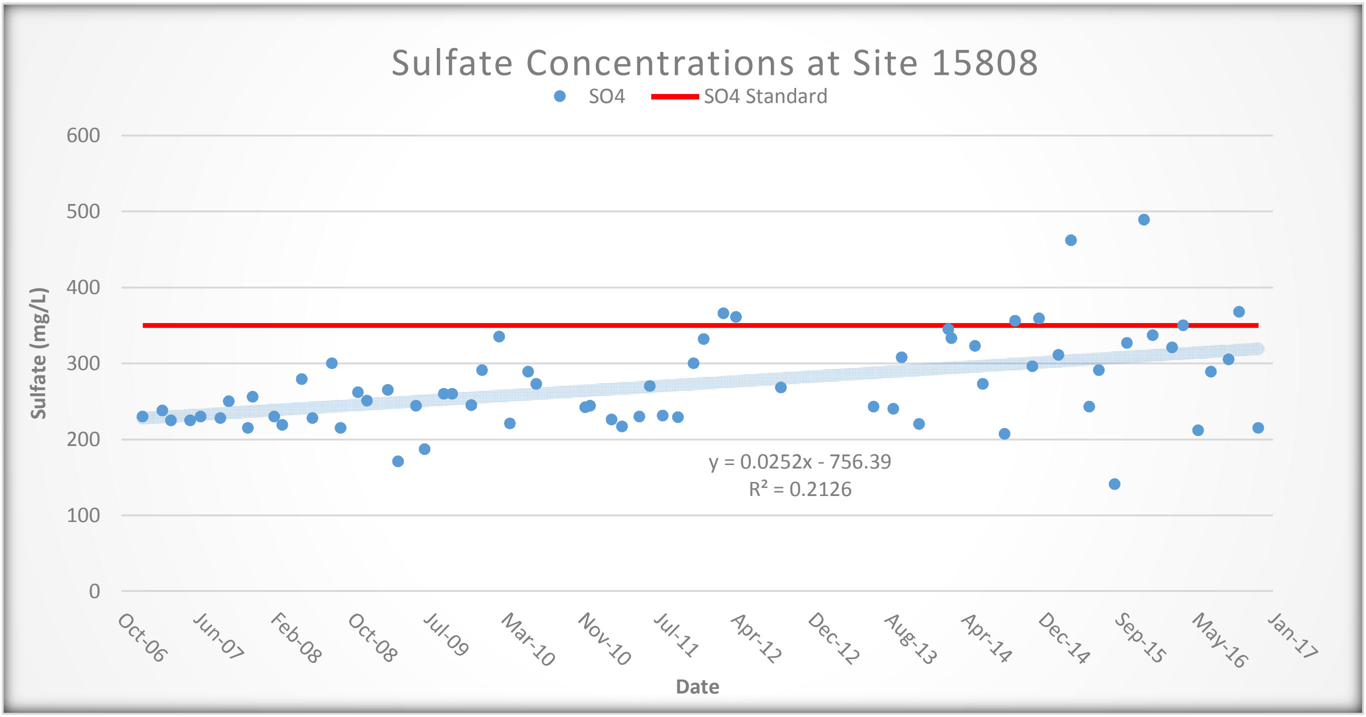

Figure 128. Station 17247, Chlorophyll-a

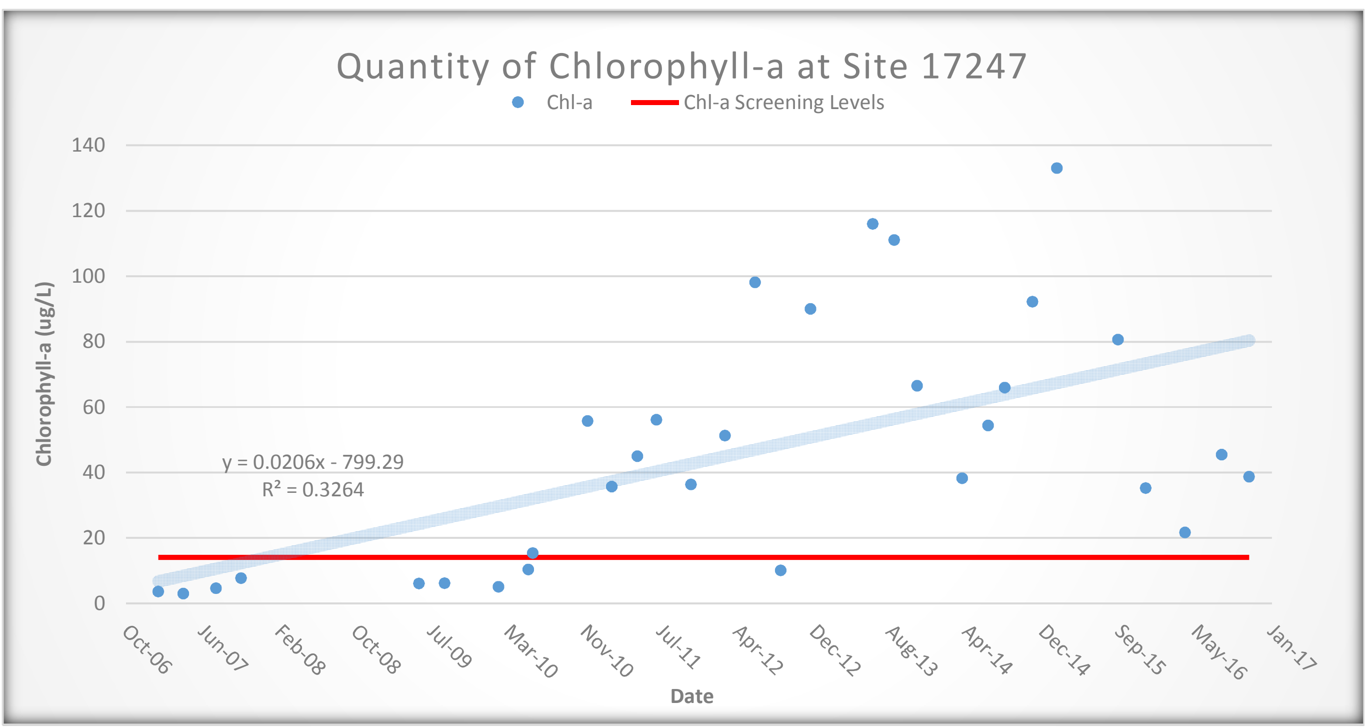

Figure 129. Station 17247, Ammonia

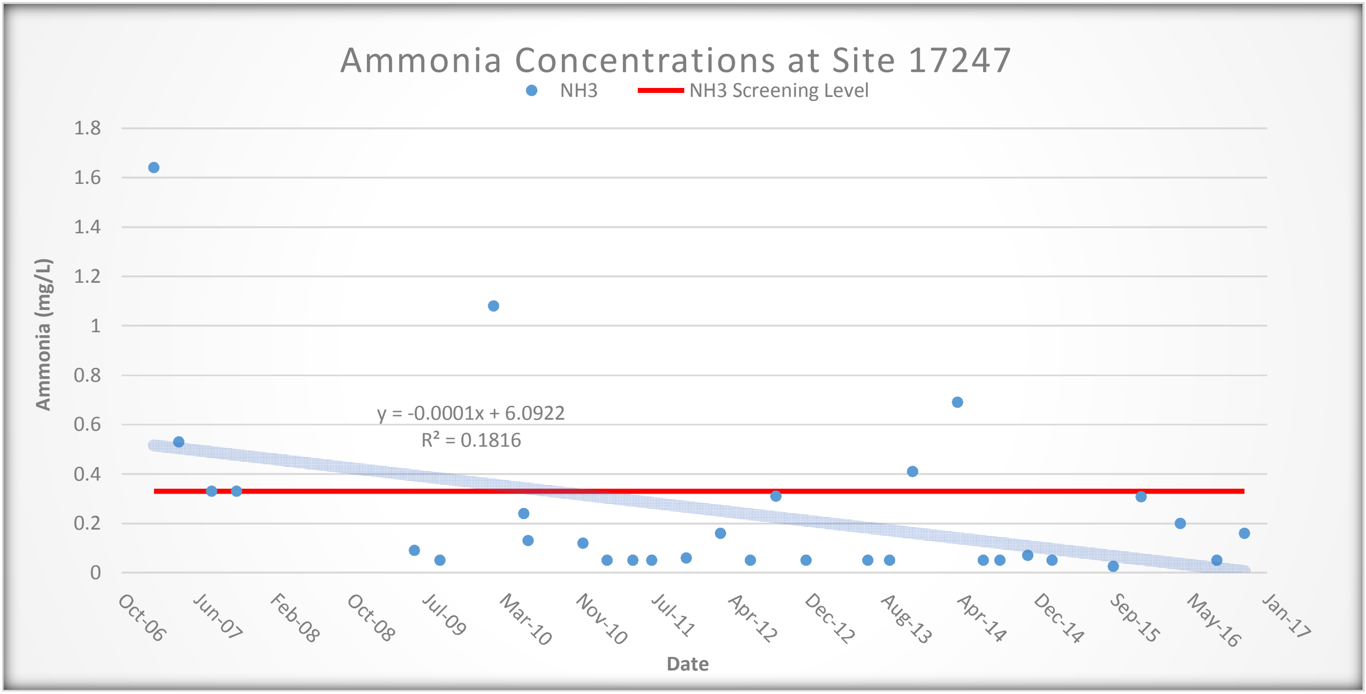

Figure 130. Station 13181, Chlorophyll-a

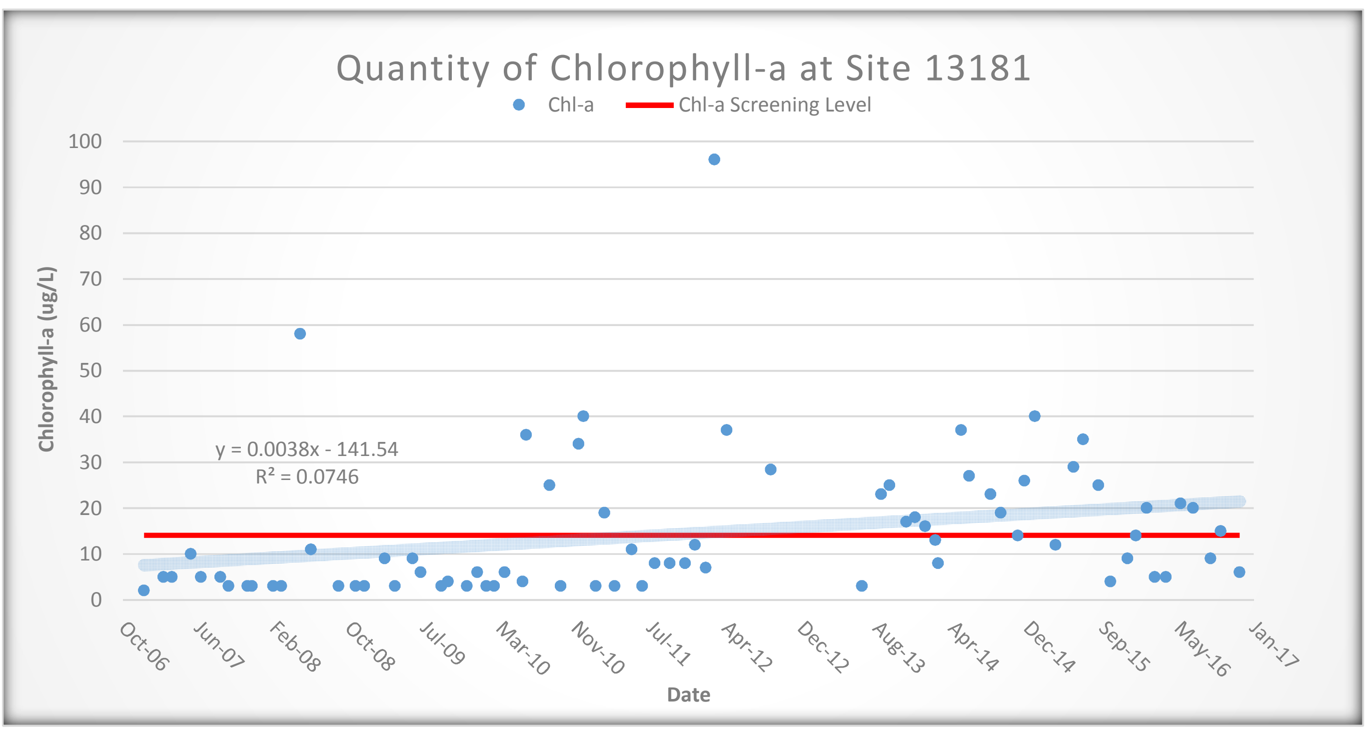

Figure 131. Station 13181, Sulfate

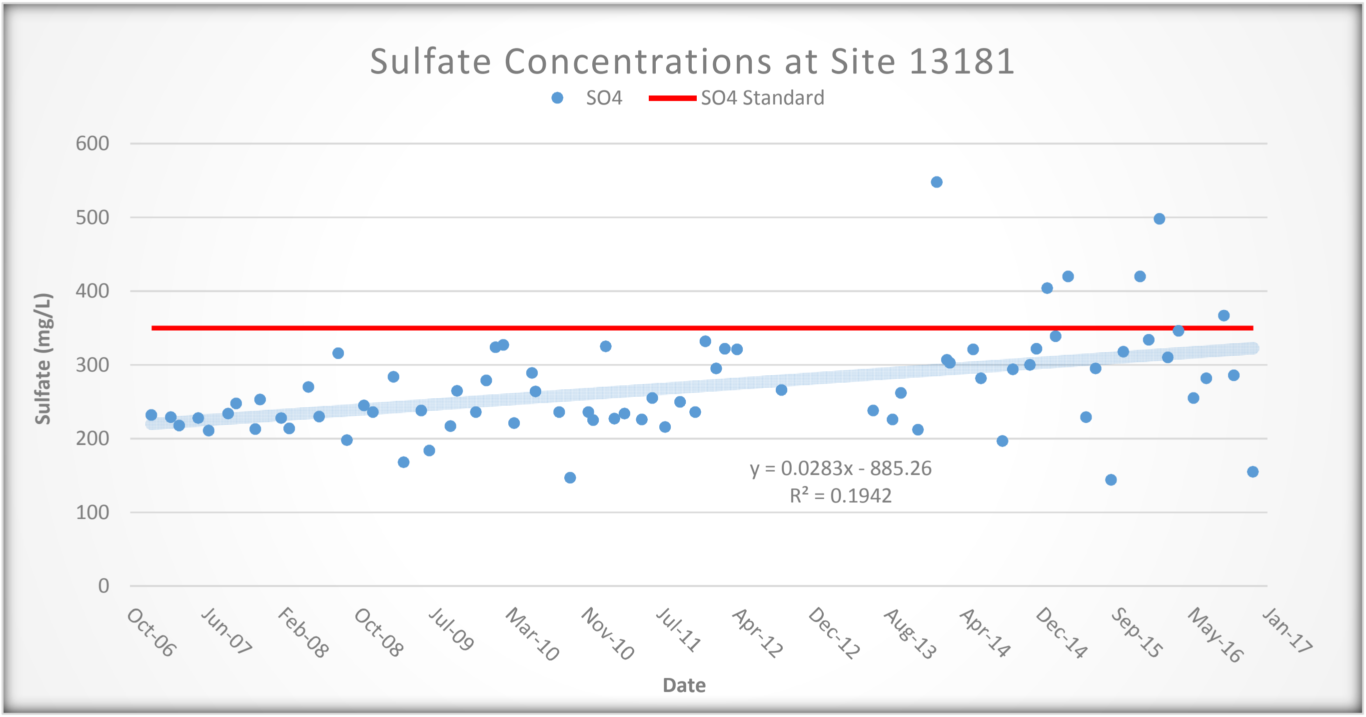

Figure 132. Station 10249, Ammonia

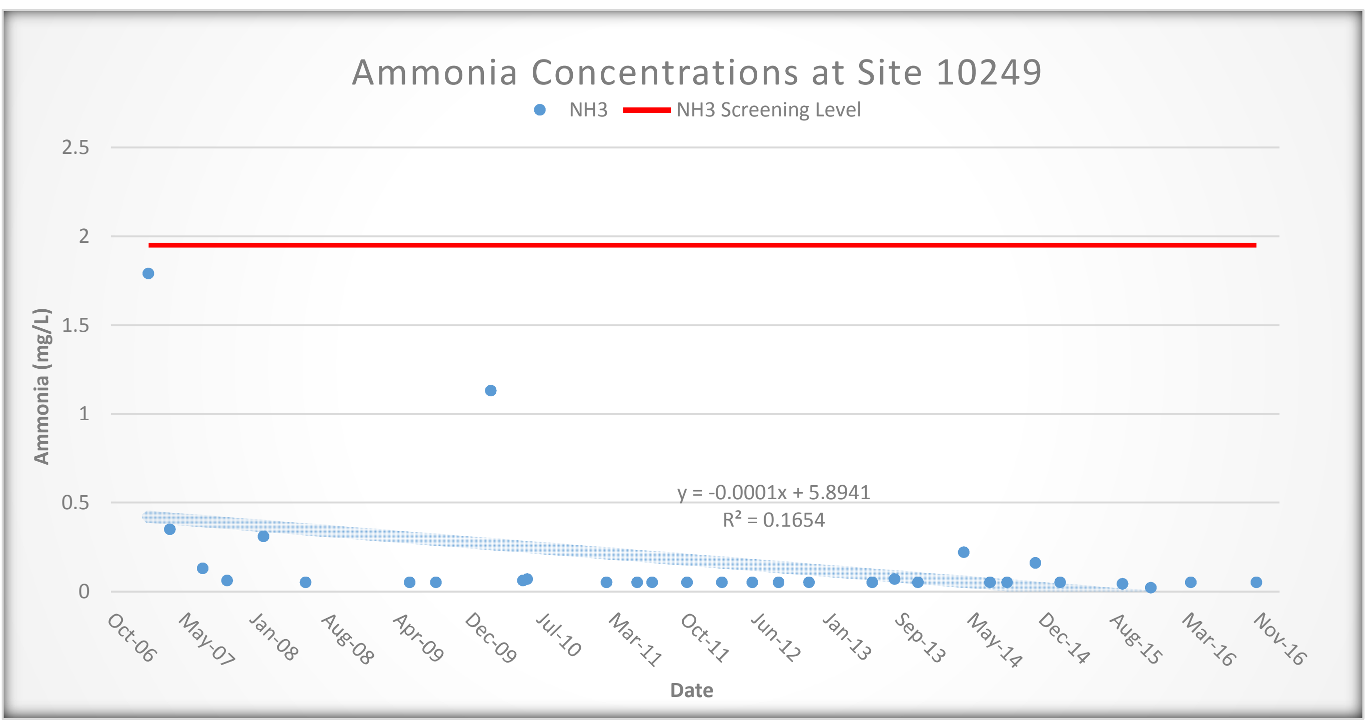

Figure 133. Station 13664, Sulfate

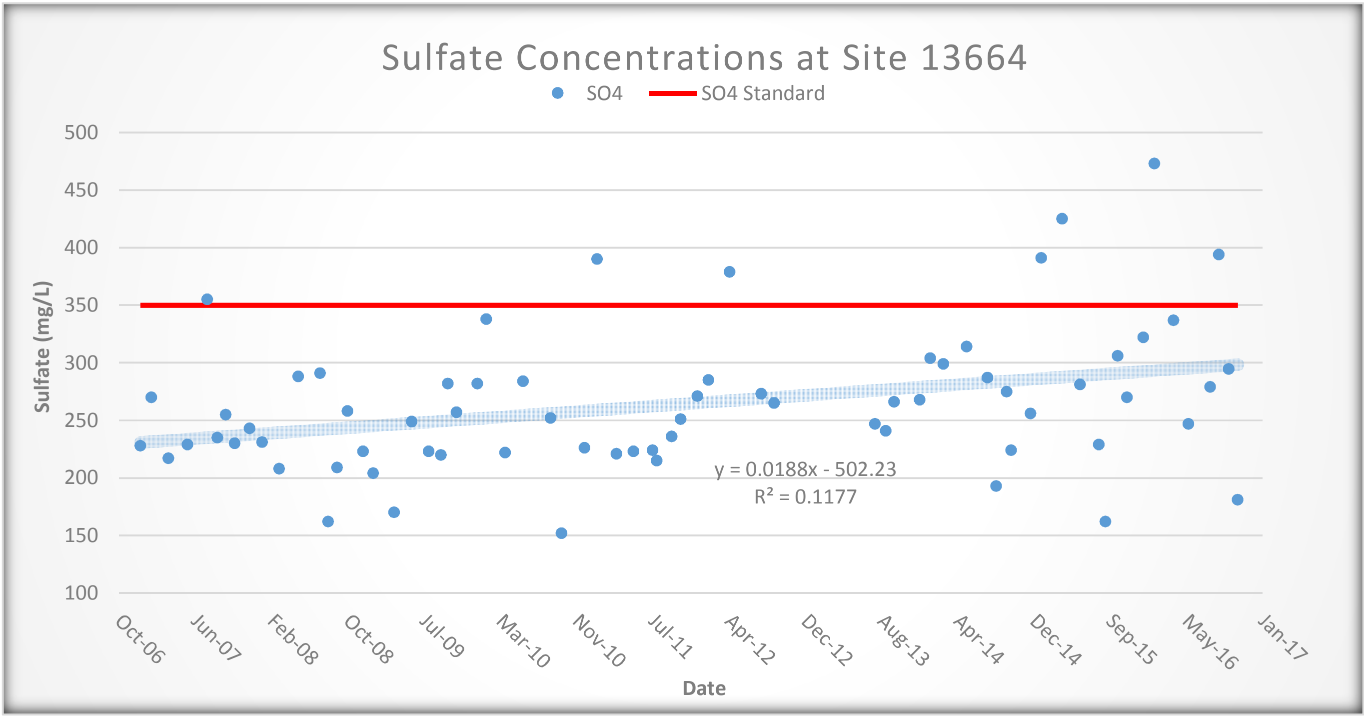

Figure 134. Station 13186, Sulfate and Chloride

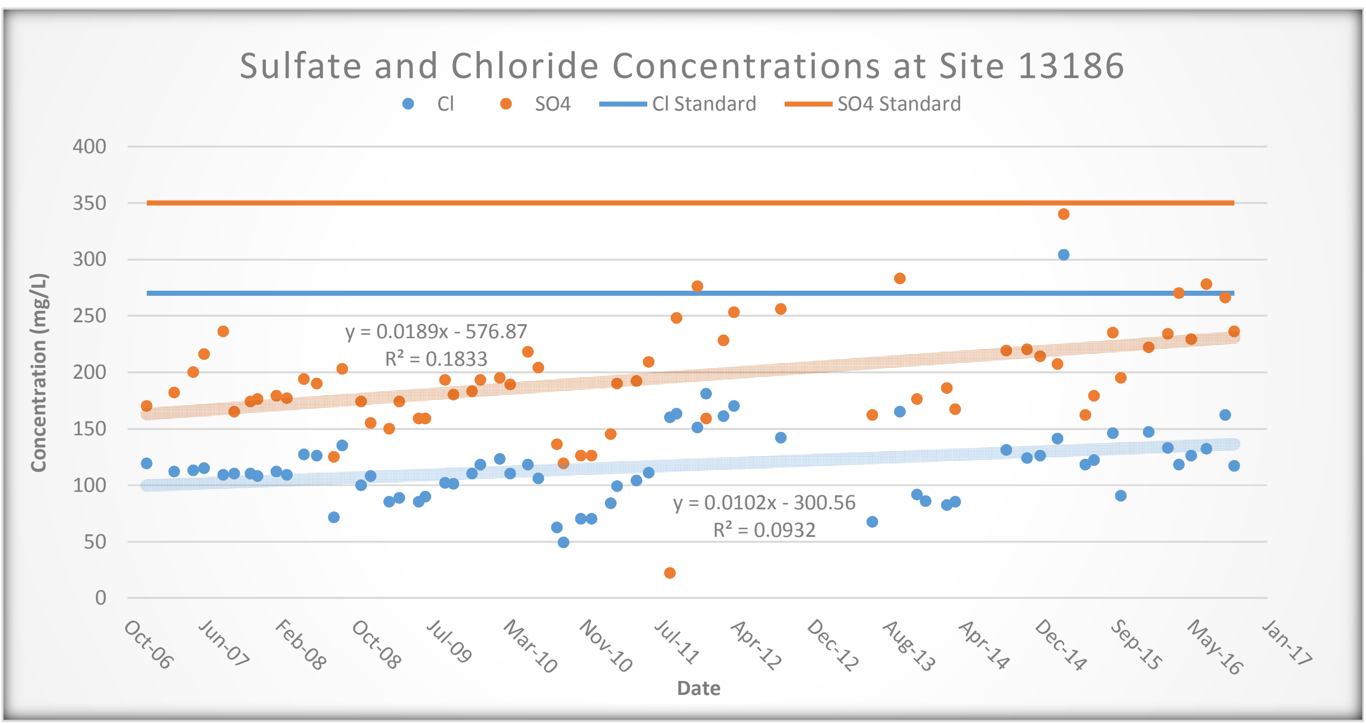

Figure 135. Station 13185, TDS

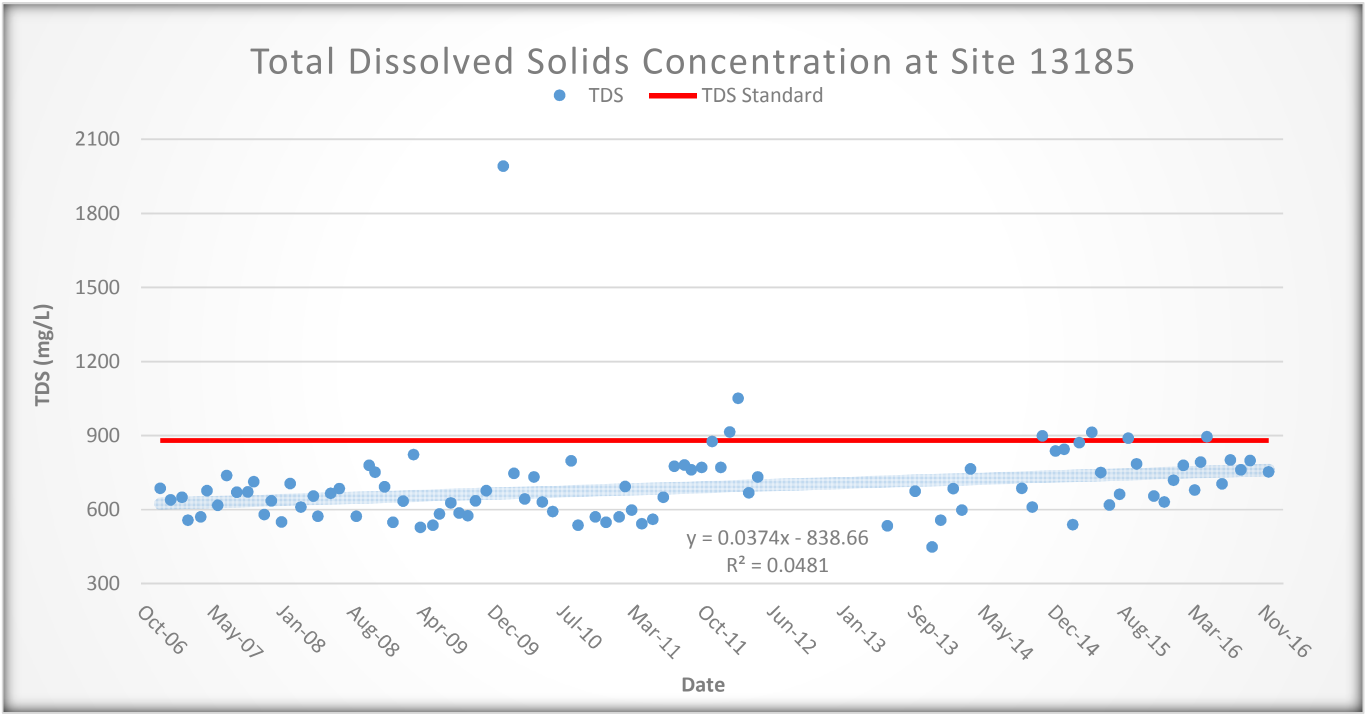

Figure 136. Station 13185, Phosphorus

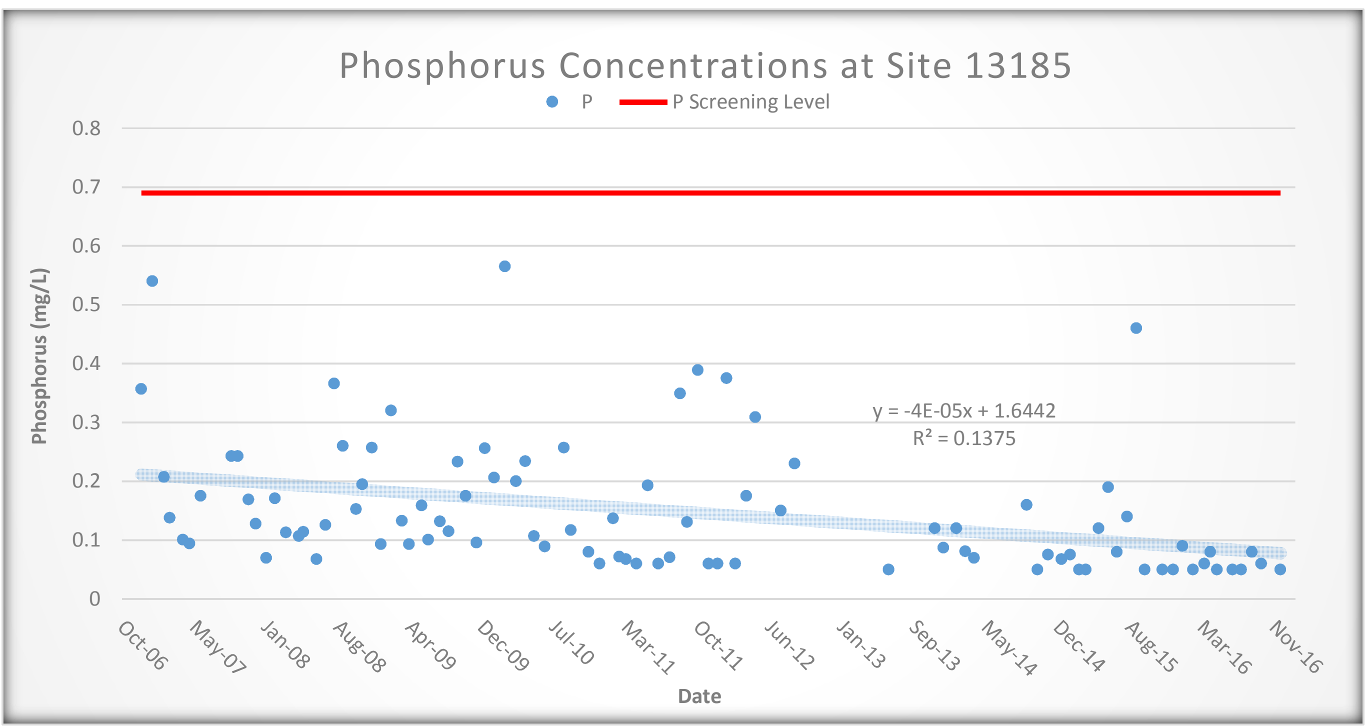

Figure 137. Station 13185, Sulfate and Chloride

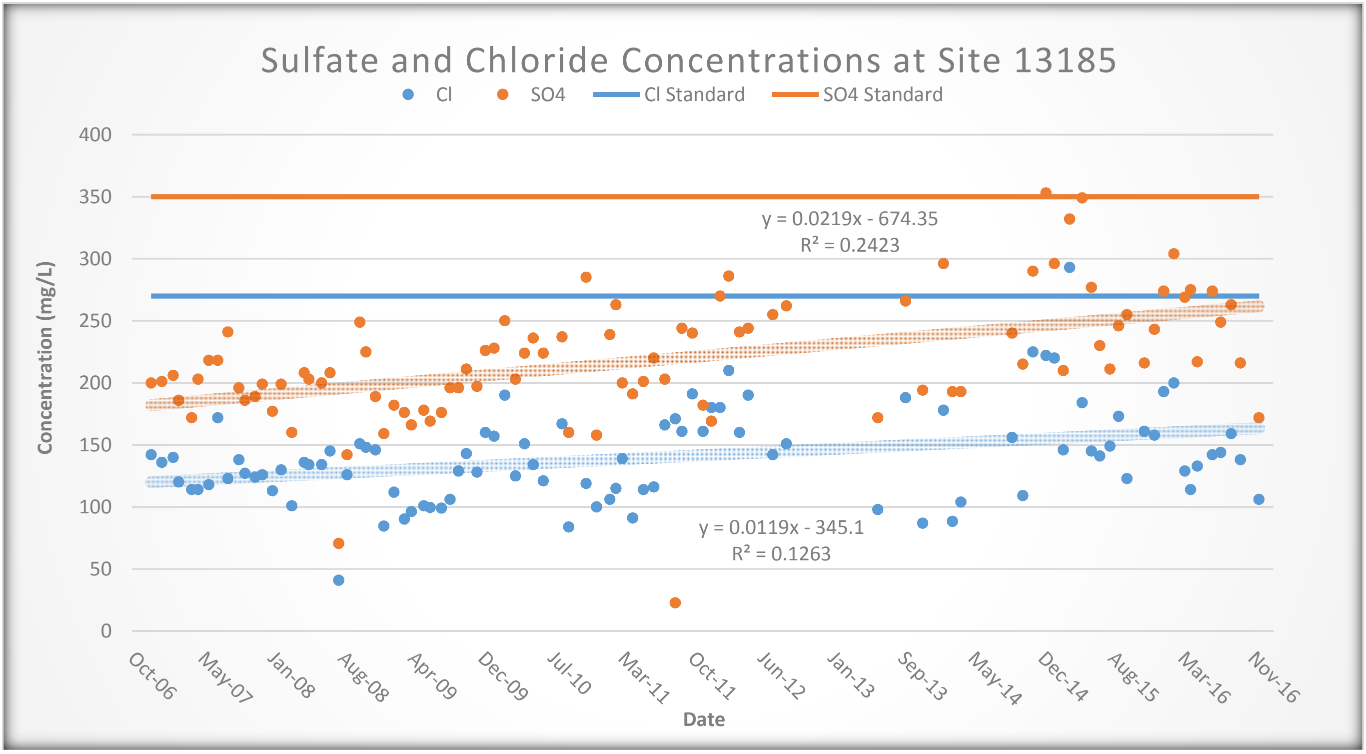

Figure 138. Station 15817, Chlorophyll-a

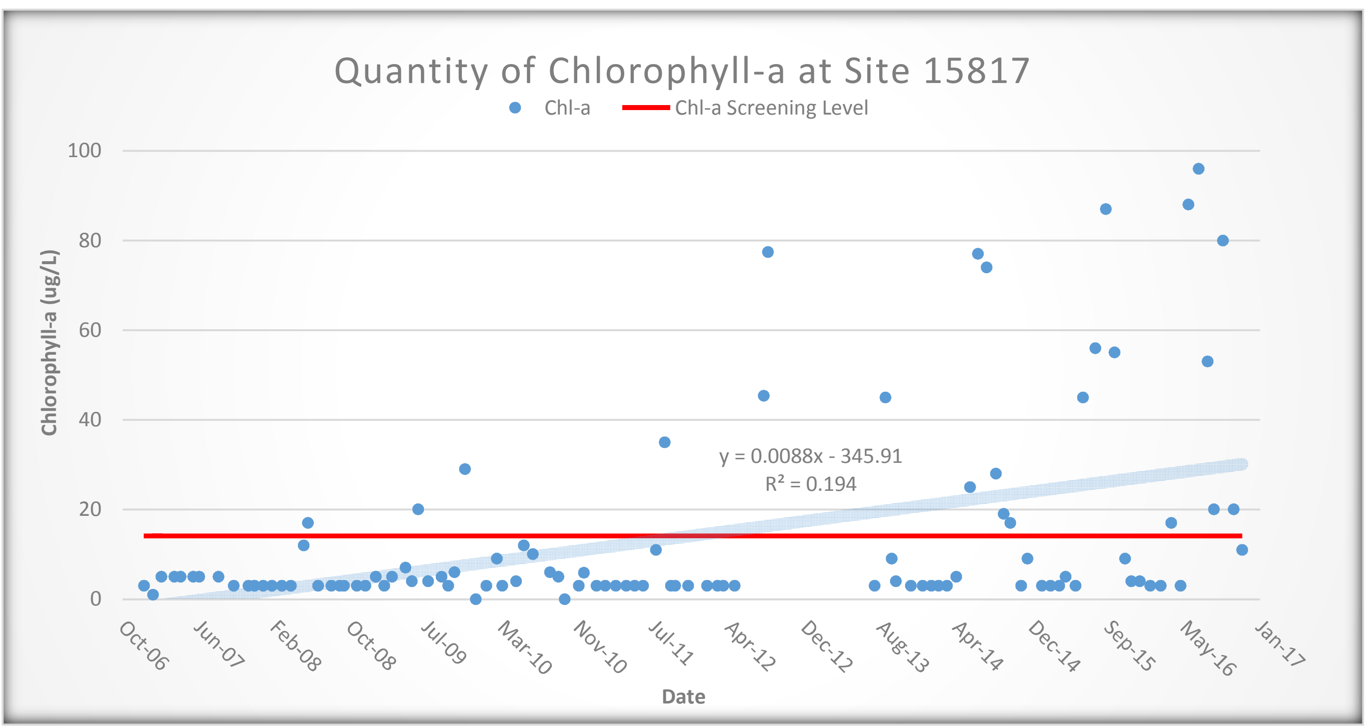

Figure 139. Station 15817, Phosphorus

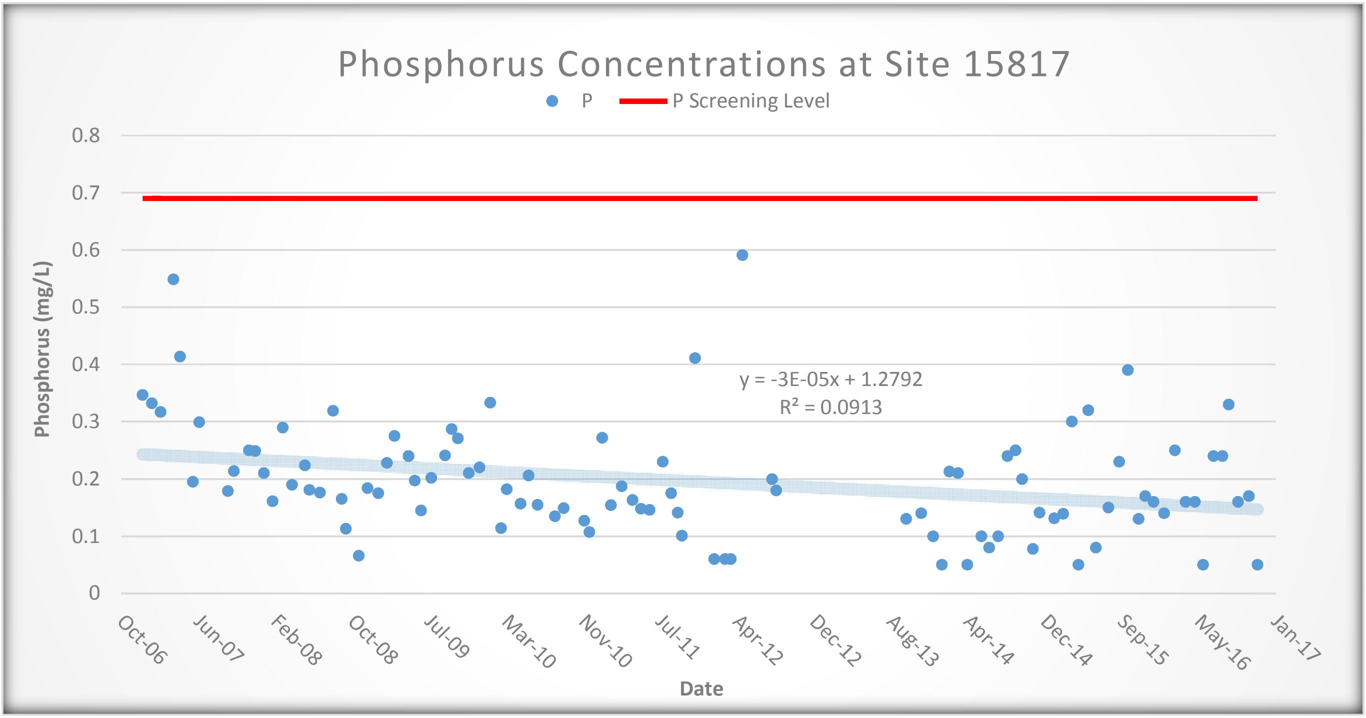

Figure 140. Station 15817, Sulfate and Chloride

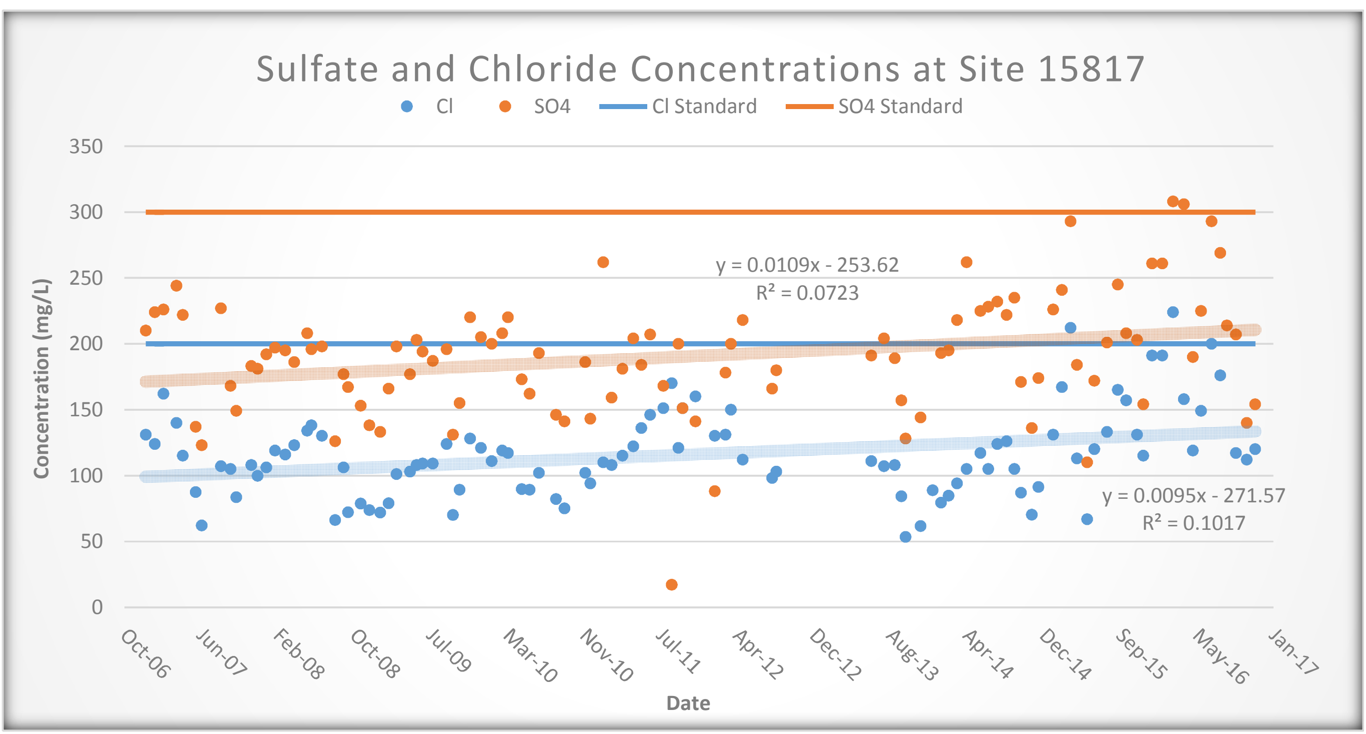

Figure 141. Station 20999, Ammonia

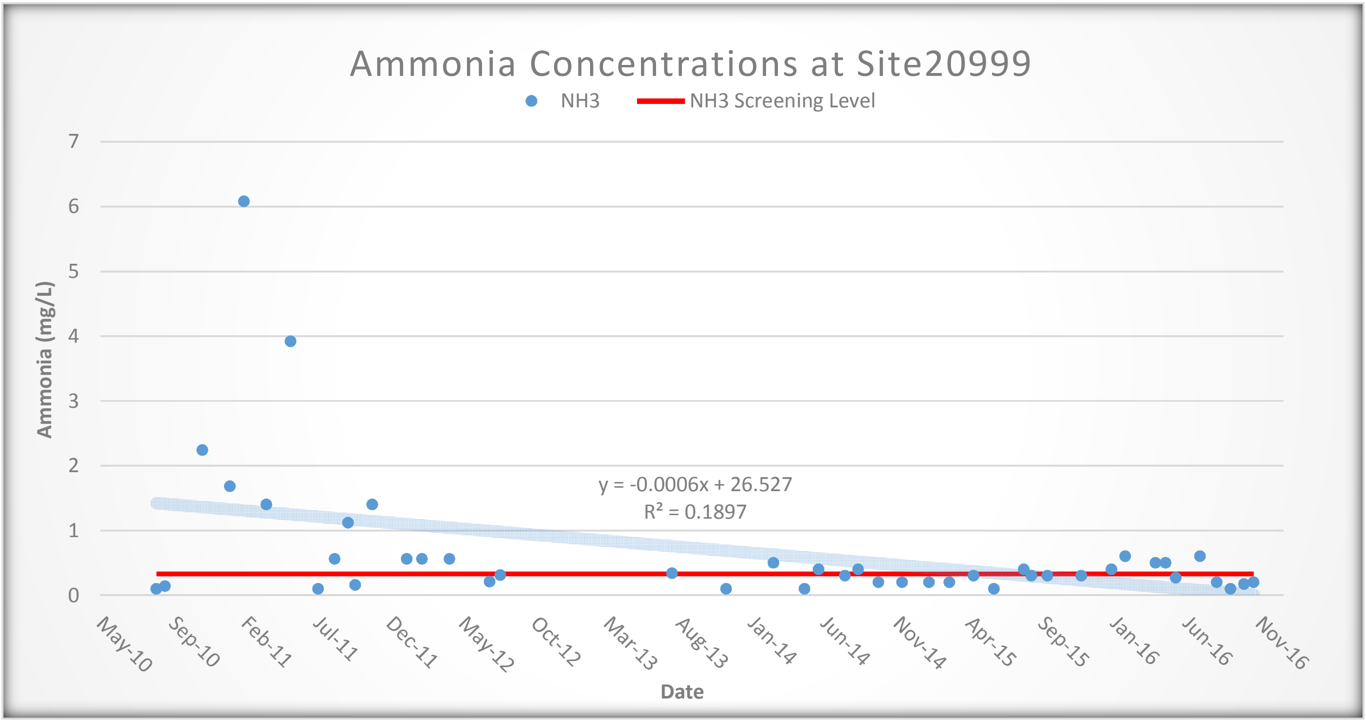

Figure 142. Station 20999, Chlorophyll-a

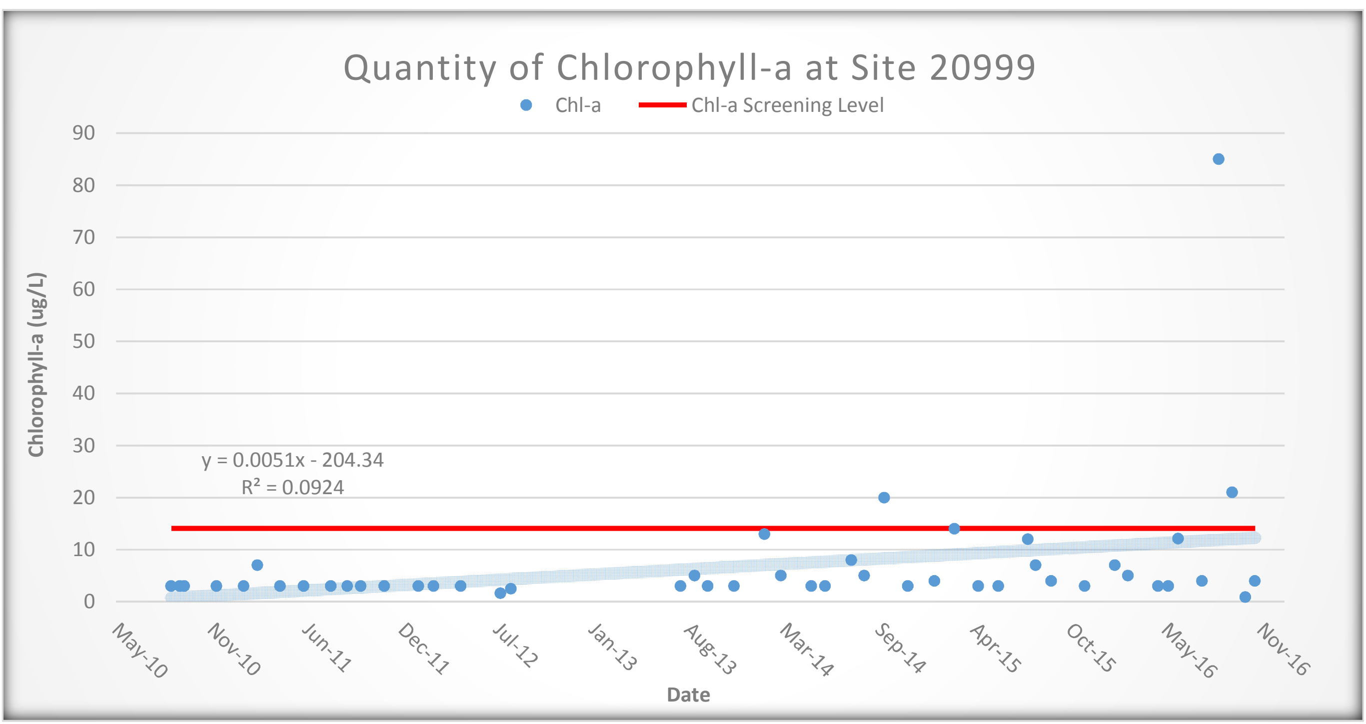

Figure 143. Station 20999, Sulfate

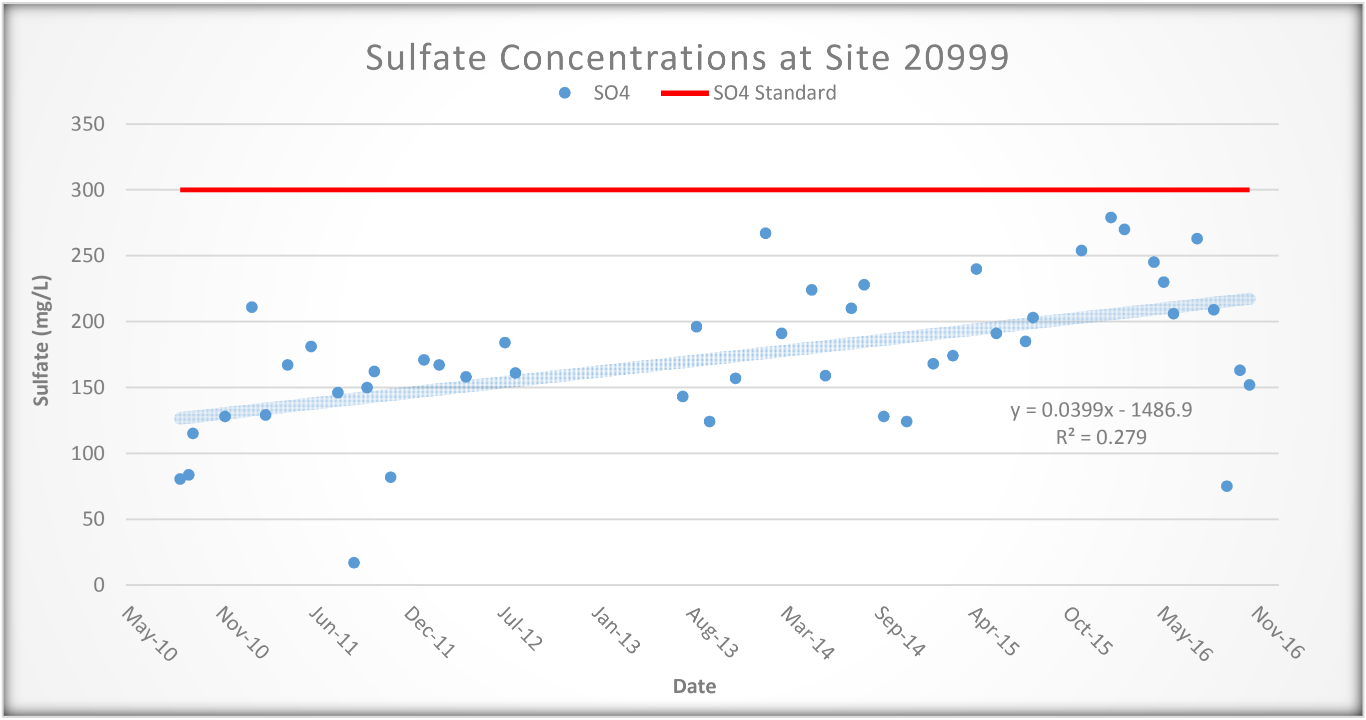

Figure 144. Station 20999, TDS

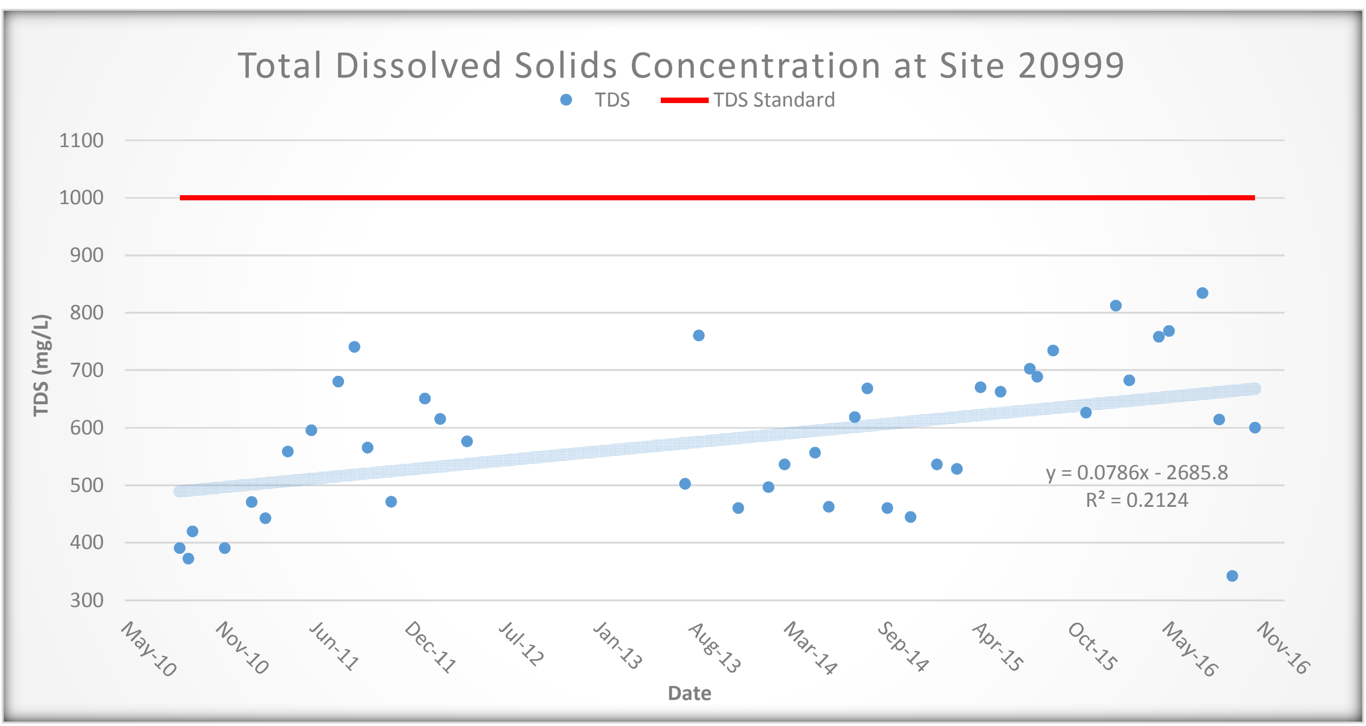

Figure 145. Station 20997, Ammonia

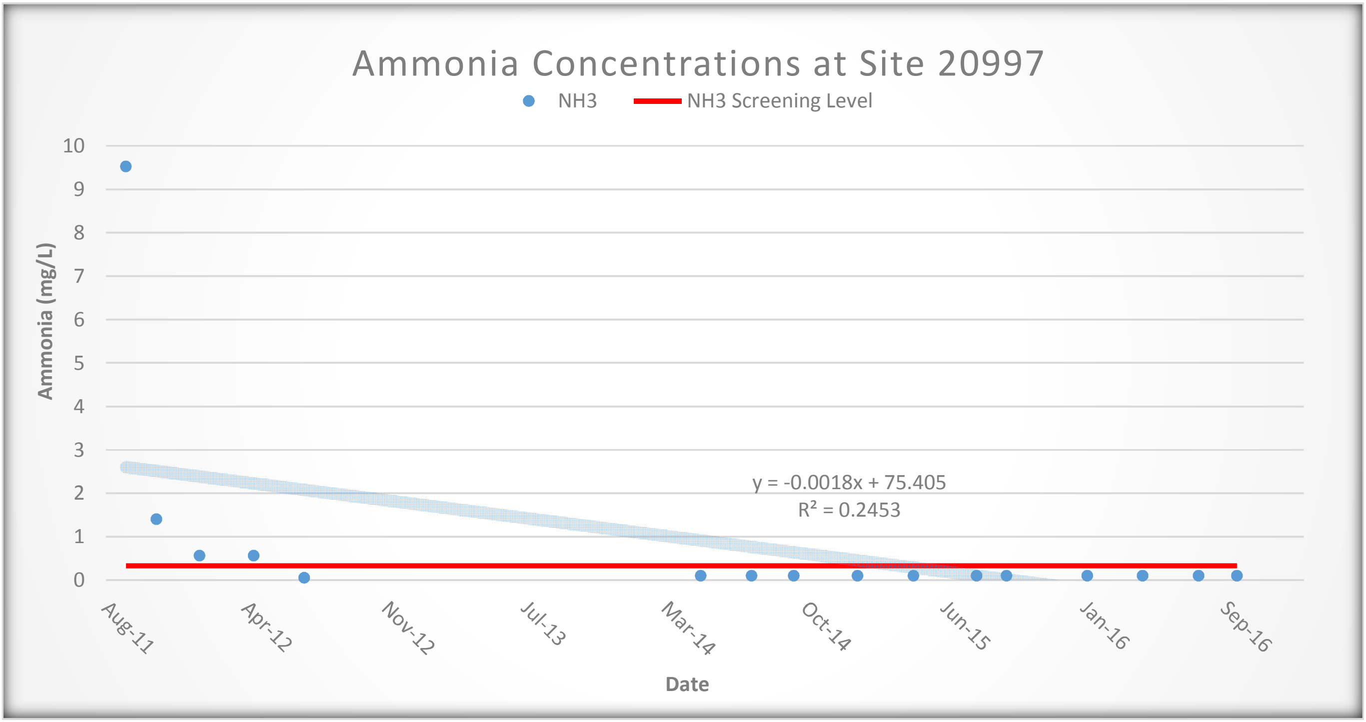

Figure 146. Station 20997, Chlorophyll-a

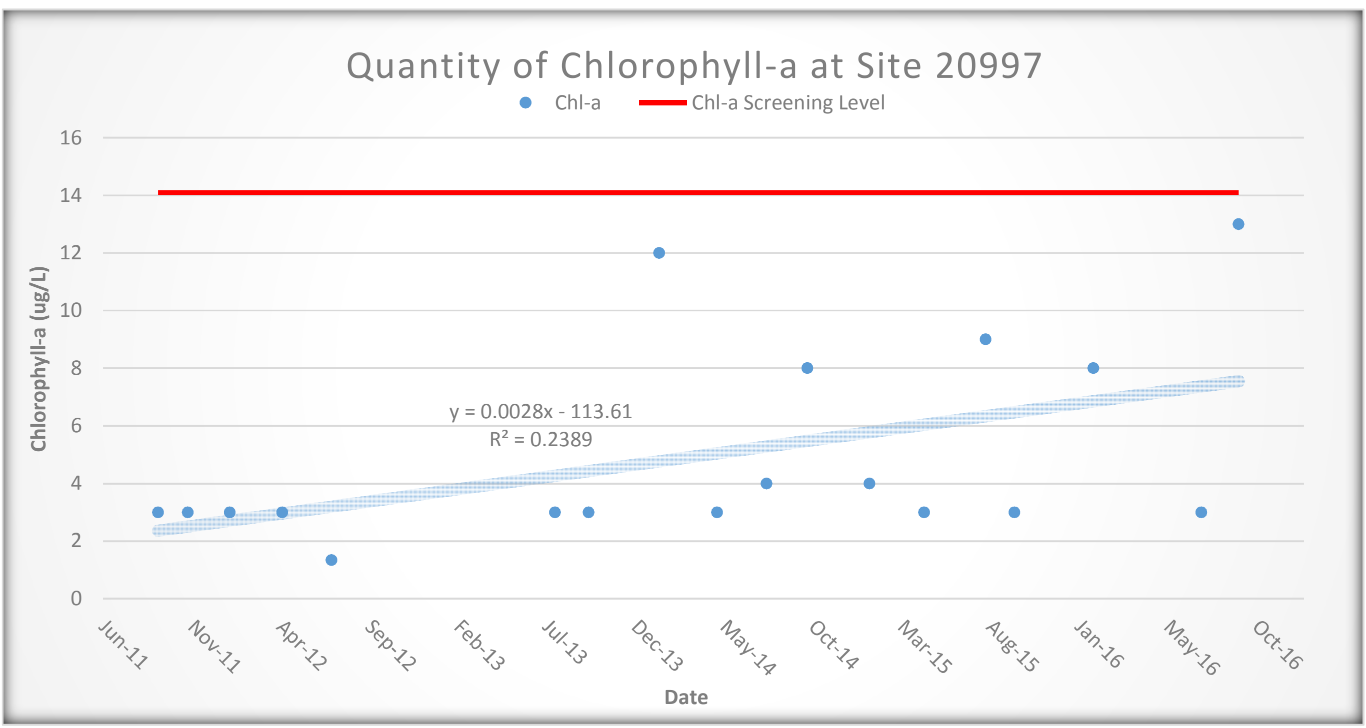

Figure 147. Station 13560, TDS

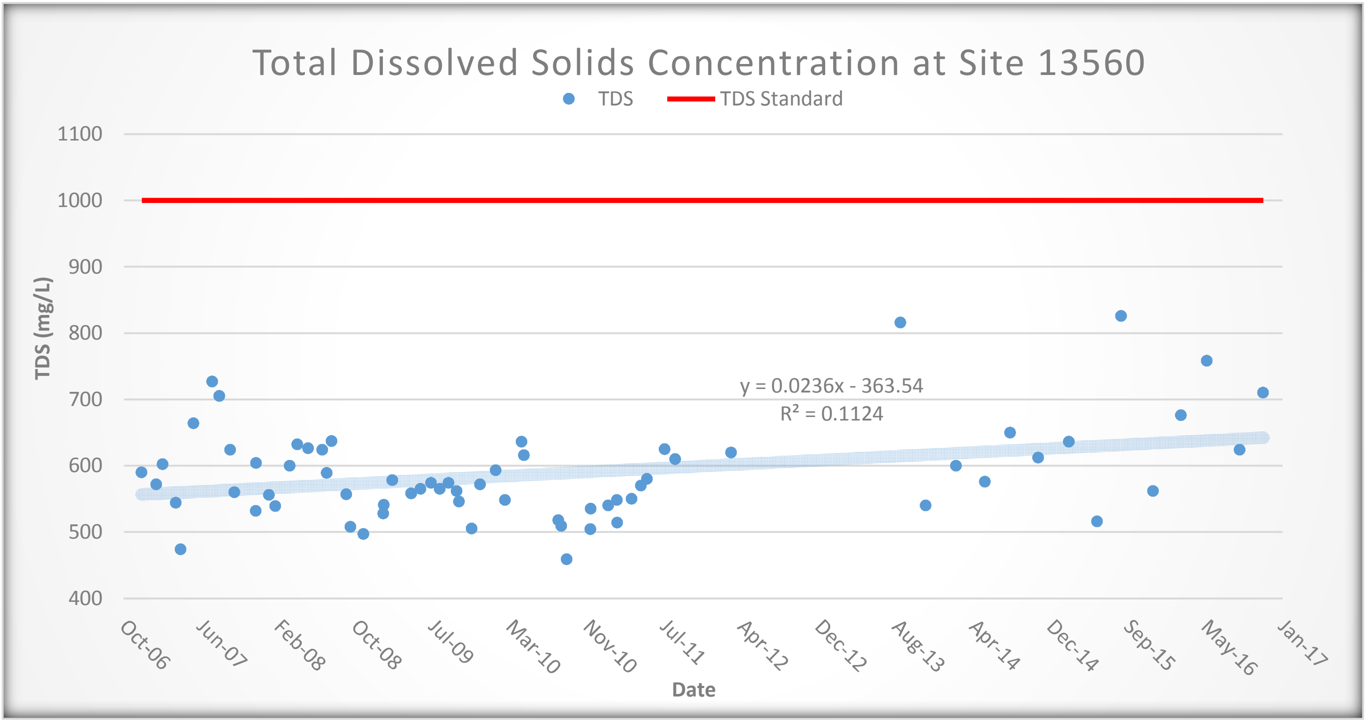

Figure 148. Station 13560, Phosphorus

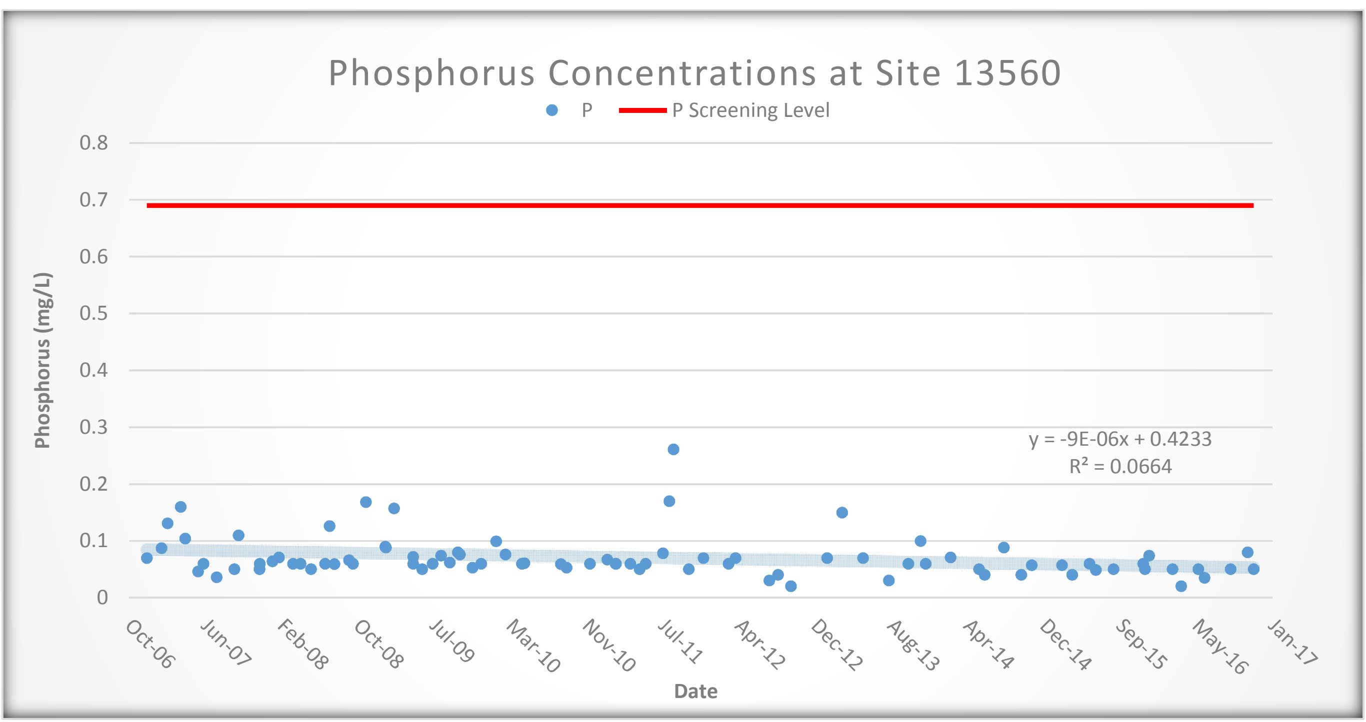

Figure 149. Station 13208, Chloride and Sulfate

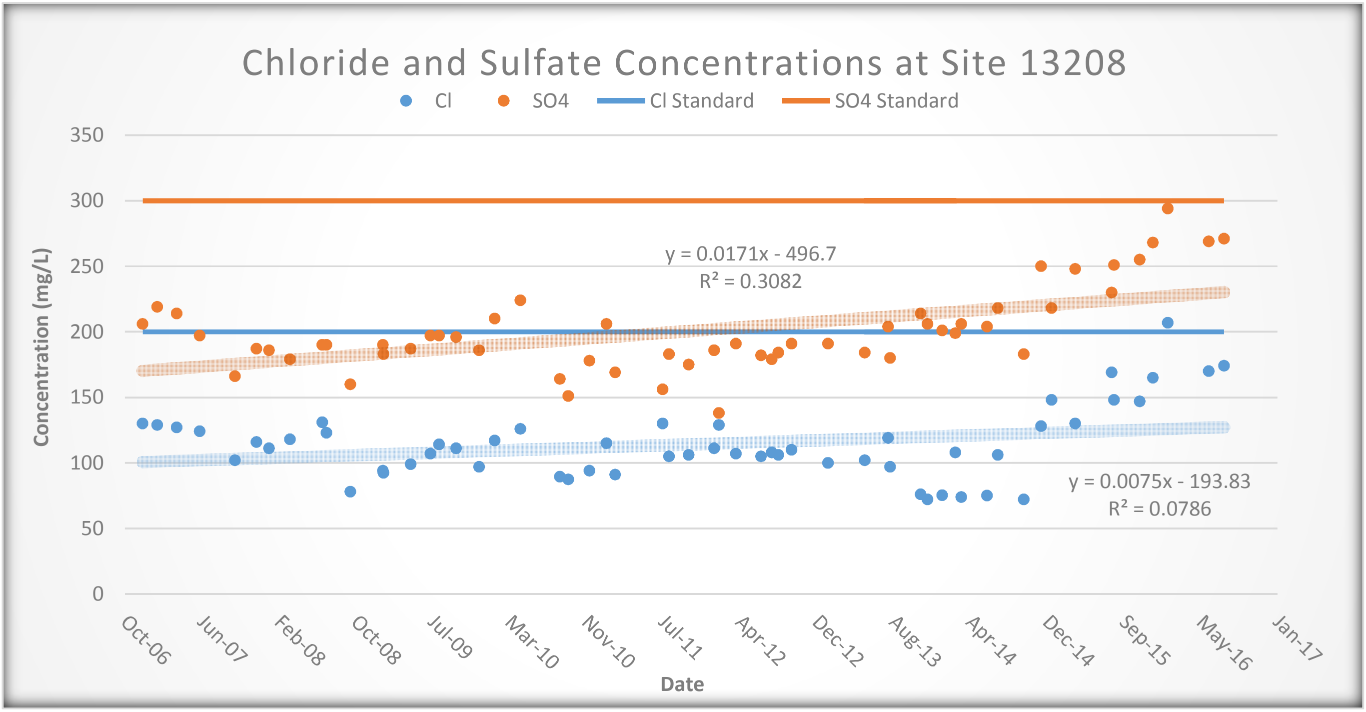

Figure 150. Station 13116, Nitrate+Nitrite

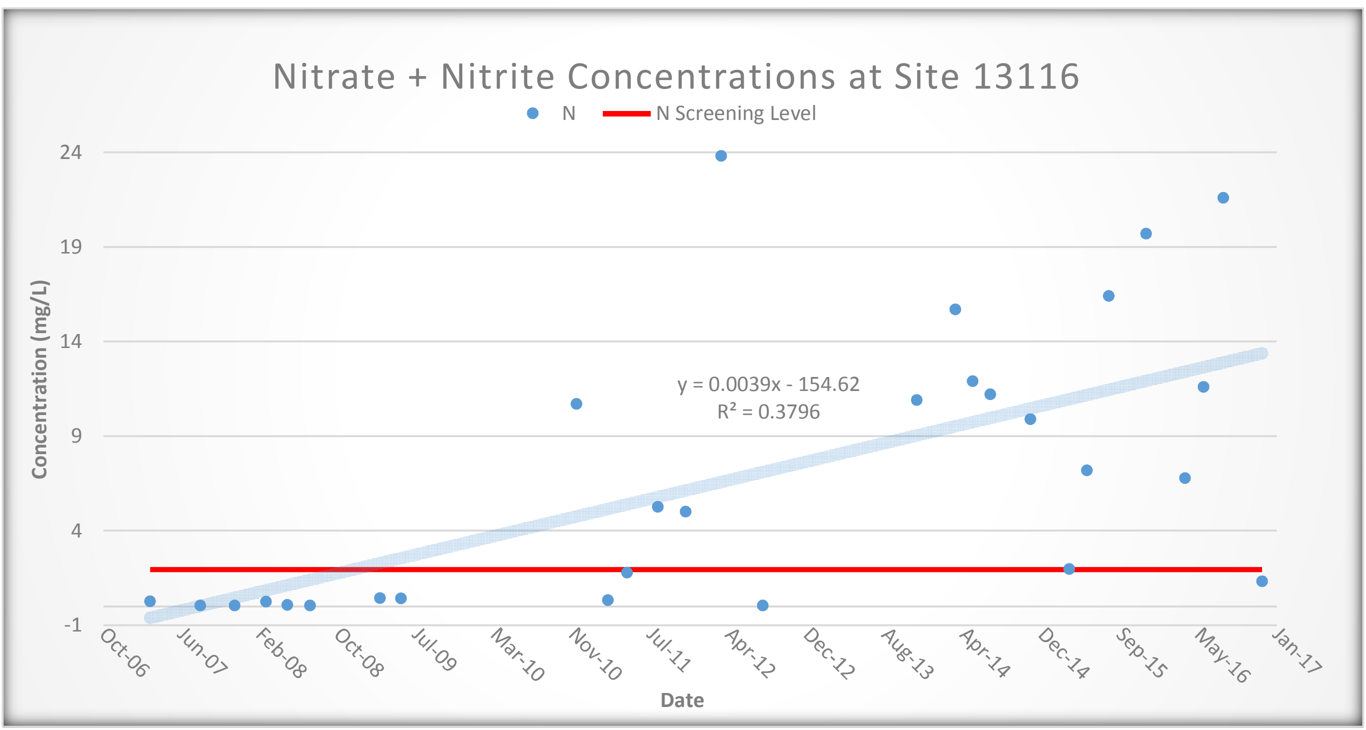

Figure 151. Station 13116, Chloride

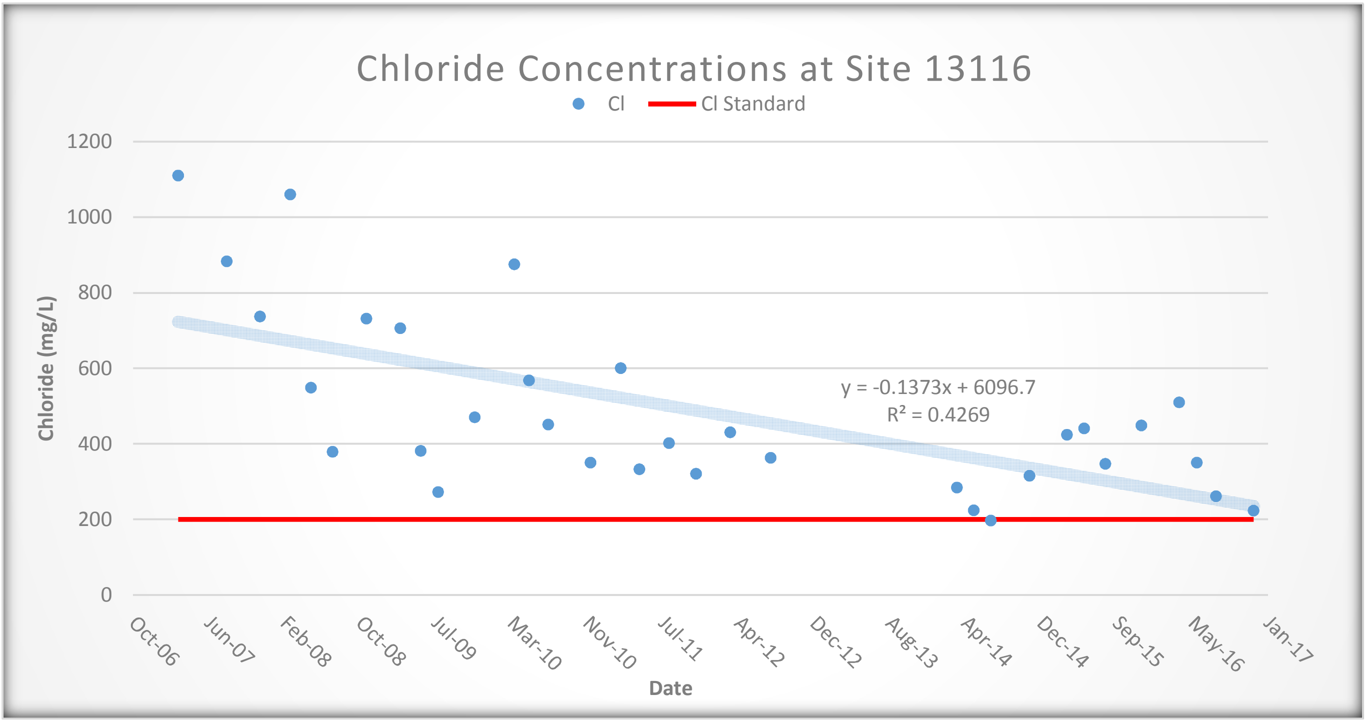

Figure 152. Station 13116, Sulfate

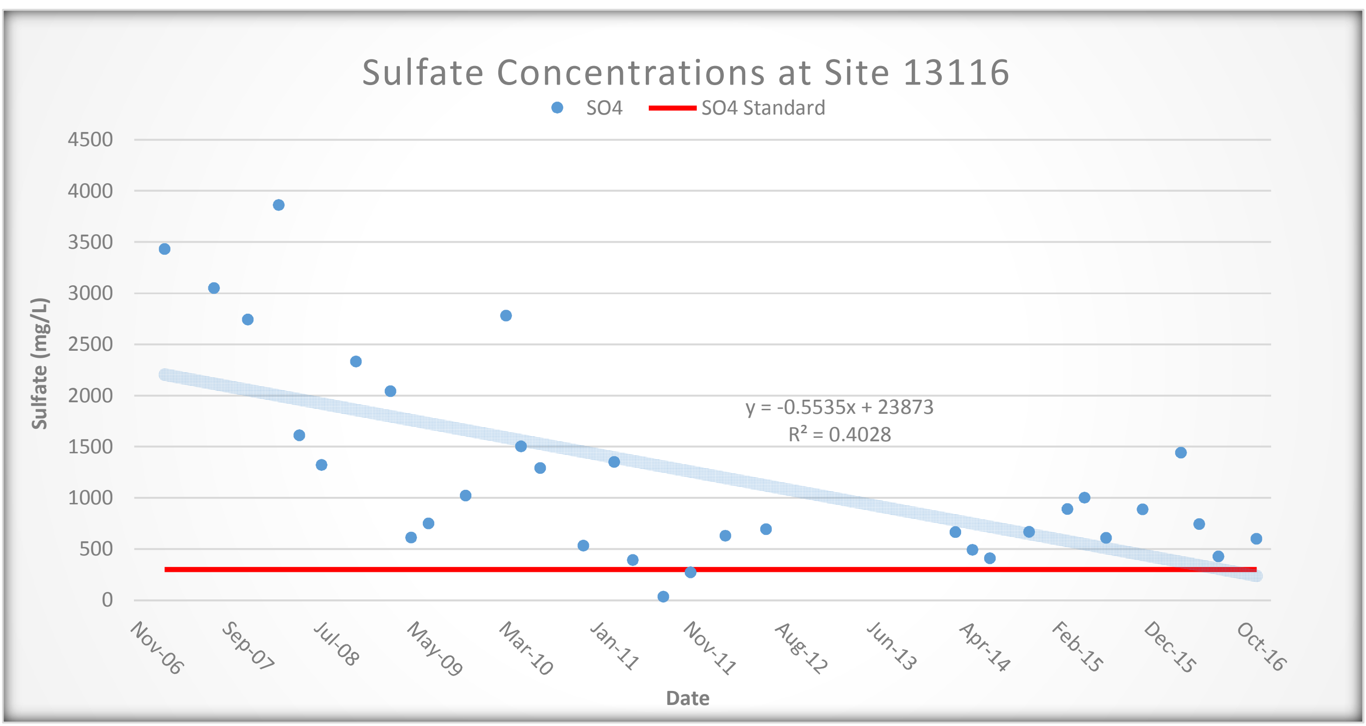

Figure 153. Station 13116, Phosphorus

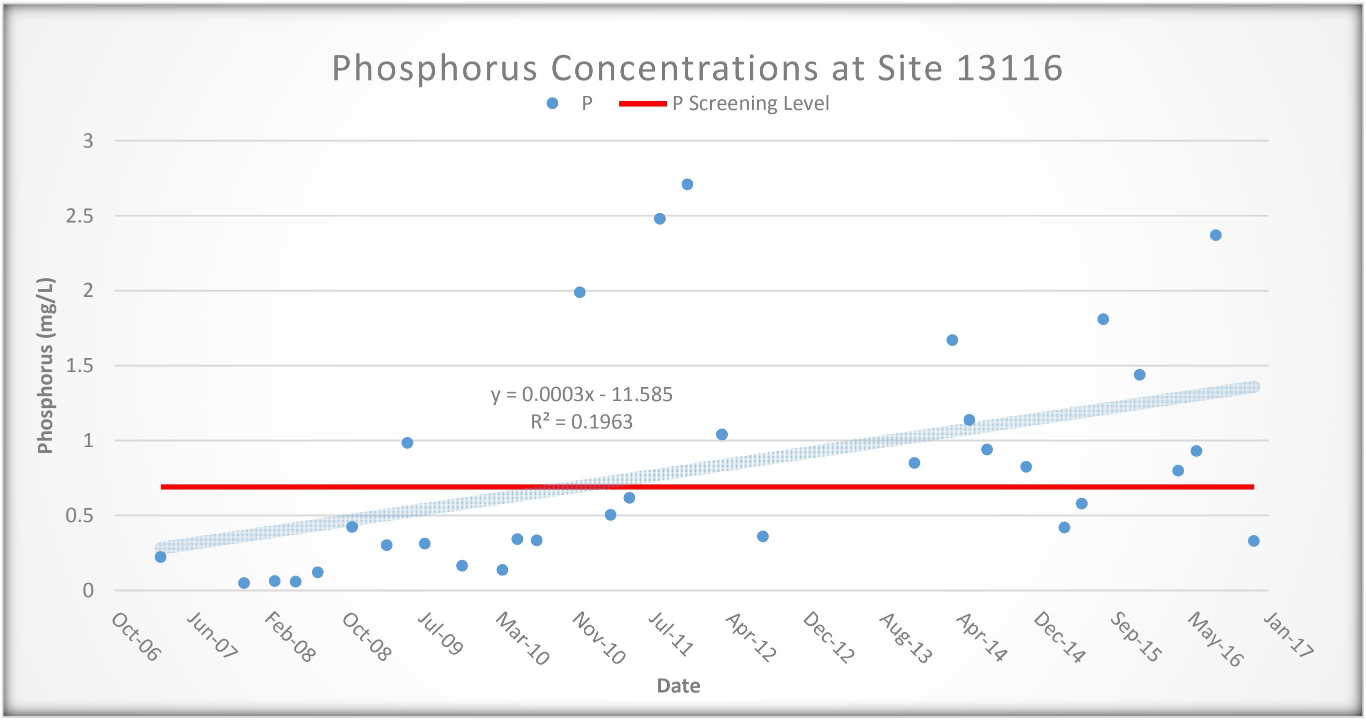

Figure 154. Station 13116, Chlorophyll-a

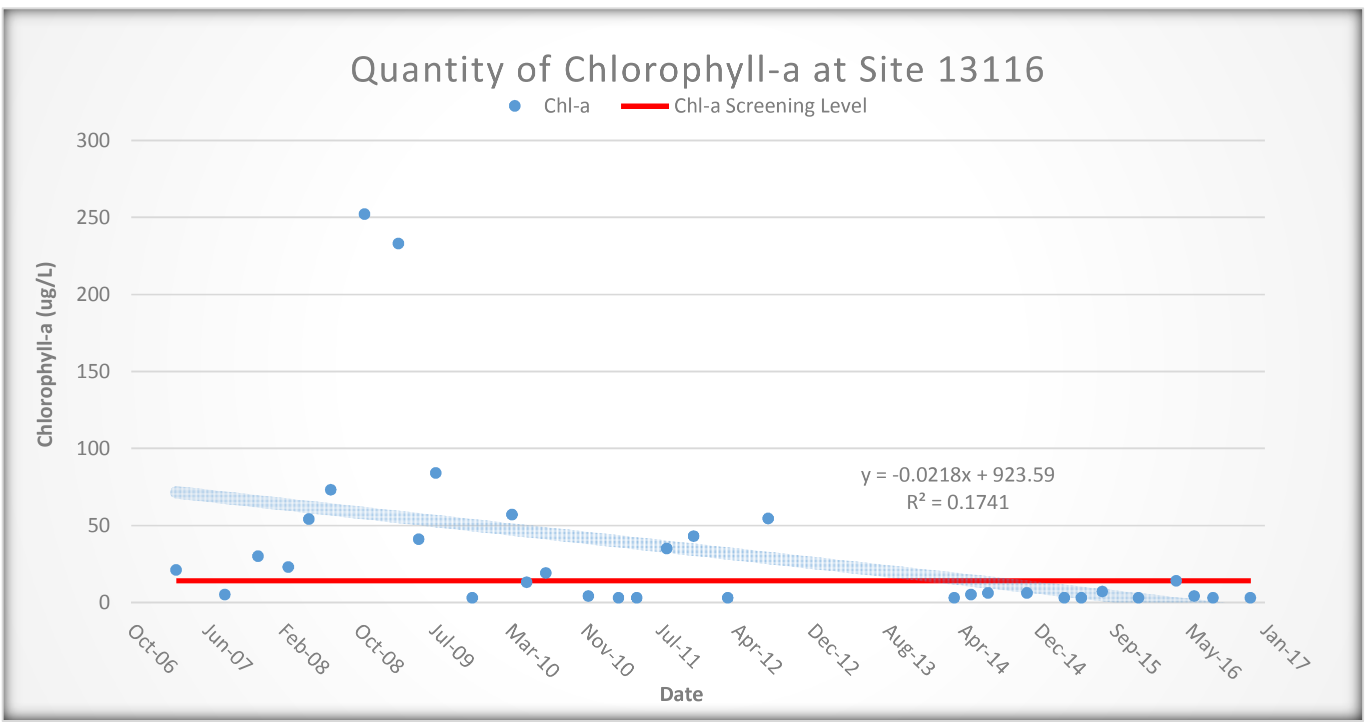

Figure 155. Station 13228, Chlorophyll-a

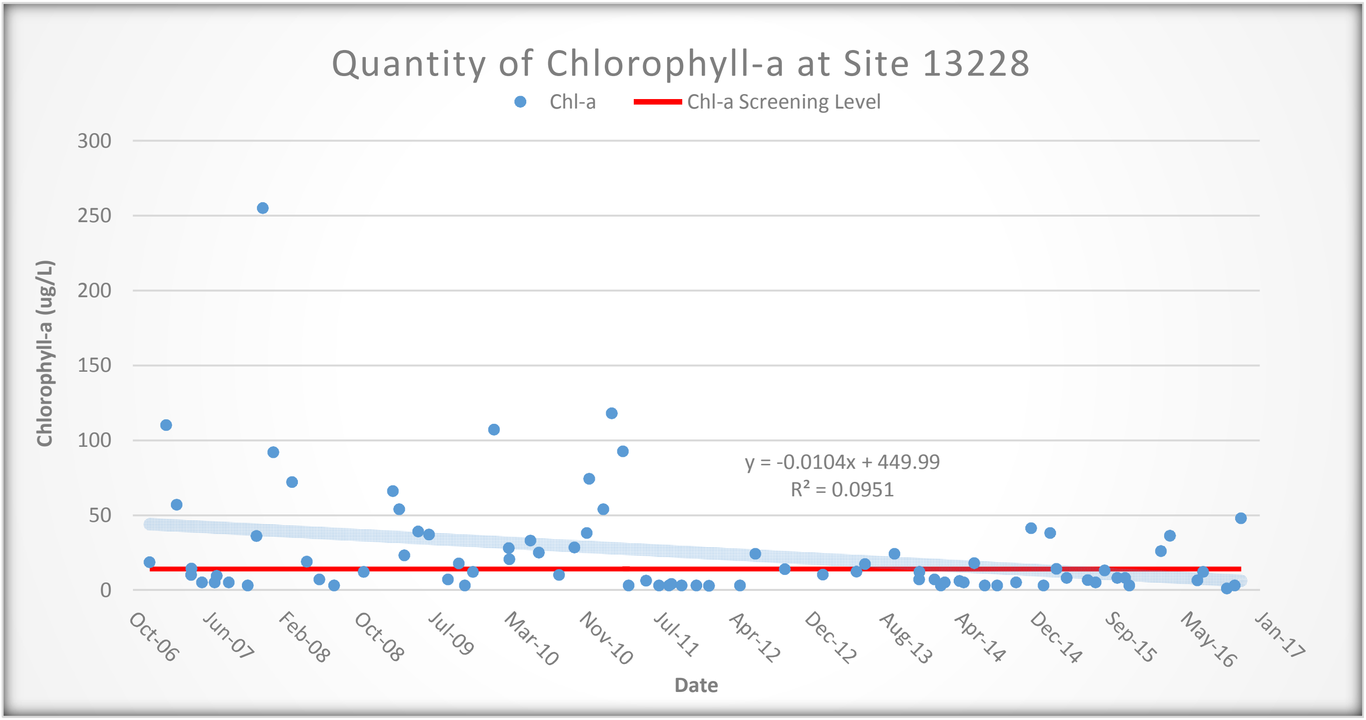

Figure 156. Station 13228, Chlorophyll-a

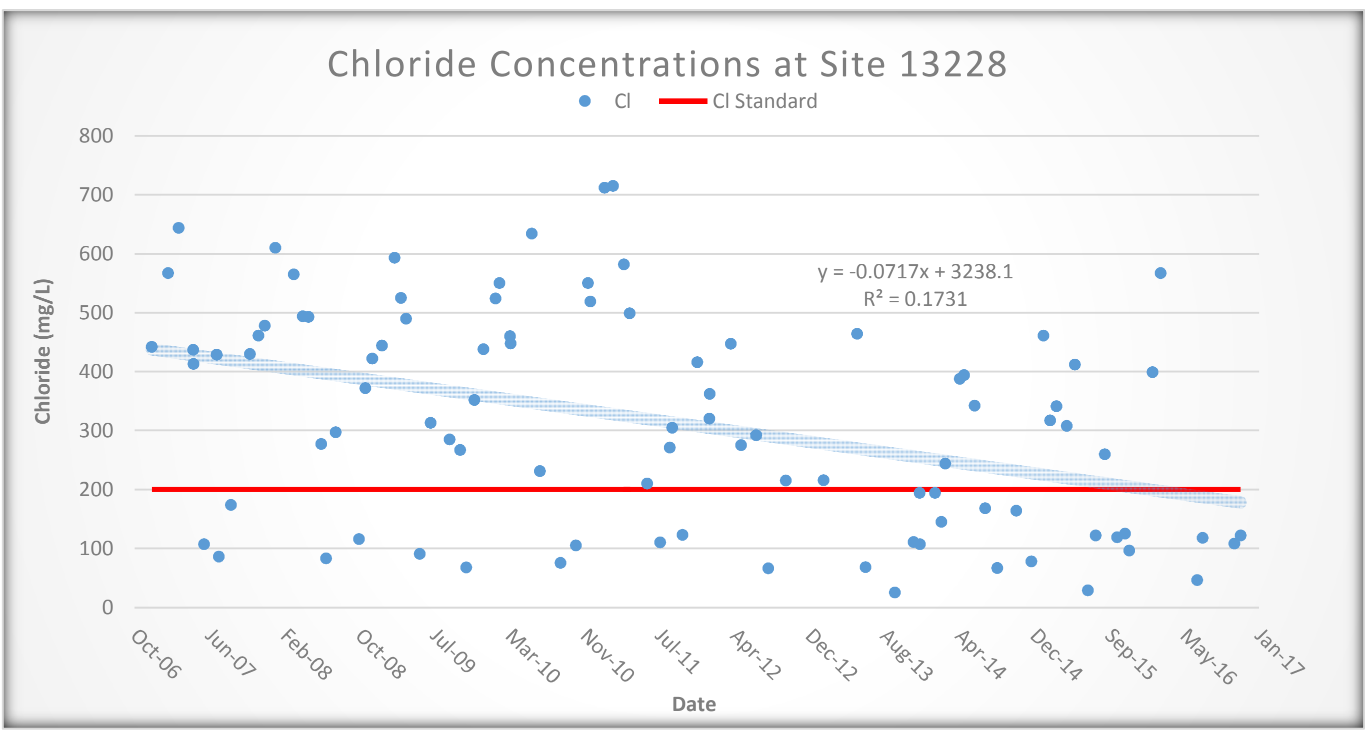

Figure 157. Station 16862, Sulfate

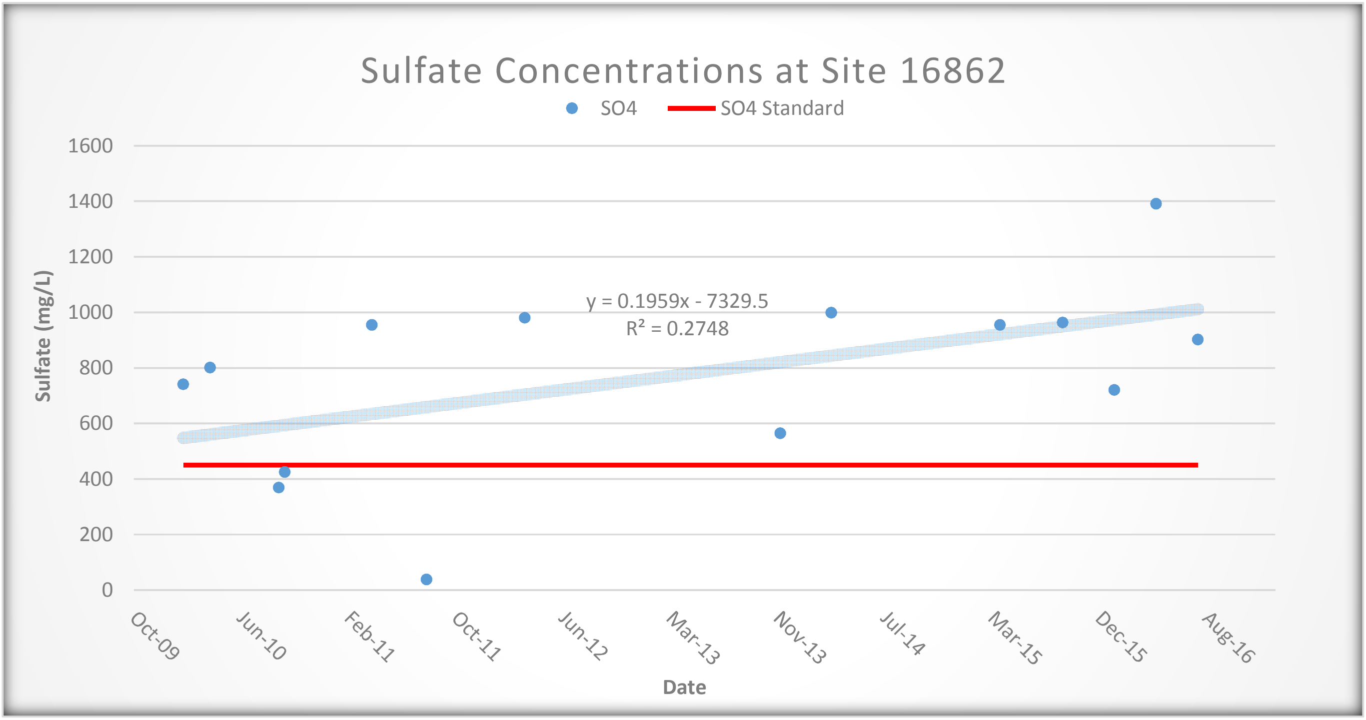

Figure 158. Station 13229, TDS

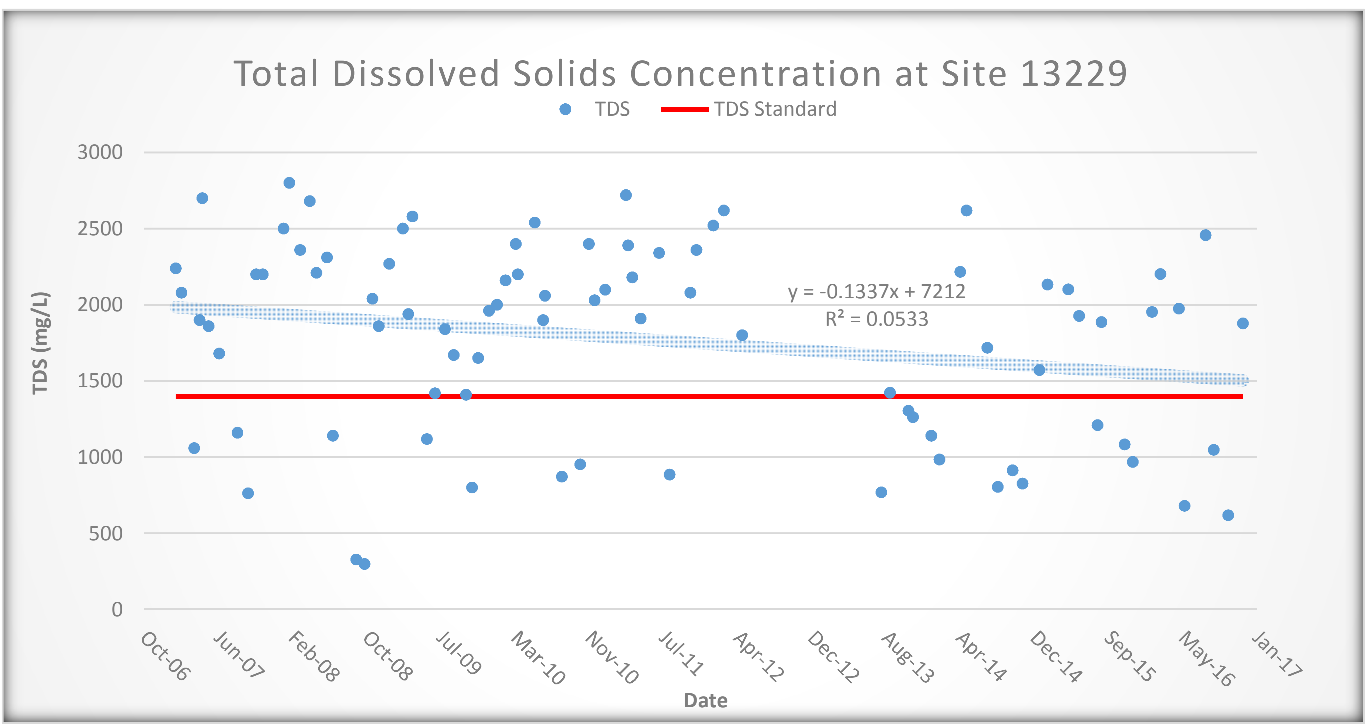

Figure 159. Station 13229, Nitrate+Nitrite

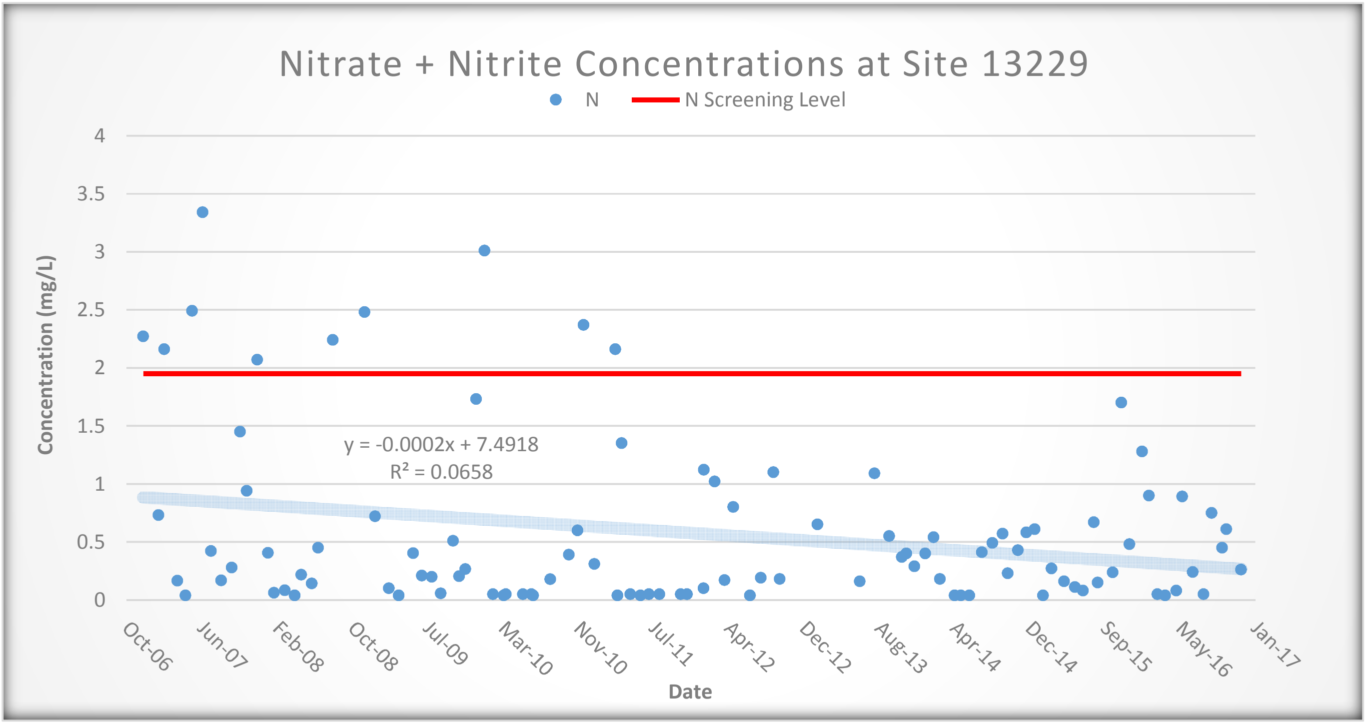

Figure 160. Station 13229, Chloride

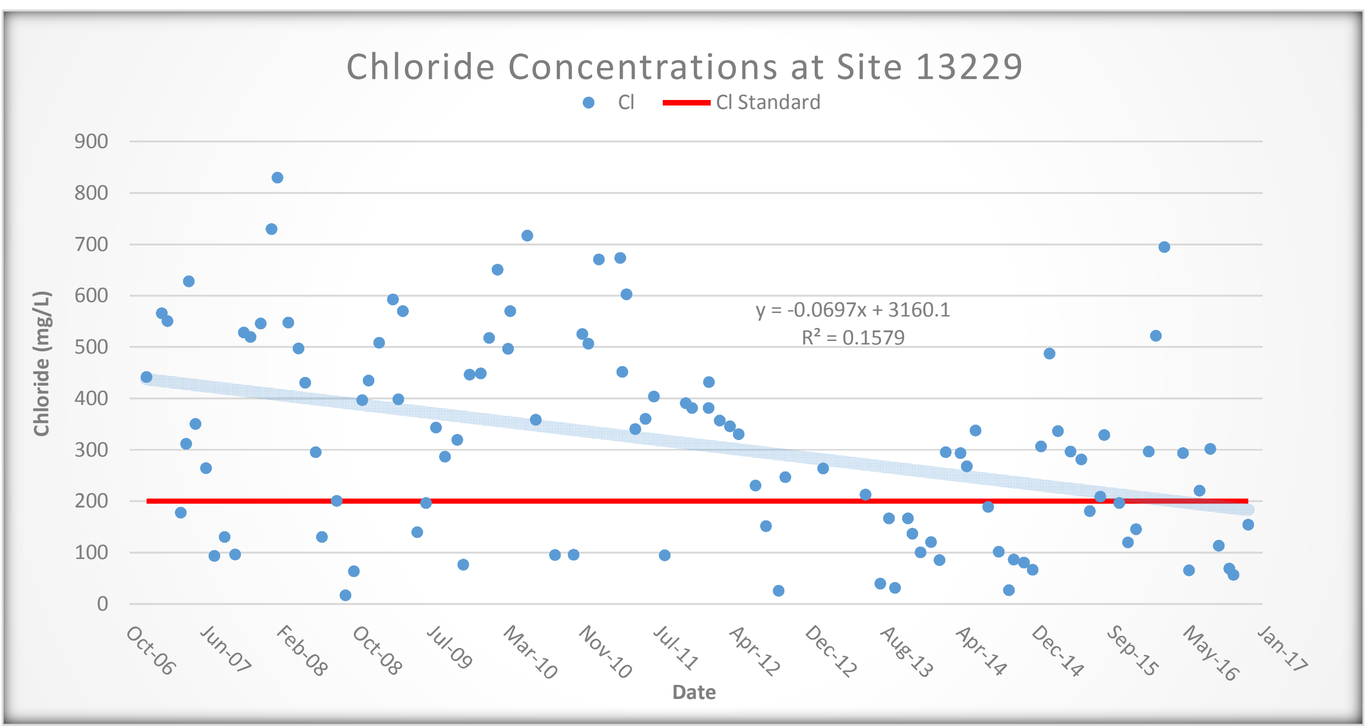

Figure 161. Station 13230, Chlorophyll-a

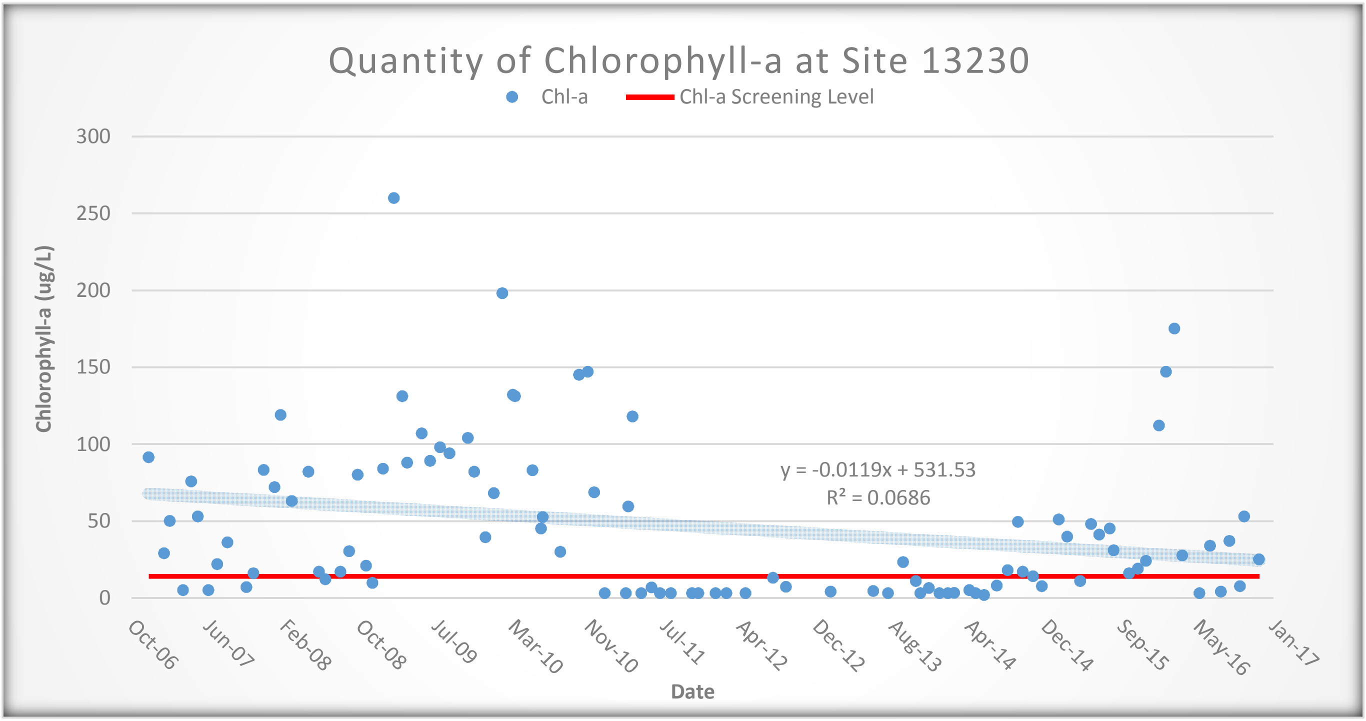

Figure 162. Station 13230, Chloride

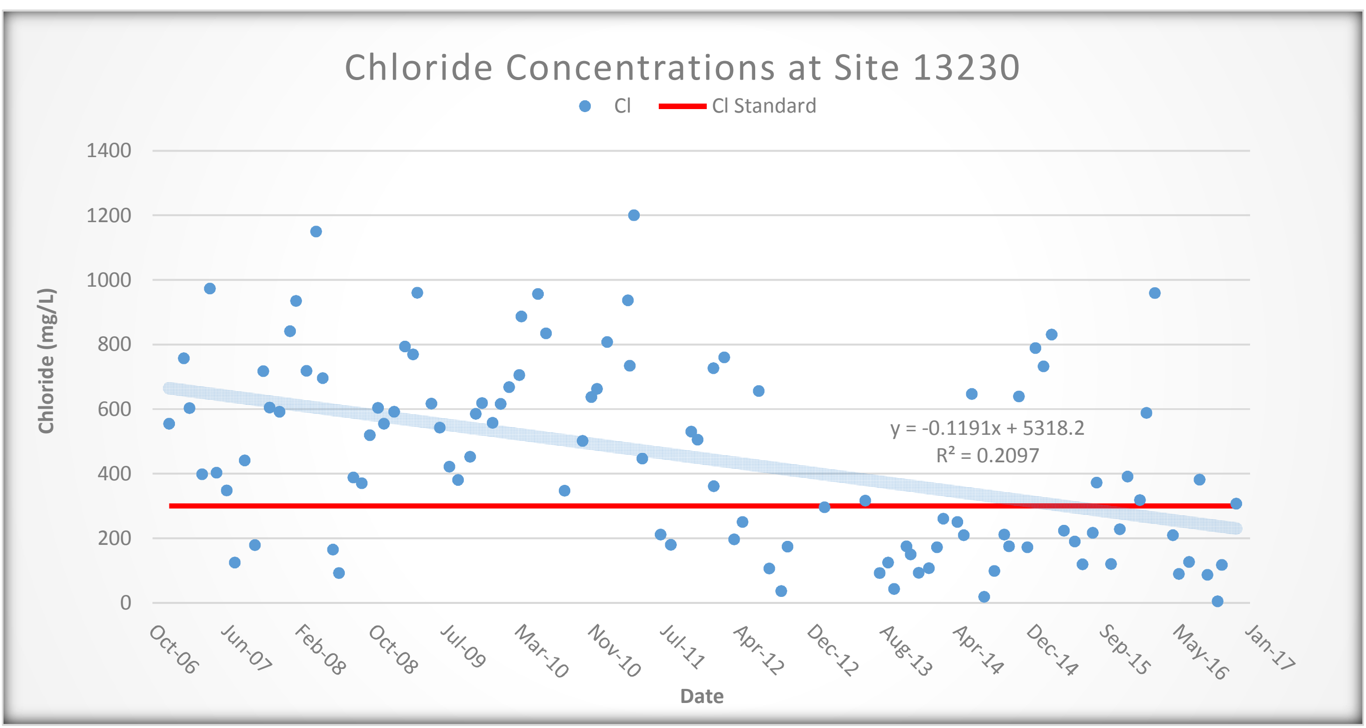

Figure 163. Station 13230, Nitrate+Nitrite

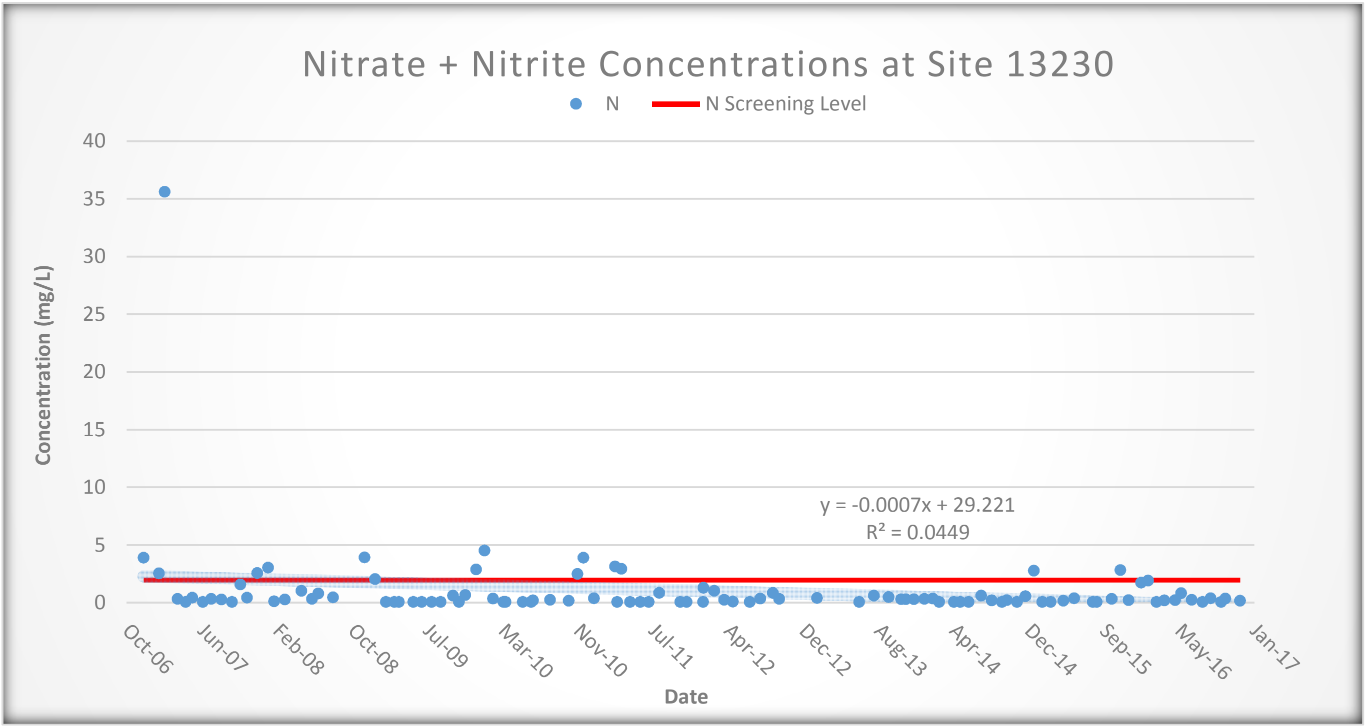

Figure 164. Station 13230, TDS

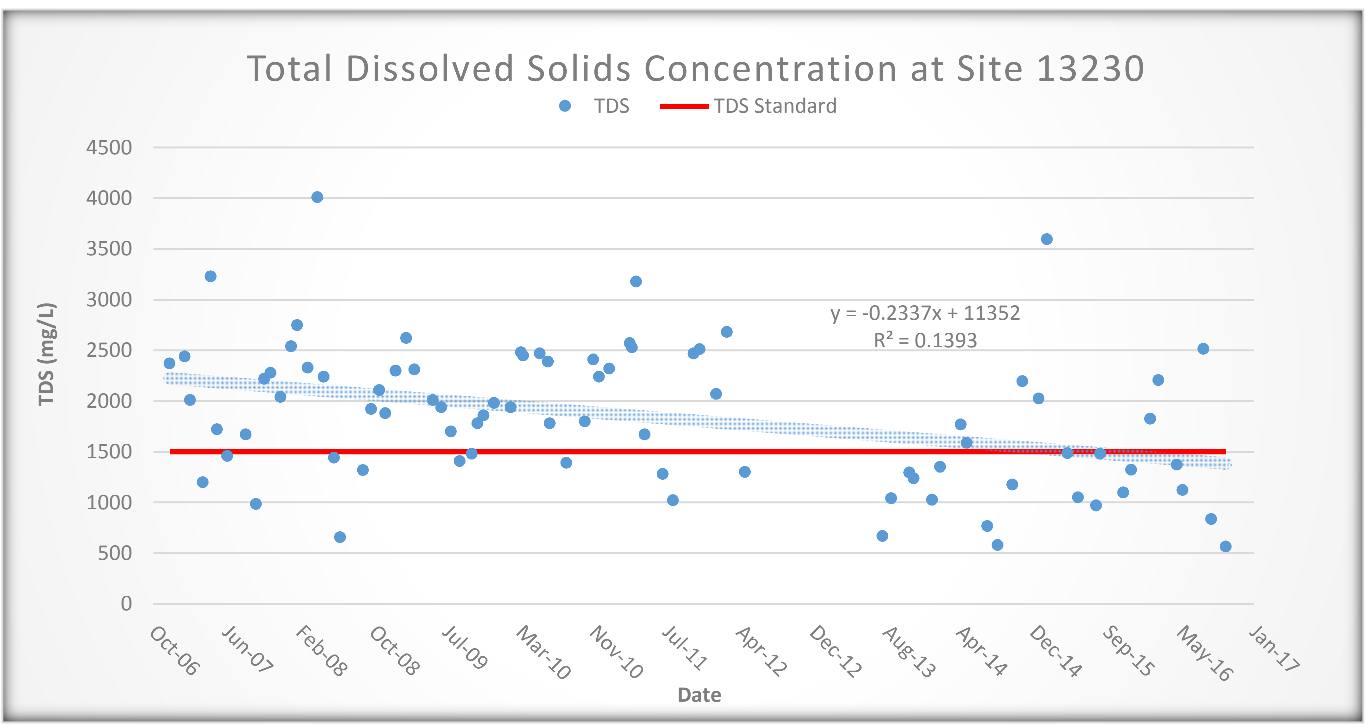

Figure 165. Station 16272, Chloride

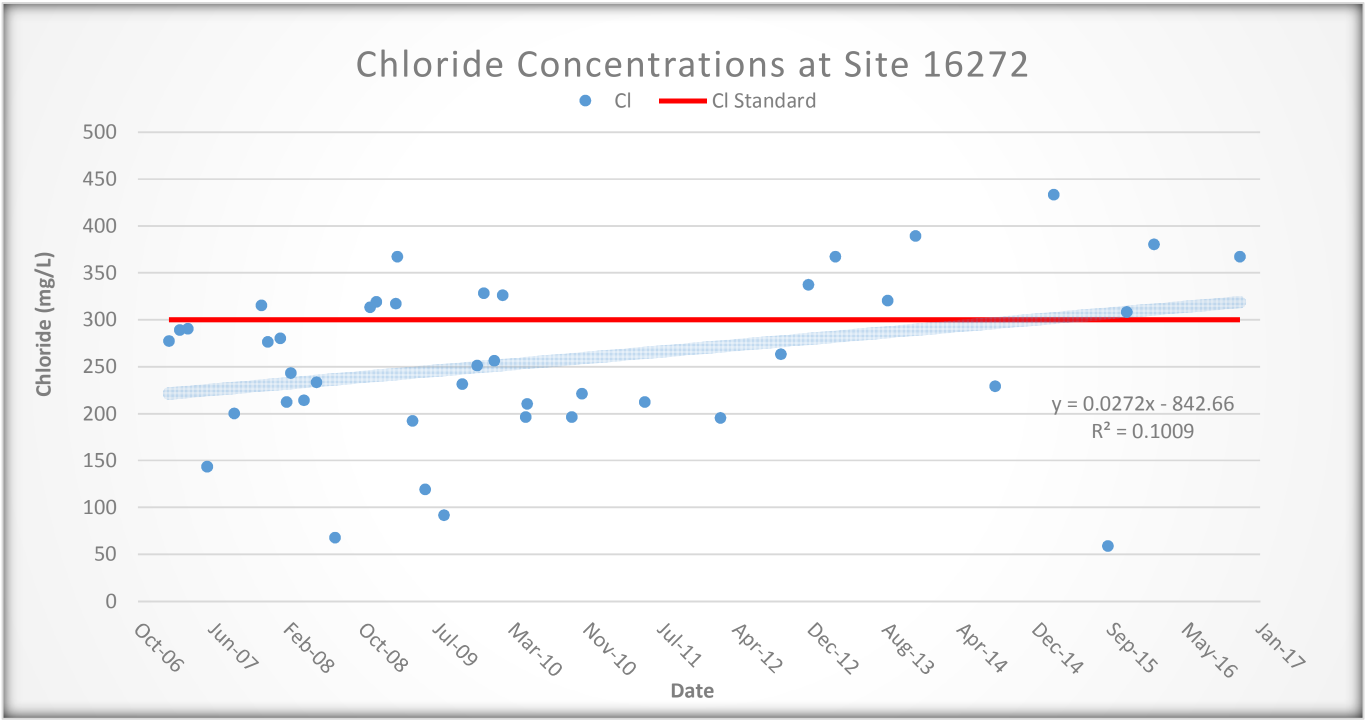

Figure 166. Station 16272, Nitrate+Nitrite

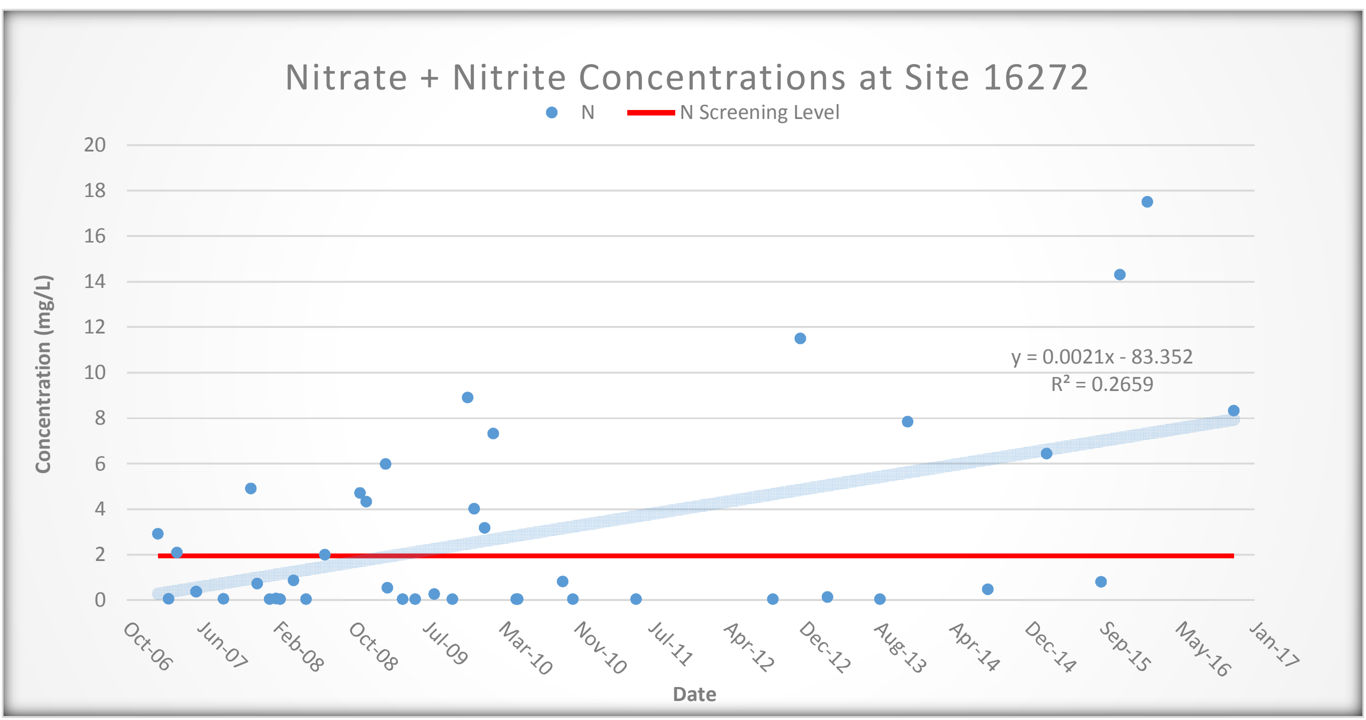

Figure 167. Station 15528, Chlorophyll-a

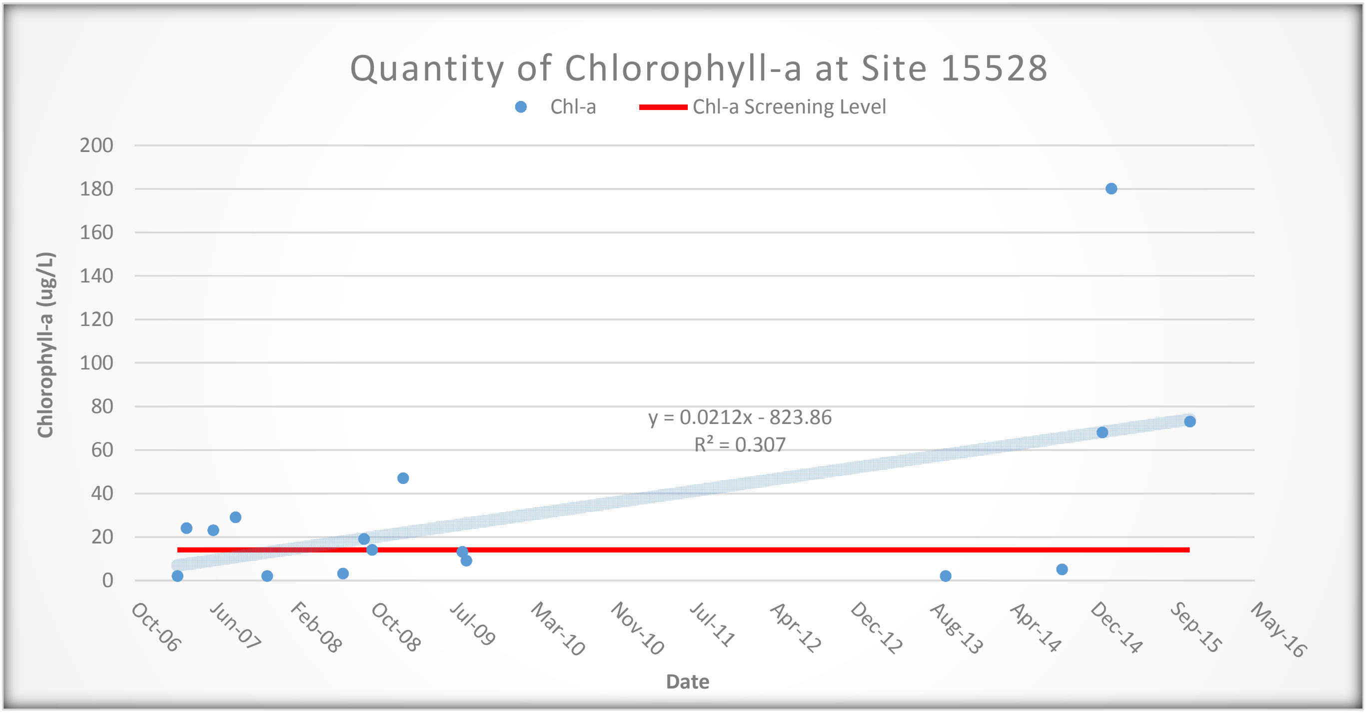

Figure 168. Station 15893, Sulfate and Chloride

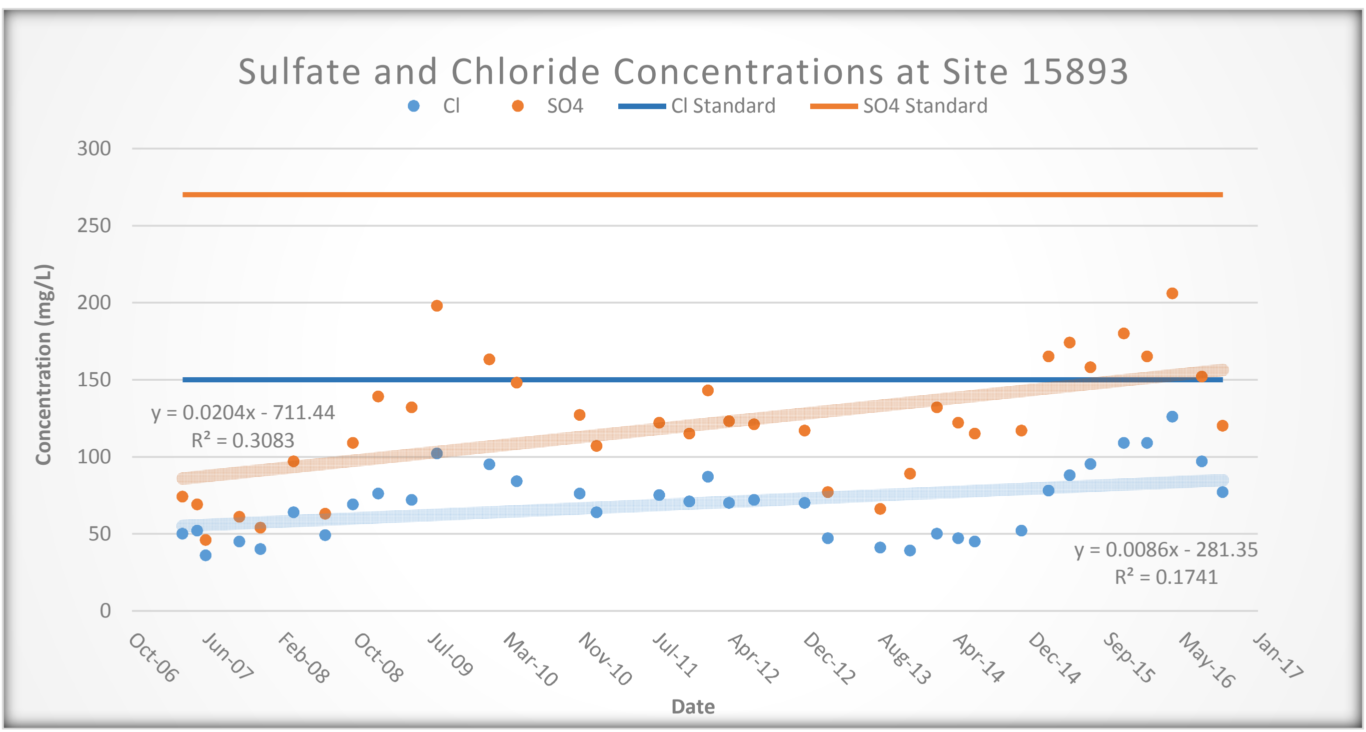

Figure 169. Station 15893, TDS

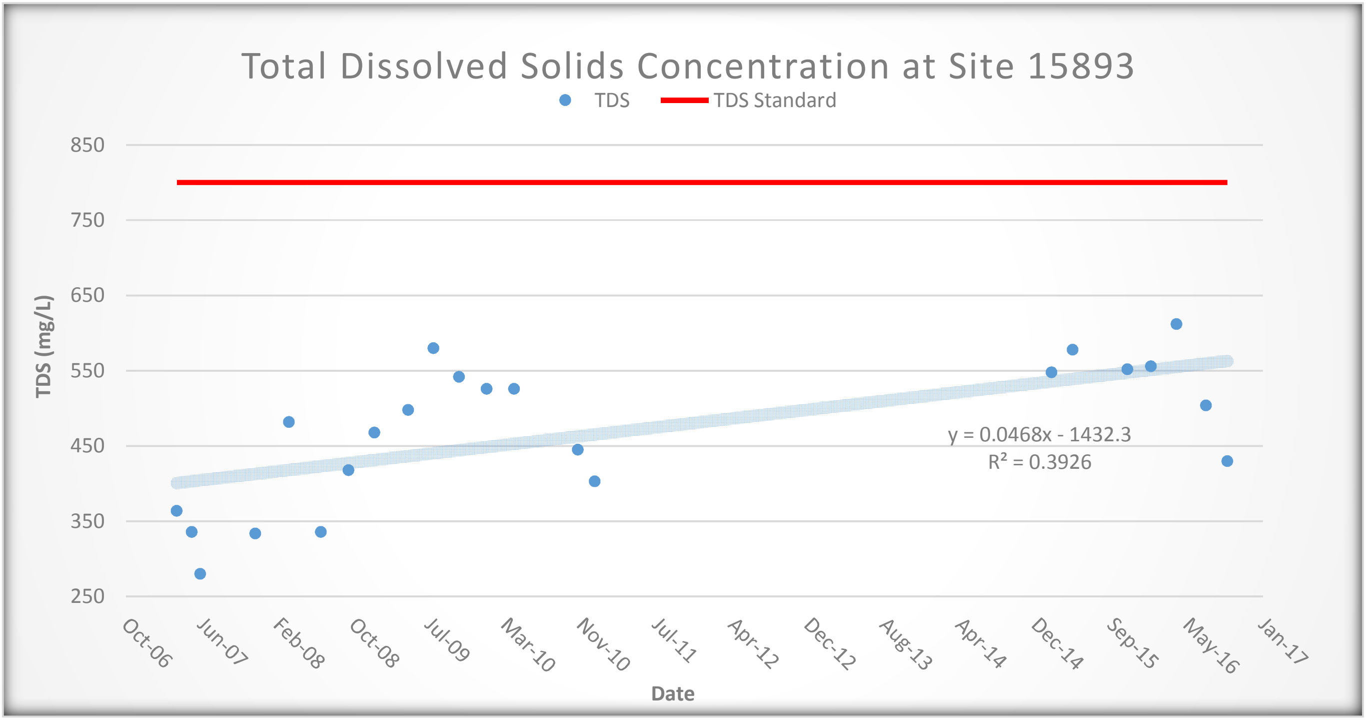

Figure 170. Station 13237, Nitrate+Nitrite

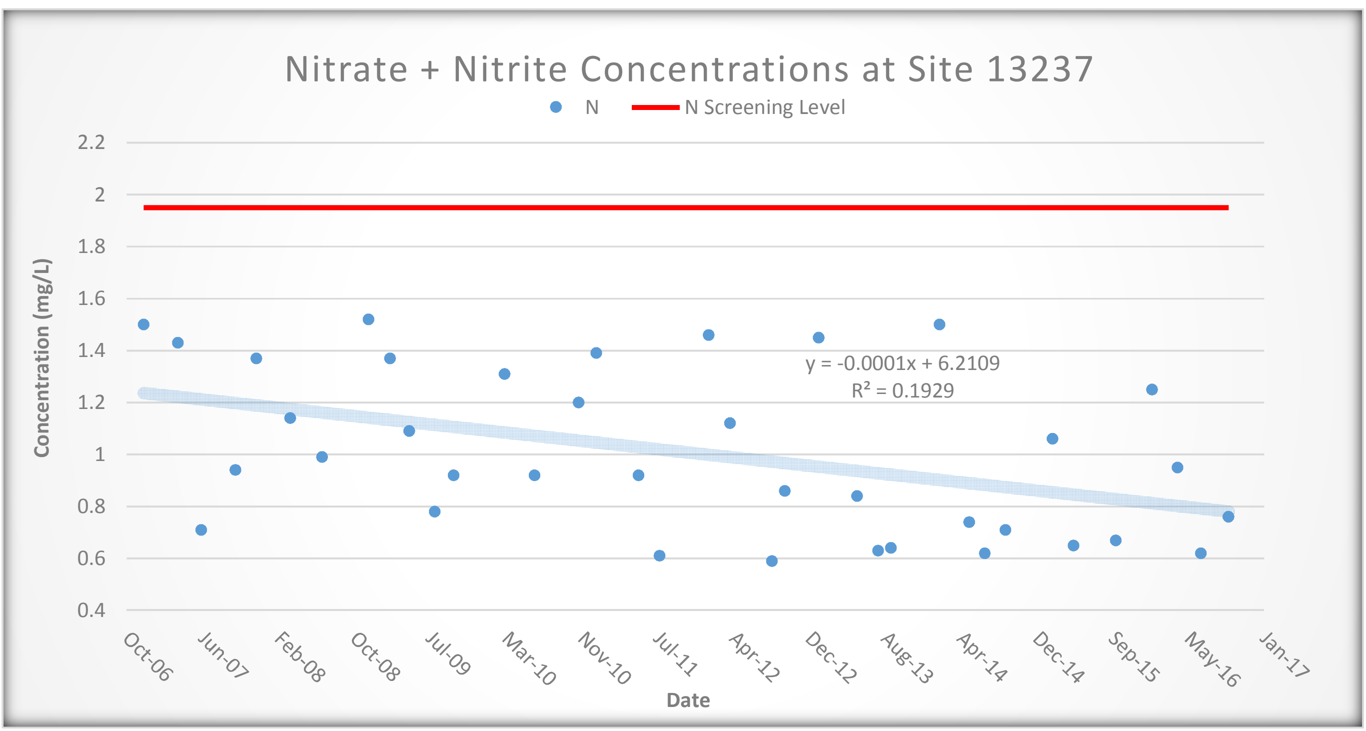

Figure 171. Station 13272, Phosphorus

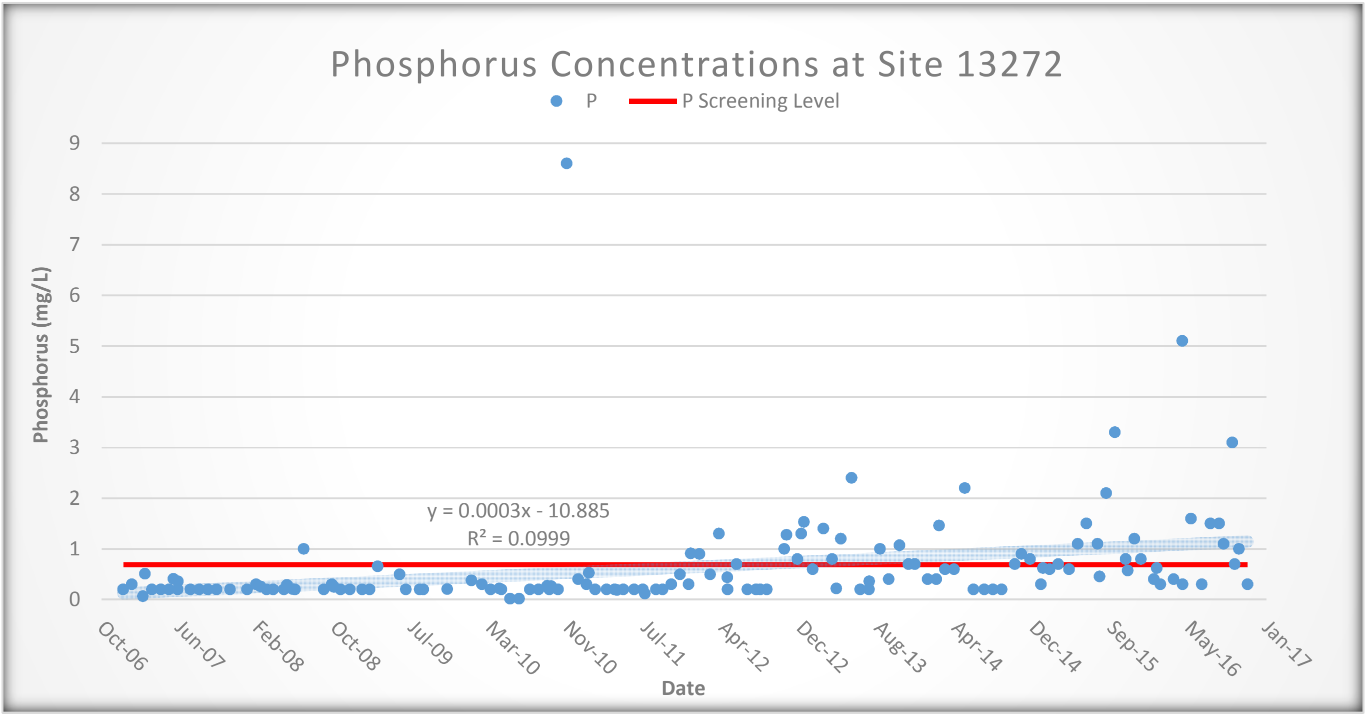

Figure 172. Station 13272, Ammonia

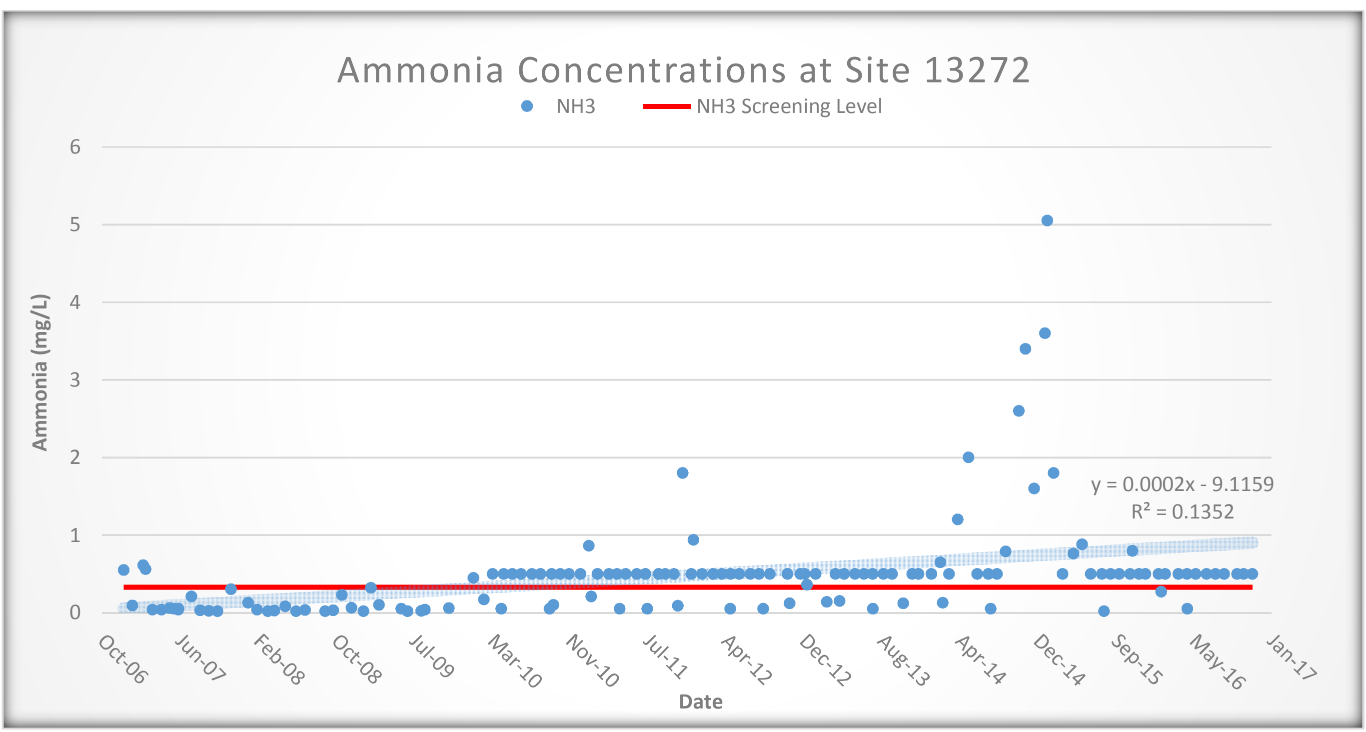

Figure 173. Station 15089, Chloropyll-a

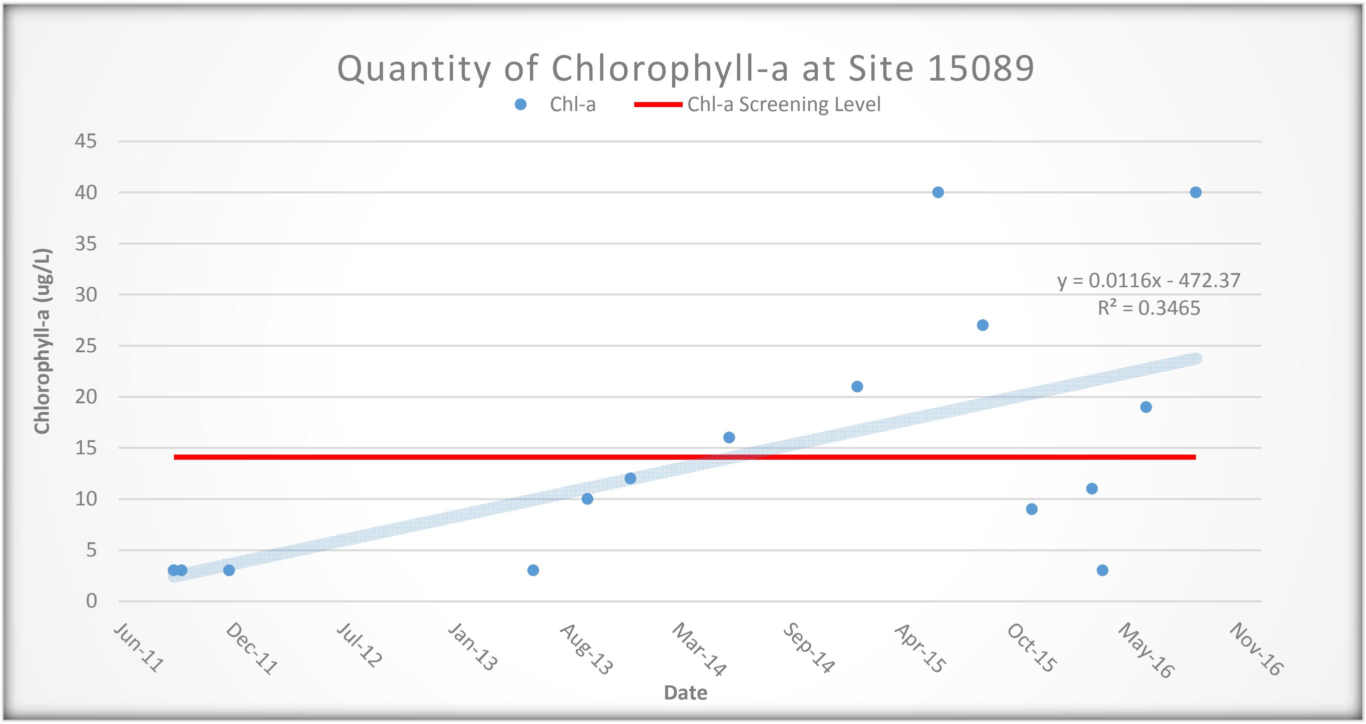

Figure 174. Station 15089, Nitrate+Nitrite

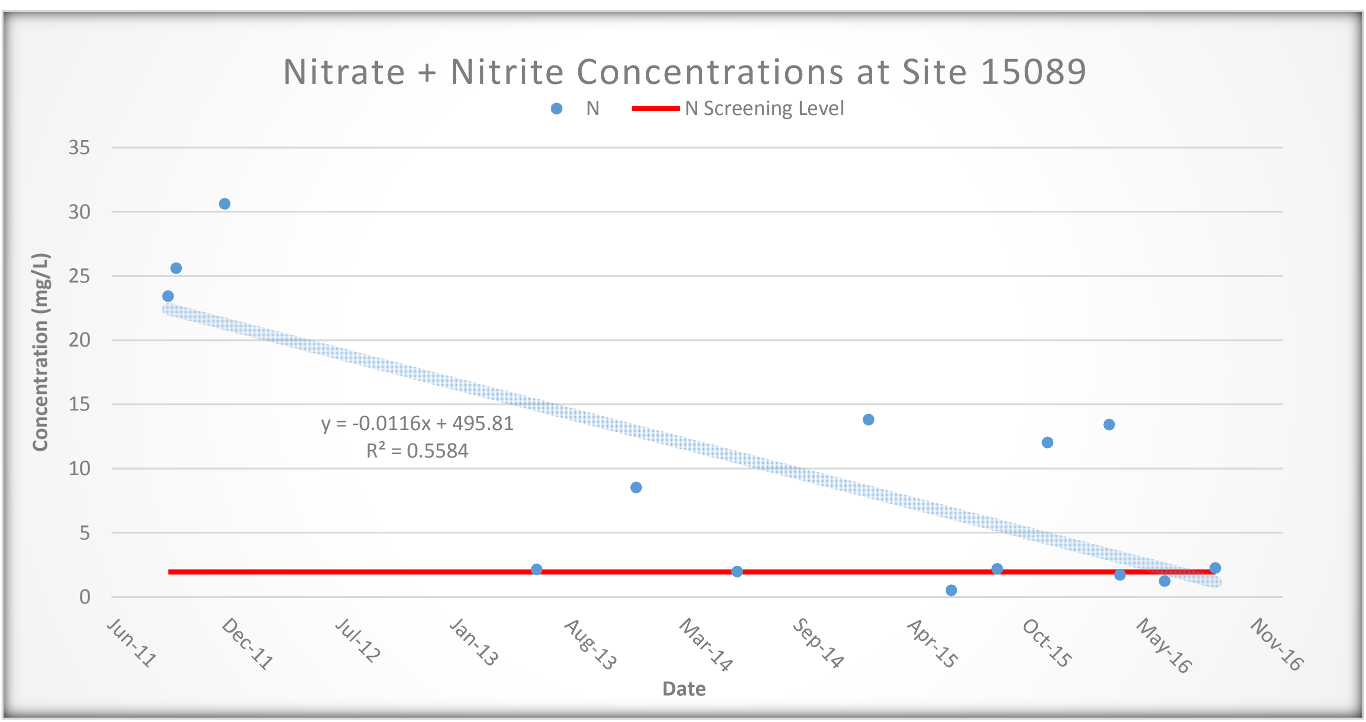

Figure 175. Station 13276, Phosphorus

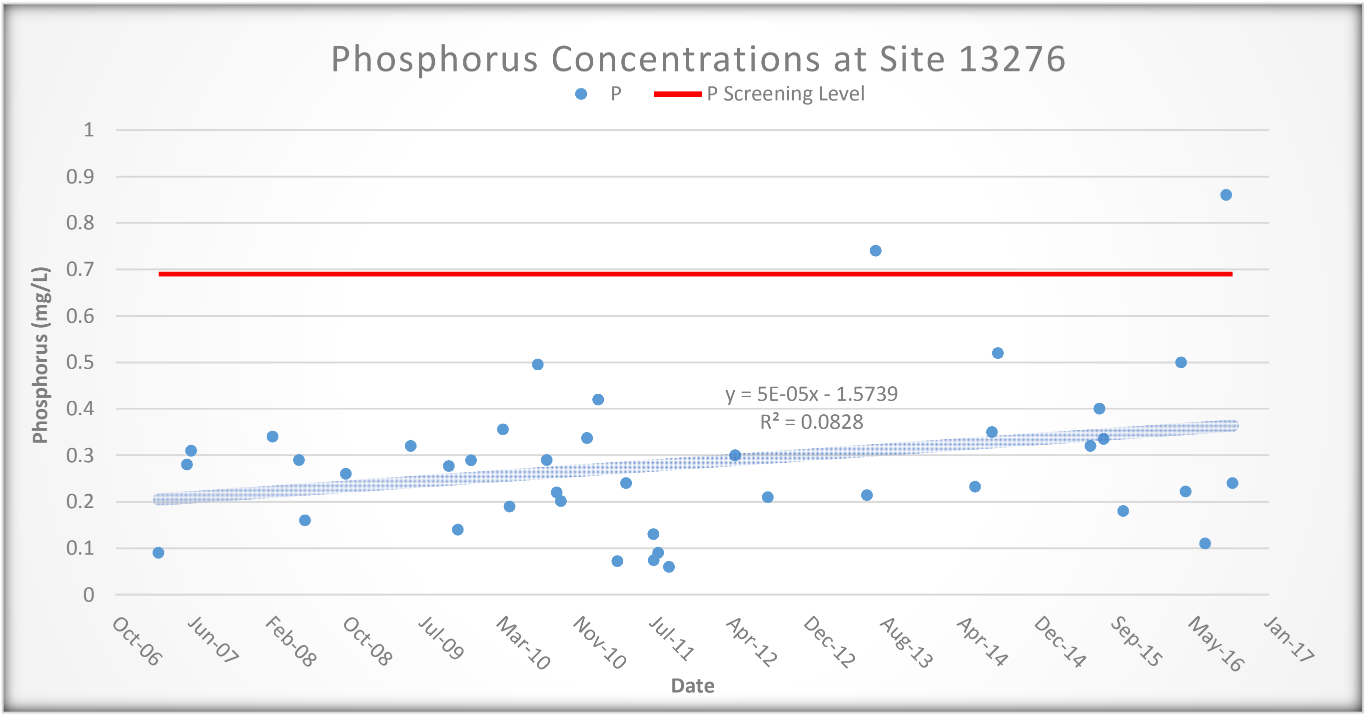

Figure 176. Station 13276, Sulfate

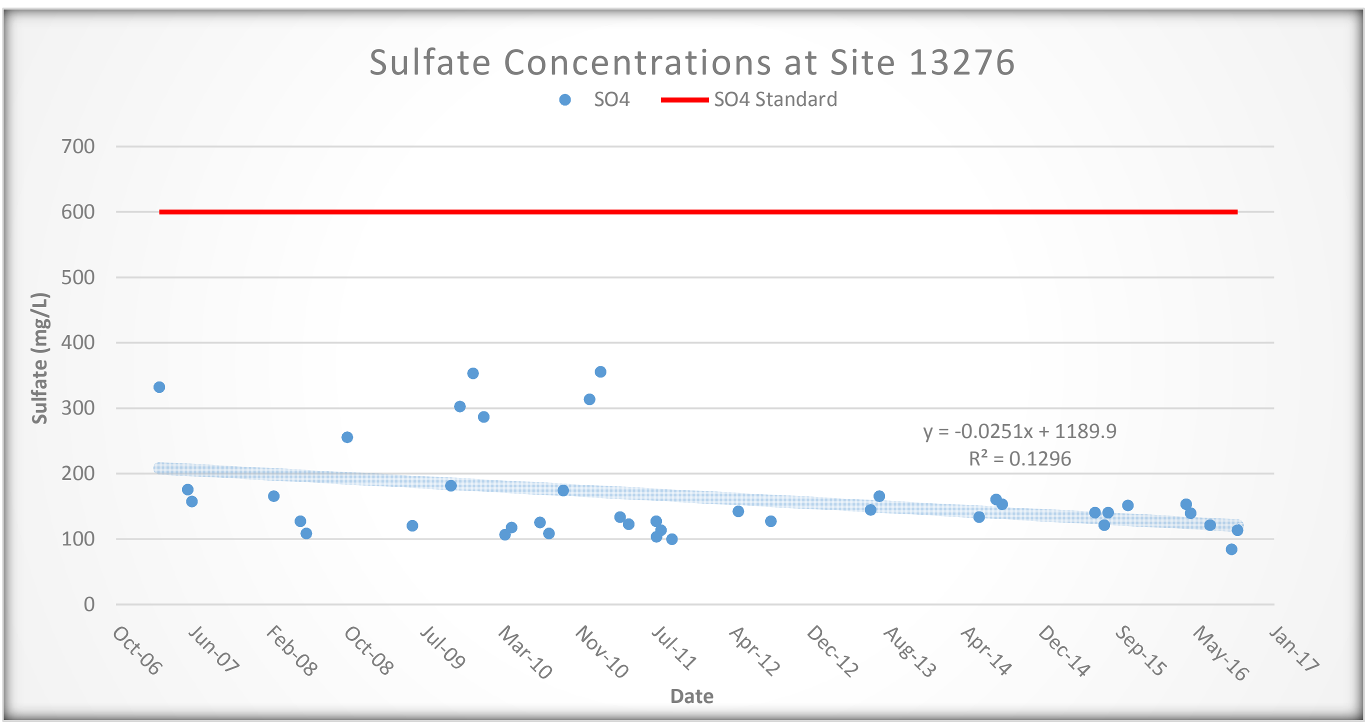

Figure 177. Station 13249, Phosphorus

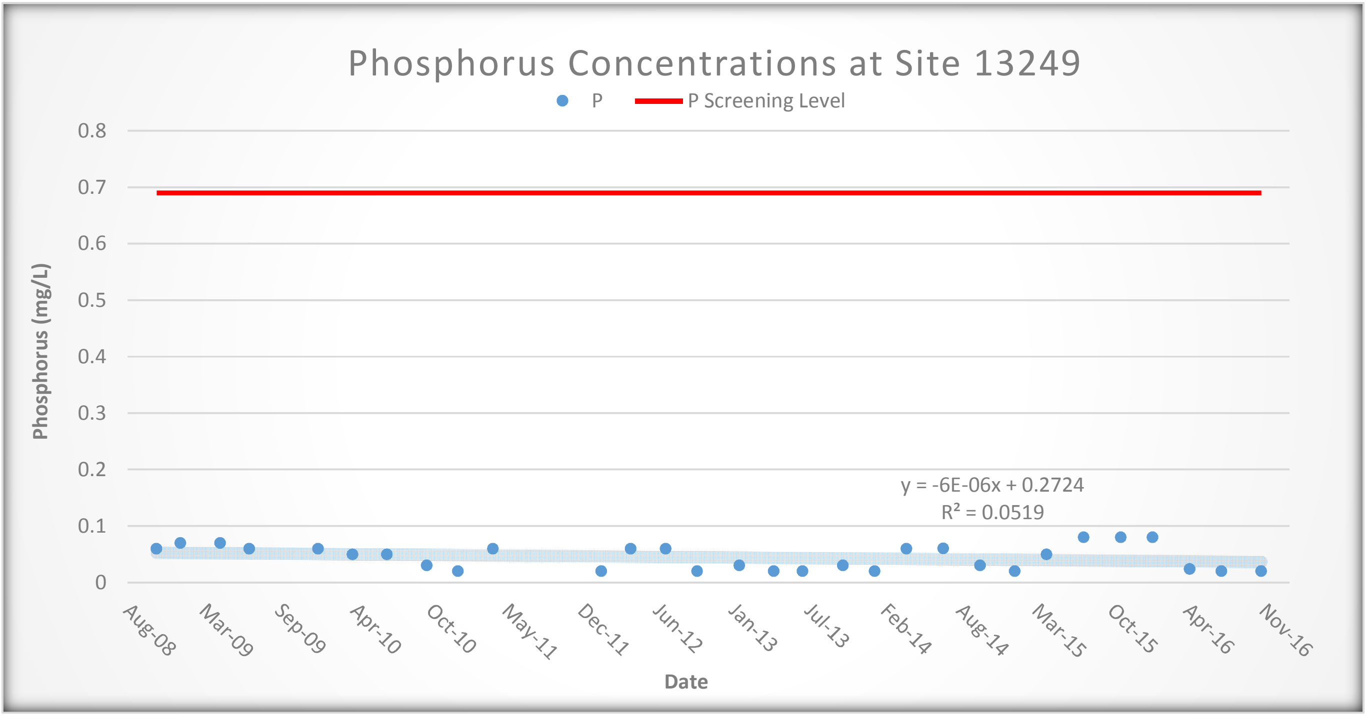

Figure 178. Station 13249, Nitrate+Nitrite