REGIONAL ASSESSMENT OF WATER QUALITY

2008 RIO GRANDE BASIN

Texas Clean Rivers Program
International Boundary and Water Commission, United States Section

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PARTICIPATING AGENCIES

Federal

International Boundary and Water Commission, United States Section

United States Geological Survey

Big Bend National Park Service

Natural Resource Conservation Service

State

Texas Commission on Environmental Quality

Local

Sabal Palm Audobon Center and Sanctuary

The City of El Paso, Public Service Board

The City of Laredo Environmental Services Division

The City of Laredo Health Department

The Rio Grande International Study Center

Texas A&M AgriLife Extension Service

Texas Cooperative Extension, Fort Stockton

The University of Texas at El Paso

The University of Texas at Brownsville

El Paso Community College

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LIST OF ACRONYMS

AWRL	Ambient Water Reporting Limit
BEAT	Border Environmental Assessment Team
BOD	Biochemical Oxygen Demand
BMP	Best Management Practice
CAFO	Concentrated Animal Feeding Operation
COC	Chain of Custody
CRP	Texas Clean Rivers Program
DO	Dissolved Oxygen
EPA	United States Environmental Protection Agency
EPCC	El Paso Community College
EPWU	El Paso Water Utilities
GIS	Geographic Information Systems
IBC	International Boundary Commission
IBWC	International Boundary and Water Commission, United States and Mexico
MAL	Minimum Analytical Limit
MCLs	Maximum Contaminant Levels
MSA	Monitoring Systems Audit
MXIBWC	Mexican Section, International Boundary and Water Commission
NELAC	National Environmental Laboratory Accreditation Council
NMSU	New Mexico State University
NLIWTP	Nuevo Laredo International Wastewater Treatment Plant
NPS	National Park Service
PREP	Pecos River Ecosystem Project
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RGACE	Rio Grande American Canal Extension
RGISC	Rio Grande International Studies Center
7Q2	Seven day, two year low flow
TCEQ	Texas Commission on Environmental Quality
TDSHS	Texas Department of State Health Services
TDS	Total Dissolved Solids
TDWS	Texas Drinking Water Standards
TNRCC	Texas Natural Resource Conservation Commission
TMDL	Total Maximum Daily Load
TPWD	Texas Parks and Wildlife Department
TSS	Total Suspended Solids
TSWQS	Texas Surface Water Quality Standards
USGS	United States Geological Survey
USIBWC	United States Section, International Boundary and Water Commission
UTEP	University of Texas at El Paso
UTB	University of Texas at Brownsville
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

The purpose of this report is to inform the public, the stakeholders, and other agencies as to the condition of the Rio Grande basin, improvements and potential problems within the watershed, the efforts of the Texas Clean Rivers Program (CRP) and its partners to monitor and assess the waters of the basin, and potential resolutions to any negative trends within the basin.

The Texas Clean Rivers Program was initiated by the State of Texas in 1991 in response to growing concerns that water resource issues were not being pursued in an integrated, systematic manner. At that time, no river agency existed for the Rio Grande Basin. Matters were further complicated by the fact that two countries share the river. In order to address the international nature of the watershed, the state of Texas through the Texas Commission on Environmental Quality, contracted with the United States Section, International Boundary and Water Commission (USIBWC) in October 1998 to administer the CRP for the Rio Grande Basin.

The legislation creating the CRP requires that ongoing water quality assessments be conducted using an approach that integrates water quality and water quantity issues within a river basin, or watershed. Another aspect of the CRP is that it provides a forum that allows for the exchange of information and ideas between the CRP and the public. Stakeholders within the basin are offered the opportunity to comment and ensure that local issues are addressed within the program. For more information on the history of the CRP and its partners, the CRP has created a video that can be downloaded at http://videos.h-gac.com/clean_rivers.wmv.

The collection of water quality data is outlined in the Rio Grande Basin Monitoring Plan- Quality Assurance Project Plan (QAPP). This document outlines the monitoring program, how data is collected and analyzed, quality assurance and quality control criteria, and reporting requirements. The USIBWC and its invaluable partners (various federal, state and local entities) collect various field and laboratory water quality parameters throughout the basin. To assist in the assessment of water quality issues at a finer scale, TCEQ has installed 10 monitoring stations in the Rio Grande and with the USGS has another 3 monitoring stations in the Rio Grande around Big Bend. For more information on the continuous water quality monitoring network and to view data from theses stations, visit:
http://www.tceq.state.tx.us/assets/public/compliance/monops/water/wqm/tx_realtime_swf.html.

Because the Rio Grande Basin is so large and encompasses a large variety of areas having differing climates, vegetation, geology, flow regimes, and environmental issues, the basin has been divided into four sub-basins: the Pecos River sub-basin, the Upper Rio Grande sub-basin, the Middle Rio Grande sub-basin, and the Lower Rio Grande sub-basin. Data collected from these sub-basins are entered into a database administered by the TCEQ. The CRP and TCEQ use the database to assess concerns about the basin and produce reports on the basin as mandated by federal law. The database is also made available to outside interested parties for use in other projects.

The CRP has also created a website that allows access to water quality data and monitoring station locations for anyone needing the data. Public outreach by the CRP has expanded public knowledge about the program and taken water quality and quantity preservation into the classrooms of elementary, high school, and even, college students. Research projects in the basin receive support from the CRP through expertise, equipment, data, and physical assistance leading to important information on the effects and conditions in the basin.

For this report the CRP analyzed the most current water quality data. The data was statistically examined to determine if water quality at each station meets minimum standards. The water quality data was also analyzed for trends to assess for future problems or to evaluate positive improvements to previous issues. If problems were noted, possible causes of those problems were explored and recommendations were made to address the issue.

The Pecos River sub-basin extends from the Texas/New Mexico state line to the Rio Grande and contains 3 segments with samples currently being collected at 10 monitoring stations and 4 real-time stations. The Pecos Sub-basin data evaluation revealed concerns about salt concentrations and water quantity. The Pecos River enters Texas with high dissolved solids and salt concentrations. The high salinity levels are aggravated by low flows and the prevalence of salt cedar. Previous projects by Texas A&M University to eradicate salt cedar from the Pecos using herbicides has now been expanded to develop a watershed protection plan to improve riparian habitat, water quality, and water quantity.

The Upper Rio Grande sub-basin extends from the Texas/New Mexico state line to Amistad Reservoir and contains six segments with a total at present of 23 monitoring stations, 2 real-time stations with another 5 real-time stations located in Big Bend National Park, 3 of which are monitored by the USGS. Primary concerns of the sub-basin include high bacterial levels, salinity (chloride, sulfate, TDS), and nutrients (ammonia and phosphorus). Wastewater from communities along the river and agricultural runoff contribute to the high levels of bacteria, salts and nutrients found in some portions of this segment. Corrective actions such as installation of new WWTPs, upgraded WWTPs, and more stringent discharge regulations will help alleviate the problem.

The Middle Rio Grande sub-basin extends from Amistad Reservoir to Falcon Reservoir and includes 3 segments with a total of 24 monitoring stations. While salinity concerns are not as great for this area as upper reaches of the river, bacteria and nutrient levels remain a concern. Because these contaminants are typically highest below areas of higher population densities, it is probable that the high levels of bacteria and nutrients are caused by wastewater discharges. Corrective actions such as installation of new WWTPs, upgraded WWTPs, and more stringent discharge regulations will help alleviate the problem. The CRP is participating in several special studies in conjunction with other U.S. and Mexican agencies to determine sources of contaminants and possible solutions to current problems.

The Lower Rio Grande sub-basin extends from Falcon Reservoir to the mouth of the Rio Grande. The sub-basin contains two segments with a total of 12 monitoring stations and 2 real-time stations. Problems in this sub-basin also include bacteria and nutrients with the probable cause of these contaminants coming from municipal discharges. This sub-basin has also experienced problems with excessive growth of aquatic weeds.

Potential solutions to the problems noted in basin lead to the following recommendations for future studies for the CRP. The current level of monitoring effort should remain the same or increase. An increased number of strategically placed monitoring stations will only increase our ability to understand current problems. The CRP should also facilitate efforts by partners to perform special studies on water quality issues in the Rio Grande Basin as well as support their efforts to gain funding for these projects. In order to better understand the concerns of various stakeholders in the Basin, CRP staff has incorporated the annual meetings with other groups in the basin in an effort to receive greater input into the program and to inform more members of the public about our efforts in the basin. CRP will continue to hold meetings within each sub-basin and strive to improve communication with basin stakeholders as well as improving communication with stakeholders outside the CRP monitoring area such as Mexico and New Mexico.

1.0 INTRODUCTION

1.0 INTRODUCTION

RIO GRANDE WATERSHED

The Rio Grande Basin drains an area of over 330,000 square miles (800,000square km) in Colorado, New Mexico, and Texas in the United States and Chihuahua, Durango, Coahuila, Nuevo Leon, and Tamaulipas in Mexico. It forms the international boundary between the United States and Mexico along the last 1,254 miles (2,018km) of its journey from the Colorado Rockies to the Gulf of Mexico.

The Texas CRP monitors and assesses the portion of the Rio Grande Basin from the point it enters Texas to its end at the Gulf of Mexico **(Figure 1)**. The Rio Grande Basin in Texas drains an area of 86,720 square miles (224,600 square km). The Texas portion of the Rio Grande forms the border between the United States and Mexico for 1,254 miles (2,020 km). The Pecos River enters Texas from New Mexico and runs 409 miles (660 km) through Texas to the Rio Grande. Because of the large distances and the varying ecosystems, the basin is divided into four sub-basins **(Figure 2)**. The Pecos River sub-basin runs from Red Bluff Reservoir at the Texas - New Mexico border to its confluence with the Rio Grande in Val Verde County; the Upper Rio Grande sub-basin runs from the point the river enters Texas at the Texas - New Mexico border to International Amistad Dam in Val Verde County; the Middle Rio Grande sub-basin runs from a point just below International Amistad Dam to International Falcon Dam in Starr County; the Lower Rio Grande sub-basin runs from a point just below International Falcon Dam to the confluence with the Gulf of Mexico.

Figure 1 The Rio Grande Basin in Texas

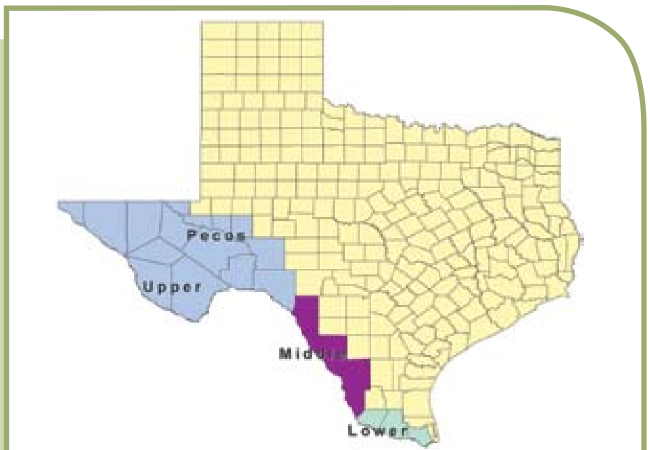


Figure 2 Sub-basins of the Rio Grande Basin

Population along the U.S. – Mexico border is rapidly increasing with the majority of the population situated in sister cities lying adjacent to each other. The El Paso – Ciudad Juárez area boasts the largest population with over 700,000 in El Paso and about 1.2 million in Juárez. Projections on population in this area for the year 2025 are over three million people.

With such a large population growth, the primary concerns are health and water. Drinking water supplies in the basin are a combination of groundwater resources and Rio Grande water from El Paso to Del Rio. Below that point, groundwater becomes too brackish to use for drinking water forcing communities along the border to depend on surface water or to build desalination plants to treat brackish groundwater to drinking water standards.

Although water quality predominantly meets State of Texas water quality standards, pollution of the river continues to occur and affects all aspects of use. The two largest contaminants in the Rio Grande are high salinity levels in the Upper Rio Grande and the Pecos River and high bacteria levels throughout the entire basin.

Salinity

High salt levels in the Rio Grande limit its use for agriculture and municipal use. Increases in salinity occur as return flows with elevated dissolved salt levels from Texas and Mexico enter the Rio Grande in west Texas. Additional salt loadings are observed at the confluence with the Rio Conchos just upstream of Presidio, Texas and Ojinaga, Chihuahua. In the Pecos River, high salt content from geologic formations limit its use and is currently being studied to determine sources and potential management practices to reduce salt loading into the river from invasive plants and anthropogenic effects. Tributaries in the Lower Pecos River and below Big Bend National Park dilute and improve the quality of the water as it enters International Amistad Reservoir. The salinity in the Middle and Lower Rio Grande currently meets the applicable surface water quality standards; however the water periodically climbs above these standards.

Bacteria/Nutrients

The trend of high bacterial and nutrient levels is seen throughout the border around the larger populated sister cites that continue to grow at a rapid pace. Different requirements for wastewater treatment between states and countries, nonpoint source influences such as cattle and aquatic fowl, and in some cases, untreated wastewater discharges result in high bacterial concentrations. Urban discharges and nonpoint sources add additional burdens by increasing nutrient levels above water quality standards, which can lead to excessive algae and plant growth.

Watershed Characteristics

The Rio Grande basin passes through several eco-regions, seeing many different climates, soils, vegetation, and geology. The Pecos River sub-basin lies in the Trans-Pecos eco-region with a small portion of the eastern edge lying in the Edwards plateau eco-region. The Upper Rio Grande sub-basin lies entirely in the Trans-Pecos eco-region. The top most portion of the Middle Rio Grande sub-basin lies in the Edwards plateau eco-region with the remainder of the sub-basin lying in the South Texas Brush Country. The Lower Rio Grande sub-basin occupies the southeastern portion of the South Texas Brush Country eco-region.

Topography in the Pecos River sub-basin is generally plains as the river runs along the Permian Basin and empties into the Rio Grande downstream of Big Bend National Park, forming an arm of International Amistad Reservoir. In the Upper Rio Grande sub-basin, the river rounds the mountains of the Chihuahuan desert and flows through arid mountains, high hills, and rock outcrops until it passes Big Bend National Park. Upon leaving the International Amistad Reservoir and entering the Middle Rio Grande sub-basin, the topography begins to form rolling, irregular plains and continues this pattern until turning into coastal plains as the river approaches the Gulf of Mexico in the Lower Rio Grande sub-basin. Major tributaries to the main rivers include:

- Independence Creek in the Lower Pecos River sub-basin,
- the Rio Conchos, in the Upper Rio Grande sub-basin near Presidio, Texas,
- the Devils River, also in the Upper Rio Grande sub-basin, forms an arm of International Amistad Reservoir,
- San Felipe Creek in the Middle Rio Grande sub-basin in Del Rio, Texas,
- the Rio Salado below Laredo, Texas, and,
- the Rio San Juan above McAllen, Texas.

There are many other smaller tributaries and springs that also contribute to the Rio Grande Basin from the United States and Mexico.

Soils in the Pecos River sub-basin are primarily silts mixed with clay and loam underlain by caliche and clays, which prevent much of the rainfall in the region from percolating into the ground and, instead, aid in the evaporation of rainfall. In the Upper Rio Grande sub-basin, the soils are sands underlain by clay and loam away from the river. These soils are interrupted by weathered and un-weathered bedrock along the river. In the Middle Rio Grande sub-basin, the soils are primarily clay and loam mixed with gravels. In the Lower Rio Grande sub-basin, soils are primarily silts and clays laid down by estuarine conditions and coastal processes. The extreme Lower Rio Grande region is composed of deltaic deposits laid down when the region was a large river delta, much like what is visible at the confluence of the Mississippi with the Gulf of Mexico.

Vegetation in the Pecos River sub-basin consists of desert grasses, mesquite, sage, and creosote. Along the banks of the Pecos River, invasive saltcedar bushes have taken over as the dominant species. In the Upper Rio Grande sub-basin, the vegetation consists of tobosa shrubs, tarbrush, creosote, and blackgrass in the plains areas, and mesquite, creosote, and lechuguilla in the mountain regions. Saltcedar is also creating monocultures in many parts of the upper Rio Grande. The Middle Rio Grande sub-basin vegetation is primarily cropland near the river and blackgrass and mesquite away from the river. The Lower Rio Grande sub-basin vegetation below Falcon Reservoir is also mesquite and blackgrass, but the remainder of the basin is cropland all the way to the Gulf of Mexico where there are some wetland environments.

The Rio Grande Basin receives very little rainfall compared to other basins in Texas. The Rio Grande relies on snow pack from the Southern Rocky Mountains in Colorado and in New Mexico to drain into the upper reservoirs for delivery to the lower part of the Rio Grande in Texas. Drought conditions (below average rainfall and snow pack) have affected water storage in the reservoirs upstream of Texas. The Pecos River and the Upper Rio Grande sub-basins are primarily arid, desert environments with very little rainfall and high evaporation rates. Normal annual rainfall ranges from 9 inches (23 cm) in the upper portion of the two sub-basins to 15 inches (38 cm) near Amistad Dam. The Middle Rio Grande sub-basin averages 25 inches (63 cm) of rain, as does the western portion of the Lower Rio Grande sub-basin. The remainder of the Lower Rio Grande sub-basin receives over 25 inches (63 cm) of rainfall. The Lower Rio Grande region is experiencing the effects of the drought conditions throughout the basin even though it has such a relatively high annual rainfall. Some of the heavy rainfall that occurs from ocean source storms drives far enough upstream to be captured by Falcon Dam, but the majority of the rainfall flows out into the Gulf of Mexico.

USIBWC Clean Rivers Program

The Rio Grande in Texas serves as the border between the United States and Mexico, and divides the watershed of the Rio Grande in half. In order to address the international nature of the watershed, the state of Texas through the TCEQ, contracted with the United States Section, International Boundary and Water Commission (USIBWC) in October 1998 to administer the CRP for the Rio Grande Basin. This partnership has resulted in better coverage within the basin and additional information to better address issues along the border. The USIBWC has expanded the program to include additional partners and water quality monitoring stations. Specific items of concern are addressed by supporting special projects in the basin both in the United States and Mexico.

History of the International Boundary and Water Commission

As established by Treaties in 1848 and 1853, the international boundary between the United States and Mexico along Texas follows the center of the Rio Grande from its mouth on the Gulf of Mexico, a distance of 1,254 miles (2,019 km), to a point just upstream of El Paso, Texas and Ciudad Juárez, Chihuahua.

Although sparsely settled at the time of the 1848 and 1853 Treaties, the region rapidly developed, beginning with the coming of the railroads in the 1880s and the development of irrigated agriculture after the turn of the century. The Treaty of Guadalupe Hidalgo, February 2, 1848, established the international boundary. Temporary commissions were formed by these boundary treaties to perform the first joint mission of the Governments of the United States and Mexico, which was to survey and demarcate the boundary on the ground in accordance with the treaties. In the late nineteenth century, as the settlements grew along the boundary, the rivers and the adjoining lands began to be developed for agriculture. Questions arose as to the location of the boundary when the rivers changed their course and transferred tracts of land from one side of the river to the other. The two Governments by the Convention of November 12, 1884 adopted certain rules designed to deal with such questions.

1889

By the Convention of March 1, 1889, the Governments of the United States and Mexico created the International Boundary Commission (IBC), to consist of a United States Section and a Mexican Section. The IBC was charged with the application of the rules of the 1884 Convention, for the settlement of questions arising as to the location of the boundary when the rivers changed their course. That Convention was modified by the Banco Convention of March 20, 1905 to retain the Rio Grande as the boundary.

1906

The Convention of May 21, 1906 provided for the distribution, between the United States and Mexico, Rio Grande water above Fort Quitman, Texas for the 89-mile (143 km) international boundary reach of the Rio Grande through the El Paso-Juárez Valley. This Convention allotted to Mexico 60,000 acre-feet annually Rio Grande water to be delivered in accordance with a monthly schedule at the head gate to Mexico's Acequia Madre just above Ciudad Juárez, Chihuahua. To facilitate such deliveries, the United States constructed, at no expense to Mexico, the Elephant Butte Dam in its territory. The Convention includes the proviso that in case of extraordinary drought or serious accident to the irrigation system in the United States, the amount of water delivered to the Mexican canal shall be diminished in the same proportion as the water delivered to lands under the irrigation system in the United States downstream of Elephant Butte Dam.

1933

In the Convention of February 1, 1933, the two Governments agreed to jointly construct, operate and maintain, through the IBC, the Rio Grande Rectification Project, which straightened and stabilized the 155-mile (249 km) river boundary through the highly developed El Paso-Juárez Valley. The project further provided for the control of the river's floods through this Valley.

1944

The Treaty of February 3, 1944 for "Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande" distributed between the two countries Rio Grande water from Fort Quitman to the Gulf of Mexico. Of the Rio Grande water, the Treaty allocates to Mexico:

(1) All of the waters reaching the main channel of the Rio Grande from the San Juan and Alamo Rivers, including the return flows from the lands irrigated from those two rivers;

(2) Two-thirds of the flow in the main channel of the Rio Grande from the measured Conchos, San Diego, San Rodrigo, Escondido and Salado Rivers, and the Arroyo Las Vacas, subject to certain provisions; and

(3) One-half of all other flows occurring in the main channel of the Rio Grande downstream from Fort Quitman.

The Treaty allots to the United States:

(1) All of the waters reaching the main channel of the Rio Grande from the Pecos and Devils Rivers, Good Enough Spring and Alamito, Terlingua, San Felipe and Pinto Creeks;

(2) One-third of the flow reaching the main channel of the river from the six named measured tributaries from Mexico and provides that this third shall not be less, as an average amount in cycles of five consecutive years, than 350,000 acre-feet annually; and

(3) One-half of all other flows occurring in the main channel of the Rio Grande downstream from Fort Quitman.

The 1944 Treaty further provided for the two Governments to jointly construct, operate and maintain on the main channel of the Rio Grande the dams required for the conservation, storage and regulation of the greatest quantity of the annual flow of the river to enable each country to make optimum use of its allotted waters. In the 1944 Treaty, the two Governments agreed to give preferential attention to the solution of all border sanitation problems.

It changed the name of the International Boundary Commission (IBC) to the International Boundary and Water Commission (IBWC). This Treaty entrusts the IBWC with the application of its terms, the regulation and exercise of the rights and obligations which the two Governments assumed there under, and the settlement of all disputes to which its observance and execution may give rise. The Treaty also provides that the IBWC study, investigate and report to the Governments on hydroelectric facilities that should be built at the international storage dams and flood control works, other than those specified in the Treaty. These studies also estimate the cost and the parts to be built, operated, and maintained by each Government through its Section of the IBWC.

1970

The Treaty of November 23, 1970 resolved all pending boundary differences and provided for maintaining the Rio Grande as the international boundary. The Rio Grande was reestablished as the boundary throughout its 1,254-mile (2,019 km) section. The Treaty includes provisions for restoring and preserving the character of the Rio Grande as the international boundary. Provisions include restoration of lost character, to minimize channel changes, and to resolve problems of sovereignty that may arise due to future changes in the Rio Grande channel. It contains procedures designed to avoid territory loss by either country related to future changes in the river's course. This Treaty, too, charged the IBWC with carrying out its provisions.

Current IBWC Mission

The mission of the IBWC is to apply the rights and obligations, which the Governments of the United States and Mexico assume under the numerous boundary and water treaties and related agreements. The mission is carried out in a way that benefits the social and economic welfare of the peoples on both sides of the boundary and improves relations between the two countries.

As provided for in the treaties and agreements, those rights and obligations include:

- Distribution between the two countries of the waters of the Rio Grande;
- Regulation and conservation of the waters of the Rio Grande for their use by the two countries by joint construction, operation and maintenance of international storage dams, reservoirs, and plants for generating hydroelectric energy at the dams;
- Protection of lands along the river from floods by levee and floodway projects;
- Solution of border sanitation and other border water quality problems;
- Preservation of the Rio Grande as the international boundary; and
- Demarcation of the land boundary.

History of the Clean Rivers Program

In 1991, the Texas Legislature passed the Texas Clean Rivers Act (Senate Bill 818) in response to growing concerns that water resource issues were not being pursued in an integrated, systematic manner. The TCEQ, then TNRCC, had partnered with river agencies throughout Texas to Administer the CRP in each river basin in Texas. Because there was no river authority in the Rio Grande basin, the USIBWC was approached as the prime governmental agency tasked with addressing environmental concerns between the U.S. and Mexico. The USIBWC has field offices along the border with Mexico and can coordinate projects through its counterpart in Mexico, the International Boundary and Water Commission, Mexican Section (MXIBWC).

The act requires that ongoing water quality assessments be conducted for each river basin in Texas. This approach integrates water quality and water quantity issues within a river basin, or watershed, using a watershed management approach. The Clean Rivers Program (CRP) legislation mandates that each river authority (or local governing entity) shall submit quality-assured data collected in the river basin to the Commission (TCEQ). Quality assured data in the context of the legislation; means data that complies with the Commission rules for water quality monitoring programs, including rules governing the methods under which water samples are collected and analyzed and data from those samples are assessed and maintained. To further insure that water quality data means these high standards, the TCEQ requires that all water quality data submitted must be analyzed by a lab carrying a National Environmental Laboratory Accreditation Council (NELAC) certification, excluding field data.

A watershed is a geographic area in which water, sediments, and dissolved materials drain into a common outlet. The watershed management approach looks at the entire watershed for water quality issues. Using this approach, problems can be tracked upstream to determine potential sources of contamination. This helps identify and fix water quality problems within the basin in the most efficient way. It also gives us insight into the complexity of the watershed and to see how solutions or problems in one area can affect the watershed far from the source. The state of Texas is divided into 23 river basins and the bays and estuaries along the Gulf of Mexico. The Rio Grande Basin is designated as Basin 23.

Another aspect of the CRP is that it provides a forum that allows for the exchange of information and ideas between the CRP and the public. The citizens of the basin are offered the opportunity to comment and ensure that local issues are addressed within the program. Every year, public meetings are held to update stakeholders on the progress of current projects and to present results of water quality monitoring. Maintaining local support is critical to the CRP and its' success in addressing water quality issues. To learn more about the Clean Rivers Program throughout Texas, the CRP has created a video that can be downloaded at http://videos.h-gac.com/clean_rivers.wmv.

DATA COLLECTION AND ANALYSIS

In the Rio Grande basin, each of the 4 sub-basins are further broken down into river segments created by TCEQ. There are 14 river segments in the Rio Grande basin. The CRP monitors the basin at various water quality monitoring stations along the Rio Grande, Pecos River, and several tributaries to the Rio Grande in Texas. Since the basin is so long (over 1200 miles), we receive help in the collection of samples throughout the basin by partnering agencies. Sample collectors record field observations/measurements (weather, flow, pH, temperature, conductivity, and dissolved oxygen) and collect water chemistry samples. The water samples are then sent to a NELAC certified contract laboratory for chemical analysis.

After the sample collectors and the contract lab do the analyses/measurements, all of the data is sent to the CRP for entry into the USIBWC CRP database. The database information is used by the CRP in assessment of the water quality at the monitoring stations. Data is also posted on the webpage for public access.

The criterion for the collection and analysis of water quality data is outlined in the Rio Grande Basin Monitoring Plan - Quality Assurance Project Plan (QAPP). This document outlines the monitoring program, how data is collected and analyzed, quality assurance/quality control (QA/QC), and reporting requirements. Prior to collecting any samples, the USIBWC, TCEQ, and its CRP partners must agree to follow the protocols established in the QAPP. CRP partners are provided the equipment and training to perform the fieldwork. From the time samples are collected to the actual reporting, the samples and data must meet specific criteria in order to be considered valid, quality assured data. Once the data has been verified, the data is then sent to TCEQ for further quality assurance measures. Upon approval by TCEQ, the data is uploaded into the TCEQ database and the CRP website.

PARAMETERS

The parameters in this report were selected to present information on constituents that can affect water quality, limit the intended uses of the water, or harm the aquatic life. A brief explanation of the parameters analyzed includes:

- Alkalinity - A measure of the acid-neutralizing capacity of water. Bicarbonate, carbonate and hydroxide are the primary forms of alkalinity in natural waters. The presence of borates, phosphates, and silicates may increase the concentration of alkalinity.
- Ammonia Nitrogen - Naturally occurring in surface and wastewaters, it is produced by the breakdown of compounds containing organic nitrogen. High levels can be lethal to certain fish species. Possible sources of ammonia are from animal waste from CAFO's or from urban wastewater that is not treated for ammonia removal.
- Biochemical Oxygen Demand (BOD) - A measure of the amount of oxygen consumed in the biological processes that break down organic matter in water. High BOD levels are an indicator of increased pollution in the water, usually from untreated sewage, which may result in decreased oxygen levels in the receiving stream.
- Chloride - One of the major inorganic ions in water and wastewater. Industrial and agricultural processes can increase concentrations. High levels can affect plant growth and the use of the water for agricultural or municipal purposes.
- Chlorophyll-*a* - Photosynthetic pigment that is found in all green plants. The concentration of chlorophyll-a is used to estimate phytoplankton biomass in surface water.
- Conductivity - Dissolved substances in water dissociate into ions with the ability to conduct electrical current. Conductivity is a measure of how salty the water is; salty water has high conductivity.
- Dissolved Oxygen (DO) - The oxygen freely available in water. Dissolved oxygen is vital to fish and other aquatic life and for the prevention of odors. Low DO can occur in stagnant waters as well as from waters polluted with chemicals that deplete the oxygen or from water high in BOD.
- Fecal coliform/*Escherichia coli (E. coli)* - Bacteria found in the intestinal tracts of warm-blooded animals. These organisms are used as indicators of bacterial pollution and possible presence of waterborne pathogens. Sources of high bacteria are wastewater that has not been treated for bacteria, concentrations of animals, and application of animal based fertilizers.
- Metals (Total and Dissolved) - Metals occur naturally in the watershed and may increase when used for anthropogenic processes. High levels can result in bioaccumulation within aquatic species causing short or long-term effects and may pose health concern issues with regards to fish consumption, agriculture, or public water supply. Sources of metals can be naturally occurring in the water, like arsenic, or deposited from industrial processes. Wastewater effluent that has not been treated for metals can also introduce high levels of metals.
- Nitrate-Nitrogen - A compound containing nitrogen that can exist as a dissolved solid in water. Excessive amounts can have harmful effects on humans and animals. Potential sources of nitrates are agricultural fertilizers and wastewater treatment plants converting ammonia to nitrates.
- Organic Compounds (Volatile and Semi-volatile) - Compounds used in industry (commercial or agricultural). When present in water they could potentially affect aquatic life and human health. Examples are herbicides and pesticides.

- Orthophosphate as Phosphorus - Nearly all phosphorus exists in water in the phosphate form. Orthophosphate can be directly utilized by plants and organisms, but is usually the least abundant nutrient. Because of this, orthophosphate is commonly the limiting factor, meaning aquatic plant growth is limited by the amount of orthophosphate in the water. Excessive amounts of phosphorus can contribute to the eutrophication (growth of aquatic vegetation because of excess nutrients resulting in depressed DO levels) of lakes and rivers.
- pH - The hydrogen ion activity of water caused by the breakdown of water molecules and presence of dissolved acids and bases.
- Sulfate - Sulfate is derived from rocks and soils containing gypsum, iron sulfides and other sulfur compounds. Industrial discharges may contain high levels of sulfate and can affect conveyance systems, under anaerobic conditions, due to bacterial activity that converts sulfate to hydrogen sulfide, subsequently forming sulfuric acid.
- Total Dissolved Solids (TDS) - The amount of material (inorganic salts and small amounts of organic material) dissolved in water. High TDS concentrations can limit the use of water for agriculture, drinking water, and industrial use.
- Total Hardness - The sum of the calcium and magnesium concentrations, expressed as calcium carbonate in mg/L.
- Total Organic Carbon (TOC) - Method used to determine the amount of organic carbon present in water and wastewater. Sources of TOC are decaying organic matter as well as pesticides, fertilizers, herbicides, and detergents.
- Total Phosphorus - Phosphorus is found in surface water and waste streams almost exclusively in the form of phosphates. It is found in solution, particulates, detritus, or in living aquatic organisms. Other sources of phosphates include decomposition of organic material and erosion of rock.
- Total Suspended Solids (TSS) - A measure of the total suspended particles in water, both organic and inorganic.
- Volatile Suspended Solids (VSS) – A measure of the inorganic component of TSS.
- 7Q2 - The 7Q2 (low flow) is defined as the seven-day, two-year low flow. The lowest average stream flow for seven consecutive days with a recurrence interval of two years, as statistically determined from historical data. For perennial freshwater streams, the only parameters that are applicable below 7Q2 are chloride, sulfate, TDS, acute toxics, and toxicity.

VALIDATING WATER QUALITY DATA

The QAPP is an integrated, comprehensive surface water quality monitoring program for the international reach of the Rio Grande that achieves multiple water quality monitoring objectives.

The overall goal is to provide valid water quality data that can be used to assess water quality in the Rio Grande. Each monitoring station consists of routine monitoring and special studies in the Rio Grande basin and is a coordinated effort by several entities participating in the CRP.

Samples are collected according to the procedures outlined in the TCEQ Surface Water Quality Monitoring (SWQM) Procedures. Personnel participating in the Rio Grande are trained using this guidance. Proper sample collection requires knowledge of proper sampling and preservation techniques, container specifications, and documentation. Each CRP partner is evaluated every other year on field sampling techniques, known as a Monitoring Systems Audit (MSA) to ensure that proper sampling techniques and instrument use are being applied.

Field personnel submit field data sheets that contain site information and water quality data that were collected in the field. The field data form is sent to the CRP staff to be included in the water quality database. Samples are shipped to the laboratory for analysis accompanied by a chain of custody form (COC). The COC is used to document sample handling during transfer from the field to the laboratory and to document the analyses to be performed on the samples.

Samples that are submitted to the laboratory are analyzed using methods approved by TCEQ and are specified in the QAPP. The QA/QC requirements, which are also listed in the QAPP, must be met in order for data to be considered valid. Each method describes how the sample will be handled prior to and during the analysis. Samples must also be analyzed within a specified time to be considered valid. The method must be sensitive enough to be reported at the Ambient Water Reporting Limit (AWRL) established by the TCEQ. The laboratory QA/QC program must meet or exceed the criteria and must adhere to the requirements specified in the QAPP prior to analyzing samples in the Rio Grande Basin.

CRP staff review field data sheets, COCs, and laboratory reports to verify that all criteria from the time of sample collection up to the report generation have been completed and meet the requirements specified in the QAPP. Data that does not meet these criteria will not be reported in the dataset but will be archived with an explanation as to why the data did not meet QA/QC requirements. Data that has been verified will be entered into the Rio Grande CRP database and undergo a final check for errors in the dataset. The database checks the data for values above the AWRL, incorrect station numbers, incorrect parameter codes, and for data that is outside the normal range for a given parameter. TCEQ field offices in the Rio Grande basin submit the data collected directly to TCEQ in Austin and fall under the reporting requirements of the TCEQ statewide SWQM QAPP. All data collected by the CRP and TCEQ field offices is stored in the TCEQ database, which contains data from the entire state of Texas. TCEQ then analyzes the data for all of the above stated requirements prior to inclusion of the data into their database. When all data have passed the many checks, it is used in producing the many assessments done on the basin.

REAL-TIME MONITORING STATIONS

Part of the effort by TCEQ and CRP to create a more precise picture of water quality in the state and in the Rio Grande has been to install monitoring stations at key locations that collect data 24 hours a day. These stations collect data on dissolved oxygen, pH, temperature, and conductivity. Currently there are 13 continuous water quality monitoring stations in the Rio Grande basin and there are several more in development phases. These stations provide data that would not be possible through a routine monitoring process. To view data on the real-time stations in the Rio Grande basin and throughout the state of Texas, visit the real-time site at www.tceq.state.tx.us/assets/public/compliance/monops/water/wqm/tx_realtime_swf.html

PARTNERS

Monitoring efforts in such a large basin would not be possible by a single entity. The Rio Grande Basin CRP receives huge support from many other agencies, offices, and institutions in its efforts to monitor the Rio Grande Basin. This support comes in the form of sample collection, visual inspection of sites, recommendations about problems or special areas of concern, recommendations for new sites, and assistance with special studies. Below is a list of our partners and the support they provide.

Big Bend National Park National Park Service – Collect samples at two sites along the Rio Grande in the Big Bend National Park area. This part of the river is a popular area for rafting and wading. Park personnel collect water quality samples to insure this information is available for people who plan on being in the water.

City of Laredo – The City of Laredo's Environmental Services Division (ESD) provides support in the Laredo/Nuevo Laredo reach of the Rio Grande. ESD collects water samples in Manadas Creek, a tributary of the Rio Grande in Laredo. The ESD also provides support to the CRP by hosting public and CRP meeting and providing local expertise in addressing water quality issues and public education.

City of Laredo Health Department – Collects bacteria data at eight sites around the City of Laredo. The health department provides field and laboratory support to the CRP on a monthly basis.

Texas A&M Cooperative Agrilife Extension Service – The CRP has provided support for special studies and receives recommendations and information about conditions along the Pecos River and Upper Rio Grande.

Rio Grande International Study Center (RGISC) – Collects water samples in the Middle Rio Grande around Laredo at seven sites. The RGISC also provides academic research and special studies on water quality and environmental issues in the Middle Rio Grande.

University of Texas at El Paso – UTEP provides academic research and special studies on water quality and environmental issues in the Upper Rio Grande.

University of Texas Brownsville – Collect water samples at two sites in the Lower Rio Grande in Brownsville. UTB also provides academic research and special studies on water quality and environmental issues in the Lower Rio Grande.

El Paso Community College – EPCC collects water samples at four sites in the Upper Rio Grande in El Paso for academic research and special studies on water quality and environmental issues.

El Paso Water Utilities – Analyzes water quality samples collected in the Upper Rio Grande in the El Paso area.

USIBWC American Dam Office – Collect water samples at four sites in the Upper Rio Grande around El Paso.

USIBWC Amistad Office – Collect water samples at four sites along the Upper Rio Grande near Del Rio.

USIBWC Falcon Dam Office – Collect water samples at three sites along the Middle Rio Grande.

USIBWC Mercedes Field Office – Collect water samples at five sites in the Lower Rio Grande around Anzalduas Dam and at one site in a Mexican drain.

USIBWC Presidio Field Office – Collect water samples at four sites in the Upper Rio Grande around Presidio.

2.0 PUBLIC INVOLVEMENT

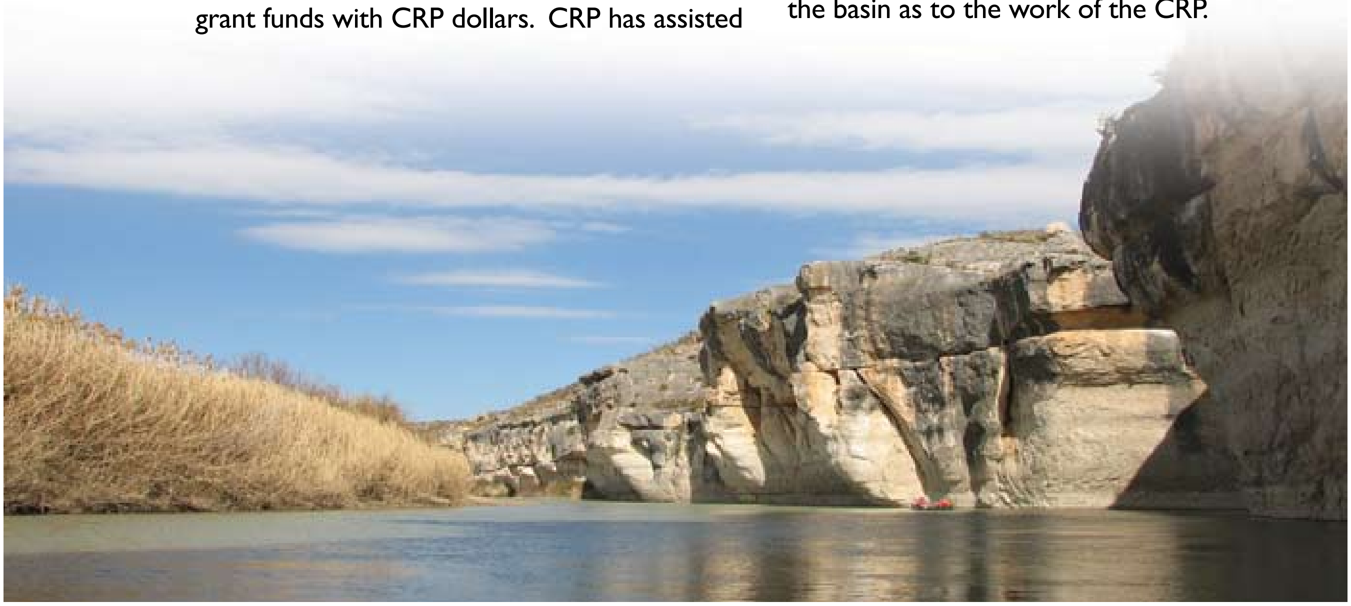
2.0 PUBLIC INVOLVEMENT

Public involvement comes in many different forms for the CRP. CRP staff attends various meetings organized by interest groups in the Rio Grande Basin to hear what issues they think need attention. Presentations at these meetings serve to inform these groups of the goals and efforts in the basin and to learn what other groups and agencies are doing in the basin to ensure that water quality data is readily available for the Rio Grande in Texas and to eliminate duplication of efforts. A more comprehensive assessment will be possible by expanding the assessment to include data from New Mexico and Mexico. An initiative is currently underway with cooperation from the U.S. and Mexican environmental agencies to create a bi-national water quality database. Because of the numerous agencies involved and varying analytical methods and standards employed by both countries, several meetings are scheduled to agree upon the parameters, standards, and data delivery.

Support is also provided to academia and other agency research studies within the basin. Some of these studies include chemical and bacteriological studies around major metropolitan areas and possible adverse impacts on the wildlife due to domestic wastewater. One goal within the CRP is to maximize the level of effort within the basin by leveraging grant funds with CRP dollars. CRP has assisted other agencies and groups who have received grants to do research in the Rio Grande by providing support either through additional field personnel, lab support, or project coordination with Mexico.

BASIN ADVISORY COMMITTEE

One of the ways that we communicate with our stakeholders is through the Basin Advisory Committees (BAC). Members of this committee include public and special interest groups within the sub-basins concerned with the protection of the water resources. Basin Advisory Committee meetings are held once a year to discuss what issues the CRP has been involved in and areas of concern within the basin. The meeting gives the committee a chance to inform us about areas of concern that they would like to see the CRP address. Also at the meeting, we provide a forum for the presentation of research progress and findings within the basin conducted by the CRP and our partners. In an effort to maximize the audience learning about the CRP and its goals, assessments, and future work in the basin, The CRP has been combining the BAC meetings with other meetings with a common interest. We have also requested to be placed on other meeting agendas of organizations with a common goal to capture everyone interested in protecting the health of the basin as to the work of the CRP.



ADOPT A RIVER CAMPAIGN

The USIBWC operates a program in the greater El Paso area to encourage citizens to adopt a section of the river to periodically beautify by removing trash and debris from the banks. To date, this program has brought in many adoptions from community organizations and businesses.

FRIENDS OF THE RIO GRANDE

The Friends of the Rio Grande Initiative (FORG) is a joint effort by the Texas Commission on Environmental Quality (TCEQ) and the United States Section of the International Boundary and Water Commission (USIBWC). FORG was set up to provide the Texas - Mexico border region of the state of Texas with assistance in promoting environmental awareness in an effort to improve the quality of the environment along the border.

The 4 main goals of the initiative are:

(1) Create a volunteer monitoring network along the Rio Grande

(2) Provide assistance to existing or starting public education and outreach programs

(3) Promote and assist in river and lake volunteer cleanups

(4) Provide award recognition for outstanding efforts in environmental awareness

Volunteer monitoring and teacher education are being accomplished through Texas Stream Team. Texas Stream Team has been teaching educators and establishing a volunteer monitoring network throughout the entire state for many years and is described in more detail below.

To meet goals 2 and 3, FORG issued Request for Proposals for assistance in cleanups and education and outreach programs. FORG assisted with many education and outreach programs in existence in the basin in order to bolster their program through our efforts. A list of the grants awarded is below.

FORG and Texas Stream Team established a volunteer monitoring network in Laredo, TX and Texas Stream Team certified 13 teachers and 2 trainers from Laredo and 18 teachers and 5 trainers from Nuevo Laredo. FORG provided Texas Stream Team with 25 water quality testing kits. FORG assisted the Amistad Lake NPS with a lake clean-up of the Amistad Lake recreational areas in Del Rio, TX. Volunteers collected over 2000 pounds of trash, including 21 tires, from around the lake.

AWARDEE	AWARD
The Rio Bosque Wetlands Park	Weather station and teaching station
Groundwork El Paso	Pamphlet publication
Paso Del Norte Watershed Council	Outreach based website
International Museum of Art and Science	Mobile water quality teaching station
University of Texas - Brownsville	Water quality classroom equipment
Laredo Community College	Educational teaching kits and native habitat trail equipment
Sabal Palm Sanctuary	Materials to construct a classroom near the river
Amistad National Park	Water quality education kits

All of the above named awardees were presented with a plaque in thanks for their commitment to environmental education and outreach.

VOLUNTEER MONITORING-TEXAS STREAM TEAM

Texas Stream Team, formerly Texas Watch, is a network of trained volunteers and supportive partners working together to gather information about the quality of surface water in Texas. Texas Watch was established in 1991 through a cooperative partnership between Texas State University, the Texas Commission on Environmental Quality (TCEQ), and the U.S. Environmental Protection Agency (EPA). Currently, over 400 Texas Stream Team volunteers collect water quality data on lakes, rivers, streams, wetlands, bays, bayous, and estuaries in Texas. About 40% of Texas Stream Team monitoring groups are teachers and their students. Educators find Texas Stream Team to be a valuable teaching tool that lends itself to cross-disciplinary instruction. By teaching students how to measure what is happening in the environment around them, Texas Stream Team helps teachers effectively present the abstract concepts of biology, chemistry and ecology. With a broader understanding of water quality issues, students are better prepared to form solutions to environmental concerns. Teachers who complete the three-phase training and become Certified Water Quality Monitors have two options for getting their students involved in Texas Stream Team monitoring. Students in grades K-12 can monitor a body of water under a teacher's supervision with activities based on the educational objectives of the class or a teacher who goes a step further and becomes a Certified Trainer can then train students (grades 6-12) to become certified monitors. These students can then go on to form groups and monitor their own sites. Texas Stream Team also receives assistance through partnerships that help volunteers collect and report water quality information, through the Texas Stream Team Partners Program. Public and private entities train, equip, manage, and offer general support to the growing number of volunteer monitors across the state.

Data collected by Texas Stream Team is housed in their database for public access. Because the data is collected by volunteers using on site water quality test kits, the data is not used for the Texas Water Quality Inventory but the data is used by the CRP and many other programs as a screening tool to assess issues that need further addressing and to monitor the effectiveness of water quality improvement efforts. To learn more about the Texas Streams Team, visit their website at http://txstreamteam.rivers.txstate.edu/

RIO GRANDE CITIZENS' FORUM

The purpose of the Rio Grande Citizens' Forum is to facilitate the exchange of information between the USIBWC and the public about USIBWC projects. Volunteer board members from the community assist the USIBWC in this outreach effort. Forum Boards have been established in the Lower and Upper Rio Grande.

Public meetings of the Citizens' Forum are held quarterly in the applicable border communities and provide a useful venue for the USIBWC to provide information to stakeholders while also learning about the community's interests and concerns regarding USIBWC work.

RIO GRANDE BASIN CLEAN RIVERS PROGRAM WEBSITE

The CRP website provides information about the clean Rivers program and provides more information about getting involved and providing input into the program **(Figure 3)**. It also makes available information on our water quality data. The address for our website is: http://www.ibwc.gov/Organization/Environmental/CRP/Index.htm

During the past year, the USIBWC and the CRP have worked together to develop an Internet Mapping Service (IMS) to allow visitors to view the water quality and quantity network in the Rio Grande basin on an interactive map. The IMS can be found by clicking on the study area link **(Figure 4)**. From this site, visitors can find sites in their areas of interest by zooming into any area within the basin **(Figure 5)**. There is also a query tool that will allow the user to select several sites to bring up a page listing all available sites within the search grid with links to those sites individual site pages **(Figure 6).**

The individual site pages contain a photograph and map of the site as well as other pertinent information. On the site page are links to the available water quality and water quantity data **(Figure 7)**. Water quality data are in Microsoft Excel format with data dating back to 1995 **(Figure 8)**. These files can be saved to the visitor's computer and are updated quarterly. This data can also be obtained from the Monitoring Station Data link on the home page, which will bring up a page that lists all of our monitoring sites. Clicking on a station ID number will bring up the same Excel file containing our water quality data **(Figure 9)**.

The website also provides updates on meetings, contact information, and links to get a PDF copy of our previous Basin Summary Report in 2003 and our annual basin Highlights Reports since then. The Partner Links page provides links to other CRP Planning Agencies in the state and links to the websites of our partnering agencies who assist in Rio Grande water quality monitoring efforts. Many of these web sites also contain water quality data.

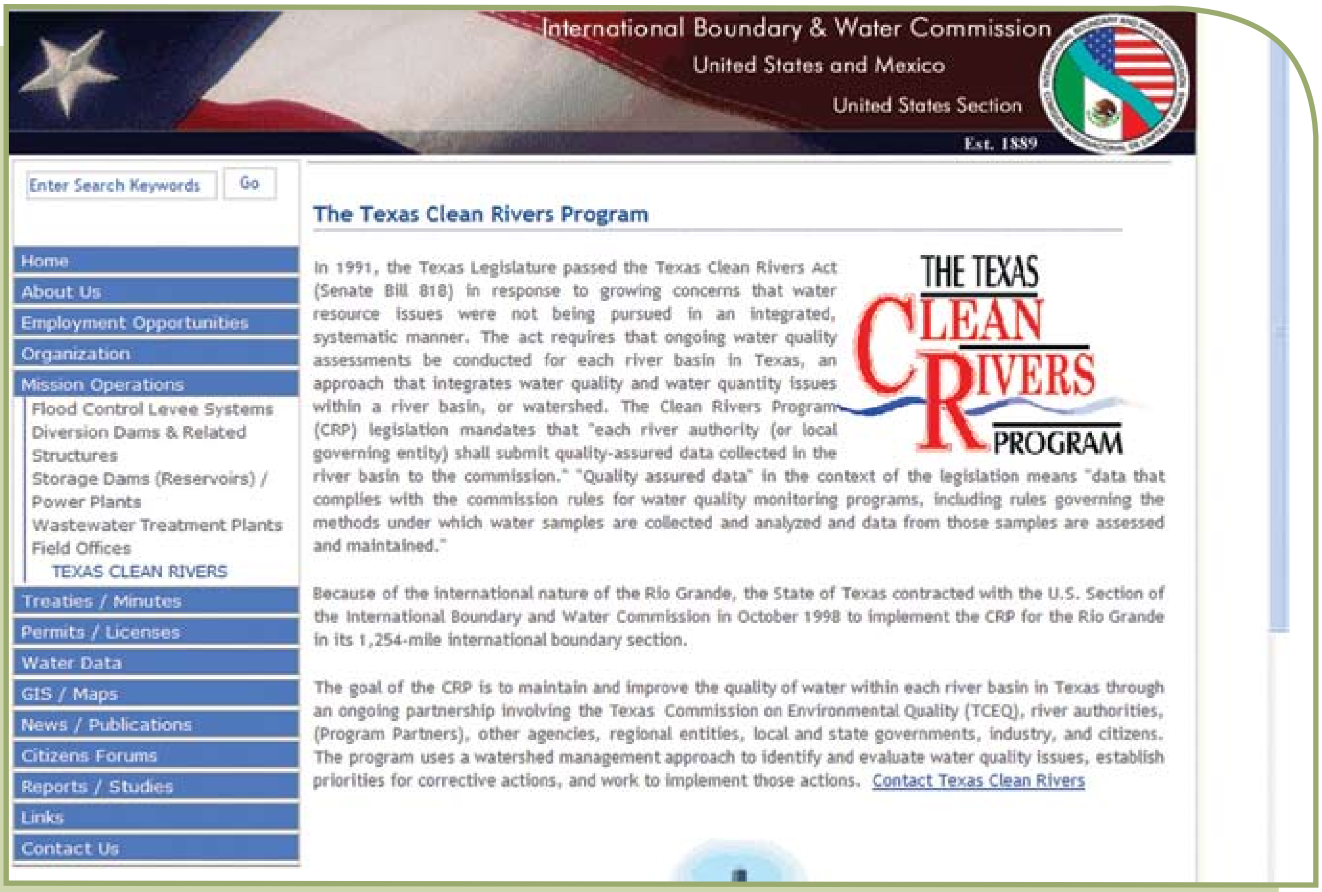


Figure 3 Rio Grande Basin Clean Rivers Program Website

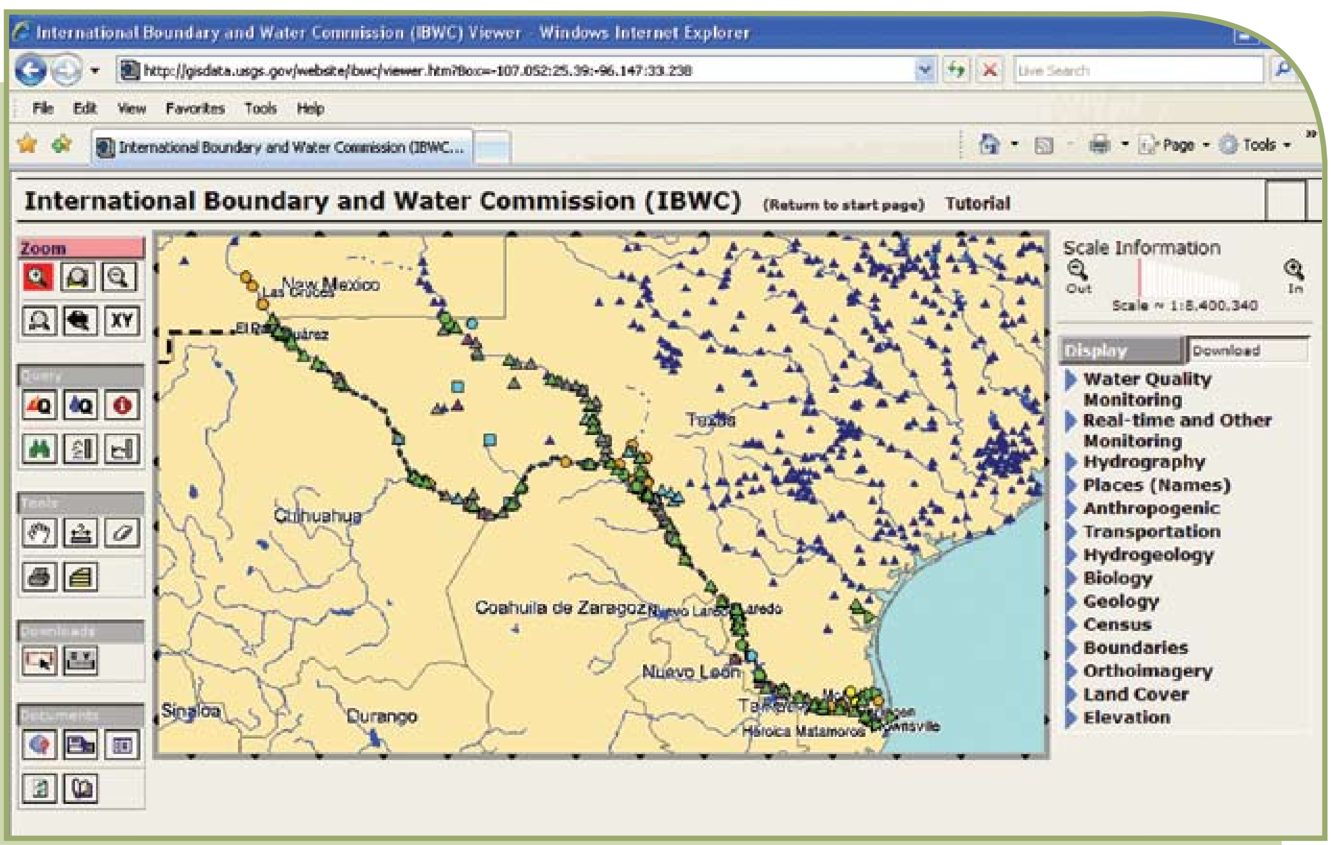


Figure 4 USIBWC IMS web page

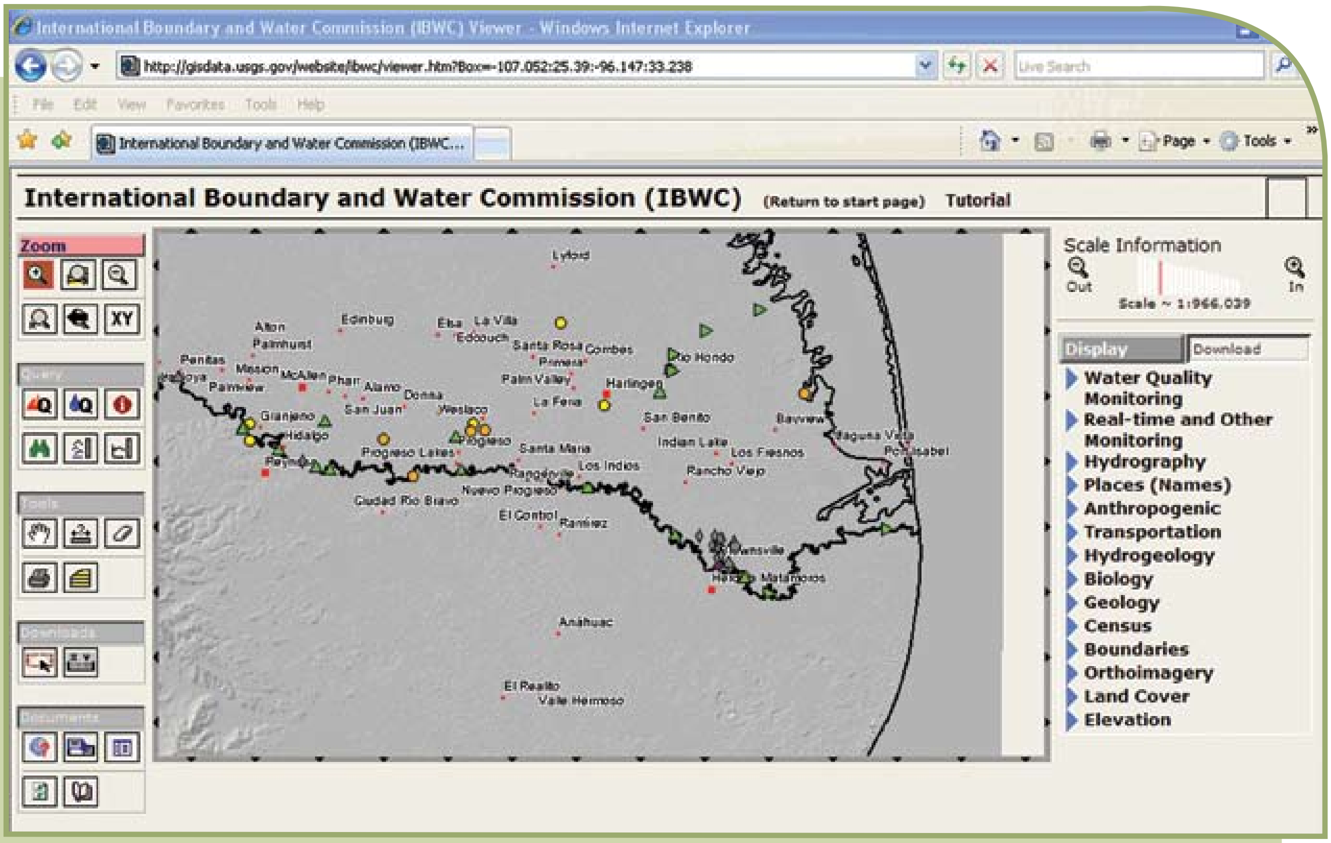


Figure 5 IMS after zooming in on Lower Rio Grande

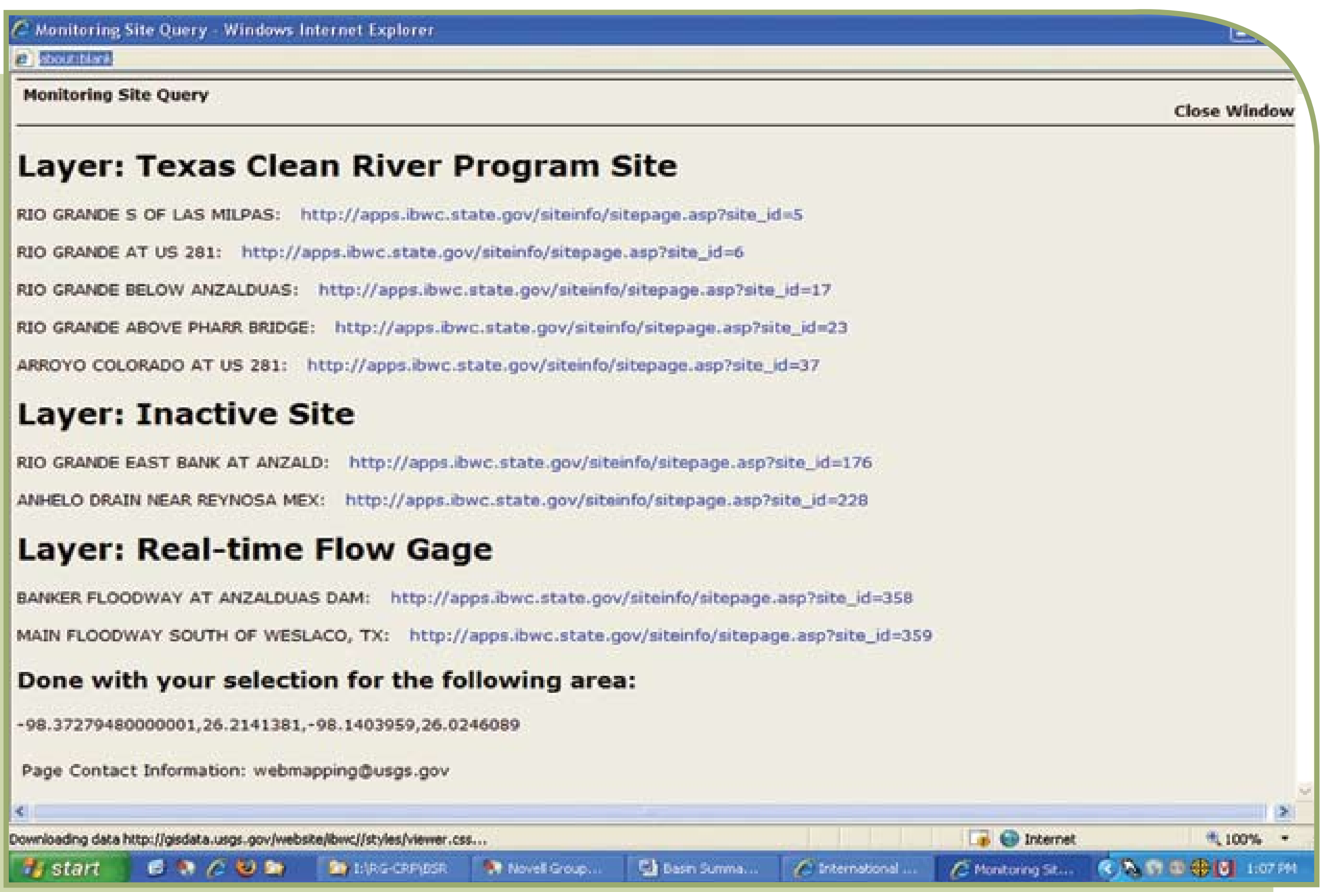
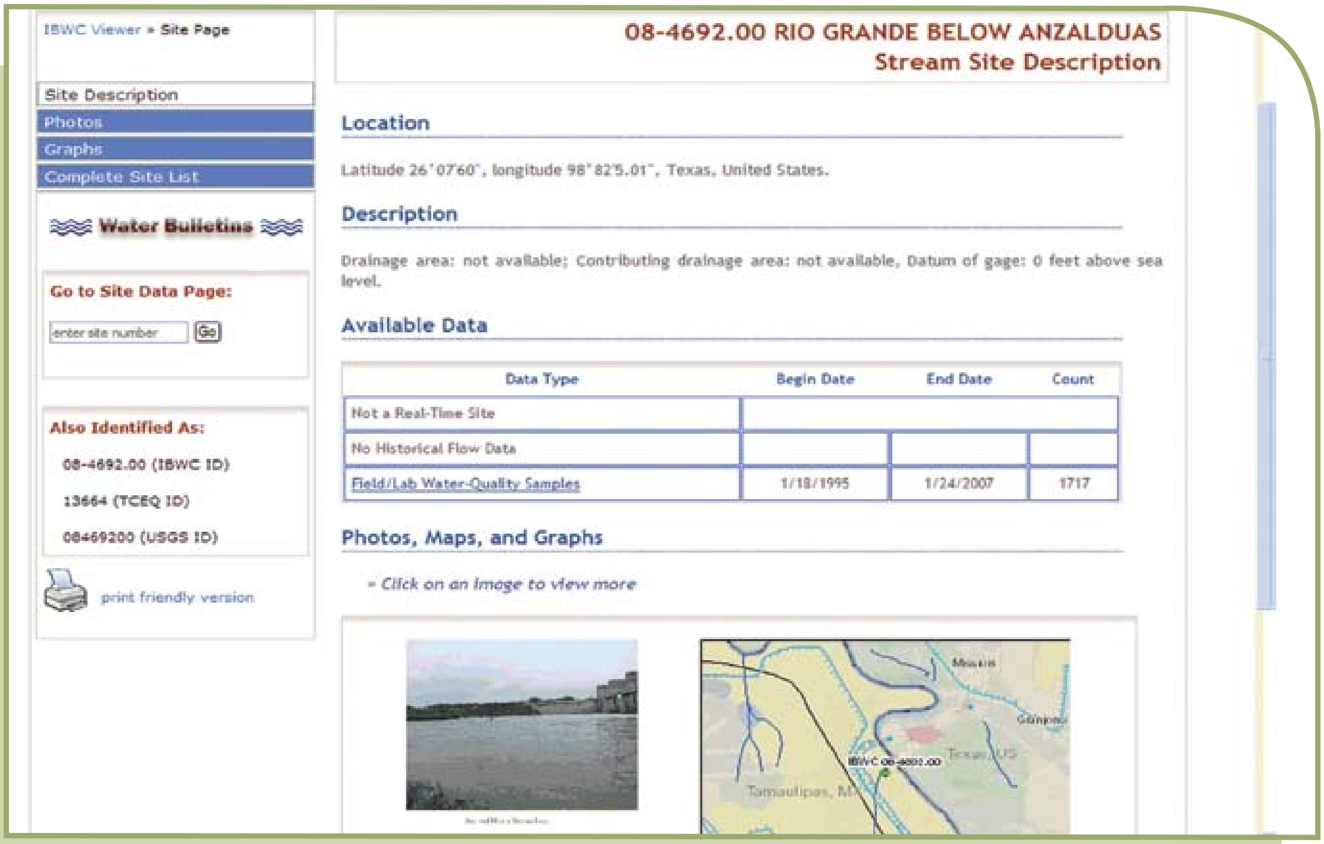


Figure 6 IMS query of sites



IBWC Viewer » Site Page

08-4692.00 RIO GRANDE BELOW ANZALDUAS
Stream Site Description

- Site Description
- Photos
- Graphs
- Complete Site List

Water Bulletins

Go to Site Data Page:

enter site number [Go]

Also Identified As:

08-4692.00 (IBWC ID)

13664 (TCEQ ID)

08469200 (USGS ID)

print friendly version

Location

Latitude 26°07'60", longitude 98°82'5.01", Texas, United States.

Description

Drainage area: not available; Contributing drainage area: not available, Datum of gage: 0 feet above sea level.

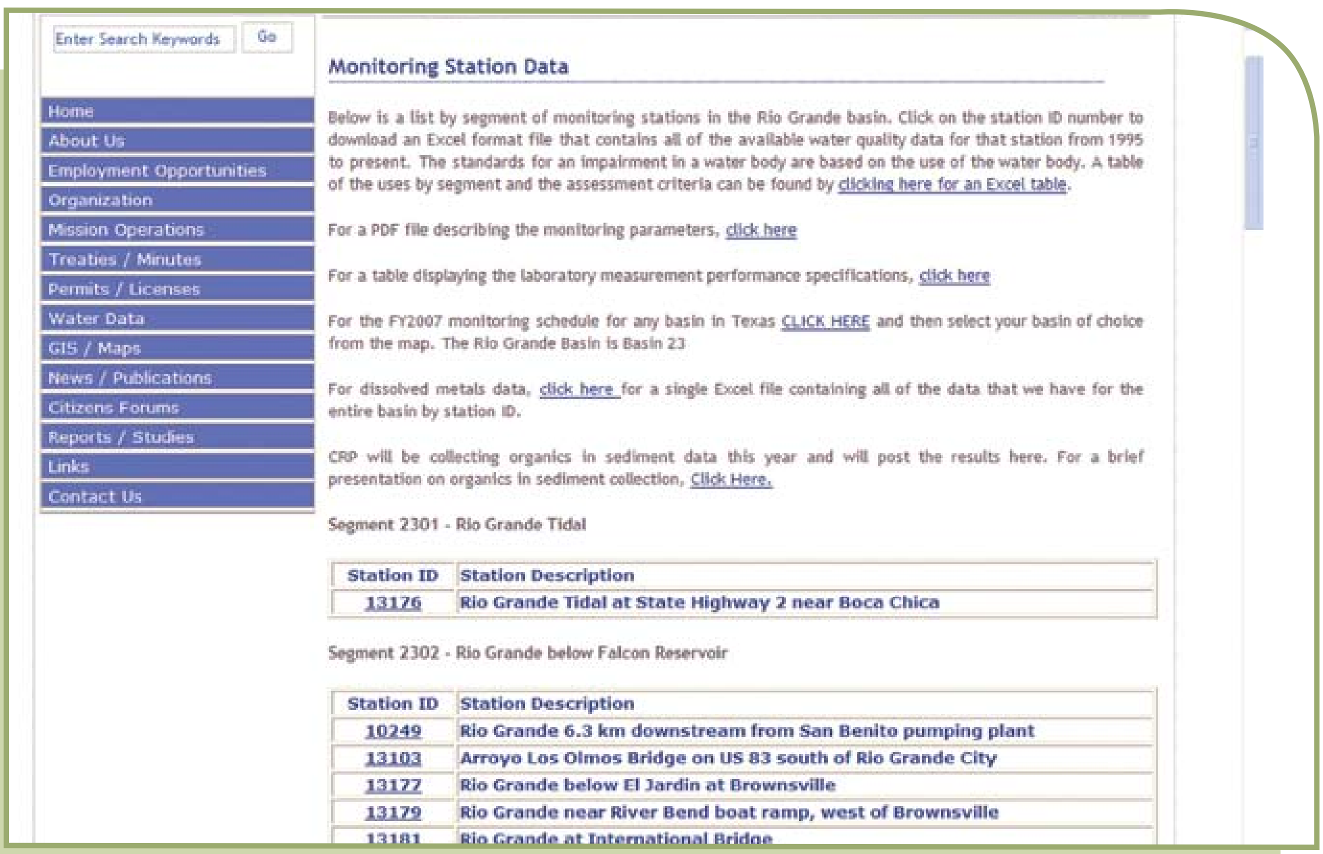
Available Data

Data Type	Begin Date	End Date	Count
Not a Real-Time Site			
No Historical Flow Data			
Field/Lab Water-Quality Samples	1/18/1995	1/24/2007	1717

Photos, Maps, and Graphs

- Click on an image to view more

Figure 7 Individual site page



Enter Search Keywords [Go]

- Home
- About Us
- Employment Opportunities
- Organization
- Mission Operations
- Treaties / Minutes
- Permits / Licenses
- Water Data
- GIS / Maps
- News / Publications
- Citizens Forums
- Reports / Studies
- Links
- Contact Us

Monitoring Station Data

Below is a list by segment of monitoring stations in the Rio Grande basin. Click on the station ID number to download an Excel format file that contains all of the available water quality data for that station from 1995 to present. The standards for an impairment in a water body are based on the use of the water body. A table of the uses by segment and the assessment criteria can be found by clicking here for an Excel table.

For a PDF file describing the monitoring parameters, click here

For a table displaying the laboratory measurement performance specifications, click here

For the FY2007 monitoring schedule for any basin in Texas CLICK HERE and then select your basin of choice from the map. The Rio Grande Basin is Basin 23

For dissolved metals data, click here for a single Excel file containing all of the data that we have for the entire basin by station ID.

CRP will be collecting organics in sediment data this year and will post the results here. For a brief presentation on organics in sediment collection, Click Here.

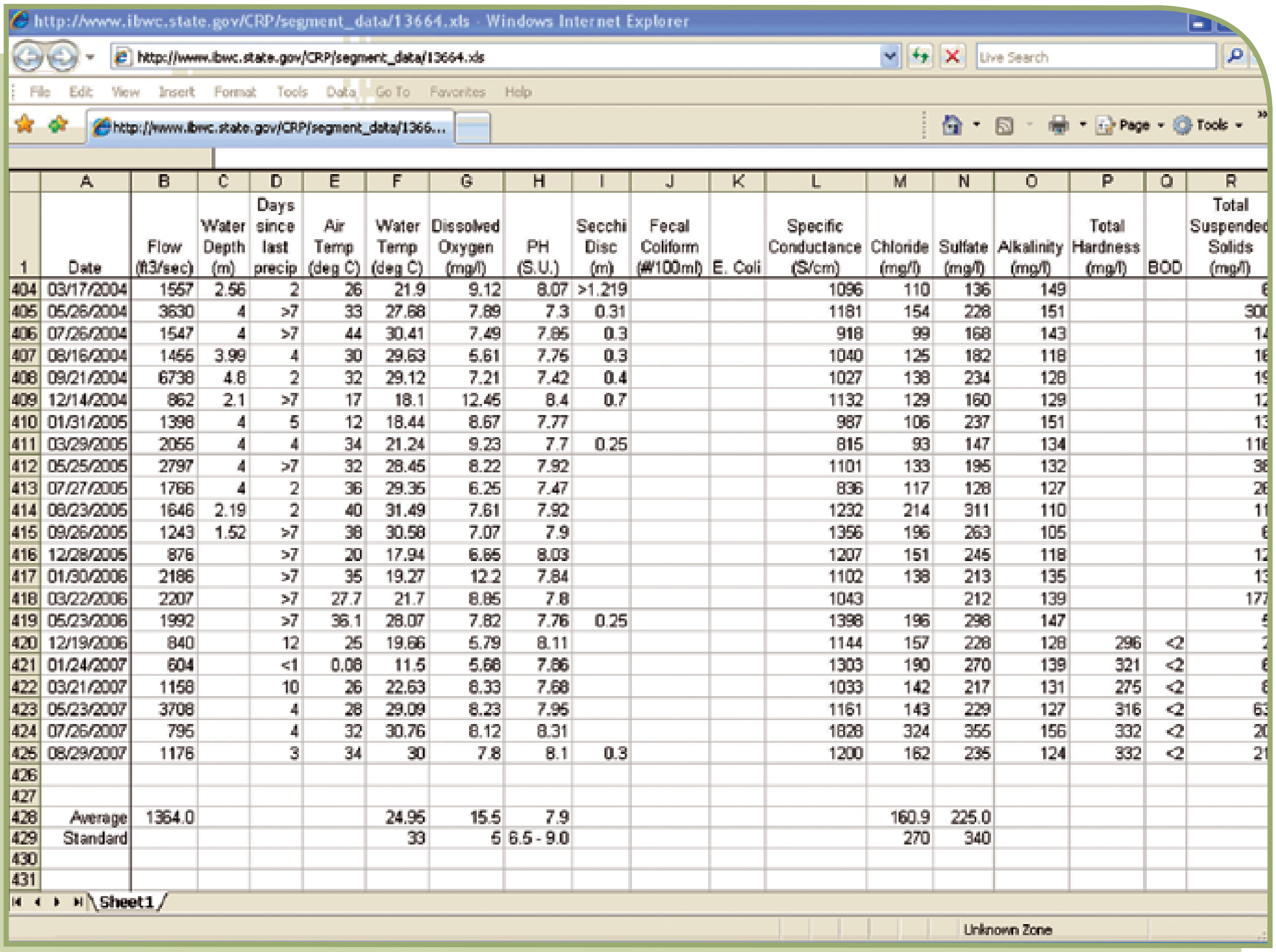
Segment 2301 - Rio Grande Tidal

Station ID	Station Description
13176	Rio Grande Tidal at State Highway 2 near Boca Chica

Segment 2302 - Rio Grande below Falcon Reservoir

Station ID	Station Description
10249	Rio Grande 6.3 km downstream from San Benito pumping plant
13103	Arroyo Los Olmos Bridge on US 83 south of Rio Grande City
13177	Rio Grande below El Jardin at Brownsville
13179	Rio Grande near River Bend boat ramp, west of Brownsville
13181	Rio Grande at International Bridge

Figure 8 Monitoring locations web page



1	Date	Flow (ft3/sec)	Water Depth (m)	Days since last precip	Air Temp (deg C)	Water Temp (deg C)	Dissolved Oxygen (mg/l)	PH (S.U.)	Secchi Disc (m)	Fecal Coliform (#/100ml)	E. Coli	Specific Conductance (S/cm)	Chloride (mg/l)	Sulfate (mg/l)	Alkalinity (mg/l)	Total Hardness (mg/l)	BOD	Total Suspended Solids (mg/l)
404	03/17/2004	1557	2.56	2	26	21.9	9.12	8.07	>1.219			1096	110	136	149			6
405	05/26/2004	3630	4	>7	33	27.68	7.89	7.3	0.31			1181	154	228	151			300
406	07/26/2004	1547	4	>7	44	30.41	7.49	7.85	0.3			918	99	168	143			14
407	08/16/2004	1455	3.99	4	30	29.63	5.61	7.76	0.3			1040	125	182	118			16
408	09/21/2004	6738	4.8	2	32	29.12	7.21	7.42	0.4			1027	138	234	128			19
409	12/14/2004	862	2.1	>7	17	18.1	12.45	8.4	0.7			1132	129	160	129			12
410	01/31/2005	1398	4	5	12	18.44	8.67	7.77				987	106	237	151			13
411	03/29/2005	2055	4	4	34	21.24	9.23	7.7	0.25			815	93	147	134			116
412	05/25/2005	2797	4	>7	32	28.45	8.22	7.92				1101	133	195	132			38
413	07/27/2005	1766	4	2	36	29.35	6.25	7.47				836	117	128	127			26
414	08/23/2005	1646	2.19	2	40	31.49	7.61	7.92				1232	214	311	110			11
415	09/26/2005	1243	1.52	>7	38	30.58	7.07	7.9				1356	196	263	105			6
416	12/28/2005	876		>7	20	17.94	6.65	8.03				1207	151	245	118			12
417	01/30/2006	2186		>7	35	19.27	12.2	7.84				1102	138	213	135			13
418	03/22/2006	2207		>7	27.7	21.7	8.85	7.8				1043		212	139			177
419	05/23/2006	1992		>7	36.1	28.07	7.82	7.76	0.25			1398	196	298	147			5
420	12/19/2006	840		12	25	19.66	5.79	8.11				1144	157	228	128	296	<2	2
421	01/24/2007	604		<1	0.08	11.5	5.68	7.86				1303	190	270	139	321	<2	6
422	03/21/2007	1158		10	26	22.63	8.33	7.68				1033	142	217	131	275	<2	6
423	05/23/2007	3708		4	28	29.09	8.23	7.95				1161	143	229	127	316	<2	63
424	07/26/2007	795		4	32	30.76	8.12	8.31				1828	324	355	156	332	<2	20
425	08/29/2007	1176		3	34	30	7.8	8.1	0.3			1200	162	235	124	332	<2	21
426																		
427																		
428	Average	1364.0				24.95	15.5	7.9					160.9	225.0				
429	Standard					33	5	6.5 - 9.0					270	340				
430																		
431																		

Figure 9 Excel sheet of water quality data

For more information on the USIBWC Clean Rivers Program, please feel free to contact any CRP staff member listed in the following table:

Table 1 Rio Grande Basin Clean Rivers Staff

STAFF – TITLE	PHONE NUMBER & E-MAIL ADDRESS
Carlos Pena Division Engineer	915 • 832 • 4740 carlospena@ibwc.gov
Bethany Ansell TCEQ Project Manager	512 • 239 • 1739 bansell@tceq.state.tx.us
Elizabeth Verdecchia USIBWC Program Manager	915 • 832 • 4701 elizabethverdecchia@ibwc.gov
Leslie Grijalva Quality Assurance Officer	915 • 832 • 4770 lesliegrijalva@ibwc.gov

3.0 TECHNICAL SUMMARY

3.0 TECHNICAL SUMMARY

TEXAS WATER QUALITY INVENTORY- 305(B) AND 303(D) REPORT

Under the Clean Water Act (CWA), each state is required to submit to the Environmental Protection Agency (EPA) a report on water quality known as the 303(d) and 305(b) reports. These reports identify which bodies of water are meeting, and which are not, the designated uses assigned to each river segment by analyzing the data against established indicators of water quality.

The Water Quality Inventory is the State-defined status of water quality for certain water bodies in Texas. The State defines water quality based on the Texas Surface Water Quality Standards, TCEQ Rules Chapter 307. The Standards specify numeric criteria for some water quality constituents, and narrative criteria for other water quality constituents. Numeric criteria established in the Standards are used to determine whether a water body is meeting its designated uses (e.g., contact recreation, aquatic life, drinking water). Most of the water bodies in Texas that flow all year have been assigned one or more segment numbers and are considered "classified segments". Numeric criteria are often specific to these water bodies. If a water body (or portion thereof) is found to not be meeting one of its designated uses, it will be considered to be *Impaired* and placed on the *303d List of Impaired Waters*.

Screening levels have been developed by the State to enable an assessment of water quality for some of the narrative criteria. Screening levels are used to determine if there is a water quality *Concern* and does not indicate an *Impairment.*

In the tables below, several water quality constituents are listed with their numeric criteria or screening level and the calculation used (e.g., number/percentage of samples over the criteria) for determining whether there is an *Impairment* or a *Concern*. Appendix I lists the Texas Water Quality Standards for the Rio Grande Basin.

Constituent	Criteria	Calculation Used for Impairment*
Total Dissolved Solids (TDS) Chloride Sulfate	Water body (segment) specific	Average of samples in the segment are above the criteria
Dissolved Oxygen (for High Aquatic Life Use)	3.0 grab sample 5.0 24-hr average	10% of samples are below the criteria 10% of samples are below the criteria
pH	6.5 and 9	10% of samples are above or below the criteria
E. coli	126 394	Geometric mean is greater than the criteria 25% of samples are above the criteria
Enterococci	35 89	Geometric mean is greater than the criteria 25% of samples are above the criteria

**The percent of samples exceeding the criteria or screening level varies somewhat with small sample sizes (between 10 and 20). When sample sizes are greater than 20 samples, the percentage shown in the calculation column is much more accurate.*

*** Screening Levels were developed by calculating the 85th percentile value for all water quality data in the TCEQ's water quality database over a 10 year period.*

Constituent	Screening Levels			Calculation Concern*
	Stream	Reservoir	Tidal Stream	
Ammonia-Nitrogen	0.33	0.11	0.46	20% of samples are above the screening level
Nitrate-Nitrogen	1.95	0.37	1.10	
OrthoPhosphate-Phosphorus	0.37	0.05	0.46	
Total Phosphorus	0.69	0.20	0.66	
Chlorophyll a	14.1	26.7	21.0	

The Water Quality Inventory 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 portions, such as the upper third, middle third, and lower third of a stream 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.

For a more detailed explanation of the Water Quality Inventory, you can view the TCEQ's Guidance for Assessing and Reporting Surface Water Quality in Texas at www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wqm/305_303.html.

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

- Water temperature (general use)
- PH (general use)
- Chloride (general use and public water supply)
- Sulfate (general use and public water supply)
- TDS (general use and public water supply)
- Fecal coliform, *E. coli* (contact recreation)
- DO (aquatic life)

DESIGNATED USES

Rivers in Texas are divided into segments based on factors such as stream characteristics, land use, habitat, and water quality. Evaluation of the stream segment further identifies the quality of the water and habitat in the segment and is assigned the appropriate designated use. Designated uses for rivers are based on how the water in that segment is used as listed below.

Aquatic Life Use

Segments in Texas are designated as exceptional, high, intermediate, or limited categories for aquatic life use. Support of the aquatic life use is based on assessment of dissolved oxygen, toxic substances in water criteria, ambient water and sediment toxicity test results, and biological screening levels for habitat, benthics, and fish.

Each set of criteria is generally evaluated independently of each other and the segment is considered impaired when any of the individual criteria are not met. Support of this use is based on the assessment of the following parameters:

- Dissolved oxygen,
- Ambient water and sediment toxicity,
- Biological screening levels for habitat, benthics, and fish.

Dissolved Oxygen (DO)

Each classified water body in the TSWQS is assigned one of the following aquatic life uses, based on physical, chemical, and biological characteristics: *exceptional, high, intermediate, limited,* or *no significant aquatic life use*. DO criteria to protect this aquatic life use for freshwater are 6.0, 5.0, 4.0, 3.0 and 2.0 mg/L, respectively. Unclassified perennial water bodies are presumed to have a high aquatic life use and corresponding DO criteria.

Most of the DO data collected at fixed monitoring stations are instantaneous measurements collected during daylight hours. A comparison between 24-hour and instantaneous DO is conducted to determine compliance, which may result in a concern. Water bodies with Tier 2 aquatic life primary concerns are candidates for 24-hour sampling. The water body will be placed on the 303(d) list if impairment of the aquatic life use is indicated by sufficient 24-hour DO data or if the average DO minimum is exceeded with 10 or more grab samples.

Toxic Substances in Water Criteria

Support of the aquatic life use, based on toxic chemicals in water, includes evaluation of those metals and organic substances for which criteria have been developed. The TCEQ has developed water quality criteria in the TSWQS for 12 metals and 26 organic substances. Acute criteria apply to all waters of the state except in small zones of initial dilution near wastewater discharge points. Chronic criteria apply wherever there are aquatic life uses outside of mixing zones, in intermittent streams that maintain large perennial pools, and in flowing streams when the stream flow is greater than the 7Q2.

Ambient Water and Sediment Toxicity Tests

Aquatic life use support is also evaluated based on ambient water and sediment toxicity testing. The TCEQ and the CRP routinely collect water and sediment samples for ambient toxicity testing to assess potential toxicity in water bodies, and to evaluate the effectiveness of implemented toxicity control measures. Laboratories conduct standard 24- to 48-hour acute and 7-day chronic toxicity tests on ambient water and sediment samples using *Ceriodaphnia dubia* (water flea) and *Pimephales promelas* (fathead minnow) in freshwater. Support of the aquatic life use using ambient toxicity data when ten or more samples are available is based on the occurrence of toxicity in water and/or sediment.

Biological and Habitat Assessment

Biological characteristics are assessed based on fish and/or benthic macroinvertebrate data using multi-metric indices of biological integrity, which integrate structural and functional attributes. An overall score is assigned to the water body and compared to the designated aquatic life use category. Unlike other parameters that are evaluated separately, the indices combine a number of parameters to determine compliance.

Contact Recreation

This designation applies to all waters of the state with the exception of a portion of the Houston Ship Channel and Segment 2308 in the Rio Grande. All other segments in Texas are considered primary contact because of the use of the rivers for fishing, wading, and swimming. The indicators used to assess this use are *Escherichia coli (E. coli)* in freshwater streams and enteroccoci for saltwater. These indicators measure the amount of bacteria that are present in the water that could be associated with pathogens. Texas adopted *E. coli* as the primary indicator (replacing fecal coliform) because it is more indicative of contamination by disease causing bacteria than fecal coliform, however the USIBWC still collects and analyzes for fecal coliform for reporting to Mexico.

Full support of the contact recreation use is not a guarantee that the water is completely safe of disease-causing organisms. Most of the bacteriological data are routinely monitored at fixed stations at quarterly or monthly frequencies. Support of the contact recreation use is based on a 10-sample minimum. For bacteria data, the following long-term geometric averages established as criteria include; fecal coliform- 200-colonies/100 ml, *E. coli*- 126 colonies/100 ml, and Enterococci- 35 colonies/100 ml. A fecal coliform criterion of 400-colonies/100 ml, an *E. coli* criterion of 394-colonies/100 ml, and an Enterococci criterion of 89-colonies/100 ml also apply to individual grab samples. The contact recreation use is not supported if the geometric average of the samples collected exceeds the mean criterion or if the criteria for individual samples are exceeded greater than 25 percent of the time.

The equation for the geometric mean is:
GM = n $\sqrt{}$(y1y2y3…yn).

Non-Contact Recreation

Bacteria densities are elevated and recurrent in Segment 2308 of the Rio Grande near El Paso. Elevated bacterial densities are caused by pollution that cannot be reasonably controlled under Texas law. A fecal coliform geometric average of 2,000 colonies/100 ml or an *E. coli* geometric average of 605 colonies/100 ml are assigned to protect the non-contact recreation use in this segment. A fecal coliform criterion of 4,000 colonies/100 ml applies to individual grab samples. Segment 2308 is lined by concrete and has fencing preventing passage into this segment. Water is diverted from this section and therefore very little water flows through this segment.

A non-contact recreation use is assigned to water bodies where ship and barge traffic makes contact recreation unsafe (Segments 1005, 1701, 2437, 2438, 2484, and 2494), and to Rita Blanca Lake (0105), which is a waterfowl refuge. The non-contact recreation use for these water bodies is protected by the same criteria assigned to contact recreation water- fecal coliform, *E. coli,* and Enterococci. Some water bodies such as segments 1006 and 1007 of the Houston Ship Channel are not assigned either contact or non-contact recreation uses due to local statutes that preclude recreational uses for safety reasons.

Public Water Supply Use

Many communities rely on surface water for their drinking water supply. Standards are in place to insure water quality meets not only TSWQS but secondary drinking water standards also.

Finished Drinking Water

In the TSWQS, 219 segments are designated for the public water supply use. That use for these water bodies is protected by both the TSWQS and the TDWS. The criteria apply to finished (after treatment) drinking water that is sampled at the point of entry to distribution systems. Public water supply use support is based on exceedances of maximum contaminant levels (MCLs) for organic and inorganic drinking water standards. A running annual average of samples (minimum of four) is computed and compared to the TDWS.

Surface Water

The public water supply use is also assessed for surface water by evaluation of the same organic and inorganic chemical standards developed for finished drinking water. These assessments are restricted to water bodies designated in the TSWQS for public water supply use. For each parameter at each site, the average of all concentrations (10-sample minimum) collected during a five-year period and the running annual average (of at least four quarterly samples) are compared against the drinking water standards to determine public water supply use support. A primary concern is identified if the average concentration exceeds the MCL and is based on only four to nine samples.

Fish Consumption

Whether commercial or recreational, the consumption of fish is monitored because of the ability of certain chemicals to accumulate in the tissue of the fish. Support of the fish consumption use is determined by two assessment methods. The first is by the designation of the human health criteria in the TSWQS. For each toxicant parameter at each site, the average of all values for water samples collected during a five-year period is computed. The averages are compared to human health criteria. The second is assessed by TDSHS for fish consumption advisories and aquatic life closures. The TDSHS has a website, (http://www.dshs.state.tx.us/seafood/), which contains information concerning fish consumption advisories and aquatic life closures. The fish consumption use is supported in water bodies where the TDSHS has collected tissue data and a subsequent risk assessment indicates no appreciable risk of deleterious effects due to consumption over a person's lifetime. The use is partially supported when a restricted-consumption advisory has been issued for the general population, or a sub-population that could be at greater risk (children or women of child bearing age). The fish consumption use is not supported when a no-consumption advisory has been issued for the general population, sub-population, or when an aquatic life closure has been issued that prohibits the taking of aquatic life from the affected water body.

General Use Criteria

TDS, chloride, sulfate, pH, and water temperature are used to assess multiple designated uses. These criteria are assessed based on 10 samples minimum over the past five years against the established standard. If the parameter exceeds the standard more than 25 percent then the parameter is impaired.

Preparation of Water Quality Inventory Report

If data meet the criteria in this section, the data are evaluated against TSWQS criteria and attainment/non attainment is determined. An inventory of each segment is created using current monitoring station information. The report summarizes water quality and identifies use support by station and segment. This data in turn is used to generate the 303(d) that lists only segments that are not meeting water quality standards. Both reports are required to fulfill federal CWA requirements and update water quality inventories that were previously conducted. The process maintains an ongoing water quality database that outlines water quality over the years to determine if the waterways in Texas are being protected and if not, to develop a plan to correct the problem.

The Texas Water Quality Inventory report (Appendix II) summarizes the data by segment for each river basin in Texas. This list identifies river segments that are not protecting a designated use as identified by the water quality indicators that exceed the state standard(s). Segments on the 303(d) list must have a corrective action plan developed to achieve the water quality standard(s) not being attained. This is called the Total Maximum Daily Load (TMDL) process. The TCEQ Water Quality Inventory report contains the 305(b) and 303(d) reports in the same document.

The analyses were done using approved TCEQ and USIBWC guidance documents and were a joint effort by USIBWC, CRP partners, and TCEQ staff. This section explains in greater detail the steps taken for the:

- Preparation and review of the Texas Water Quality Inventory, 305(b)/303(d) report, and
- Screening water quality data for Trends.

Data that has undergone review and is submitted to the TCEQ is entered into the database. Every two years, TCEQ staff takes the most recent five years of data and assesses the data against the TSWQS and drinking water (Texas Drinking Water Standards-TDWS). The data must meet the criteria specified in the most recent version of TCEQ's "Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data" (www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wqm/mtr/swqm_resources.html).

The TSWQS most recently adopted by the TCEQ and approved by the EPA are used for the assessment. Numerical criteria established in the TDWS for finished water (after treatment) provides a quantitative basis for evaluating support of the public water supply use. The data must undergo a series of checks before it is used for evaluation. The following areas represent some of the criteria that must be met:

A. Sources of data – Information that may be considered includes SWQM and CRP data found in the TCEQ database system. Data from the TCEQ's Water Permits and Resource Management databases (for secondary drinking water standards), volunteer monitoring programs, and/or other quality assured data. Other data from state or federal agencies, such as data from Texas Department of State Health Services (TDSHS), Texas Parks and Wildlife Department (TPWD), and the USGS found in the database may also be included. All data must be collected under QAPPs to ensure data are of known and appropriate quality.

B. Period of record – Data from the most recent 7-year period are considered for assessment. Most monitoring groups collect data at fixed sites on a monthly or quarterly basis. Data outside the 7-year period may be used for some assessment purposes at the discretion of TCEQ SWQM staff when there is insufficient number of samples collected during the past 7 years. Such uses may include the determination of trends or the identification of concerns of sediment and tissue contamination.

C. Frequency and duration of sampling – The assessment must use a sample set that is spatially and temporally representative of conditions in the water body. At a minimum, samples distributed over at least two seasons and over two years must be utilized, with some made during an index period (March 15-October 15). The data set should not be biased toward unusual conditions, such as flow, runoff, or season. Sediment and fish samples generally do not vary greatly over time and are considered useful integrators of water quality over time and space. Samples for fish and sediment can be collected as part of a one-time special monitoring event.

D. Minimum numbers of samples – At least ten samples over the 7-year period of record are required at each site for use assessment.

- All field measurements (DO, pH, and temperature);
- Water quality constituents (nutrients, bacteria, chlorophyll-a, dissolved solids, and ions); and
- Toxicants in water, sediment, and fish tissue collected routinely in the water body, and ambient water and sediment toxicity.

If there are less than ten samples, the use can only be assessed as a primary concern. For example, sample sets of three measurements, where all three measurements exceed the criterion or screening level. In this instance, the water body will be identified as a primary concern.

In finished drinking water, an average calculated from at least four samples is required for comparison to the primary and secondary drinking water standards.

E. Use of the binomial method for establishing required number of exceedances for partial and nonsupport of designated uses – This method was selected by TCEQ to eliminate potential sources of error (Type I and Type II error). An example of Type I error is classifying a water body as partially or not supporting, when that water body is actually fully supporting. Type II error is classifying a water body as fully supporting when that water body is actually partially or not supporting. Previous methods for determining support/non-support did not thoroughly take into account Type I & II error. The binomial method is a useful tool for estimating the probability of committing Type I and/or Type II error. By setting an acceptable rate of exceedances for committing either type of error with respect to sample size, the minimum number of samples exceeding the use support becomes more valid and thus more valuable when assessing water quality.

F. Flow conditions – Streams are routinely monitored under highly variable flow conditions from extreme low flows that typically occur in late summer months, to high flows that follow seasonal storm events. Water quality criteria and screening levels generally apply to flowing streams as long as flow exceeds the seven-day, two-year low flow (7Q2). Small, unclassified streams in Texas develop intermittent stream flow in summer months and eventually become completely dry, while others maintain perennial pools when flow is interrupted. Additional guidance was developed by TCEQ to apply to streams under these different flow conditions.

G. Values below limit of detection – For values reported as less than the reported value, there is no generalized way to determine the true value of the data between zero and the reported value. For assessments, 50 percent of an analytical reporting limit is computed for these nondetects. This is done to include as many individual data points in the analysis as possible and to indicate the level of monitoring effort. These occurrences are particularly noteworthy, because they may indicate concentrations that are below those of concern.

H. Spatial coverage – A single monitoring station is considered to be representative of no more than 25 miles (40 km) in freshwater, tidal stream, and ocean shoreline. In reservoirs and estuaries, one station can represent 25 percent of the total square miles, but not to exceed more than 5,120 acres or eight square miles (20.7 square km). Other factors such as the confluence of a major tributary or an instream dam may also limit the spatial extent of the assessment based on only one station. The remaining area not covered by a single site will be reported as not assessed.

SCREENING WATER QUALITY FOR TRENDS

Analyzing data for trends is another important aspect of understanding water quality data. It helps the CRP determine areas that are improving, or degrading, as well as providing information on areas that may need additional monitoring. It helps to demonstrate if water quality improvement projects and other changes are making a difference. This information can be presented to steering committees to provide input and help to prioritize issues that are of importance to the community.

One way to determine if a trend exists is by running a statistical analysis on the water quality data. The method chosen by the TCEQ and CRP is through a linear regression. This method uses a formula that draws a line through the data that indicates the best fit based on the data presented. You can estimate how a dependent variable, such as dissolved oxygen, is affected by one or more independent variables, such as season or the amount of flow in the river. By applying certain criteria to the data to improve confidence in the results, it provides for a quick response as to whether a trend exists in the data. For example, in certain parts of the Rio Grande Basin, flow in the river is dependent on the allocation of water for irrigation and municipal/industrial use, and it has been noticed by looking at historical trends that the conductivity levels increase when the flow in the river is lowest during the non-irrigation season.

In order to better understand the water quality issues in the Rio Grande, a statistical analysis was done on water quality data pulled from the database for the most recent back to as much as 15 years. If a site has more than five years but less than 10 years, it was still analyzed provided there were at least 20 data points for any specific parameter assessed. The analyses help identify trends in data by providing more information to identify areas where potential problems exist, highlight areas that are improving, and determine if water quality improvement projects and other changes are making a difference in water quality.

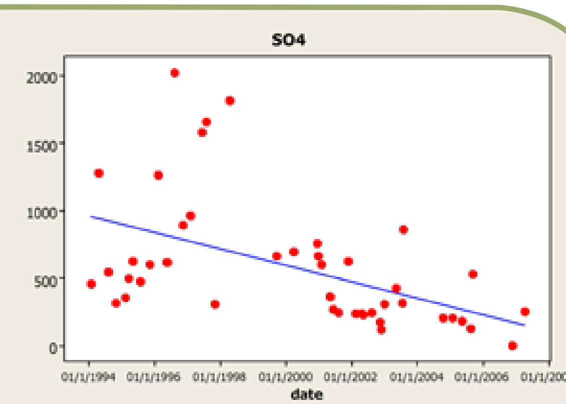


Figure 10 Graph of a linear regression of SO4 data

The trend analysis of water quality data involves a series of steps to identify those sites and parameters that exhibit a potential trend and determine if that trend still exists after accounting for stream flow and season. The data was prepared by selecting the data sets that met the minimum required number of samples and period of record. In order to account for changes in water quality due to seasonal flow changes, additional regression analyses are done to determine if a trend still exists after accounting for flow and season using the same criteria for the initial linear regression.

Simple Linear Regression

The method selected by the TCEQ to identify trends is through a linear regression. A specific set of statistics was used to determine whether a potential trend exists. By using current spreadsheet software available, the criteria were entered and a summary report was created for each analysis. The following statistical criteria were used:

- *T-ratio* – If the ratio is > or = |2| (absolute value), then the slope is significantly different from 0 (a straight horizontal line when plotted on a graph) and a trend may exist. The greater the value than |1|, the more pronounced the trend. Positive values indicating an increasing trend and a negative value indicating a decreasing trend with respect to time.
- *P-value* – (attained significance level) <0.1 (10 percent) gives significance to the statistics. The smaller the value from 0.1, the greater the effect of the trend.

Appendix III displays the data gathered for the trend analysis to include the T-Ratio, P-value, Min, Max, and Mean for each parameter at each station in the basin.

Plot the Data

Along with the information from the linear regression, graphs are created to view the data to help CRP staff determine if the assumptions about the data are valid. The graphs used to test for assumptions were:

- Plot the data versus time
  - Does the relationship look linear or is there some sort of curve to the data?
  - Is there a shift in the trend (does the slope of the line follow an upward or downward direction with respect to time)?
  - Is the variability around the regression line constant or do the measurements exhibit much higher or lower values during a specific period in the graph such as during summer or winter months?
  - If either of these situations occurs, then the parameter data may need to be transformed.

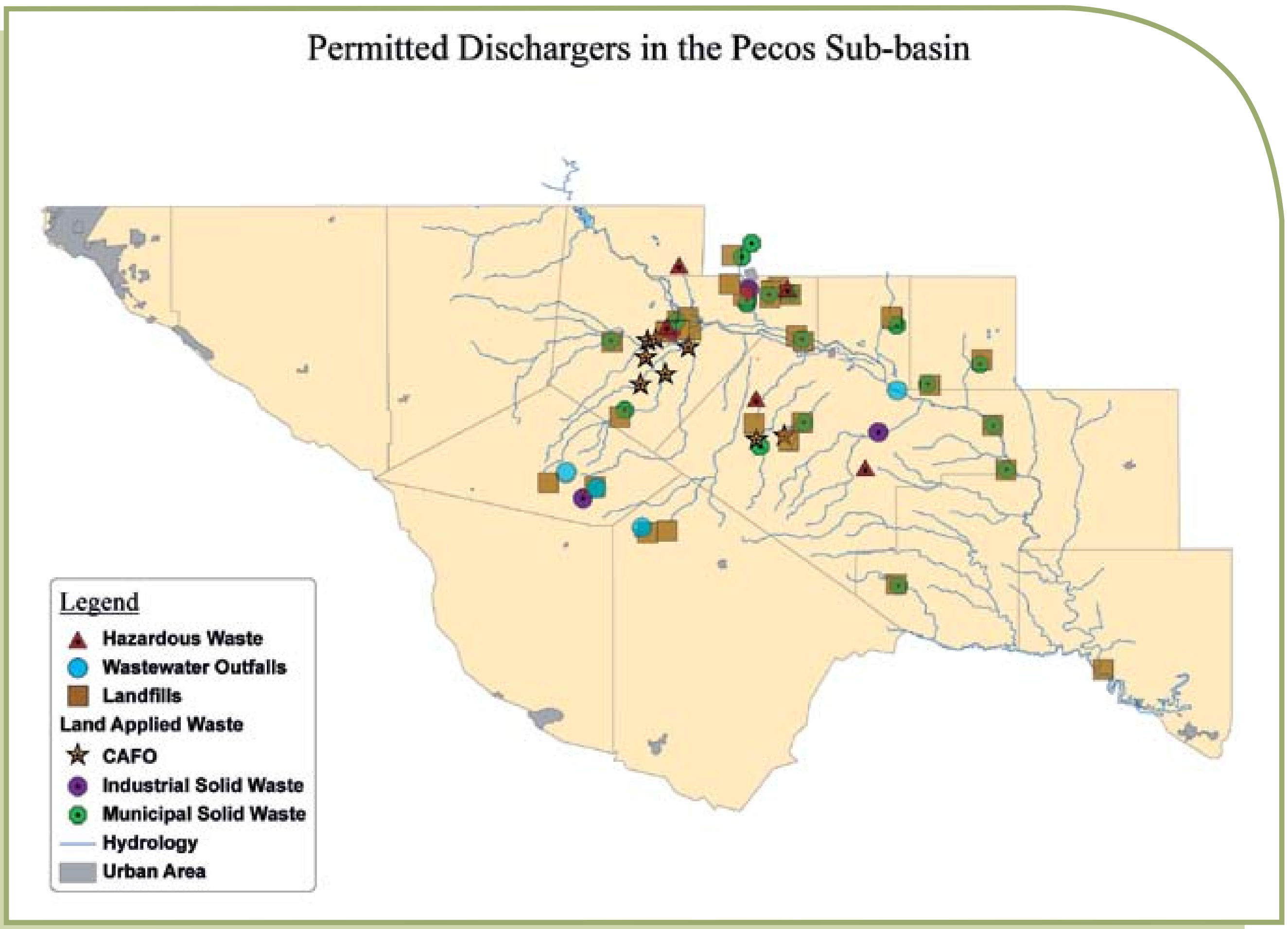


Figure 11 Pecos River Sub-basin Permitted Dischargers

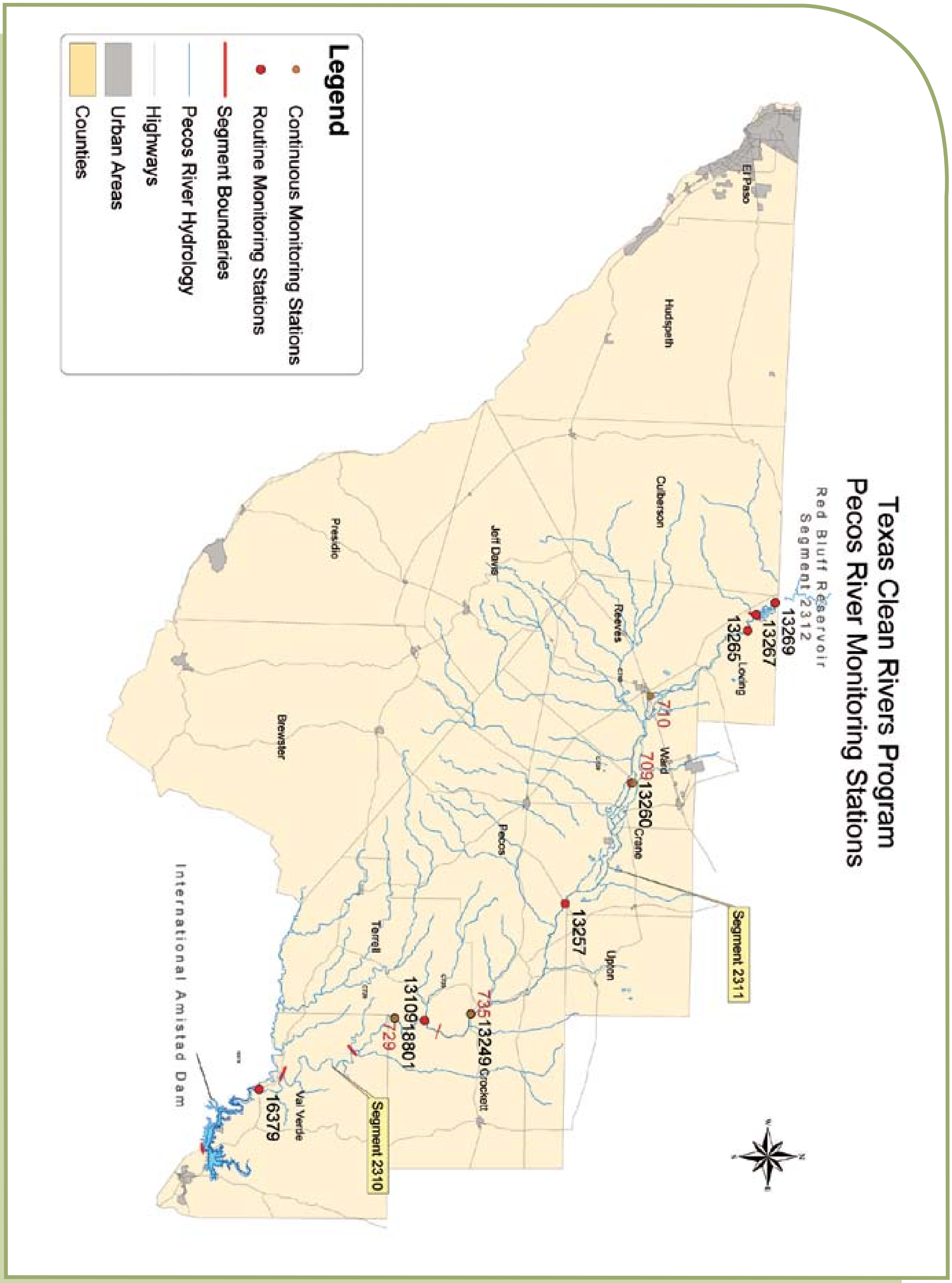


Figure 12 Pecos River Sub-basin Monitoring Stations

Figure 13 Red Bluff Reservoir

Figure 14 Pecos River at station 13261

WATERSHED SUMMARIES

The analysis of water quality data is one of the most important aspects of the CRP. The CRP staff has attempted to take technical analyses and reports and present them in a user-friendly format. Each level of analysis performed on the water quality data provides information that by itself explains one or more aspects of either water quality or the overall health of the river. When put together with other analyses, it provides a better understanding of the data and can be presented to planning agencies or interested individuals in various forms depending on the desired format, such as a graph, report, table or map. It is still important to explain the technical aspect of the creation of the reports because it is an important part of the data quality and may be important to end users of the data as a point of reference. The following section provides information and a concise summary of any issues as determined by the analyses of the data by station within each respective sub-basin.

Pecos River Sub-Basin

Watershed Overview

Population centers along the Pecos are relatively few and the entire area has seen a general decline in population. Water in the Pecos River is naturally high in salts. Because of the high salt concentrations in the river, there is a watershed protection plan in development to provide guidance for preventing further increases in the salt loading (more details on this study are covered below). Invasion of non-indigenous saltcedar has further tasked the ecosystem by draining precious water resources and reducing riparian health.

Four real-time monitoring stations are located on the Pecos River. There are 77 permitted dischargers in the sub-basin including five hazardous waste sites, 7 wastewater outfalls, 35 landfills, 8 Concentrated Animal Feeding Operations (CAFOs), 4 industrial solid waste permits, and 18 municipal solid waste permits **(Figure 11)**.

The Pecos River sub-basin is the portion of the Pecos River from the point it enters Texas at Red Bluff Reservoir to its confluence with the Rio Grande. The sub-basin contains three segments:

- Red Bluff Reservoir (2312) – from Red Bluff Dam in Loving/Reeves County to the New Mexico state line in Loving/Reeves County, up to the normal pool elevation of 2842 feet (866 m) (impounds the Pecos River), which runs for 11 miles (18 km).
- Upper Pecos River (2311) – From a point immediately upstream of the confluence of Independence Creek in Crockett/Terrell County to Red Bluff Dam in Loving/Reeves County, which runs for 349 miles (561 km).
- Lower Pecos River (2310) – From a point 0.4 miles (0.7 km) downstream of the confluence of Painted Canyon in Val Verde County to a point immediately upstream of the confluence of Independence Creek in Crockett/Terrell County, which runs for 49 miles (79 km).

Red Bluff Reservoir - Segment 2312

Segment 2312 is the Texas portion of Red Bluff Reservoir encompassing 11,700 acres. This reservoir is used to impound the waters of the Pecos River entering Texas from New Mexico. This water is then released based on requests from the municipalities and irrigation districts. Listed uses include high aquatic life use, contact recreation, general use, and fish consumption. Segment 2312 contains two monitoring stations with all uses fully supporting

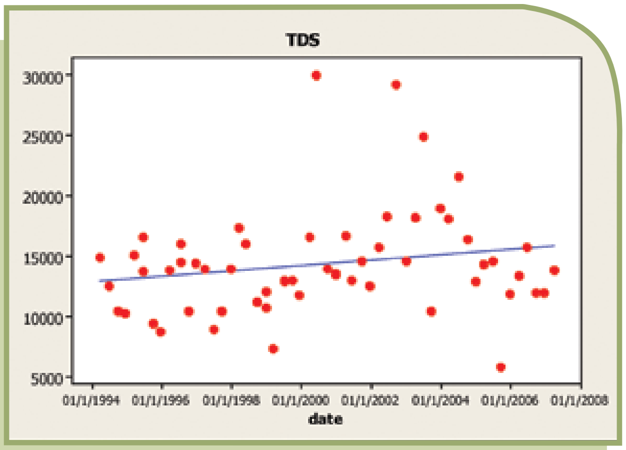


Figure 15 TDS values for station 13257

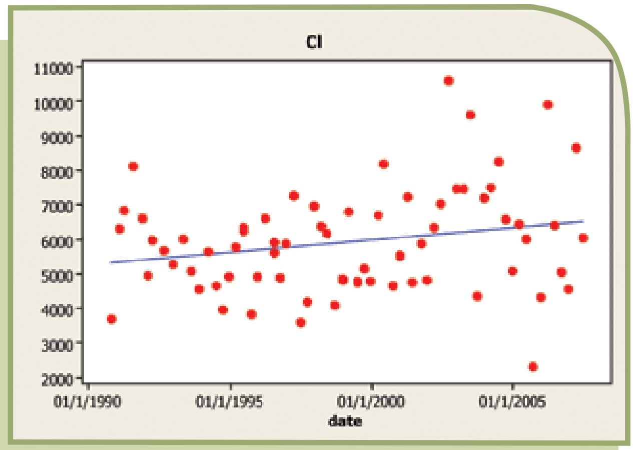


Figure 16 Increasing trends in chlorides at station 13257

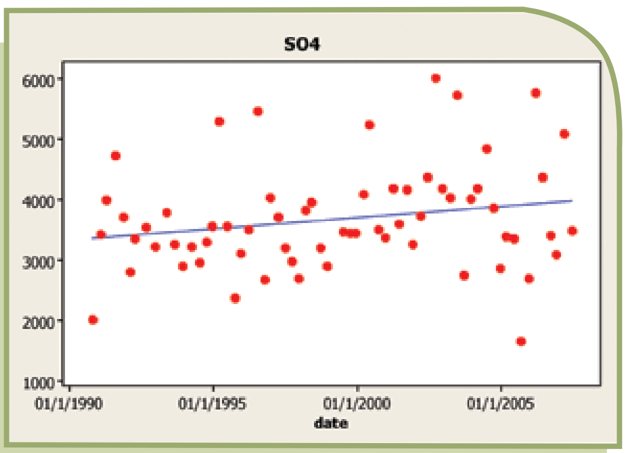


Figure 17 Increasing trend in sulfates at station 13257

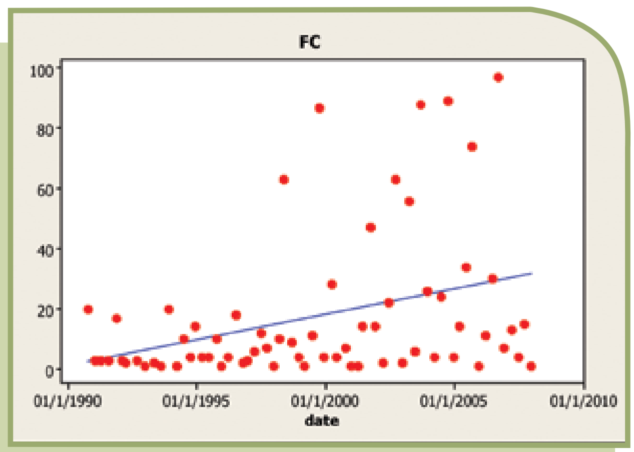


Figure 18 Increasing bacteria trends at station 13257

but there are some areas of concern as listed at the stations below.

Station 13269 – Red Bluff Reservoir ½ mile (0.8 km) south of the Texas/New Mexico border - is listed as having a concern for golden alga based on past occurrences. This site also exhibits an increasing trend in chlorophyll, which can lead to excessive plant and green algae growth. Previously this site had a concern for nitrate-nitrite but this site is in a downward trend for that parameter; however, this station shows a very slight increasing trend in salt concentrations.

Station 13267 – Red Bluff Reservoir above dam, north of Orla - also has a concern for chlorophyll and has a concern for golden alga as several fish kills within the reservoir have been attributed to golden alga. This station is also listed as having a concern for ammonia and orthophosphorus and has an increasing trend in total phosphorus, which is an essential nutrient for increased algal growth. This site has had several exceedances in the DO standard and is listed with a concern for this parameter. During the last report, this site exhibited an increasing trend for conductivity, chloride, sulfate, and total dissolved solids (TDS), however, in the last few years these parameters have decreased slightly.

Upper Pecos River - Segment 2311

Segment 2311 is classified as a freshwater stream stretching for 349 miles (562 km). Its listed uses are high aquatic life use, contact recreation, general use, and fish consumption, all of which are fully supported except for an aquatic life use impairment at 13257. The entire segment is listed as having a concern for golden alga as fish kills due to the golden alga have occurred several times in the past few years. This reach of the Pecos River is naturally high in salts due to groundwater passing through salt-bearing geologic formations. Because the salt concentrations are historically high, the standards for this site are also high e.g. TDS standard is 15,000 mg/L. This segment contains six monitoring stations.

Station 13265 – Pecos River at FM 652 bridge NE of Orla - has no listed concerns or impairments for the designated uses. The trend analyses show a beneficial decline in salt constituents but a slight increasing trend in all of the nutrient parameters.

Station 13264 – Pecos River near Mentone, Texas - and station 13261 - Pecos River near Pecos, Texas - are listed as having no concerns or impairments. These sites have a limited amount of data of only six data points but the data shows very slight decreasing trends for salts and nutrients; however the last data collection occurred in early 2005.

Station 13260 – Pecos River at FM 1776 SW of Monahans - has an aquatic life use impairment as the 24 hour DO values are below the standards. This site is also listed as having a concern for high chlorophyll levels and shows an increasing trend. Trend analyses show a slight increase in fecal coliform contamination. Trends for chlorides and conductivity show a decline in salt levels with sulfates having no trend at all.

Station 13257 – Pecos River at US 67 NE of Girvin - shows an aquatic life use concern and impairment for depressed dissolved oxygen. This site also exhibits increasing trends in TDS, chlorides, and sulfates (see associated graphs). There is also an increase in bacteria although the values are still well below the standard. Station 13257 exhibits some of the highest TDS values in the Pecos River. This site is influenced by groundwater springs that pass through subsurface salt formations resulting in a large spike in salt loading.

Station 15114 – Pecos River 1.6 miles (2.6 km) upstream of US 290, SE of Sheffield has a chlorophyll concern and a very sharp increasing trend as well. Trends at this site show declines in pH, conductivity, TDS, and salt concentrations and an increasing trend is nutrients like nitrate and nitrite, ammonia, and phosphorus.

Lower Pecos River - Segment 2310

Segment 2310 is classified as a freshwater stream with a length of 89 miles (143 km). Its designated uses are high aquatic life use, contact recreation, general use, fish consumption, and public water supply. This segment contains four monitoring stations. This segment also has a new sampling site for FY2008 labeled 18801 - Lower Pecos River west bank 3.56 km/2.3 miles upstream of Terrell/Val Verde/Crockett County Line on Brotherton Ranch but has no data for evaluation yet.

Station 13109 – Independence Creek 0.5 miles (0.8 km) downstream of John Chandler Ranch headquarters - was listed as having no concerns or impairments and is fully supporting all of its designated uses. Trend analysis shows rapidly improving trend for TDS and salt constituents. Nutrient values are all below current AWRLs as well as chlorophyll and phaeophytin values.

Figure 19 Pecos High Bridge on Highway 90 over the Pecos River

Station 13246 – Pecos River 4.67 miles (7.52 km) upstream of the Val Verde/Crockett/Terrell county line - is listed as having a concern for golden algae. This site also has a slight decline in dissolved oxygen (DO) levels but also shows a decline in pH from over 8 to 7.7. Other parameters showing trends that are moving towards exceeding standards are salt concentrations and fecal contamination. These trends are directly influenced by the decline in water quantity in this segment.

Station 13240 – Pecos River at gaging station 7.4 miles (11.9 km) east of Langtry, 15 miles (24.1 km) upstream of confluence with Rio Grande - is not listed as having concerns or impairments for its designated uses. This site also exhibits a declining trend in salt concentrations and TDS. Nutrient trends are also showing a decreasing trend in values, however, chlorophyll values are increasing slightly.

Station 16379 – Pecos River 0.7 miles (1.1 km) downstream from US 90 W in Val Verde County - contains fewer data points than station 13240 but it is located in the same reach of the Pecos River and is also not listed for any concerns or impairments. The trend analysis shows the same declining trends in all parameters except for chlorophyll, which is increasing.

Basin Concerns

The largest concern within the sub-basin is the quantity of water for irrigation. Water quality is too salty to be used for potable drinking water. The primary source for drinking water in the communities along the Pecos River comes from near brackish groundwater sources. Residents in this region use water purification in their homes and businesses.

Even though the Pecos River is not listed as impaired for salt constituents and TDS due to naturally high levels, the water in the river enters Texas with a TDS that exceeds drinking water standards and gets progressively higher in the Upper Pecos. Therefore the water is only used for irrigation of crops. The primary concern then for the water is to prevent increased salt concentrations and to increase water quantity.

Special Studies

Texas A&M University along with the USIBWC, TCEQ, the Texas Water Resources Institute, and the Texas State Soil and Water Conservation Board is working on a three year USEPA funded project to develop a watershed protection plan in the Pecos River. This project will assess the physical features of the Pecos River basin, facilitate communications with stakeholder groups and landowners in eight neighboring counties, and monitor the water quality of the Pecos River. Through this research, the watershed protection plan will be designed to assess current management measures as well as determine what future management measures need to be implemented in the river basin to protect the water quality of the Pecos River.

This plan is vital to the future ecosystem of the Pecos River. The Pecos River has experienced lowered water quality and stream flows and the aquatic community of the Pecos River has been drastically altered according to fishery biologists and to local users of the river. No longer does it have a healthy diverse community of aquatic plants, invertebrates, microorganisms, fish and amphibians. The greatly reduced aquatic diversity has been negatively affected by changes in river hydrology, riparian community destruction, oil and gas activities, irrigation demands, long and short-term droughts, damming of the river and the desertification of the upland watershed due to grazing mismanagement. These factors, both natural and man-made, have allowed introduced plant species, such as saltcedar, to dominate the riparian systems within the watershed.

Figure 20 Upper Rio Grande Sub-basin Permitted Dischargers

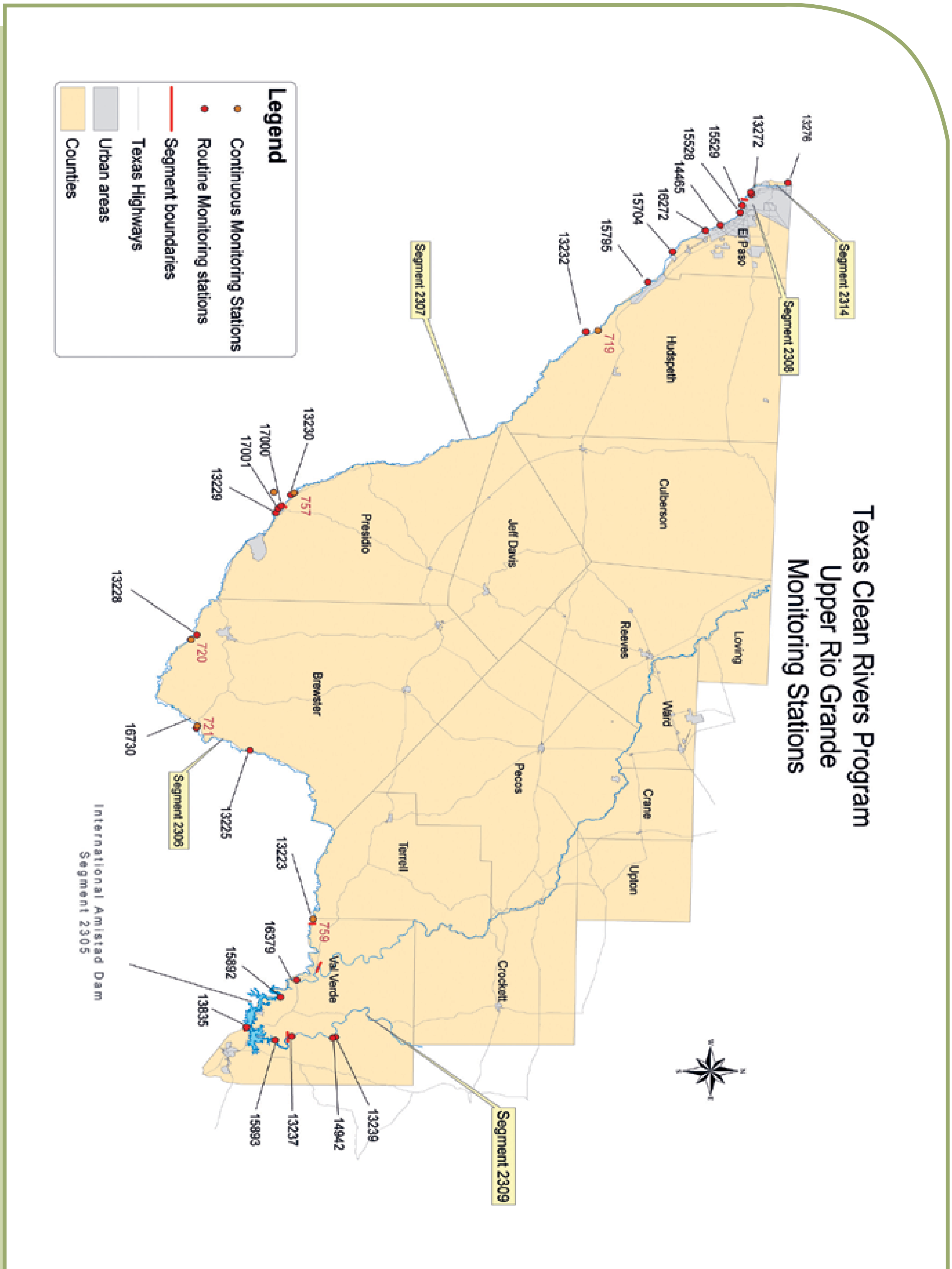


Figure 21 Upper Rio Grande Sub-basin Monitoring Stations

The Pecos River contributes approximately 11% of the stream inflow into Amistad Lake. However, it also contributes to salt loading into Amistad Lake at an annual rate 29.5% of the total salt loading. Salinity of the waters in Amistad Lake exceeded 1000 ppm for a month in 1988, and has fluctuated since. It is important to control salt loading from the Pecos to Rio Grande if we are to be successful in keeping salinity of the reservoir within drinking water standards.

For more information on the project and to view reports developed from the research conducted by the various partnering agencies, visit the project website at http://pecosbasin.tamu.edu.

Future studies in this area are being planned to determine the sources and pathways for the high salt loads in the Pecos River and to assess the effectiveness of the management plan after implementation.

Upper Rio Grande Sub-Basin

Watershed Overview

The Upper Rio Grande basin extends from the New Mexico-Texas state line downstream to the International Amistad Reservoir. The Rio Grande forms the international border between Texas in the United States and four states (Chihuahua, Tamaulipas, Nuevo Leon, and Coahuila) in Mexico. Along this border the Rio Grande flows through communities known as sister cities, where one community is located in the United States and the other in Mexico. The first of these communities, the cities of El Paso and Ciudad Juárez, form the largest population along the border in Texas with an estimated population of over two million people.

The Rio Grande is used as a drinking water supply for the city of El Paso and is also used for irrigated agriculture on both sides of the border. Downstream of El Paso/Ciudad Juárez, the water in the river is primarily made up of return flows from irrigated lands. This water then makes its way through a part of the river known as the "forgotten river", so named because of the lack of instream flows and the policies in place that allocate all of the waters of the Rio Grande. The river flows for about 150 miles (241 km) with only minimal use of the river for ranching and limited agriculture. Large stands of the invasive species saltcedar form monocultures along the riparian corridor upstream of Presidio, Texas. The Rio Conchos flows into the Rio Grande above Presidio, Texas and Ojinaga, Chihuahua. Currently, the Rio Conchos provides approximately half of the flow in the Rio Grande at this point. Additional flow is picked up around Big Bend National Park as additional tributary and spring flows make their way into the river. Upstream of Del Rio, Texas and Ciudad Acuña, the Pecos River meets the Rio Grande providing additional flows prior to entering International Amistad Reservoir.

Intrastate compacts and international treaties govern the distribution and allocation of water in the upper Rio Grande from the headwaters in Colorado downstream to the area just below Fort Hancock, Texas at the IBWC gaging station known as the Fort Quitman gage.

The **Convention of May 21, 1906** provides for the distribution between the United States and Mexico of the waters of the Rio Grande in the international reach of the river between the El Paso-Juárez Valley and Fort Quitman, Texas. Article I provided for the delivery of 60,000 acre-feet of water annually to Mexico.

Figure 22 Rio Grande in segment 2314 during drought conditions

Figure 23 Concrete lined section of Rio Grande in segment 2308

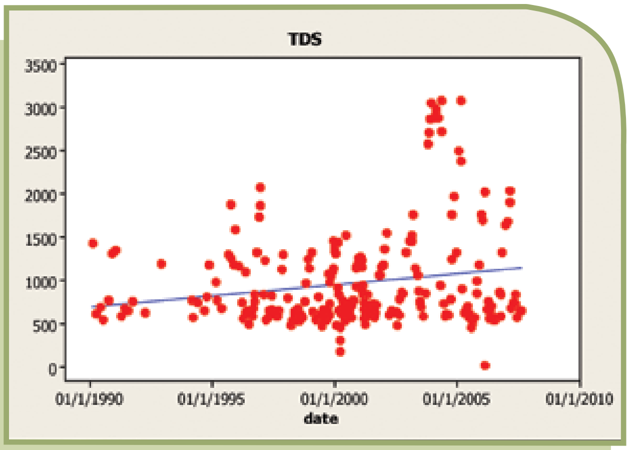


Figure 24 Increasing TDS trends at station 13272

The **Rio Grande Project** allocates the waters of the Rio Grande between New Mexico and Texas. The agricultural community receives the majority of the water through the Elephant Butte Irrigation District in New Mexico and the El Paso County Water Improvement District #1 in Texas with the City of El Paso receiving a portion of the water for municipal use.

There are 145 permitted dischargers in the sub-basin including two superfund sites, six hazardous waste sites, 57 landfills, 16 CAFOs, 18 industrial permits, and 22 municipal.

The Upper Rio Grande sub-basin is the portion of the Rio Grande from the point it enters Texas to Amistad Reservoir. The sub-basin contains six segments:

- Rio Grande above International Dam (2314) – From International Dam in El Paso County to the New Mexico state line in El Paso County, which runs for 21 miles (33 km).
- Rio Grande Below International Dam (2308) – From the Riverside Diversion Dam in El Paso County to the International Dam in El Paso County, which runs for 15 miles (24 km).
- Rio Grande Below Riverside Diversion Dam (2307) – From the confluence of the Rio Conchos (Mexico) in Presidio County to Riverside Diversion Dam in El Paso County, which runs for 222 miles (357 km).
- Rio Grande Above Amistad Dam (2306) – From a point 1.1 miles (1.8 km) downstream of the confluence of Ramsey Canyon in Val Verde County to the confluence of the Rio Conchos (Mexico) in Presidio County, which runs for 313 miles (503 km).
- International Amistad Reservoir (2305) – From Amistad Dam in Val Verde County to a point 1.1 miles (1.8 km) downstream of the confluence of Ramsey Canyon in Val Verde County, which runs for 75 miles (120 km).
- Devils River (2309) – From a point 0.4 miles (0.6 km) downstream of the confluence of Little Satan Creek in Val Verde County to the confluence of the Dry Devils River in Sutton County, which runs for 67 miles (108 km).

Rio Grande above International Dam - Segment 2314

Segment 2314 extends for 21 river miles (33.8 km) from the New Mexico-Texas state line downstream to International Dam in El Paso County. It is a classified water body with designated uses that include high aquatic life use, public water supply, fish consumption, and contact recreation. The amount of water in the river depends largely on the needs of water rights holders with the majority of the flow delivered between March and October. The water is diverted for use by the United States at the American Dam that flows in the Rio Grande American Canal Extension (RGACE). About two miles (3.2 km) downstream, water is delivered to Mexico at the International Diversion Dam for agricultural use. There are two stations monitored in Segment 2314.

Station 13276 – Rio Grande upstream of east drain near Anthony, Texas - is currently meeting of the water quality parameters for its designated uses and has no additional concerns. Trend analyses of this site show a slow increase in TDS and salts as well as chlorophyll. Nutrient levels, pH, and DO values have remained the same at levels below the water quality limits.

Station 13272 – Rio Grande at Courchesne Bridge - is listed as being impaired for contact recreation use due to elevated bacteria levels. This station is also listed as having a concern for chlorophyll and the trend shows a continuing increase in this parameter. This may be due to all nutrient levels climbing as well. TDS and salt concentrations also show a steady increasing trend that, unless improvements in the river are made, will result in impairments in those parameters. This site historically has shown increased bacterial levels but after improvements to wastewater infrastructure, bacteria levels have dropped considerably but are still above the water quality standards.

Rio Grande below International Dam - Segment 2308

Segment 2308 begins at International Dam and flows through El Paso and Ciudad Juarez. Because of water diversions upstream in segment 2314, this segment rarely contains water and should be classified as

Figure 25 Rio Grande at station 15795 heavily influenced by high phosphate detergents

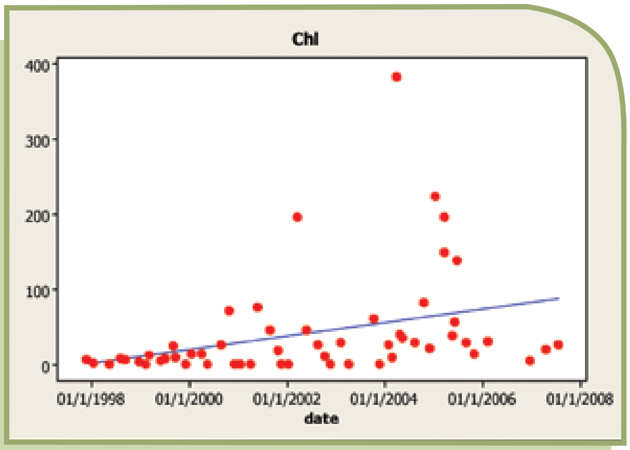


Figure 26 Rising chlorophyll levels due to high nutrient values at station 15795

intermittent. Wastewater effluent is discharged into the RGACE to be credited for water used by the City of El Paso from the Rio Grande for part of its drinking water supply. This has caused the Rio Grande in this area to be dry most of the time with some water coming from stormwater and past the diversion dam.

Because this segment in a concrete lined channel and is blocked by fencing, it is the only segment in the Rio Grande listed as noncontact recreation. Other designated uses for this segment are limited aquatic life use and general use. All use standards were fully supported. Three stations are monitored in this segment.

Station 15529 – Rio Grande 1.5 miles (2.4 km) upstream from Haskell WWTP outfall, south of Bowie High School football stadium in El Paso - is located within the concrete lined portion of the river upstream of the Haskell R. Street WWTP. The majority of the flow at this station is from the International Dam and occasional releases from the RGACE diversion structure located upstream of the station. When sampling is possible, trend analyses show that most parameters are increasing as would be expected from such low flows and lack of drainage.

Figure 27 Sample collecting in the Rio Grande near Presidio, TX

Station 15528 – Rio Grande 0.8 miles (1.3 km) downstream from Haskell Street WWTP outfall - is very similar to 15529. It is also located in the concrete lined portion of the segment and throughout the year only receives minimal flow. Trends at this station are also similar to those in station 15529 as this site is located just a few miles downstream.

Station 14465 – Rio Grande at Riverside Canal 1.1 miles (1.8km) downstream of Zaragosa International Bridge - is located downstream of the concrete section but still doesn't receive any water as the RGACE diverts water past this station also. Trend analyses indicate that all parameters are increasing with the exception of ammonia.

Rio Grande below Riverside Diversion Dam - Segment 2307

Segment 2307 extends from below Riverside Diversion Dam in El Paso County and flows over 220 river miles (354 km) downstream to the confluence with the Rio Conchos in Presidio County. Water in this reach of the Rio Grande come from mostly return flows from irrigation canals and some groundwater. This segment is designated for contact recreation, public water supply, high aquatic life use, and fish consumption. The aquatic life and public water supply uses are fully supported. The general uses and contact recreation were not fully supported due to high TDS and high bacteria levels. There are five monitoring stations in this segment.

Station 16272 – Rio Grande at San Elizario, 1,640 feet (500 m) upstream of Capomo Road and 6.3 miles (10.2 km) downstream of Zaragosa International Bridge - and station 15704 - Rio Grande at Guadalupe port of entry bridge at FM 1109 west of Tornillo,

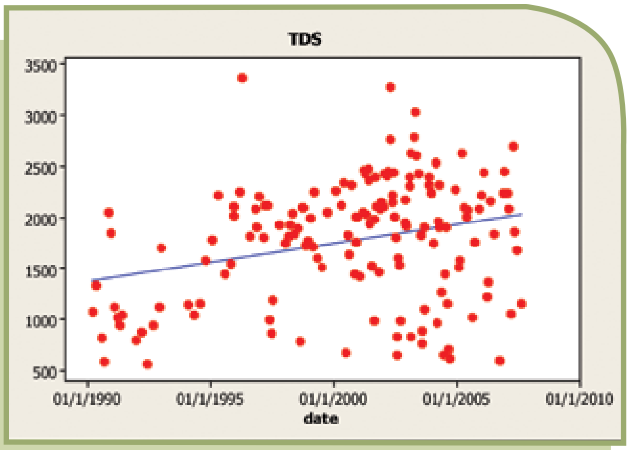


Figure 28 Increasing TDS values at station 13229

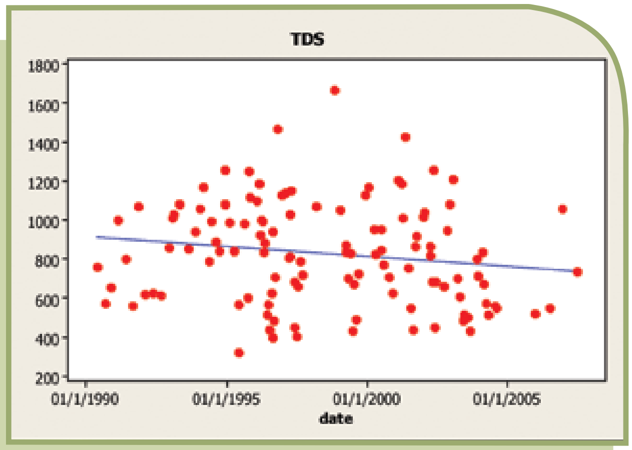


Figure 29 Improving TDS values at station 13223

Texas - are impaired for TDS and chloride for general use standards and are impaired for high bacteria for contact recreation use. These sites are also listed as having a concern for ammonia. Analysis of the data at these sites show that both have gradual declining trends for TDS and salts but have an increasing trend for all of the nutrient parameters with bacteria values remaining constant.

Station 15795 – Rio Grande at Alamo Grade Control Structure, 6 miles (9.7 km) upstream of the Fort Hancock port of entry - is listed as being impaired for TDS, chloride, and bacteria also and is listed as having concerns for ammonia, chlorophyll, nitrate, DO, and phosphorus. Trend analysis shows that the concentrations at this site have been staying at current levels except for a slight increase in chlorophyll values. The Rio Grande at this point begins to be more heavily influenced by irrigation and wastewater return flows from both the United States and Mexico. Mexico does not have a phosphorus ban in their cleaning products; therefore returns into the river run high in nutrient concentrations. Agricultural returns in this region also put high nutrient and salt concentrations into the river.

Station 13232 – Rio Grande at Neely Canyon, south of Fort Quitman - receives all remaining return flows for this region from both countries. These return flows are a combination of water drained from agricultural use as well as wastewater discharges from urban areas that empty into the agricultural drains. This site is impaired for TDS and chloride and is also listed as having a concern for ammonia, chlorophyll, and phosphorus. The trends for TDS and salts are decreasing slightly, but nutrient values and chlorophyll show increasing trends. Bacteria levels appear to be slightly lower than compared to the upstream station at Alamo Grade Control Structure, however, the trend for bacteria is increasing.

Station 13230 – Rio Grande 2.4 miles (3.9 km) upstream from the Rio Conchos confluence - is impaired for TDS and chlorides and is listed for a concern with elevated chlorophyll levels. The samples collected here show that water quality improves slightly when compared to the upstream station. Small communities in this region may divert some water for small scale ranching but this part of the river is used minimally. Trend analyses show that TDS, salinity, bacterial, and nutrient values haven't changed but flows have decreased slightly.

Rio Grande above Amistad Dam - Segment 2306

Segment 2306 begins just downstream of the confluence with the Rio Conchos and flows through the Big Bend Ranch State Park and National Park and is then impounded at the International Amistad Reservoir. This segment is approximately 313 river miles (504 km) long. The cities along with the smaller communities utilize the river for farming and ranching.

The designated uses assigned to this segment are high aquatic life, contact recreation, fish consumption, and public water supply use. Overall, this segment is meeting the standards for its designated uses with a couple of areas showing concerns. There are seven monitoring stations in this segment.

Station 13229 – Rio Grande below Rio Conchos confluence near Presidio - captures the flows of the Rio Grande and Rio Conchos upstream of the cities of Presidio, Texas and Ojinaga, Chihuahua. This site is listed as being impaired for contact recreation use as the average bacteria concentrations exceed the criteria. Current trend analyses indicate that chloride, sulfate, and TDS have been increasing steadily during the assessment period. This may be due in part to reduced flows in this reach. The data

Figure 30 Rio Grande below Amistad Dam

for conductivity helps to support this inference as the trend during this period shows it as increasing for this time period. Nutrient trends have remained fairly constant except for ammonia, which exhibits an increasing trend.

Station 17001 – Rio Grande at Presidio/Ojinaga Vehicle Bridge and station 17000 - Rio Grande at Presidio Railroad Bridge - are only collected for field parameters and bacteria. These stations are located within both communities and are collected to determine the impacts of the cities and recent infrastructure improvements on water quality. Bacterial trends at 17001 are increasing while at 17000 they remain constant.

Station 13228 - Rio Grande at the mouth of Santa Elena Canyon - is located below Presidio/Ojinaga picks up additional flow from tributaries such as Terlingua Creek and San Carlos Creek. This site has no listed impairments but is listed for a chlorophyll concern. This may not last though as the trends for TDS, conductivity, and salts are all increasing.

Station 16730 - Rio Grande at Rio Grande Village in Big Bend National Park - is not listed for any impairments or concerns. This may be in part to additional tributary and natural spring flows as the river flows through the Big Bend National Park in Texas and the Canyon de Santa Elena and Maderas del Carmen in Mexico. The trends for TDS and salts are steady and flows have increased slightly but the levels are still above the level for public water supply. Trend analysis on nutrients indicate the concentration of parameters analyzed have not changed significantly during the assessment period with only a slight increase in chlorophyll.

Station 13225 - Rio Grande at FM 2627 (Gerstacker Bridge) below Big Bend - is also not listed for any impairments or concerns. Trends for salts and nutrient parameters are constant and flows have increased slightly. The levels at this site for dissolved salts are also slightly above the public water supply limit.

Station 13223 - Rio Grande at Foster Ranch west of Langtry off HWY 90 W - has a secondary concern for the level of total phosphorus found in the river that exceeds the secondary screening level. Comparing the total and ortho- phosphorus data, there appears to be no trend in the data, meaning the level of phosphorus in the water appears to be remaining constant, however the ammonia and nitrate trends are climbing. TDS and salt levels at this meet both surface water and finished drinking water standards and the trends for those parameters are decreasing.

International Amistad Reservoir - Segment 2305

This is the part of the Rio Grande impounded by International Amistad Reservoir in Val Verde County. Flows from the Pecos River enter the Rio Grande just upstream of Amistad Reservoir, as do flows from the Devils River. The area of the reservoir encompasses 64,900 acres (263 square km) with a normal pool elevation of 1117 feet (340.5 m). Levels at Amistad Reservoir are currently at near conservancy levels. Amistad Reservoir is a popular place for boating, fishing, and picnicking. Hydroelectric power is generated at the dam by both the United States and Mexico. The dam also serves as a sink for sediment, resulting in clearer water released from the dam compared to the heavy sediment load the river carries above the reservoir. Water stored at the reservoir belongs to both the United States and Mexico based on the allocation of waters outlined in the 1994 Water Treaty. Water is released from Amistad Reservoir to downstream water rights holders in the United States and Mexico as well as to provide water for storage at Falcon Reservoir for use further downstream.

Figure 31 Pristine waters of the Devil's River

The designated uses for the reservoir include high aquatic life use, contact recreation, general uses, fish consumption and public water supply. There are three monitoring stations on the reservoir.

Station 15892 – Amistad Reservoir Rio Grande Arm at Buoy 28 - is located at the farthest upstream point in the reservoir. This site meets all of its designated use standards. TDS and salt trends at this site have been steadily decreasing, as have all of the nutrient parameters. This is important for the downstream users who rely on this supply for drinking water.

Station 15893 – Amistad Reservoir Devils River Arm at Buoy DRP - is located at the confluence of the Devils River and the reservoir. This site is not listed for any impairments but does have a nitrate concern that is exhibiting a decreasing trend. TDS and salt concentrations are low and are also decreasing.

Station 13835 – Amistad Reservoir at Buoy #1 - is not listed for any impairments or concerns. This site was listed as having a concern for total phosphorus in previous reports but is no longer listed and the values have remained low. All other parameters show declining trends.

Devils River - Segment 2309

Segment 2309 is defined from a point 0.4 miles (0.6 km) downstream of the confluence of Little Satan Creek in Val Verde County to the confluence of Dry Devils River in Sutton County. It is 67 river miles (107.8 km) in length and empties into the Amistad Reservoir. This area of the basin is mostly undisturbed and remains in pristine condition. Areas that are disturbed are due to current oil and gas exploration in the region. Designated uses include exceptional aquatic life use, contact recreation, public water supply, fish consumption and general uses. All uses are fully supporting with no impairments or concerns at any station.

There are three monitoring stations in this segment: 13239- Devils River on Devils River State Natural Area 1.1 miles (1.7 km) upstream of Dolan Creek and 13237- Devils River at Pafford Crossing near Comstock. Additionally, Dolan Creek, Segment 2309A, is also monitored at Station 14942- Dolan Springs 100 yards (91.4 m) upstream of confluence with Devils River immediately upstream of road crossing.

The Devils River is a high quality stream with an average TDS of 380 mg/L compared to the 700 mg/L that is found in the Rio Grande in the same area. All parameters are below surface water quality standards and no trends have been identified in the data.

Basin Concerns

The primary concerns in the upper Rio Grande can be grouped into three categories:

- Elevated levels of bacteria,
- Salinity (chloride, sulfate, TDS), and
- Nutrients (ammonia and phosphorus)

Bacteria

One of the primary concerns in this area is the lack of wastewater infrastructure to meet the needs of communities within the upper basin. Colonias and cities are not providing the necessary treatment of municipal sewage to prevent bacterial contamination of the river.

Additional concerns were identified upstream of El Paso, Texas where bacterial levels exceed the standard in an area where canals containing elevated bacteria levels discharge into the Rio Grande, causing exceedances compared to the surface water quality standards. Segment 2314 in Texas overlaps with a segment in New Mexico, Segment 2101 for about 16 miles (25.7km). In this stretch, both states adhere to the same bacteria standards of 200 cfu/100 mls for fecal coliforms. New Mexico has also designated this segment as impaired for bacteria levels and has initiated a TMDL.

Other communities are upgrading their existing WWTPs to meet the demands from increased population and to protect public health or have applied for assistance to bring in improved infrastructure and construction of WWTPs. Communities around Big Bend Ranch State Park and Big Bend National Park as well as the parks themselves rely on tourism through rafting, camping, fishing, and wading. Elevated bacteria levels can have an adverse impact to the economy in this area when the standards are not met. The CRP will continue to monitor the river for fecal coliform and E. coli at all of its routine monitoring stations to determine the benefits of upgraded and new wastewater treatment projects. Another source that the CRP is trying to identify is nonpoint source pollution that may also be a potential source of impairment for bacteria from either natural sources or runoff from concentrated animal feeding operations. The ability to differentiate between species to identify the source of contamination is now possible and being tested in the upper basin. CRP will be an active participant in using this new technology to help provide more information to assess bacterial levels and their sources in the basin.

Salinity

Salinity has been a concern for many years in the upper basin primarily due to extensive water use for agriculture and as a drinking water supply. Water from the Rio Grande picks up salt from the soil after it has been used for irrigation from one community to the other, increasing the dissolved salt content to a point where it does not meet the standards for a public water supply. Municipalities, such as the City of El Paso's Water Utility (Public Service Board), that use conventional treatment may have to use additional treatment technologies to meet drinking water standards, which will result in increased customer cost. The salinity concentration in the river below El Paso almost doubles making it difficult for farmers to use the water for growing crops in both the United States and Mexico.

Nutrients

Although still considered secondary indicators and have not been adopted as water quality standards, these parameters still provide valuable information for assessing the water quality. Elevated levels of phosphorus and ammonia concentrations usually lead back to a discharge from municipal/industrial or agricultural source in general. It can be the result of a WWTP that is not operating properly, not converting ammonia to nitrate, or a system that is not capable of converting at all, as most primary systems for example. Phosphorus travels unchanged

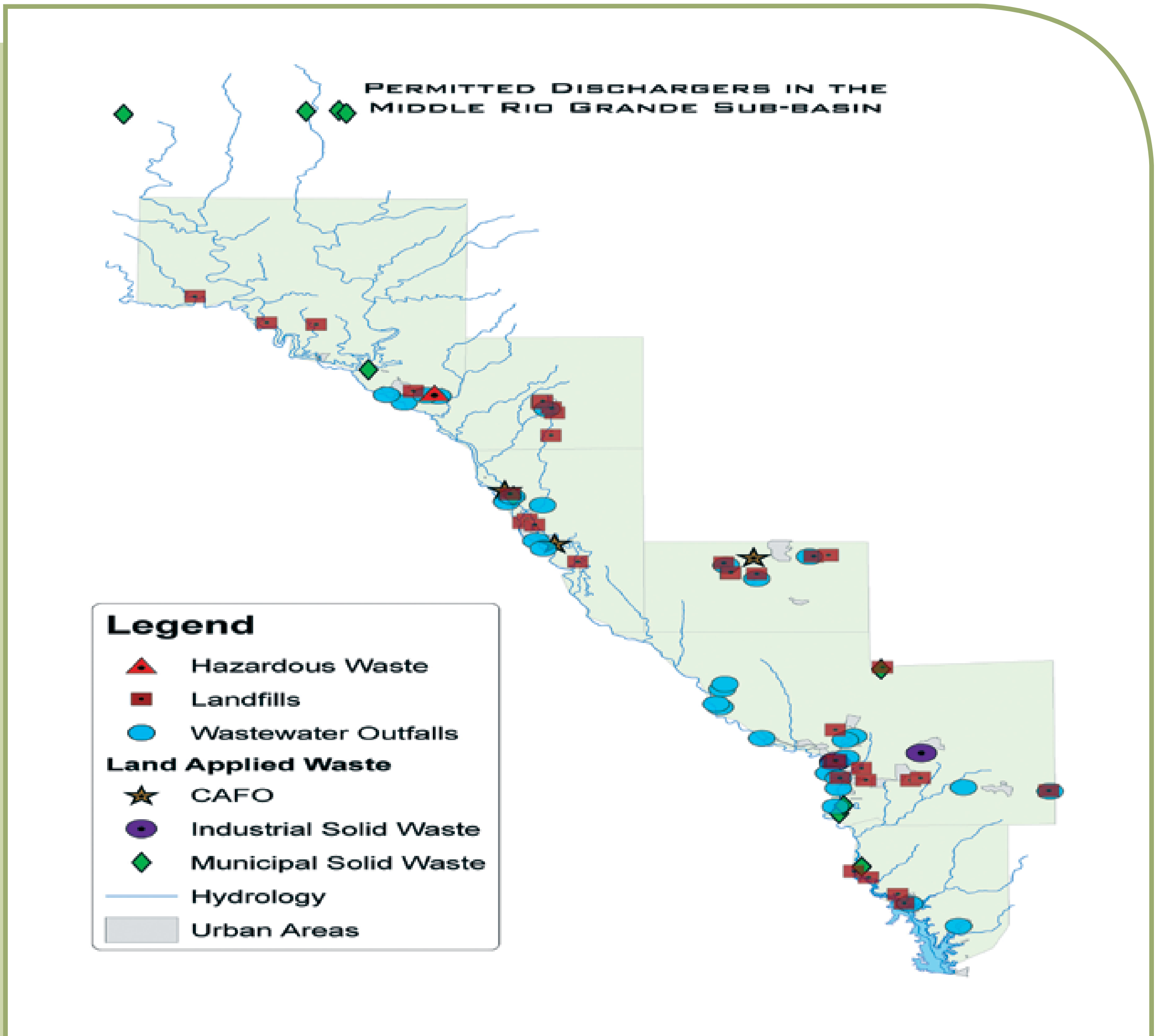


Figure 33 Middle Rio Grande Sub-basin Permitted Dischargers

Figure 34 Middle Rio Grande Sub-basin Monitoring Stations

through the treatment process and is used in many types of fertilizer. Ammonia can be toxic to certain aquatic species and, as stated, could be an indicator that other pollutants may be present in the water associated with the source. High nitrogen and phosphorus levels can lead to algal blooms, which may lead to eutrophication (depressed dissolved oxygen levels). Certain species of algae such as Golden Alga are toxic to fish species and can result in large fish kills. This has happened several times in the Pecos River and has also occurred in the Rio Grande around Big Bend. Maintaining nutrient concentrations below the standards can limit and prevent algae blooms from occurring.

Special Studies in the Upper Rio Grande

Saltcedar is an exotic, scale-leafed, tree or shrub introduced from Eurasia of the genus Tamarix. Saltcedar has colonized millions of acres of riparian land throughout the western U.S. and Northwest Mexico. Saltcedar is a hardy plant with heavy water requirements, which grows in dense thickets along waterways, lakes, and wetlands. Where established, it rapidly and aggressively invades riparian areas, becoming dominant to native species and resulting in displacement and exclusion of native vegetation, degradation of native wildlife habitat, disturbance of natural hydrologic processes, and decreased biodiversity. The U.S. Department of Agriculture's (USDA) Agricultural Research Service (ARS) has been studying means of controlling saltcedar using biological control agents by introducing a Eurasian beetle native to saltcedar. The beetle, *Diorhabda elongata*, is a host specific insect that consumes the leaves of saltcedar, thereby defoliating the plant and preventing saltcedar from surviving and also reduces the ability of saltcedar to distribute seed that can wash down streams and colonize riparian areas far from the original colony. The ARS studied beetles from various ecotypes and have been successful in establishing colonies in areas of the United States above the 37th parallel. Current studies are using two of the beetle species to determine if they can establish and overwinter along the Rio Grande at Presidio and by the National Park Service in Big Bend National Park.

Middle Rio Grande Sub-Basin

Watershed Characteristics

The Middle Rio Grande sub-basin represents the portion of the river below Amistad Dam downstream to include International Falcon Reservoir. Pristine spring water flows into the Rio Grande below Amistad Dam improving water quality even more. Downstream of Amistad Dam the river continues to flow through sister cities that utilize the river for irrigation and as their drinking water supply. The City of Del Rio, Texas is the only large city along the river in this part of the basin that utilizes groundwater, as its principal water supply. The other communities such as Eagle Pass, Texas and Laredo, Texas rely on the river as their primary drinking water supply. The release of water from Amistad Dam is based on allocation of water rights in the United States and Mexico and to provide flow to International Falcon Dam for further distribution. As is the case along the United States-Mexico border throughout Texas, sister cities located in this reach struggle to stay ahead of development and to provide the infrastructure to minimize the pollution going into the Rio Grande.

There are 86 permitted dischargers in the sub-basin including one hazardous waste site, 38 landfills, 32 wastewater outfalls, three CAFOs, two industrial permits, and 10 municipal.

Figure 35 San Felipe Creek in Del Rio, TX

Figure 36 Rio Grande at station 13208

The Middle Rio Grande sub-basin is the portion of the Rio Grande from below International Amistad Dam to International Falcon Reservoir. The sub-basin contains three segments:

Rio Grande Below Amistad Reservoir (2304) – From the confluence of the Rio Salado (Mexico) in Zapata County to Amistad Dam in Val Verde County, which runs for 226 miles (364 km).

International Falcon Reservoir (2303) – From Falcon Dam in Starr County to the confluence of the Rio Salado (Mexico) in Zapata County, which runs for 68 miles (110 km).

San Felipe Creek (2313) – 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 - Segment 2313

Segment 2313 is 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. It flows through a portion of the city providing it with a high quality water supply for drinking, fishing, and swimming. Urban parks and growth have been a concern for potential impacts to this creek.

The segment is designated for high aquatic life, contact recreation, general use, fish consumption, and for public water supply use. All uses were fully supported and no sites in this segment are listed as impaired or exhibiting any 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 loading in the Rio Grande as it travels downstream to other communities. There are three monitoring stations in this segment.

Station 15820 – San Felipe Creek at West Springs, near west wells in Del Rio - has a sharply increasing trend for TDS and salts but they are still way below the standards for this segment. West spring is a constant flowing spring but can be affected by rainfall in the recharge zone that introduces higher sediment loads. Nutrient values and chlorophyll are far below the standards and have no trends.

Station 15821 – San Felipe Creek at Blue Hole flood gates, in park between U.S. 90 Bridge and Southern Pacific Railroad Bridge in Del Rio, Texas - has a declining trend for TDS and salts and nutrient values are below the AWRLs. Bacterial counts, however, are climbing even though they are below the water quality standards.

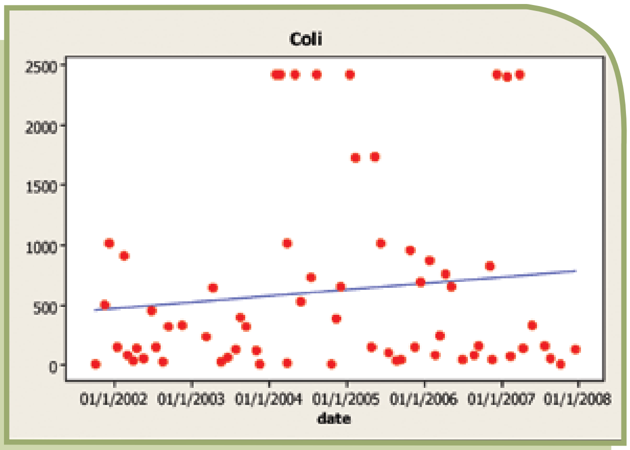


Figure 37 Bacteria issues at station 13560

Station 13270 – San Felipe Creek at Guyler Confluence with the Rio Grande - trend analysis showed no change in the concentration of evaluated parameters over the assessment period except for E. coli, which has an increasing trend as well. This station is located downstream of the city of Del Rio and the city's wastewater treatment plant.

Rio Grande below Amistad Reservoir - Segment 2304

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 and Ciudad Acuña, Coahuila, Eagle Pass, Texas and Piedras Negras, Coahuila, Laredo, Texas and 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 use being fully supported except for contact recreation at some sites due to high bacteria levels. There are 18 monitoring stations in this segment primarily located within the populated areas along the river.

Station 15340 – Rio Grande 2.1 miles (3.4 km) downstream of Amistad Dam above weir dam (IBWC gage #08-4509.00) - is listed as having a concern for low DO levels. This occurs occasionally below impoundment structures when releases have not been made in some time. Analysis of the data at this site shows a consistent decrease in TDS and salts at this site and nutrient levels below the AWRLs. Bacteria data is limited but shows that levels are well below the water quality standards but show an increasing trend.

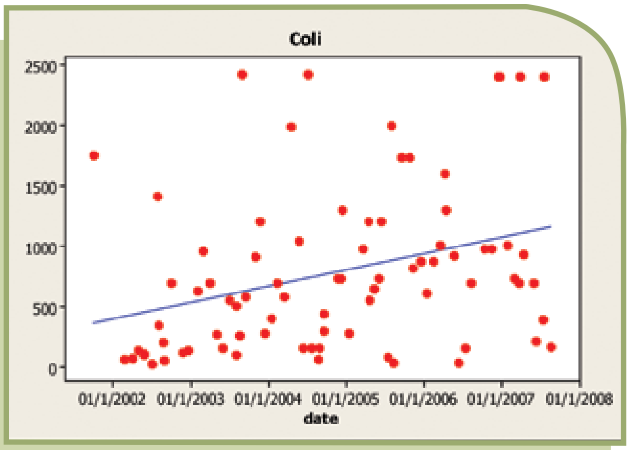


Figure 38 Increasing bacteria trends at station 15814

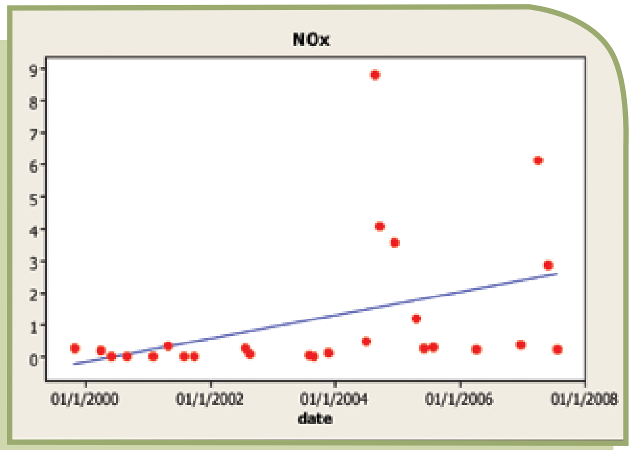


Figure 39 Increasing nitrate values for station 15814

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 - is also listed as having a concern for low DO levels as the dam also affects this site. Like station 15340, this site has a declining trend for TDS, conductivity, and salt concentrations. Nutrients levels had spiked in 1999 but have not shown any concern since that year.

Stations 13560 – Rio Grande, 4.5 miles (7.2 km) downstream of Del Rio, Texas at Moody Ranch - is located just below the confluence of the Rio Grande with the pristine waters of San Felipe Creek. This site is listed as having an impairment for high bacteria levels. The trends at this site mimic the previous sites with decreasing salts and low nutrient levels. This site is, however, affected by municipal impacts and exhibits increasing trends in bacterial contamination.

Station 13206 – Rio Grande at U.S. 277 in Eagle Pass, Texas - is not listed for any impairments or concerns. Water quality is being met with the concentration of parameters below surface water quality standards. Bacteria levels are within acceptable limits at this site as compared to the upstream station.

Station 18792 – Rio Grande at Kickapoo Casino 300 m south and 70 m west of Kurt Bluedog Road at Riverside Drive south of Eagle Pass - also has no impairments but is listed as having a concern for bacteria. As the river flows through Eagle Pass, Texas, the concentration of bacteria goes up above the surface water standard and exhibits an increasing trend. This is a pattern seen when discharges from communities are returned to the river. This site was formerly labeled station 13205 but was changed to provide a better description of the site.

Station 15274 – Rio Grande at USIBWC Weir Dam six miles south of El Indio, 0.6 miles (1 km) downstream of Cuervo Creek - is not listed for any impairments or concerns. Analysis of the data at this site shows the same decreasing trend in TDS and salts and nutrients are highly variable. Bacterial levels

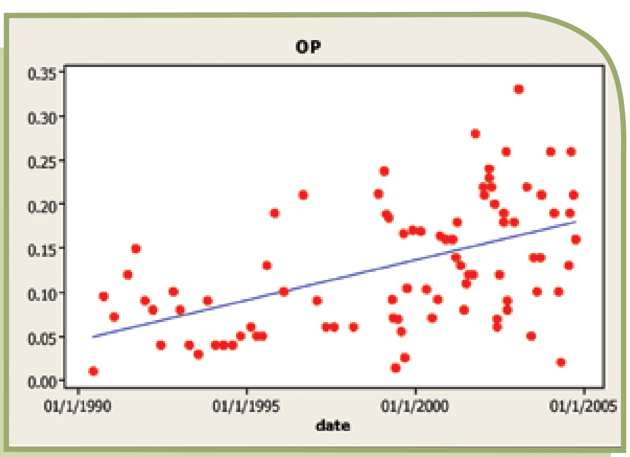


Figure 40 Increasing phosphorus values at station 13196.

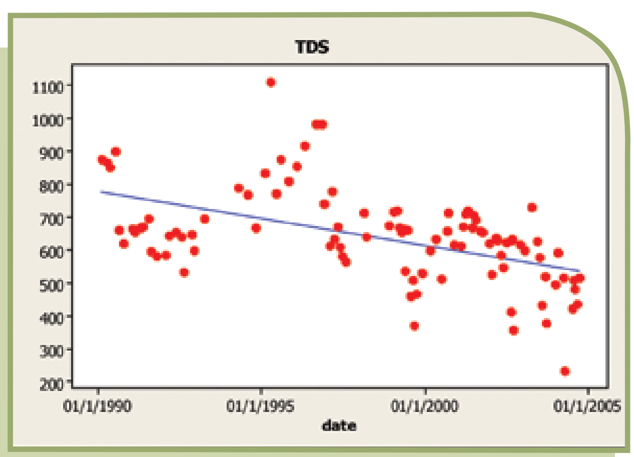


Figure 41 Decreasing TDS trends at station 13196

are below surface water standards at this station and show a slight declining trend.

Station 17596 – Rio Grande at Apache Ranch - is not listed for any concerns or impairment. This station also shows a decline in salt concentrations but shows a slight increase in TDS. Nutrient values are very low and do not show any trends. Bacteria levels show slight increasing trends but are still below the water quality standards.

Station 15839 – Rio Grande at the Colombia Bridge - does not have any listed impairments or concerns. This station is located upstream of the Laredo, Texas and Nuevo Laredo, Tamaulipas, upstream of the populated areas. Assessment of the data indicates a similar decreasing trend in TDS and salts but exhibits an increasing trend for all of the nutrient parameters.

Station 17410 – Rio Grande below World Trade Bridge - is not listed for impairments or concerns. Trend analysis of the data for this site indicates that all water quality parameters are below the standards and show no discernible trends in any direction.

Station 13116 – Manadas Creek at FM 1472 North of Laredo - is not listed in the water quality inventory and there is limited data on this site. Assessment of available data shows increasing trends in salt concentrations and relatively neutral nutrient trends. Bacteria values, however, exceed the water quality standards. This creek is located adjacent to recent urban and industrial developments. This site has had a special study performed to look at impacts from industrial pollutants and is discussed in the special study section below.

Station 15813 – Rio Grande at CP&L Power Plant Intake - is not listed as having any impairments but is listed as having an ambient water toxicity concern. This site is only monitored for bacteria, which shows that bacteria levels are meeting surface water quality standards and has no trend.

Station 13202 – Rio Grande at Laredo Water Treatment Plant pump intake - also has no impairments and is also listed for an ambient water toxicity concern. Trend analysis shows a general decline in TDS and salt values but a slight increasing trend for all nutrient levels. Bacteria levels are below the standards and show no changes with respect to time.

Station 13201 – Rio Grande 98 feet (30 m) upstream of U.S. 81 Bridge (Convent Avenue) in Laredo - is listed as being impaired for bacteria levels exceeding the water quality standards. Analysis of the data shows that bacteria starts to increase at this site exceeding surface water quality standards set for contact recreation. From this site to the end of the segment, bacteria levels exceed the standards for contact recreation and are coincident with high urbanization of the areas around the river.

Station 15814 – Rio Grande at International Bridge #2 (East Bridge) in Laredo - is listed as having an impairment for high bacteria levels. Trend analysis for bacteria shows that the concentration during the assessment period was increasing. Trends for nutrient parameters show an increasing degradation for these parameters and subsequently the trend for chlorophyll is also increasing. Solids and salt trends, however, are improving. This site begins a pattern for the following sites within this stretch of the river for increasing bacteria and nutrients and decreasing salts

Station 15815 – Rio Grande at Masterson Road in Laredo, 6.2 miles (9.9 km) downstream of International Bridge #1 is listed as having a bacteria impairment and the trend analysis shows that this problem in getting worse.

Station 15816 – Rio Grande at Rio Bravo, 0.3 miles (0.5 km) downstream of the community of El Cenizo - is also listed for bacteria and is showing no signs of improving according to the trend analysis of the data.

Station 13196 – Rio Grande at Pipeline Crossing, 8.6 miles (13.9 km) below Laredo - is listed as being impaired for bacteria. This station, much like most of the upstream station within the Cities of Laredo and Nuevo Laredo (Dos Laredos), shows an increasing trend in bacteria. The concentration of ammonia and other nutrients are also increasing. This is indicative of contamination of the river from poorly treated municipal wastewater. TDS and salt trends, however, show improvements for these parameters.

Station 15817 – Rio Grande at Webb/Zapata County line is also listed as impaired for bacteria, although the bacteria values are not as high as station 13196. This site is located downstream but outside of the high urbanization upstream. The levels of ammonia and other nutrients are lower and TDS concentrations have decreasing trends showing that the water quality can improve when not impacted by source pollutants like at station 13196.

International Falcon Reservoir - Segment 2303

Segment 2303 is defined as that part of the Rio Grande that is impounded by the International Falcon Dam at a normal pool elevation of 301 feet (91.7 m). The reservoir, like Amistad, is used for recreation, water supply, and hydroelectric power generation. The water levels for this reservoir are currently at 53 percent of conservancy. Water impounded by the reservoir is released based on downstream requests from municipalities and irrigation districts. The designated uses for the reservoir include contact recreation, high aquatic life, fish consumption, and for public water supply use. There are two monitoring sites in the reservoir.

Station 15818 – Falcon Reservoir at San Ygnacio Water Treatment Plant intake, 984.2 feet (300 m) downstream from U.S. B83 Bridge - has no listed impairments. Trend analyses show a decline in solids and salt concentrations. showsNutrient trends show an increase in all parameters and an increase in chlorophyll levels.

Station 13189 – Falcon Lake at International Boundary Monument #1 - is not listed for any impairments or concerns. Trends at this station paint a different picture with not only salt concentrations dropping but nutrients as well.

Basin Concerns

Overall, the water quality in the Middle Rio Grande Basin from below Amistad to Falcon Reservoir has remained the same or is improving. The concerns for salts in the Upper portion of the Rio Grande are not found in this reach as most sites show not only values below the water quality standards but decreasing trends as well. From reviewing the water quality data though, it becomes apparent that bacteria contamination continues to occur and remain a concern within and below communities that border the Rio Grande. The increases typically occur below return drains and tributaries, which leads CRP staff to believe that the main source of contamination is due to wastewater discharges. Cities in both the United States and Mexico are working to address this problem by constructing new

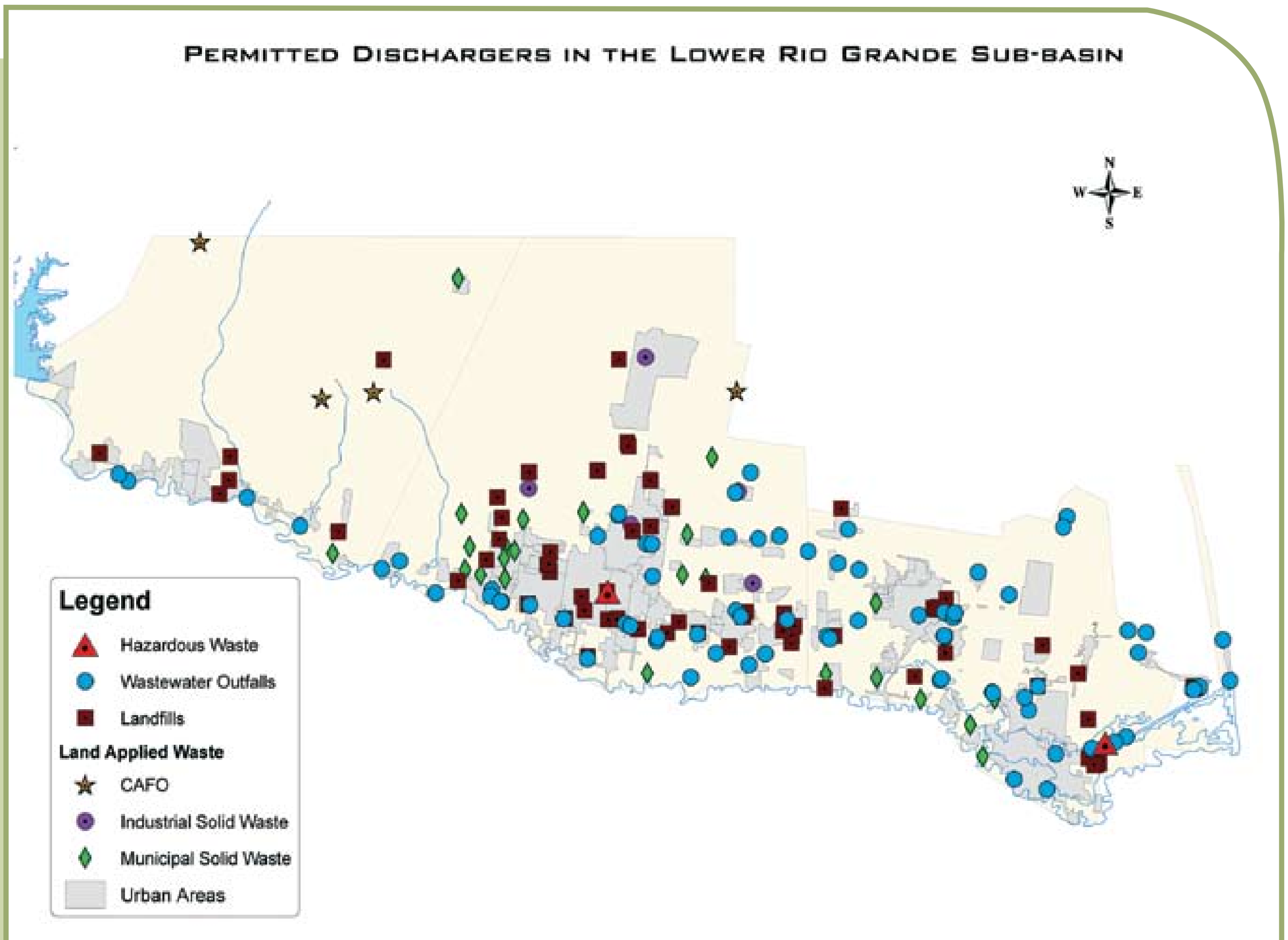


Figure 42 Lower Rio Grande Sub-basin Permitted Dischargers

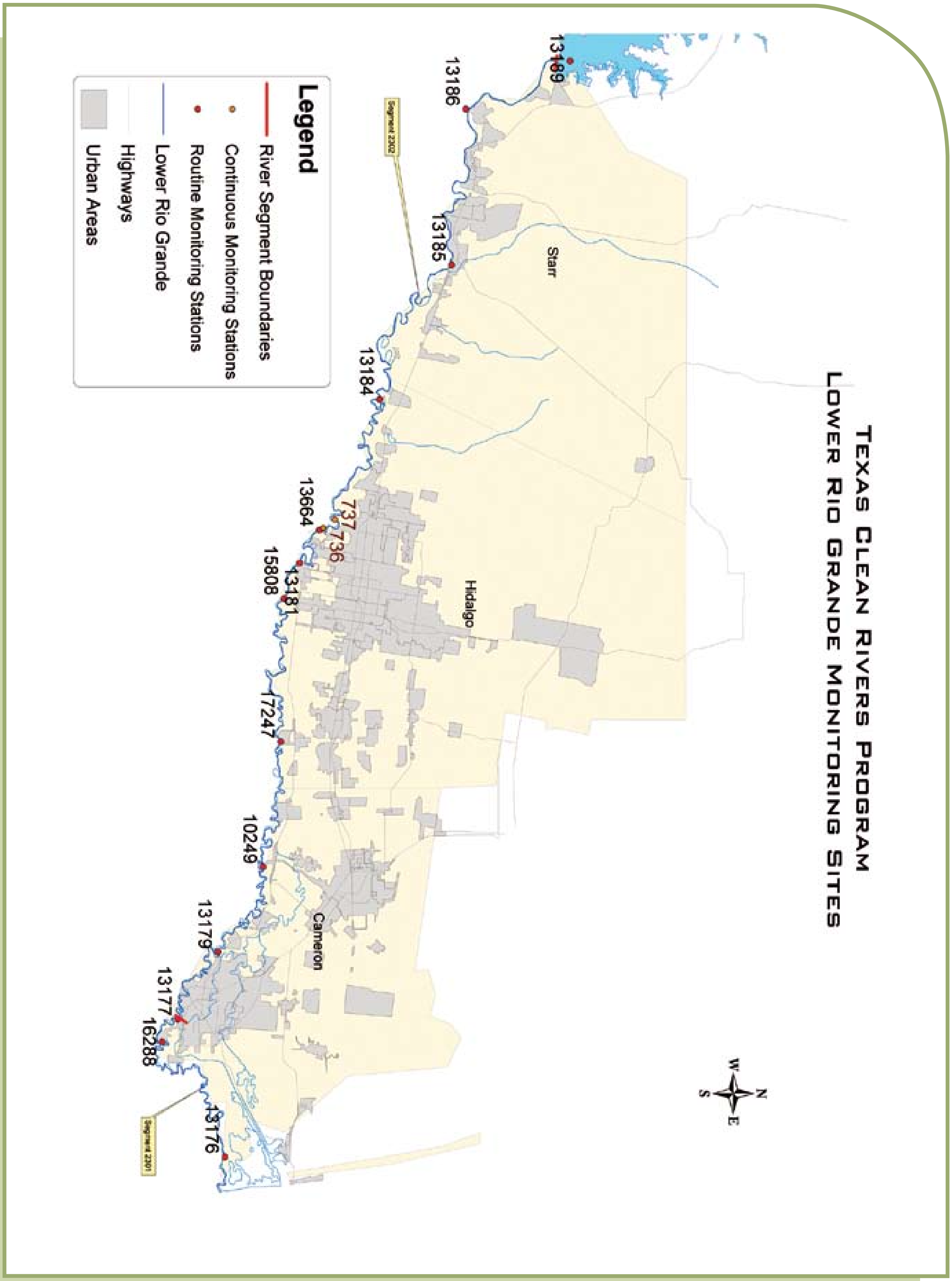


Figure 43 Lower Rio Grande Sub-basin Monitoring Stations

Figure 44 Rio Grande at station 13184

WWTP plant facilities and upgrading collection systems. This is the first step in controlling the concentration of bacteria and associated pollutants found in wastewater.

Special Studies

Texas A&M University - Kingsville (TAMUK) with cooperation from CRP and the Rio Grande International Studies Center RGISC) in Laredo completed an assessment of nutrient and heavy metals in Manadas Creek, a tributary to the Rio Grande, and its potential impacts to the Rio Grande in Laredo, TX.

The study showed that the heavy metals arsenic and antimony exceeded state water quality standards and that phosphorus values were also periodically higher than the water quality standards. Impacts to the river were measured in the Rio Grande relatively far from the confluence. At those sites, the nutrient and metals contamination in Manadas Creek were not present.

Future studies will continue studying the metals impacts from metals refining in Manadas Creek and TAMUK is currently looking at organochlorinated pesticides in the Rio Grande and tributaries in Laredo.

Lower Rio Grande Sub-Basin

Watershed Characteristics

Population centers along the Lower Rio Grande have grown tremendously in the last ten years. The entire stretch of the segment is bounded by urban growth. Drinking water needs of the Lower Rio Grande rely entirely on the river. Most agricultural and urban discharges do not enter the Rio Grande in this reach as they are diverted to canals that empty into the Gulf of Mexico, however, excessive flows that exceed the capacity of the canals can be routed to the Rio Grande

There are 194 permitted dischargers in the sub-basin including two hazardous waste sites, 76 wastewater outfalls, 81 landfills, four CAFOs, 7 industrial permits, and 24 municipal dischargers. The majority of the dischargers listed above lie in the Arroyo Colorado drainage area and do not impact the Rio Grande.

The Lower Rio Grande is the section of the Rio Grande from a point just below Falcon Reservoir to the mouth of the Rio Grande at the Gulf of Mexico. The sub-basin contains two segments:

- Rio Grande below Falcon Reservoir (2302)– From a point 6.7 miles (10.8 km) downstream of the International Bridge in Cameron County to Falcon Dam in Starr County, which runs 231 miles (371 km).
- Rio Grande Tidal (2301)– From the confluence with the Gulf of Mexico in Cameron County to a point 6.7 miles (10.8 km) downstream of the International Bridge in Cameron /county, which runs 49 miles (79 km)

Rio Grande below Falcon Reservoir - Segment 2302

Segment 2302 is classified as a freshwater stream with a length of 231 miles (371.8 km) that flows from Falcon Reservoir through the Lower Rio Grande Valley, an area of high growth. The designated uses for this segment are high aquatic life use, contact recreation, general use, fish consumption, and public water supply. This segment is meeting all of its uses, except for bacteria issues at the end of the segment. The entire segment is listed as having a concern for mercury in fish tissue. This region of the Rio Grande is primarily agricultural and municipal. It is unknown as to the source of the mercury contamination but influx from ocean could be a source. Segment 2302 contains 11 monitoring stations.

Station 13186 – Rio Grande below Rio Alamo near Fronton - has no concerns or impairments. Trend analyses show an improvement in all parameters except bacteria, which have an increasing trend. Bacteria levels are well below the water quality standards with values below 100 CFU/100mls but source identification needs to be addressed to prevent levels from climbing further.

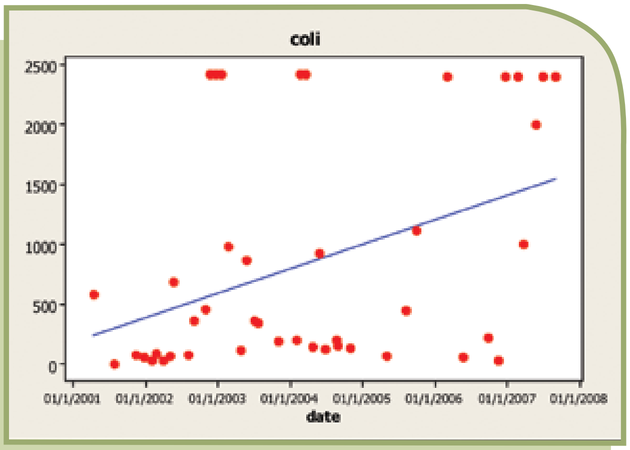


Figure 45 High bacterial contamination at station 13177

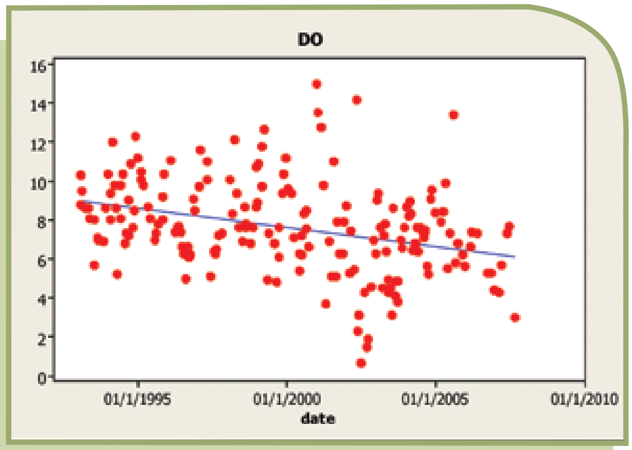


Figure 46 Declining dissolved oxygen levels at station 13177

Station 13185 – Rio Grande at Fort Ringgold 1 mi. downstream from Rio Grande City - is not listed for any concerns or impairments but, like 13186, bacteria levels are increasing and the most recent data shows the levels to exceed the water quality standards. Nutrient trends are also increasing resulting in an increase in the values for chlorophyll.

Station 13184 – Rio Grande at SH 886 near Los Ebanos - does not have any concerns or impairments. This site has a slight declining trend in chloride, sulfate, TDS, and nutrients but has a steeply increasing trend for chlorophyll. Nutrient values are very low and are not climbing so it is uncertain as to why the chlorophyll is so high.

Station 13664 – Rio Grande 0.5 mi (0.8 km) below Anzalduas dam, 12.2 mi (19.6 km) from Hidalgo - is not listed for any concerns or impairments. This site also has a steeply climbing trend in chlorophyll values while salts and nutrients have declining or flat trends.

Figure 47 Rio Grande as it passes Sabal Palm Sanctuary at station 16288

Station 13181 – Rio Grande International Bridge at US 281 at Hidalgo - is also free of any concerns or impairments. This site does not have the same chlorophyll issues as the two upstream sites and is in fact declining. Trends and values for all other parameters are similar to the upstream sites.

Station 15808 – Rio Grande 656 feet (200 m) upstream of Pharr International Bridge - Salt concentrations, ammonia, and total phosphorus levels at this site show a declining trend.

Station 13180 – Rio Grande below El Anhelo drain south of Las Milpas is not listed as impaired. This site is was previously listed on the 303(d) as having a contact recreation use impairment due to high bacteria levels. This site had limited data and had not been collected for several years, so the CRP began collecting data during the past few years to determine if the impairment still existed. After collecting more data, this site has been shown to meet the water quality standards for bacteria and is no longer going to be collected as there are sites nearby both upstream and downstream.

Station 17247 – Rio Grande 238 feet (100 m) upstream from the FM 1015 Bridge at Progresso - does not have any impairments or listed concerns. TDS and salt values are below the water quality standards but current trends are climbing towards these levels. Nutrient and chlorophyll values are also climbing towards the limits of the standards.

Station 10249 – Rio Grande 3.9 miles (6.3 km) downstream from San Benito pumping plant, 9.5 miles (15.3 km) SW of San Benito - is not listed for impairments or concerns, however like station 17247 the salt, TDS, and nutrient levels have all been increasing during the assessment period.

Station 13179 – Rio Grande near River Bend boat ramp, approximately five miles west of Brownsville on US 281 - is listed as having a depressed oxygen concern and the trend analysis shows that DO is declining. Nutrient values are showing rapidly increasing trends and chlorophyll is also high. This segment of the river has historically had severe problems with invasive aquatic weeds such as hydrilla and water hyacinth, which contributes to the addition of chlorophyll to the water. TDS and salt trends for this site are decreasing, unlike the upstream sites.

Station 13177– Rio Grande El Jardin pump station 300 feet (91 m) below intake - is impaired for high bacterial contamination. Trends for bacteria show a marked increase for E. coli. This site also has a concern for low dissolved oxygen and the trend analysis shows that DO is still declining. TDS and salts have a decreasing trend but nitrate, ammonia, and ortho-phosphorus exhibit a rapidly climbing trend. Based on the trends, this site is most likely influenced by wastewater discharges not meeting standards.

Rio Grande Tidal - Segment 2301

Segment 2301 is classified as a tidal stream with a length of 49 miles (79 km). Its designated uses are exceptional aquatic life use, contact recreation, general use, and fish consumption. All uses are fully supported, except fish consumption, which has not been assessed. This segment contains two monitoring stations.

Station 16288 – Rio Grande at Sabal Palm Sanctuary at northeast boundary off Park Road approximately 1mi south of FM1419 near Palm Grove - is a relatively new station and is not listed for any impairments or concerns. Bacteria trends exhibit the same upward climb that was noticed from station 13177 as this site is the next downstream site. TDS and salt concentrations, however, have an upward trend not visible upstream. Nutrients show sporadic trends with nitrates climbing, ammonia and falling, and phosphorus remaining constant.

Station 13176 – Rio Grande Tidal at SH 4 near Boca Chica - contains an algal growth concern for excessive algae as determined by high chlorophyll levels. Trend analyses show that chlorophyll levels are still increasing and nutrients levels are also increasing. pH values are a little high and the trend indicates that it will climb even higher.

Basin concerns

Water quality in the region has seen many improvements with slight problems with bacterial and phosphorus contamination. The sources for these water quality issues can be traced to municipal impacts. They can also be associated with the main concern in the sub-basin, lack of substantial infrastructure to handle high growth rates and increased amounts of municipal waste.

Groundwater in this region is too brackish to use for public consumption, so municipalities rely solely on surface water as their drinking water source. Several initiatives are in place to build groundwater desalination plants in this region to supplement water demands for municipal growth.

Texas Parks and Wildlife Department (TPWD), with assistance from several state, federal, and international agencies, have been reasonably successful in removing water hyacinth blockages from key areas on the river over the last few years. Removal efforts generally take place in the fall. Part of the effort is to use mechanical removal, but the TPWD is working on a Memorandum of Understanding with Mexico to use herbicides to assist in the removal of water hyacinth.

4.0 Conclusions and Recommendations

4.0 CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The USIBWC has expanded the range of the CRP by adding additional monitoring stations, recruited more partners, and supported ongoing research in the basin. These efforts have resulted in:

- Increased data collection. More data is being provided to the TCEQ in the Rio Grande than has been in the past. CRP staff has stressed the importance of collecting quality assured data and will continue to provide support and training to insure that all individuals involved in water quality monitoring are aware of these requirements. Data is now being collected under NELAC accreditation.
- CRP's website serves as a clearinghouse of water quality data that can be easily downloaded by any user via the Internet. Current information on the CRP's activities is available along with reports and interactive basin maps through our newly developed Internet Mapping Service.
- Concerns for bacteria occur throughout the basin along the border. CRP and its partners have collected additional bacteria data to identify the sources of pollution. Intensive surveys such as the study conducted by the IBWC to assess the affects of the NLIWTP show the benefits of providing communities with this type of facility.

- Continued studies being done by the EPCC to identify contaminants in the upper Rio Grande has provided valuable information regarding bacterial, viral, and chemical concentrations that can be found in an area affected by municipal, industrial, and agricultural discharges.
- Installation and maintenance of several real-time monitoring stations in the Rio Grande and Pecos. Future plans to expand the real-time network will place stations in other tributaries and in the Lower Rio Grande.
- Salinity studies in the Upper Rio Grande and in the Pecos River that are providing a greater insight into sources and potential management of contamination.

Pecos River Sub-basin

There are no impairments for this basin on the 303(d) list, but there are listed concerns for high salt levels in the upper segments of the river. Chloride, sulfate, and TDS levels in the Pecos River enter the state of Texas at high levels and get increasingly higher in its travels towards the Rio Grande. Saltcedar invasion, natural salt intrusions, and decreased flows have all contributed to this increase. The upper portion of the river is not used for public drinking water supply, so the high salt levels meet the designated uses. The salt levels in the lower segment of the river are reduced because of freshwater tributaries and springs such as Independence Creek. Because this segment of the river is listed as a public drinking water supply, the high levels of salt in the upper segment create a concern in the lower segment. Ever increasing salt levels are not being diluted enough by the freshwater tributaries to maintain drinking water levels in the lower segment of the river.

Upper Rio Grande Basin Sub-basin

Water quality concerns in the Rio Grande consists of elevated levels of bacteria, dissolved salts, and nutrients. Exceedances in bacteria occur in Segment 2314, 2307, and 2306. The main cause of high bacteria is due to point and nonpoint source discharges around populated areas above and below El Paso/Ciudad Juárez and the Presidio/Ojinaga area. The high levels of salts are due to return flows that carry dissolved salts from irrigated agriculture, municipal discharges, and runoff from soil that is high in salinity. Salinity only decreases when additional flow from tributaries and springs help dilute the level of salts in the water prior to reaching International Amistad Reservoir.

Middle Rio Grande Sub-basin

The water quality found in the Rio Grande has shown improvement during the assessment period. Trend analysis either showed no change or improved conditions for the majority of the parameters. The main concerns in this sub-basin are exceedances in bacteria and nutrients. As in the upper sub-basin, bacterial levels increase around sister cities because of municipal discharges into the river of partially treated and untreated wastewater. As stated above, it is believed nutrients are found to exceed the secondary screening criteria because of the same discharges that cause high bacterial counts.

Lower Rio Grande Sub-basin

Overall water quality in the lower sub-basin meets all of the water quality standards for the designated uses except for bacteria contamination around Brownsville, Texas/Matamoros, Tamaulipas. Most of the future issues for this region will be due to rapid municipal growth requiring increased freshwater resources.

RECOMMENDATIONS

Water Quality Monitoring

The level of effort should remain the same or increase in this area. Routine, baseline data is the primary source of data used in the assessment process. New monitoring stations have been added in the Rio Grande Basin and plans to introduce more monitoring stations are underway in an effort to create a complete picture of the changes in water quality throughout the basin. The concerns identified in the basin are part of the regular suite of parameters analyzed under the CRP. CRP will assess and introduce additional parameters as needed into the monitoring schedule.

Current projects are underway in communities that will either upgrade wastewater treatment capabilities or construct new ones. These improvements along with Best Management Practices (BMP) being established for farming and range management should result in an improvement to water quality in the Rio Grande. These efforts should continue until the infrastructure is available to all people who live in the United States-Mexico border.

Intensive Studies

CRP partners provide a means for the program to expand on the routine monitoring program. There is a lot of enthusiasm to pursue separate studies by Rio Grande partners and the CRP fully supports these efforts. Additional information is being gathered on pathogens, salinity, and saltcedar, and future efforts are going to focus on real-time monitoring, pesticides and herbicide studies, fish surveys, and biological monitoring.

Steering Committee Development

CRP has continued to solicit the input of steering committee members to help guide the CRP during the year. In order to reach more individuals, CRP staff has incorporated the annual meetings with other groups in the basin in an effort to receive greater input into the program and to inform more members of the public about our efforts in the basin. CRP will continue to hold meetings within each sub-basin and strive to improve communication with basin stakeholders.

Because of the international nature of the border region and identification of water quality concerns, it is becoming apparent that any long-term program established to improve water quality will need to include the participation of communities where the watershed is located. Part of the Rio Grande watershed lies in New Mexico and Mexico. Areas of concern to water quality affect the entire region and any plan to address these concerns will require intrastate, binational support. The CRP staff intend on developing a binational, intrastate steering committee in the hope of developing a stakeholder group that will be able to address issues such as TMDL development when the time comes.

APPENDIX I

TEXAS SURFACE WATER QUALITY STANDARDS FOR THE RIO GRANDE BASIN

RIO GRANDE BASIN		USES			CRITERIA						
Segment No	Segment Name	Recreation	Aquatic Life	Domestic Water Supply	Cl (mg/L)	SO4 (mg/L)	TDS (mg/L)	Dissolved Oxygen (mg/L)	pH Range (SU)	Indicator Bacteria[1] #/100ml	Temp (°F)
2301	Rio Grande Tidal	CR	E					5.0	6.5-9.0	35/200	95
2302	Rio Grande Below Falcon Reservoir	CR	H	PS	270	350	880	5.0	6.5-9.0	126/200	90
2303	International Falcon Reservoir	CR	H	PS	200	300	1,000	5.0	6.5-9.0	126/200	93
2304	Rio Grande Below Amistad Reservoir	CR	H	PS	200	300	1,000	5.0	6.5-9.0	126/200	95
2305	International Amistad Reservoir	CR	H	PS	150	270	800	5.0	6.5-9.0	126/200	88
2306	Rio Grande Above Amistad Reservoir	CR	H	PS	300	570	1,550	5.0	6.5-9.0	126/200	93
2307	Rio Grande Below Riverside Diversion Dam	CR	H	PS	300	550	1,500	5.0	6.5-9.0	126/200	93
2308	Rio Grande Below International Dam	NCR	L	PS	250	450	1,400	3.0	6.5-9.0	605/2,000	95
2309	Devils River	CR	E	PS	50	50	300	6.0	6.5-9.0	126/200	90
2310	Lower Pecos River	CR	H	PS	1,700	1,000	4,000	5.0	6.5-9.0	126/200	92
2311	Upper Pecos River	CR	H		7,000	3,500	15,000	5.0	6.5-9.0	126/200	92
2312	Red Bluff Reservoir	CR	H		3,200	2,200	9,400	5.0	6.5-9.0	126/200	90
2313	San Felipe Creek	CR	H	PS	50	50	400	5.0	6.5-9.0	126/200	90
2314	Rio Grande Above International Dam	CR	H	PS	340	600	1,800	5.0	6.5-9.0	126/200	92

APPENDIX II DRAFT 2008

DRAFT 2008 Texas Water Quality Inventory - Sources of Impairments and Concerns

PS - Point Source; NPS - Nonpoint Source; NS - Non-Supporting;
CN - Concern for Near Non-attainment; CS - Concern for Screening Level; AU ID - Assessment Unit ID

2301 Rio Grande Tidal

Segment Description: 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

AU ID: 2301_01 Assessment Area: Upper segment boundary to 25 miles upstream of lower segment boundary (mouth of Rio Grande)

CN Bacteria Geomean
NPS- Urban Runoff/Storm Sewers; NPS- Sources Outside State Juristiction or Borders

CS Nutrient Screening Levels
NPS- Urban Runoff/Storm Sewers; NPS- Sources Outside State Juristiction or Borders

AU ID: 2301_02 Assessment Area: 25 miles upstream of lower segment boundary (mouth of Rio Grande)

CS Nutrient Screening Levels
NPS- Non-Point Source; NPS- Urban Runoff/Storm Sewers; NPS- Sources Outside State Juristiction or Borders

2302 Rio Grande Below Falcon Reservoir

Segment Description: From a point 10.8 km (6.7 miles) downstream of the International Bridge in Cameron County to Falcon Dam in Starr County

AU ID: 2302_01 Assessment Area: Falcon Dam to Arroyo Los Olmos confluence

CS Bioaccumulative Toxics in fish tissue
UNK- Source Unknown

AU ID: 2302_02 Assessment Area: Arroyo Los Olmos confluence to Los Ebanos Ferry Crossing

CS Bioaccumulative Toxics in fish tissue
UNK- Source Unknown

AU ID: 2302_03 Assessment Area: Los Ebanos Ferry Crossing to Anzalduas Dam

CS Bioaccumulative Toxics in fish tissue
UNK- Source Unknown

AU ID: 2302_04 Assessment Area: Anzalduas Dam to McAllen Int'l Bridge (US 281)

CS Bioaccumulative Toxics in fish tissue
UNK- Source Unknown

AU ID: 2302_05 Assessment Area: McAllen Int'l Bridge(US 281) to Progresso Int'l Bridge (FM 1015)

DRAFT 2008 Texas Water Quality Inventory - Sources of Impairments and Concerns

PS - Point Source; NPS - Nonpoint Source; NS - Non-Supporting;
CN - Concern for Near Non-attainment; CS - Concern for Screening Level; AU ID - Assessment Unit ID

CS Bioaccumulative Toxics in fish tissue
UNK- Source Unknown

AU ID: 2302_06 Assessment Area: Progresso Int'l Bridge (FM 1015) to the Rancho Viejo Floodway area

CS Bioaccumulative Toxics in fish tissue
UNK- Source Unknown

AU ID: 2302_07 Assessment Area: Rancho Viejo Floodway area to El Jardin Pump Station

NS Bacteria Geomean
NPS- Urban Runoff/Storm Sewers; NPS- Sources Outside State Juristiction or Borders

NS Bacteria Single Sample
NPS- Sources Outside State Juristiction or Borders; NPS- Urban Runoff/Storm Sewers

CS Bioaccumulative Toxics in fish tissue
NPS- Urban Runoff/Storm Sewers; NPS- Sources Outside State Juristiction or Borders

CS Dissolved Oxygen grab screening level
NPS- Sources Outside State Juristiction or Borders; NPS- Urban Runoff/Storm Sewers

2302A Arroyo Los Olmos (unclassified water body)

Segment Description: From confluence with the Rio Grande at Rio Grande City to El Sauz in Starr County

AU ID: 2302A_01 Assessment Area: Entire water body

NS Bacteria Geomean
UNK- Source Unknown; NPS- Non-Point Source

NS Bacteria Single Sample
UNK- Source Unknown; NPS- Non-Point Source

2303 International Falcon Reservoir

Segment Description: From Falcon Dam in Starr County to the confluence of the Arroyo Salado (Mexico) in Zapata County, up to normal pool elevation of 301.1 feet (impounds Rio Grande)

AU ID: 2303_02 Assessment Area: Area around Zapata WTP intake

CN TOXNET ambient toxicity tests in water - sublethality
PS- Municipal Point Source Discharges; NPS- Sources Outside State Juristiction or Borders; NPS- Urban Runoff/Storm Sewers

2304 Rio Grande Below Amistad Reservoir

Segment Description: From the confluence of the Arroyo Salado (Mexico) in Zapata County to Amistad Dam in Val Verde County

AU ID: 2304_01 Assessment Area: Amistad Dam to San Felipe Creek confluence

DRAFT 2008 Texas Water Quality Inventory - Sources of Impairments and Concerns

PS - Point Source; NPS - Nonpoint Source; NS - Non-Supporting;
CN - Concern for Near Non-attainment; CS - Concern for Screening Level; AU ID - Assessment Unit ID

CS Dissolved Oxygen grab screening level
NPS- Upstream Impoundments (e.g., Pl-566 NRCS Structures)

AU ID: 2304_02 Assessment Area: San Felipe Creek confluence to the Las Moras Creek confluence

NS Bacteria Geomean
PS- Point Source Unknown; NPS- Sources Outside State Juristiction or Borders

NS Bacteria Single Sample
PS- Point Source Unknown; NPS- Sources Outside State Juristiction or Borders

AU ID: 2304_04 Assessment Area: Hwy 277 (Eagle Pass) to El Indio

CN Bacteria Single Sample
PS- Municipal Point Source Discharges; NPS- Sources Outside State Juristiction or Borders; NPS- Urban Runoff/Storm Sewers

AU ID: 2304_07 Assessment Area: World Trade Center Bridge to Laredo water treatment plant intake

CN TOXNET ambient toxicity tests in water - sublethality
NPS- Sources Outside State Juristiction or Borders; PS- Municipal Point Source Discharges; NPS- Urban Runoff/Storm Sewers

AU ID: 2304_08 Assessment Area: Laredo water treatment plant intake to International Bridge #2

NS Bacteria Geomean
NPS- Non-Point Source; PS- Point Source Unknown; NPS- Sources Outside State Juristiction or Borders

NS Bacteria Single Sample
PS- Municipal Point Source Discharges; NPS- Sources Outside State Juristiction or Borders; NPS- Urban Runoff/Storm Sewers

CN TOXNET ambient toxicity tests in water - sublethality
NPS- Non-Point Source; PS- Point Source Unknown; NPS- Sources Outside State Juristiction or Borders

AU ID: 2304_09 Assessment Area: International Bridge # 2 to just below Chacon Creek confluence

NS Bacteria Geomean
NPS- Non-Point Source; NPS- Sources Outside State Juristiction or Borders; PS- Point Source Unknown

NS Bacteria Single Sample
NPS- Non-Point Source; NPS- Sources Outside State Juristiction or Borders; PS- Point Source Unknown

AU ID: 2304_10 Assessment Area: Chacon Creek confluence to the Arroyo Salado confluence

NS Bacteria Geomean
NPS- Urban Runoff/Storm Sewers; PS- Municipal Point Source Discharges; NPS- Sources Outside State Juristiction or Borders; NPS- Non-Point Source

NS Bacteria Single Sample
NPS- Urban Runoff/Storm Sewers; PS- Municipal Point Source Discharges; NPS- Sources Outside State Juristiction or Borders; NPS- Non-Point Source

DRAFT 2008 Texas Water Quality Inventory - Sources of Impairments and Concerns

PS - Point Source; NPS - Nonpoint Source; NS - Non-Supporting;
CN - Concern for Near Non-attainment; CS - Concern for Screening Level; AU ID - Assessment Unit ID

2305 International Amistad Reservoir

Segment Description: 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 Val Verde County.

AU ID: 2305_02 Assessment Area: Devils River arm

CS Nutrient Screening Levels
UNK- Source Unknown

2306 Rio Grande Above Amistad Reservoir

Segment Description: From a point 1.8 km (1.1 miles) downstream of the confluence of Ramsey Canyon in Val Verde County to the confluence of the Rio Conchos (Mexico) in Presidio County.

AU ID: 2306_01 Assessment Area: Confluence with Rio Conchos to Alamito Creek

NS Bacteria Geomean
NPS- Non-Point Source; NPS- Sources Outside State Juristiction or Borders

NS Bacteria Single Sample
NPS- Non-Point Source; NPS- Sources Outside State Juristiction or Borders

CS Nutrient Screening Levels
NPS- Non-Point Source; NPS- Sources Outside State Juristiction or Borders

AU ID: 2306_03 Assessment Area: Mouth of Santa Elena Canyon to Johnson Ranch

CS Nutrient Screening Levels
NPS- Non-Point Source; NPS- Sources Outside State Juristiction or Borders

AU ID: 2306_05 Assessment Area: Mariscal Canyon to Boquillas Canyon

CS Nutrient Screening Levels
NPS- Sources Outside State Juristiction or Borders; NPS- Non-Point Source

AU ID: 2306_06 Assessment Area: Boquillas Canyon to FM 2627

CS Nutrient Screening Levels
NPS- Sources Outside State Juristiction or Borders; NPS- Non-Point Source

AU ID: 2306_08 Assessment Area: Dryden Crossing to lower segment boundary downstream of Ramsey Canyon

CS Nutrient Screening Levels
NPS- Sources Outside State Juristiction or Borders; NPS- Non-Point Source

DRAFT 2008 Texas Water Quality Inventory - Sources of Impairments and Concerns

PS - Point Source; NPS - Nonpoint Source; NS - Non-Supporting;
CN - Concern for Near Non-attainment; CS - Concern for Screening Level; AU ID - Assessment Unit ID

2307 Rio Grande Below Riverside Diversion Dam

Segment Description: From the confluence of the Rio Conchos (Mexico) in Presidio County to Riverside Diversion Dam in El Paso County

AU ID: 2307_01 Assessment Area: Downstream of Riverside Dam to Guadalupe Bridge

NS Bacteria Geomean
PS- Point Source Unknown; NPS- Non-Point Source; NPS- Sources Outside State Juristiction or Borders

NS Bacteria Single Sample
NPS- Non-Point Source; PS- Point Source Unknown; NPS- Sources Outside State Juristiction or Borders

NS Dissolved Solids
PS- Municipal Point Source Discharges; NPS- Non-Point Source; NPS- Sources Outside State Juristiction or Borders

CS Nutrient Screening Levels
PS- Municipal Point Source Discharges; NPS- Non-Point Source; NPS- Sources Outside State Juristiction or Borders

AU ID: 2307_02 Assessment Area: Guadalupe Bridge to the Alamo Grade Structure

NS Bacteria Geomean
NPS- Non-Point Source; PS- Point Source Unknown; NPS- Sources Outside State Juristiction or Borders

NS Bacteria Single Sample
NPS- Sources Outside State Juristiction or Borders; PS- Point Source Unknown; NPS- Non-Point Source

CS Dissolved Oxygen grab screening level
NPS- Non-Point Source; PS- Point Source Unknown; NPS- Sources Outside State Juristiction or Borders

NS Dissolved Solids
NPS- Sources Outside State Juristiction or Borders; PS- Point Source Unknown; NPS- Non-Point Source

CS Nutrient Screening Levels
PS- Point Source Unknown; NPS- Sources Outside State Juristiction or Borders; NPS- Non-Point Source

AU ID: 2307_03 Assessment Area: Alamo Grade Structure to Little Box Canyon

NS Dissolved Solids
NPS- Sources Outside State Juristiction or Borders; NPS- Non-Point Source; NPS- Irrigated Crop Production

CS Nutrient Screening Levels
NPS- Sources Outside State Juristiction or Borders; NPS- Non-Point Source; NPS- Irrigated Crop Production

AU ID: 2307_04 Assessment Area: Little Box Canyon to 25 miles upstream of Rio Conchos confluence

NS Dissolved Solids
NPS- Flow Alterations from Water Diversions; NPS- Sources Outside State Juristiction or Borders; NPS- Irrigated Crop Production

DRAFT 2008 Texas Water Quality Inventory - Sources of Impairments and Concerns

PS - Point Source; NPS - Nonpoint Source; NS - Non-Supporting;
CN - Concern for Near Non-attainment; CS - Concern for Screening Level; AU ID - Assessment Unit ID

AU ID: 2307_05 Assessment Area: 25 miles upstream of the Rio Conchos confluence (lower segment boundary)

NS Dissolved Solids
NPS- Sources Outside State Juristiction or Borders; NPS- Flow Alterations from Water Diversions; NPS- Irrigated Crop Production

CS Nutrient Screening Levels
NPS- Sources Outside State Juristiction or Borders; NPS- Flow Alterations from Water Diversions; NPS- Irrigated Crop Production

2308 Rio Grande Below International Dam

Segment Description: From the Riverside Diversion Dam in El Paso County to International Dam in El Paso County

AU ID: 2308_01 Assessment Area: Entire segment

CS Nutrient Screening Levels
NPS- Urban Runoff/Storm Sewers; NPS- Sources Outside State Juristiction or Borders

2310 Lower Pecos River

Segment Description: From a point 0.7 km (0.4 miles) downstream of the confluence of Painted Canyon in Val Verde County to a point immediately upstream of the confluence of Independence Creek in Crockett/Terrell County

AU ID: 2310_01 Assessment Area: Upper segment boundary to Big Hackberry Canyon

CN Fish Kill Reports
UNK- Source Unknown

AU ID: 2310_02 Assessment Area: From FM 2083 near Pan Dale Rd to the lower segment boundary

CN Fish Kill Reports
UNK- Source Unknown

2311 Upper Pecos River

Segment Description: From a point immediately upstream of the confluence of Independence Creek in Crockett/Terrell County to Red Bluff Dam in Loving/Reeves County

AU ID: 2311_01 Assessment Area: Red Bluff Dam to FM 652

CN Fish Kill Reports
UNK- Source Unknown; NPS- Non-Point Source

CS Nutrient Screening Levels
UNK- Source Unknown; NPS- Non-Point Source

AU ID: 2311_02 Assessment Area: FM 652 to SH 302

CN Fish Kill Reports
UNK- Source Unknown

DRAFT 2008 Texas Water Quality Inventory - Sources of Impairments and Concerns

PS - Point Source; NPS - Nonpoint Source; NS - Non-Supporting;
CN - Concern for Near Non-attainment; CS - Concern for Screening Level; AU ID - Assessment Unit ID

AU ID: 2311_03 Assessment Area: SH 302 to Barstow Dam

CN Fish Kill Reports
UNK- Source Unknown

AU ID: 2311_04 Assessment Area: Barstow Dam to US 80 (Bus 20)

CN Bacteria Geomean
UNK- Source Unknown

CN Bacteria Single Sample
UNK- Source Unknown

CN Fish Kill Reports
UNK- Source Unknown

AU ID: 2311_05 Assessment Area: US 80 (Bus 20) to FM 1776

NS Continuous Dissolved Oxygen Daily 24hr Minimum
UNK- Source Unknown

NS Dissolved Oxygen 24hr minimum
NPS- Non-Point Source; UNK- Source Unknown

CN Fish Kill Reports
NPS- Non-Point Source; UNK- Source Unknown

CS Nutrient Screening Levels
UNK- Source Unknown

AU ID: 2311_06 Assessment Area: FM 1776 to US 67

NS Dissolved Oxygen 24hr minimum
UNK- Source Unknown

CS Dissolved Oxygen grab screening level
UNK- Source Unknown

CN Fish Kill Reports
UNK- Source Unknown

AU ID: 2311_07 Assessment Area: US 67 to US 290

CN Fish Kill Reports
UNK- Source Unknown

CS Nutrient Screening Levels
UNK- Source Unknown

DRAFT 2008 Texas Water Quality Inventory - Sources of Impairments and Concerns

PS - Point Source; NPS - Nonpoint Source; NS - Non-Supporting;
CN - Concern for Near Non-attainment; CS - Concern for Screening Level; AU ID - Assessment Unit ID

AU ID: 2311_08 Assessment Area: US 290 to lower segment boundary

CN Fish Kill Reports
UNK- Source Unknown

2312 Red Bluff Reservoir

Segment Description: From Red Bluff Dam in Loving/Reeves County to New Mexico State Line in Loving/Reeves County, up to normal pool elevation 2842 feet (impounds Pecos River)

AU ID: 2312_01 Assessment Area: Texas/New Mexico State Line to Mid-lake

CN Fish Kill Reports
NPS- Natural Sources; NPS- Sources Outside State Juristiction or Borders

CS Nutrient Screening Levels
NPS- Natural Sources; NPS- Sources Outside State Juristiction or Borders

AU ID: 2312_02 Assessment Area: Mid-lake to dam

CS Dissolved Oxygen grab screening level
UNK- Source Unknown

CN Fish Kill Reports
NPS- Sources Outside State Juristiction or Borders; NPS- Non-Point Source

CS Nutrient Screening Levels
NPS- Sources Outside State Juristiction or Borders; NPS- Non-Point Source

2314 Rio Grande Above International Dam

Segment Description: From International Dam in El Paso County to the New Mexico State Line in El Paso County

AU ID: 2314_02 Assessment Area: Upstream of Anthony Drain to International Dam

NS Bacteria Geomean
NPS- Non-Point Source; NPS- Sources Outside State Juristiction or Borders

NS Bacteria Single Sample
NPS- Non-Point Source; NPS- Sources Outside State Juristiction or Borders

CS Nutrient Screening Levels
PS- Municipal Point Source Discharges; NPS- Non-Point Source; NPS- Sources Outside State Juristiction or Borders

APPENDIX III TREND TABLES

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 10249								
pH	7.35	8.90	7.83	4.26	0.00	7.61	7.80	down
Ammonia	0.02	1.79	0.30	-2.64	0.01	0.05	0.16	up
Chlorophyll-a	5.00	37.90	7.59	-1.67	0.11	5.00	5.00	none
Total Phosphorous	0.11	0.66	0.28	-1.93	0.07	0.21	0.24	up
Temperature	10.99	32.70	24.76	1.02	0.32	22.70	24.60	none
E. Coli	6.00	2400.00	202.55	-0.03	0.98	15.00	22.00	none
Fecal Coliforms	ND	ND	ND	ND	ND	ND	ND	ND
Sulfates	159.00	320.00	231.48	-0.73	0.48	194.00	231.00	none
Chloride	107.00	280.00	171.26	-0.79	0.44	138.00	164.00	none
Conductivity	915.00	1800.00	1285.41	0.32	0.76	1080.00	1220.00	none
Nitrate + Nitrite	0.15	1.51	0.69	-0.39	0.70	0.45	0.65	none
DO	4.40	13.00	8.57	1.41	0.17	7.60	8.50	none
Station 13103								
pH	7.12	9.42	8.03	2.33	0.03	7.70	8.00	down
Ammonia	0.05	0.28	0.08	-1.67	0.11	0.05	0.06	up
Chlorophyll-a	1.00	66.80	23.95	-2.66	0.02	5.00	24.60	up
Total Phosphorous	0.02	0.39	0.15	-0.36	0.72	0.12	0.14	none
Orthophosphate	0.05	0.60	0.10	-0.24	0.81	0.06	0.06	none
Temperature	13.20	29.60	22.39	-0.57	0.58	17.90	23.30	none
E. Coli	21.00	11198.00	1349.18	-1.85	0.09	140.00	199.00	up
Fecal Coliforms	13.00	1000.00	343.65	-1.74	0.10	45.00	270.00	up
Sulfates	56.00	2860.00	0.00	0.68	206.00	797.00	ND	none
Chloride	47.00	11400.00	3486.62	0.10	0.92	491.00	2210.00	none
Total Dissolved Solids	456.00	23400.00	7680.95	0.11	0.91	1350.00	4640.00	none
Conductivity	613.00	32680.00	10422.70	0.19	0.85	1600.00	5700.00	none
Nitrate + Nitrite	0.04	22.00	4.69	2.40	0.03	0.05	0.06	down
DO	2.90	15.10	8.44	1.56	0.13	5.90	7.50	down

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 13109								
pH	7.80	8.20	8.00	17.03	0.00	7.90	8.00	up
Ammonia	0.05	0.08	0.05	1.54	0.13	0.05	0.05	none
Chlorophyll-a	1.00	10.00	6.66	-5.32	0.00	1.00	10.00	none
Total Phosphorous	0.01	0.66	0.06	1.02	0.31	0.05	0.05	none
Orthophosphate	0.01	0.06	0.05	2.90	0.01	0.04	0.06	none
Temperature	10.90	28.80	21.16	1.41	0.17	16.90	21.40	none
E. Coli	1.00	57.00	17.23	-0.47	0.64	5.00	13.00	none
Fecal Coliforms	1.00	190.00	18.12	0.55	0.59	4.00	11.00	none
Sulfates	132.00	189.00	161.95	4.90	0.00	145.00	162.00	down
Chloride	94.00	133.00	113.45	4.77	0.00	101.00	116.00	down
Total Dissolved Solids	562.00	3450.00	731.21	0.53	0.60	600.00	652.00	none
Conductivity	916.00	1180.00	1046.86	11.44	0.00	972.00	1060.00	down
Nitrate + Nitrite	0.36	1.34	0.72	-1.58	0.12	0.49	0.69	up
DO	7.10	10.90	8.80	-0.02	0.98	8.10	8.50	none
Station 13116								
pH	7.20	8.43	7.75	0.81	0.44	7.40	7.80	none
Ammonia	0.01	0.30	0.12	0.17	0.87	0.04	0.11	none
Chlorophyll-a	3.37	40.40	13.26	-0.43	0.68	5.00	6.90	none
Total Phosphorous	0.10	1.63	0.39	-0.85	0.42	0.11	0.22	none
Orthophosphate	0.01	0.29	0.10	-2.48	0.09	0.04	0.07	up
Temperature	13.95	30.00	23.04	-0.48	0.65	18.50	22.40	none
E. Coli	1011.10	2400.00	2101.85	-9.36	0.00	2000.00	2400.00	up
Sulfates	200.00	3430.00	1859.44	-1.15	0.29	1180.00	2211.00	none
Chloride	130.00	1110.00	598.80	-1.34	0.22	385.00	506.00	none
Total Dissolved Solids	651.00	651.00	3702.00	-1.18	0.27	2050.00	2810.00	none
Conductivity	719.00	6155.00	3283.00	1.28	0.24	950.00	2900.00	none
Nitrate + Nitrite	0.02	8.01	1.14	-0.68	0.52	0.04	0.18	none
DO	0.10	7.44	4.70	2.64	0.03	3.70	5.40	down
Station 13176								
pH	6.98	8.93	8.28	4.37	0.00	8.20	8.30	up
Ammonia	0.01	0.80	0.09	0.77	0.45	0.04	0.05	none
Chlorophyll-a	1.00	192.00	25.27	-0.91	0.37	10.00	16.40	none
Total Phosphorous	0.01	0.76	0.31	-4.71	0.00	0.17	0.25	up
Orthophosphate	0.01	0.61	0.19	-5.76	0.00	0.05	0.16	up
Temperature	15.50	31.90	25.25	0.12	0.91	22.30	25.60	none
E. Coli	2.00	365.40	68.17	0.93	0.38	3.00	14.00	none
Fecal Coliforms	1.00	820.00	60.54	-1.24	0.22	7.00	7.00	none
Sulfates	8.49	2020.00	586.55	4.19	0.00	248.00	464.00	down
Chloride	122.00	13600.00	2806.80	3.45	0.00	263.00	1620.00	down
Total Dissolved Solids	678.00	25500.00	5631.47	3.44	0.00	1030.00	3630.00	down
Conductivity	900.00	33220.00	8161.02	3.77	0.00	1666.00	5000.00	down
Nitrate + Nitrite	0.01	1.40	0.20	-0.96	0.34	0.03	0.05	none
DO	5.00	18.20	8.73	0.14	0.89	6.80	8.30	none

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 13177								
pH	6.45	9.20	7.98	20.79	0.00	7.70	8.00	down
Ammonia	0.01	1.80	0.15	-2.61	0.01	0.04	0.08	up
Chlorophyll-a	1.00	85.40	12.85	1.19	0.24	3.40	10.00	none
Total Phosphorous	0.02	17.40	0.60	0.66	0.51	0.15	0.21	none
Orthophosphate	0.00	0.74	0.15	-6.63	0.00	0.04	0.10	down
Temperature	12.25	34.66	25.79	2.00	0.05	22.20	26.50	up
E. Coli	2.00	2419.20	843.40	-2.69	0.01	81.30	357.80	down
Fecal Coliforms	1.00	5000.00	547.54	0.19	0.85	70.00	210.00	none
Sulfates	116.00	564.00	258.67	8.58	0.00	212.00	250.00	down
Chloride	93.70	515.00	196.23	4.68	0.00	156.00	186.00	down
Total Dissolved Solids	472.00	4275.00	899.94	3.03	0.00	739.00	836.00	down
Conductivity	787.00	2950.00	1410.42	7.46	0.00	1220.00	1376.00	down
Nitrate + Nitrite	0.02	16.00	0.77	-2.85	0.01	0.05	0.12	up
DO	0.68	14.97	7.59	6.92	0.00	6.30	7.56	down
Station 13179								
pH	7.80	8.80	8.26	11.31	0.00	8.00	8.20	down
Ammonia	0.01	0.40	0.07	-2.54	0.02	0.02	0.05	up
Chlorophyll-a	1.00	47.30	14.72	1.74	0.10	5.00	10.00	down
Total Phosphorous	0.06	0.51	0.25	-2.12	0.05	0.15	0.22	up
Orthophosphate	0.01	0.44	0.11	-3.14	0.01	0.04	0.06	up
Temperature	15.90	31.67	25.88	0.86	0.40	24.70	25.70	none
Fecal Coliforms	14.00	1400.00	286.56	2.35	0.03	27.00	45.00	down
Sulfates	78.00	390.00	255.63	2.54	0.02	230.00	247.00	none
Chloride	60.00	281.00	183.13	0.53	0.60	150.00	175.00	none
Total Dissolved Solids	538.00	1200.00	850.28	1.38	0.19	726.00	768.00	down
Conductivity	541.00	2130.00	1305.47	0.95	0.35	1158.00	1244.00	none
Nitrate + Nitrite	0.02	1.04	0.31	-3.20	0.00	0.04	0.10	up
DO	4.29	12.60	8.23	2.08	0.05	6.90	8.37	down
Station 13180								
pH	7.10	9.20	8.07	11.81	0.00	7.70	8.00	down
Ammonia	0.01	2.02	0.28	-0.05	0.96	0.07	0.16	none
Chlorophyll-a	1.00	68.70	11.53	0.86	0.40	1.90	9.70	none
Total Phosphorous	0.05	0.94	0.27	-0.31	0.76	0.11	0.20	none
Orthophosphate	0.01	0.49	0.10	-0.81	0.43	0.04	0.05	none
Temperature	14.50	31.80	24.85	0.36	0.72	21.00	26.10	none
E. Coli	7.00	2419.00	467.60	-0.32	0.76	34.00	44.00	none
Fecal Coliforms	14.00	30000.00	1422.47	-1.54	0.13	90.00	220.00	none
Sulfates	115.00	454.00	259.74	1.86	0.07	224.00	254.00	down
Chloride	94.70	424.00	181.87	1.01	0.32	133.00	159.00	none
Total Dissolved Solids	552.00	1350.00	854.63	1.70	0.10	700.00	808.00	down
Conductivity	750.00	2450.00	1292.40	4.13	0.00	1155.00	1230.00	down
Nitrate + Nitrite	0.03	0.51	0.20	0.95	0.35	0.05	0.18	none
DO	3.20	12.20	7.64	9.35	0.00	6.28	7.80	down

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 13181								
pH	6.38	10.10	8.05	17.75	0.00	7.80	8.00	down
Ammonia	0.01	0.60	0.08	-1.39	0.17	0.02	0.05	up
Chlorophyll-a	0.50	40.80	4.70	4.44	0.00	1.00	1.00	down
Total Phosphorous	0.01	7.31	0.32	0.28	0.78	0.06	0.08	none
Orthophosphate	0.01	0.37	0.07	0.29	0.77	0.04	0.06	none
Temperature	11.73	32.10	24.45	2.31	0.02	20.97	25.50	down
E. Coli	15.00	2400.00	326.68	-1.93	0.06	45.00	88.80	up
Fecal Coliforms	4.00	100000.00	1208.30	1.25	0.21	60.00	143.00	down
Sulfates	25.00	490.00	233.99	10.33	0.00	196.00	232.00	down
Chloride	52.50	356.00	160.27	5.87	0.00	129.00	153.00	down
Total Dissolved Solids	300.00	1800.00	750.60	5.88	0.00	640.00	730.00	down
Conductivity	537.00	2360.00	1248.71	9.16	0.00	1104.00	1202.00	down
Nitrate + Nitrite	0.02	11.20	0.46	-2.07	0.04	0.06	0.14	up
DO	4.09	14.90	8.57	8.65	0.00	7.40	8.48	down
Station 13184								
pH	5.90	8.40	7.80	10.07	0.00	7.70	7.86	down
Ammonia	0.02	0.40	0.06	-0.37	0.71	0.02	0.02	none
Chlorophyll-a	1.00	16.00	3.93	-2.46	0.02	1.00	1.00	up
Total Phosphorous	0.01	1.10	0.14	0.51	0.61	0.06	0.09	none
Orthophosphate	0.01	0.28	0.07	0.10	0.92	0.04	0.05	none
Temperature	11.40	31.14	24.04	2.55	0.01	19.04	25.22	down
Sulfates	88.00	1778.60	241.24	2.53	0.01	185.00	220.00	down
Chloride	73.04	1569.50	166.20	1.58	0.12	125.00	148.00	down
Total Dissolved Solids	47.00	4961.00	763.64	0.53	0.60	564.00	641.00	none
Conductivity	817.00	1240.00	1037.69	1.54	0.13	946.00	1035.00	up
Nitrate + Nitrite	0.02	20.00	1.24	-0.15	0.88	0.08	0.13	none
DO	5.10	11.97	7.61	1.22	0.23	6.50	7.16	none
Station 13185								
pH	6.40	8.90	7.77	15.85	0.00	7.60	7.80	down
Ammonia	0.02	2.63	0.64	-2.37	0.02	0.25	0.40	up
Chlorophyll-a	1.00	45.50	5.23	-2.34	0.02	1.00	1.00	up
Total Phosphorous	0.05	1.54	0.24	-0.12	0.91	0.10	0.17	none
Orthophosphate	0.03	0.49	0.15	-1.17	0.25	0.08	0.11	none
Temperature	4.70	36.00	23.18	3.14	0.00	19.00	23.50	down
E. Coli	2.00	2420.00	665.73	-4.44	0.00	23.50	87.00	up
Fecal Coliforms	5.00	2250.00	395.70	-1.42	0.16	38.00	75.00	up
Sulfates	59.67	320.00	213.24	15.86	0.00	180.00	219.71	down
Chloride	43.78	229.16	141.01	9.15	0.00	116.00	140.00	down
Total Dissolved Solids	408.00	821.00	580.45	-2.17	0.03	523.00	572.00	up
Conductivity	753.00	1337.00	992.73	0.57	0.57	913.00	988.00	none
Nitrate + Nitrite	0.02	27.00	1.04	-0.09	0.93	0.05	0.12	none
DO	4.90	10.10	6.94	1.11	0.27	6.50	6.80	none

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 13186								
pH	5.90	9.10	7.97	12.30	0.00	7.70	8.00	down
Ammonia	0.01	0.40	0.08	-1.23	0.22	0.02	0.05	up
Chlorophyll-a	1.00	19.80	4.06	1.58	0.12	1.00	1.00	down
Total Phosphorous	0.01	32.40	0.62	0.28	0.78	0.05	0.06	none
Orthophosphate	0.01	2.20	0.09	-0.56	0.57	0.04	0.06	none
Temperature	10.49	31.80	22.73	2.58	0.01	18.30	23.50	down
E. Coli	6.00	1119.85	102.25	0.14	0.89	20.00	48.70	none
Fecal Coliforms	1.00	290.00	62.09	-2.99	0.00	24.00	49.00	up
Sulfates	42.00	1130.00	200.04	6.90	0.00	146.00	203.00	down
Chloride	26.00	634.00	124.99	4.78	0.00	98.20	122.00	down
Total Dissolved Solids	194.00	1870.00	622.66	8.54	0.00	499.00	624.00	down
Conductivity	668.00	2110.00	1016.58	12.86	0.00	863.00	1003.00	down
Nitrate + Nitrite	0.01	6.90	0.29	-1.04	0.30	0.05	0.10	up
DO	3.50	15.50	7.61	4.35	0.00	6.50	7.20	down
Station 13189								
Ammonia	0.02	0.34	0.10	0.43	0.67	0.02	0.02	none
Chlorophyll-a	1.00	26.40	8.96	1.89	0.07	1.00	7.40	down
Total Phosphorous	0.02	0.64	0.09	0.13	0.89	0.04	0.06	none
Orthophosphate	0.01	0.06	0.03	-2.99	0.01	0.02	0.03	up
Temperature	13.70	30.30	22.55	0.05	0.96	17.60	20.50	none
E. Coli	2.00	81.00	13.77	-0.67	0.51	2.00	7.40	none
Fecal Coliforms	2.00	52.00	13.68	-2.35	0.03	7.00	7.00	down
Sulfates	72.00	296.00	184.39	9.29	0.00	143.00	184.00	up
Chloride	56.00	181.00	116.39	6.29	0.00	97.00	116.00	up
Total Dissolved Solids	349.00	768.00	528.43	4.47	0.00	456.00	523.00	up
Conductivity	678.00	1230.00	865.42	3.02	0.01	756.00	862.00	down
Nitrate + Nitrite	0.02	15.10	0.67	-1.28	0.21	0.02	0.04	up
DO	6.30	9.80	7.38	2.13	0.05	6.60	6.90	down
Station 13196								
pH	6.80	6.80	8.03	14.97	0.00	7.80	8.00	down
Ammonia	0.02	1.07	0.16	-2.18	0.03	0.06	0.13	up
Chlorophyll-a	1.00	6.95	2.76	-0.98	0.34	1.00	2.00	none
Total Phosphorous	0.05	2.55	0.27	-0.60	0.55	0.14	0.21	none
Orthophosphate	0.01	0.33	0.13	-4.71	0.00	0.07	0.12	up
Temperature	10.00	31.10	22.59	0.14	0.89	18.00	23.00	none
E. Coli	12.00	2419.20	666.46	-2.22	0.03	130.10	416.00	up
Fecal Coliforms	32.00	100000.00	7537.71	3.57	0.00	460.00	2300.00	down
Sulfates	39.40	304.00	192.68	9.03	0.00	160.00	199.00	down
Chloride	20.10	198.00	120.14	5.27	0.00	100.00	123.00	down
Total Dissolved Solids	232.00	1110.00	634.82	8.51	0.00	564.00	634.00	down
Conductivity	670.00	2244.00	1123.50	-0.50	0.61	980.00	1148.00	none
Nitrate + Nitrite	0.05	1.34	0.62	-2.85	0.01	0.38	0.61	up
DO	5.06	15.00	7.76	2.71	0.01	7.00	7.40	down

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 13201								
E. Coli	11.00	2419.20	543.62	-1.25	0.22	143.90	310.00	up
Fecal Coliforms	30.00	6300000	74005.74	-0.44	0.66	250.00	570.00	none
Station 13202								
pH	6.70	9.10	8.15	11.75	0.00	8.00	8.20	down
Ammonia	0.01	0.46	0.04	-1.85	0.07	0.02	0.02	up
Chlorophyll-a	1.00	20.10	1.97	1.51	0.14	1.00	1.00	down
Total Phosphorous	0.01	3.77	0.25	0.20	0.85	0.05	0.09	none
Orthophosphate	0.01	0.10	0.05	-0.41	0.68	0.02	0.05	none
Temperature	10.00	30.90	22.62	-0.26	0.80	18.10	23.20	none
E. Coli	1.00	1203.00	75.01	1.20	0.23	6.30	16.00	none
Fecal Coliforms	6.00	3900.00	133.48	-1.81	0.07	17.00	50.00	up
Sulfates	55.00	324.00	199.91	6.52	0.00	169.00	202.00	down
Chloride	53.00	202.00	120.42	3.81	0.00	96.00	124.00	down
Total Dissolved Solids	351.00	1100.00	663.73	5.69	0.00	582.00	653.00	down
Conductivity	9.22	2232.00	1045.90	5.99	0.00	915.00	1076.00	down
Nitrate + Nitrite	0.03	10.30	0.69	-2.10	0.04	0.13	0.26	up
DO	5.90	13.70	8.08	0.24	0.81	7.00	7.98	none
Station 13205								
pH	6.85	10.50	8.23	5.86	0.00	7.90	8.10	down
Ammonia	0.02	1.49	0.13	-1.84	0.07	0.02	0.07	up
Total Phosphorous	0.02	10.40	1.43	-1.23	0.23	0.05	0.09	up
Temperature	12.00	29.50	21.10	1.49	0.14	16.00	21.00	none
Fecal Coliforms	2.00	13600.00	1009.49	-0.71	0.48	122.00	400.00	none
Sulfates	21.50	272.00	188.50	4.01	0.00	157.00	202.00	down
Chloride	12.40	168.00	113.79	0.67	0.50	87.00	117.00	none
Total Dissolved Solids	438.00	832.00	635.29	2.79	0.01	543.00	644.00	down
Conductivity	650.00	1520.00	987.29	2.25	0.03	920.00	989.00	down
DO	3.90	13.00	8.04	3.39	0.00	7.00	8.10	down
Station 13206								
pH	7.00	10.70	8.32	8.03	0.00	8.00	8.22	down
Ammonia	0.01	0.86	0.07	-0.40	0.69	0.02	0.03	none
Chlorophyll-a	1.00	23.30	2.09	-0.75	0.46	1.00	1.00	none
Total Phosphorous	0.01	5.00	0.21	-0.78	0.44	0.03	0.04	none
Orthophosphate	0.01	0.70	0.06	-0.94	0.35	0.02	0.06	none
Temperature	8.50	29.70	20.78	1.55	0.12	15.90	21.20	none
E. Coli	3.00	113.70	31.39	-0.27	0.79	9.50	11.00	none
Fecal Coliforms	0.50	3000.00	121.23	-0.07	0.95	23.00	47.00	none
Sulfates	52.00	302.00	194.45	8.89	0.00	162.00	197.00	down
Chloride	29.00	193.00	115.49	3.86	0.00	97.00	118.00	down
Total Dissolved Solids	358.00	848.00	626.96	6.43	0.00	554.00	648.00	down
Conductivity	570.00	1490.00	985.73	4.51	0.00	912.00	993.00	down
Nitrate + Nitrite	0.02	25.00	0.93	-1.51	0.14	0.26	0.38	none
DO	6.20	14.50	9.34	1.30	0.20	8.00	9.10	none

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 13208								
pH	5.90	9.30	7.86	7.40	0.00	7.70	7.90	down
Ammonia	0.01	0.75	0.07	0.08	0.94	0.02	0.05	none
Chlorophyll-a	1.00	9.78	1.28	2.15	0.04	1.00	1.00	down
Total Phosphorous	0.01	5.83	0.31	-0.35	0.73	0.02	0.05	none
Orthophosphate	0.01	0.70	0.06	-0.21	0.84	0.03	0.05	none
Temperature	8.00	27.20	18.26	1.17	0.24	14.40	18.40	up
E. Coli	7.40	214.20	54.57	-0.73	0.47	19.90	33.70	none
Fecal Coliforms	6.00	812.00	85.77	1.11	0.27	31.00	51.00	none
Sulfates	8.00	323.00	205.48	10.94	0.00	177.00	210.00	down
Chloride	13.00	201.00	125.28	6.36	0.00	110.00	123.00	down
Total Dissolved Solids	144.00	1010.00	662.79	8.90	0.00	602.00	656.00	down
Conductivity	753.00	1422.00	1039.45	10.97	0.00	972.00	1020.00	down
Nitrate + Nitrite	0.02	25.00	0.72	-0.87	0.39	0.19	0.30	none
DO	3.70	13.20	8.91	2.26	0.03	7.00	9.29	down
Station 13223								
pH	7.14	8.50	8.02	17.47	0.00	7.90	8.10	down
Ammonia	0.01	0.14	0.04	-1.27	0.21	0.01	0.05	none
Chlorophyll-a	1.00	45.70	5.23	1.79	0.09	1.00	1.00	down
Total Phosphorous	0.00	14.51	0.94	-2.22	0.03	0.06	0.10	up
Orthophosphate	0.00	0.38	0.02	0.82	0.42	0.01	0.01	none
Temperature	9.50	28.80	21.67	1.02	0.31	17.50	22.50	none
E. Coli	4.10	580.00	102.06	-1.55	0.17	10.80	40.40	up
Fecal Coliforms	8.00	166.60	50.36	1.01	0.32	17.00	34.00	none
Sulfates	110.00	520.52	296.73	2.50	0.01	239.00	301.27	down
Chloride	14.40	322.00	130.86	2.38	0.02	54.50	120.00	down
Total Dissolved Solids	318.00	1670.00	827.97	3.28	0.00	625.00	822.00	down
Conductivity	703.00	2200.00	1345.72	2.34	0.03	1045.00	1370.00	down
Nitrate + Nitrite	0.05	1.30	0.59	-0.10	0.92	0.41	0.61	none
DO	2.60	12.80	8.27	5.11	0.00	7.10	8.00	down
Station 13225								
pH	7.00	8.70	8.01	7.76	0.00	7.82	8.05	down
Ammonia	0.01	0.39	0.05	-1.99	0.05	0.02	0.05	up
Chlorophyll-a	1.00	157.00	16.41	-0.07	0.95	1.00	3.20	none
Total Phosphorous	0.02	46.80	1.85	-0.70	0.49	0.08	0.12	none
Orthophosphate	0.01	0.41	0.08	1.74	0.09	0.06	0.06	down
Temperature	9.95	32.50	22.88	0.87	0.39	18.60	25.10	none
E. Coli	1.00	2420.00	373.20	-0.59	0.56	6.30	13.40	none
Fecal Coliforms	5.00	9000.00	457.58	-0.85	0.40	14.00	43.00	none
Sulfates	60.00	705.00	453.71	-0.52	0.60	360.00	485.00	none
Chloride	16.00	16.00	215.18	1.29	0.20	125.00	193.00	down
Total Dissolved Solids	0.01	0.41	0.08	1.93	0.06	0.06	0.06	down
Conductivity	587.00	587.00	1806.51	1.12	0.27	1320.00	1780.00	none
Nitrate + Nitrite	0.01	1.48	0.20	1.11	0.27	0.05	0.10	none
DO	4.92	13.60	8.44	3.49	0.00	7.40	8.10	down

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 13228								
pH	7.20	9.10	8.03	10.41	0.00	7.83	8.00	down
Ammonia	0.01	4.14	0.11	-0.66	0.51	0.02	0.05	none
Chlorophyll-a	1.00	366.00	23.55	-1.31	0.19	10.00	10.70	up
Total Phosphorous	0.01	15.50	0.75	-0.01	0.99	0.14	0.20	none
Orthophosphate	0.01	4.10	0.19	0.07	0.94	0.06	0.07	none
Temperature	2.20	32.98	20.34	0.60	0.55	14.40	22.40	none
E. Coli	1.00	2419.00	235.55	-1.32	0.19	12.00	43.00	none
Fecal Coliforms	1.00	8000.00	610.35	-0.79	0.43	14.00	53.00	none
Sulfates	68.60	1100.00	617.77	-2.10	0.04	443.00	609.00	up
Chloride	9.00	2240.00	365.32	1.29	0.20	182.00	410.00	none
Total Dissolved Solids	348.00	4590.00	1751.28	0.48	0.63	1300.00	1820.00	none
Conductivity	419.00	3910.00	2476.27	-1.12	0.27	1730.00	2620.00	none
Nitrate + Nitrite	0.01	8.40	0.50	-0.38	0.71	0.04	0.20	none
DO	5.07	15.36	8.75	1.93	0.06	7.11	7.99	up
Station 13229								
pH	5.40	11.00	7.85	12.11	0.00	7.60	7.80	down
Ammonia	0.01	1.34	0.11	-2.64	0.01	0.02	0.05	up
Chlorophyll-a	1.00	125.00	23.15	-0.59	0.56	1.00	16.20	none
Total Phosphorous	0.03	6.92	0.49	1.11	0.27	0.14	0.26	none
Orthophosphate	0.01	1.50	0.14	0.00	1.00	0.04	0.06	none
Temperature	6.50	31.50	19.72	1.65	0.10	13.90	20.40	down
E. Coli	5.20	2419.00	412.04	-0.34	0.73	32.00	120.00	none
Fecal Coliforms	1.00	8000.00	647.86	-2.15	0.03	62.00	186.00	up
Sulfates	79.00	1322.00	624.01	-5.29	0.00	440.00	620.00	up
Chloride	30.00	880.00	363.00	-1.59	0.11	179.00	360.00	up
Total Dissolved Solids	564.00	3370.00	1773.42	-1.90	0.06	1332.00	1900.00	up
Conductivity	163.00	4420.00	2385.08	-4.59	0.00	1651.00	2610.00	up
Nitrate + Nitrite	0.01	28.00	1.08	-1.44	0.15	0.14	0.34	up
DO	3.90	17.20	8.19	3.76	0.00	6.90	7.90	down
Station 13230								
pH	5.20	10.80	7.74	10.53	0.00	7.40	7.80	down
Ammonia	0.01	3.79	0.15	-1.49	0.14	0.02	0.05	up
Chlorophyll-a	1.00	144.00	26.43	0.69	0.49	4.81	19.20	none
Total Phosphorous	0.05	18.60	0.83	0.81	0.42	0.23	0.40	none
Orthophosphate	0.01	1.90	0.20	-0.38	0.70	0.06	0.08	none
Temperature	0.80	29.00	18.05	1.49	0.14	12.00	18.87	down
E. Coli	7.20	2400.00	144.10	-1.99	0.05	20.00	32.70	up
Fecal Coliforms	1.00	10000.00	197.05	-0.98	0.33	20.00	47.00	none
Sulfates	5.00	1985.00	585.25	1.42	0.16	460.00	569.00	down
Chloride	5.00	1298.00	537.58	2.91	0.00	346.00	560.00	down
Total Dissolved Solids	10.00	24300.00	2105.73	2.81	0.01	1431.00	2010.00	down
Conductivity	505.00	5640.00	2930.56	-0.46	0.65	2300.00	3080.00	none
Nitrate + Nitrite	0.01	35.60	1.24	-1.90	0.06	0.04	0.22	up
DO	3.76	19.20	7.75	4.05	0.00	6.50	7.70	down

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 13232								
pH	7.30	8.70	7.88	8.70	0.00	7.70	7.90	down
Ammonia	0.02	16.90	1.82	-1.45	0.15	0.05	0.13	up
Chlorophyll-a	1.00	130.00	23.40	-1.51	0.14	4.13	16.00	up
Total Phosphorous	0.01	3.32	0.96	0.95	0.34	0.46	0.68	none
Orthophosphate	0.03	2.32	0.59	-0.35	0.73	0.09	0.29	none
Temperature	6.60	33.50	17.03	3.18	0.00	10.12	17.13	down
E. Coli	29.90	2400.00	383.94	-1.31	0.20	48.10	80.00	up
Fecal Coliforms	4.00	6000.00	433.88	0.30	0.76	42.00	150.00	none
Sulfates	5.00	1470.00	598.75	1.64	0.11	489.00	570.00	down
Chloride	5.00	1750.00	707.31	1.65	0.10	546.00	641.00	down
Total Dissolved Solids	87.00	50300.00	3233.38	-1.36	0.18	2020.00	2310.00	up
Conductivity	323.00	6740.00	3441.74	-0.67	0.50	2910.00	3450.00	none
Nitrate + Nitrite	0.04	4.08	1.22	0.10	0.92	0.60	0.97	none
DO	4.90	17.50	8.95	2.52	0.01	7.47	8.60	down
Station 13237								
pH	6.40	8.70	8.13	21.25	0.00	8.09	8.20	down
Ammonia	0.01	0.10	0.04	-4.45	0.00	0.02	0.05	up
Chlorophyll-a	1.00	24.40	2.00	1.46	0.15	1.00	1.00	down
Total Phosphorous	0.01	0.07	0.03	-11.19	0.00	0.01	0.02	up
Orthophosphate	0.01	0.10	0.03	-7.08	0.00	0.01	0.01	up
Temperature	8.78	31.80	21.99	2.04	0.04	17.39	23.30	down
E. Coli	1.00	187.00	19.84	-1.20	0.25	1.00	5.20	up
Fecal Coliforms	1.00	32.00	7.69	0.72	0.48	2.00	2.40	none
Sulfates	1.00	15.00	8.63	2.60	0.01	8.00	8.30	down
Chloride	7.00	111.00	15.07	2.34	0.02	12.00	14.00	down
Total Dissolved Solids	192.00	3660.00	285.16	0.28	0.78	214.00	226.00	none
Conductivity	201.00	583.00	389.15	2.49	0.02	370.00	389.00	down
Nitrate + Nitrite	0.01	1.80	1.22	2.84	0.01	1.03	1.30	down
DO	6.71	13.20	9.72	2.57	0.01	8.80	9.60	down
Station 13239								
pH	6.60	8.60	7.75	4.75	0.00	7.54	7.80	down
Chlorophyll-a	1.00	1.00	1.00	none	none	1.00	1.00	none
Total Phosphorous	0.04	0.06	0.05	-7.30	0.00	0.05	0.05	up
Orthophosphate	0.04	0.06	0.05	9.71	0.00	0.04	0.06	down
Temperature	15.00	26.68	21.13	0.89	0.38	18.80	20.40	none
E. Coli	1.00	26.00	7.67	2.30	0.06	1.00	3.00	down
Sulfates	5.28	164.00	15.37	-1.35	0.19	9.00	9.00	up
Chloride	9.00	105.00	17.46	-1.21	0.24	13.00	15.00	up
Total Dissolved Solids	228.00	608.00	269.58	-1.02	0.32	244.00	250.00	up
Conductivity	385.00	491.00	441.96	1.85	0.08	429.00	439.00	down
Nitrate + Nitrite	0.26	1.80	1.27	1.16	0.26	1.13	1.37	down
DO	7.00	12.10	9.60	1.90	0.07	8.30	9.10	down

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 13240								
pH	7.30	8.40	8.09	24.84	0.00	8.00	8.10	down
Ammonia	0.01	0.69	0.06	0.60	0.55	0.02	0.04	none
Chlorophyll-a	1.00	21.40	3.59	-0.94	0.36	1.00	1.00	up
Total Phosphorous	0.00	3.59	0.05	1.12	0.27	0.01	0.01	down
Orthophosphate	0.00	0.09	0.01	4.77	0.00	0.00	0.01	down
Temperature	10.00	31.50	22.02	-0.33	0.74	16.10	23.50	none
Fecal Coliforms	2.00	84.00	17.80	-1.61	0.12	2.00	4.00	up
Sulfates	21.00	812.00	464.25	8.32	0.00	365.00	470.00	down
Chloride	110.00	1360.00	788.97	8.39	0.00	610.00	780.00	down
Total Dissolved Solids	387.00	5940.00	2103.86	6.17	0.00	1574.60	1968.00	down
Conductivity	2417.00	5160.00	3720.13	2.33	0.03	3230.00	3730.00	down
Nitrate + Nitrite	0.04	1.11	0.46	1.97	0.06	0.20	0.44	down
DO	6.30	11.80	8.61	6.18	0.00	7.50	8.40	down
Station 13246								
pH	7.00	8.80	7.96	12.58	0.00	7.90	8.00	down
Ammonia	0.01	0.06	0.04	-8.77	0.00	0.02	0.05	up
Chlorophyll-a	1.00	14.00	5.39	-4.42	0.00	1.07	4.00	up
Total Phosphorous	0.01	0.12	0.04	-5.27	0.00	0.03	0.05	up
Orthophosphate	0.01	0.24	0.04	-5.51	0.00	0.01	0.04	up
Temperature	11.40	30.40	20.67	1.86	0.07	16.80	20.80	down
E. Coli	4.00	517.00	60.96	0.17	0.87	17.00	30.00	none
Fecal Coliforms	3.00	386.00	36.91	-2.43	0.02	14.00	24.00	up
Sulfates	389.00	1304.00	770.82	4.88	0.00	608.00	749.00	down
Chloride	530.00	2385.00	1273.28	4.82	0.00	938.00	1260.00	down
Total Dissolved Solids	10.00	18200.00	3383.93	-0.10	0.92	2470.00	3040.00	none
Conductivity	2700.00	8860.00	5520.44	5.75	0.00	4280.00	5380.00	down
Nitrate + Nitrite	0.02	1.01	0.39	-1.96	0.06	0.17	0.35	up
DO	5.60	10.40	8.36	6.06	0.00	7.70	8.20	down
Station 13249								
Ammonia	0.01	0.13	0.05	-1.78	0.09	0.02	0.03	up
Chlorophyll-a	1.00	24.20	6.03	0.21	0.84	1.00	4.00	none
Total Phosphorous	0.01	0.08	0.05	-0.01	1.00	0.03	0.05	none
Orthophosphate	0.01	0.05	0.01	0.45	0.66	0.01	0.01	none
Temperature	7.60	29.60	19.62	-1.11	0.28	13.30	21.70	none
Fecal Coliforms	2.00	72.00	22.14	-2.78	0.01	10.00	22.00	up
Sulfates	1050.00	3230.00	2324.67	0.14	0.89	1925.00	2450.00	none
Chloride	1880.00	6440.00	4021.25	1.10	0.28	3240.00	3990.00	down
Total Dissolved Solids	4800.00	13600.00	9792.00	0.11	0.91	8700.00	10200.00	none
Conductivity	7120.00	21200.00	14787.31	0.23	0.82	12400.00	15800.00	none
Nitrate + Nitrite	0.09	0.45	0.24	0.76	0.47	0.20	0.23	none
DO	4.70	11.10	7.74	1.56	0.13	6.70	8.00	down

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 13257								
pH	6.90	9.10	8.02	10.89	0.00	7.80	8.00	down
Ammonia	0.01	0.70	0.07	-0.89	0.38	0.02	0.05	none
Chlorophyll-a	1.00	40.90	8.18	-3.93	0.00	1.30	8.31	up
Total Phosphorous	0.01	0.46	0.07	-0.25	0.81	0.04	0.05	none
Orthophosphate	0.01	1.50	0.13	-3.30	0.00	0.01	0.04	up
Temperature	3.60	32.10	18.31	1.68	0.10	12.00	18.50	down
Fecal Coliforms	1.00	97.00	17.22	-2.70	0.01	3.00	7.00	up
Sulfates	19.00	6010.00	3563.96	0.06	0.06	3110.00	3460.00	none
Chloride	2310.00	10600.00	5907.10	-0.32	0.75	4820.00	5880.00	none
Total Dissolved Solids	5860.00	30000.00	14344.31	-0.58	0.56	12000.00	13900.00	none
Conductivity	8700.00	36900.00	20469.59	1.89	0.06	17700.00	20400.00	down
Nitrate + Nitrite	0.01	0.77	0.12	-0.17	0.87	0.02	0.04	none
DO	2.30	14.40	7.75	2.76	0.01	6.10	7.90	down
Station 13260								
pH	7.30	8.70	7.79	12.76	0.00	7.70	7.80	down
Ammonia	0.01	0.15	0.05	-1.68	0.10	0.04	0.05	up
Chlorophyll-a	1.00	46.70	7.47	-0.93	0.35	1.00	2.40	none
Total Phosphorous	0.01	0.16	0.06	1.00	0.32	0.04	0.05	none
Orthophosphate	0.01	1.50	0.15	-2.76	0.01	0.01	0.04	up
Temperature	2.80	30.00	18.37	1.03	0.31	13.00	19.40	none
Fecal Coliforms	1.00	233.00	21.12	-0.58	0.57	3.00	13.00	none
Sulfates	30.00	4510.00	2675.65	1.43	0.16	2370.00	2590.00	down
Chloride	2170.00	9160.00	4524.74	1.39	0.17	3290.00	4280.00	down
Total Dissolved Solids	5740.00	42200.00	11897.41	0.66	0.51	8920.00	10700.00	none
Conductivity	8210.00	32200.00	15947.50	2.78	0.01	12700.00	15600.00	down
Nitrate + Nitrite	0.01	0.65	0.12	0.39	0.70	0.03	0.05	none
DO	2.10	13.40	8.40	1.26	0.21	6.60	9.20	down
Station 13264								
pH	7.03	9.38	8.09	2.56	0.02	7.76	8.04	down
Ammonia	0.02	0.40	0.16	-1.44	0.17	0.02	0.20	up
Chlorophyll-a	3.00	26.10	11.55	1.11	0.29	3.30	10.00	down
Total Phosphorous	0.05	2.40	0.41	-0.43	0.68	0.06	0.06	none
Orthophosphate	0.01	2.40	0.29	-0.19	0.85	0.03	0.04	none
Temperature	5.50	27.30	17.51	0.48	0.64	12.54	15.40	none
E. Coli	1.00	2419.20	352.18	0.10	0.92	3.00	21.10	none
Sulfates	322.00	7100.00	2345.64	0.71	0.49	1774.00	2150.00	none
Chloride	104.00	6670.00	3151.57	1.71	0.11	2120.00	3449.00	down
Total Dissolved Solids	687.00	14200.00	7225.58	0.98	0.35	6103.00	6885.00	none
Conductivity	1000.00	18000.00	10735.87	2.82	0.01	8390.00	12700.00	down
Nitrate + Nitrite	0.02	4.70	0.60	-1.87	0.09	0.04	0.04	up
DO	5.09	13.29	8.45	0.26	0.80	7.70	8.54	none

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 13265								
pH	7.00	8.80	7.85	12.58	0.00	7.70	7.90	down
Ammonia	0.01	0.93	0.10	-0.03	0.98	0.05	0.05	none
Chlorophyll-a	1.00	33.80	9.37	0.69	0.49	1.00	7.00	none
Total Phosphorous	0.01	0.15	0.05	-1.72	0.09	0.04	0.05	up
Orthophosphate	0.01	0.60	0.09	-3.73	0.00	0.01	0.04	up
Temperature	5.70	27.70	17.61	1.57	0.12	10.90	18.20	down
Fecal Coliforms	1.00	330.00	30.77	-0.69	0.49	6.00	18.00	none
Sulfates	1.00	2920.00	2130.66	3.64	0.00	1900.00	2240.00	down
Chloride	2.00	5600.00	2945.95	4.42	0.00	2170.00	2870.00	down
Total Dissolved Solids	4840.00	11700.00	7706.35	0.11	0.91	6480.00	7490.00	none
Conductivity	7390.00	20900.00	11861.30	4.22	0.00	9520.00	11500.00	down
Nitrate + Nitrite	0.01	0.44	0.07	-1.16	0.25	0.04	0.05	up
DO	3.30	12.10	8.52	2.66	0.01	7.20	8.60	down
Station 13267								
pH	7.40	7.40	8.10	7.33	0.00	7.90	8.10	down
Ammonia	0.01	0.78	0.09	-0.07	0.95	0.04	0.05	none
Chlorophyll-a	1.00	57.90	16.66	-1.70	0.10	3.79	14.40	up
Total Phosphorous	0.01	0.07	0.04	-2.73	0.01	0.03	0.05	up
Orthophosphate	0.01	0.48	0.09	-3.49	0.00	0.01	0.04	up
Temperature	7.50	29.60	19.46	0.62	0.54	11.30	22.90	none
E. Coli	1.00	20.00	4.00	1.34	0.22	1.00	1.00	down
Fecal Coliforms	1.00	7.00	1.44	1.04	0.31	1.00	1.00	down
Sulfates	1150.00	2710.00	1983.32	2.38	0.02	1680.00	2040.00	down
Chloride	834	3943	2172.00	1.88	0.07	1735.00	2120.00	down
Total Dissolved Solids	3830.00	9570.00	6320.00	0.62	0.54	5440.00	6090.00	none
Conductivity	5890.00	15000.00	9499.74	3.10	0.00	8010.00	9560.00	down
Nitrate + Nitrite	0.01	0.46	0.13	0.32	0.75	0.02	0.05	none
DO	4.30	14.90	8.02	0.52	0.61	6.40	7.80	none
Station 13269								
pH	7.10	8.60	8.09	6.49	0.00	7.90	8.10	down
Ammonia	0.02	0.33	0.07	-0.95	0.35	0.05	0.05	none
Chlorophyll-a	1.00	95.00	18.15	-2.43	0.02	4.41	10.00	up
Total Phosphorous	0.01	0.22	0.07	0.37	0.71	0.05	0.06	none
Orthophosphate	0.01	0.36	0.07	-2.82	0.01	0.01	0.04	up
Temperature	5.80	30.30	21.13	0.12	0.91	13.70	24.90	none
E. Coli	1.00	30.00	6.25	-1.19	0.28	1.00	2.00	up
Fecal Coliforms	1.00	24.00	6.21	-1.58	0.13	1.00	4.00	up
Sulfates	61.00	2310.00	1512.13	-0.41	0.68	1370.00	1630.00	none
Chloride	63.00	3580.00	1912.03	0.69	0.50	1510.00	1955.00	none
Total Dissolved Solids	322.00	8920.00	5296.61	-0.68	0.50	4660.00	5340.00	none
Conductivity	2460.00	13400.00	8426.76	2.28	0.03	7100.00	8620.00	down
Nitrate + Nitrite	0.01	2.50	0.68	1.31	0.21	0.07	0.28	down
DO	0.20	14.50	8.79	1.63	0.11	7.40	8.80	down

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 13270								
pH	7.40	8.10	7.88	21.64	0.00	7.80	7.90	down
Ammonia	0.01	0.80	0.08	1.98	0.05	0.02	0.05	down
Chlorophyll-a	1.00	8.01	1.36	1.51	0.14	1.00	1.00	down
Total Phosphorous	0.01	0.17	0.04	0.42	0.67	0.01	0.04	none
Orthophosphate	0.01	0.70	0.07	0.52	0.61	0.01	0.06	none
Temperature	17.00	28.50	22.55	4.05	0.00	21.30	22.50	down
E. Coli	31.60	547.00	197.33	-1.63	0.14	58.00	200.00	up
Fecal Coliforms	16.00	2800.00	225.81	0.59	0.56	70.00	135.00	none
Sulfates	3.00	181.00	25.44	-0.08	0.94	18.00	22.00	none
Chloride	5.00	111.00	19.91	-0.59	0.56	15.00	17.00	none
Total Dissolved Solids	202.00	489.00	289.80	1.89	0.07	266.00	280.00	down
Conductivity	443.00	979.00	486.65	0.87	0.39	462.00	480.00	none
Nitrate + Nitrite	0.14	1.94	1.55	0.85	0.40	1.55	1.69	none
DO	7.00	10.00	8.63	5.43	0.00	8.30	8.60	down
Station 13272								
pH	6.92	9.85	8.16	17.44	0.00	7.90	8.14	down
Ammonia	0.01	5.30	0.24	-2.05	0.04	0.05	0.08	up
Chlorophyll-a	1.00	210.00	18.95	-0.51	0.61	8.30	13.90	none
Total Phosphorous	0.03	3.08	0.41	-2.77	0.01	0.20	0.28	up
Orthophosphate	0.01	1.55	0.14	-0.56	0.57	0.05	0.07	none
Temperature	0.00	28.00	16.71	0.39	0.69	11.30	16.87	none
E. Coli	1.00	2420.00	490.00	4.13	0.00	205.00	490.00	down
Fecal Coliforms	1.00	69600.00	1419.48	-0.47	0.64	200.00	480.00	none
Sulfates	1.00	1030.00	298.83	0.18	0.86	197.12	230.00	none
Chloride	1.00	862.00	175.57	-2.92	0.00	96.00	120.00	up
Total Dissolved Solids	21.00	3090.00	968.15	-1.89	0.06	630.00	746.00	up
Conductivity	288.00	8490.00	1593.61	-2.98	0.00	1064.00	1205.00	up
Nitrate + Nitrite	0.04	2.70	0.53	-0.12	0.90	0.26	0.38	none
DO	4.90	15.07	8.27	5.37	0.00	7.01	8.00	down
Station 13276								
pH	7.40	9.70	8.17	9.68	0.00	8.00	8.11	down
Ammonia	0.01	0.51	0.07	0.39	0.70	0.03	0.05	none
Chlorophyll-a	1.00	69.40	12.73	-0.74	0.46	6.87	10.00	none
Total Phosphorous	0.05	4.14	0.31	0.70	0.49	0.13	0.19	none
Orthophosphate	0.01	0.72	0.11	2.45	0.02	0.06	0.06	down
Temperature	2.23	27.00	17.55	1.53	0.13	12.00	18.80	down
E. Coli	27.80	920.80	175.35	1.32	0.20	57.00	110.60	down
Fecal Coliforms	7.00	2419.00	228.57	-2.18	0.03	71.00	114.00	up
Sulfates	1.00	452.00	204.00	0.61	0.54	151.00	175.00	none
Chloride	1.00	204.00	96.80	-0.83	0.41	68.00	77.00	none
Total Dissolved Solids	10.00	1250.00	674.66	0.08	0.93	538.00	616.00	none
Conductivity	240.00	1950.00	1015.17	-0.10	0.92	797.00	868.00	none
Nitrate + Nitrite	0.05	2.13	0.51	-0.47	0.64	0.23	0.35	none
DO	3.08	14.90	8.74	3.39	0.00	7.40	8.50	down

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 13560								
pH	5.70	9.20	8.00	9.35	0.00	7.80	8.02	down
Ammonia	0.01	0.60	0.13	-1.21	0.23	0.04	0.10	up
Chlorophyll-a	1.00	1.00	5.20	-4.84	0.00	1.25	3.30	up
Total Phosphorous	0.01	5.70	0.46	1.88	0.06	0.05	0.07	down
Orthophosphate	0.01	1.10	0.08	-1.22	0.23	0.04	0.06	down
Temperature	1.80	31.00	19.25	0.73	0.46	15.60	19.60	none
E. Coli	10.00	2420.00	609.03	-0.87	0.39	73.00	250.00	none
Fecal Coliforms	1.00	6500.00	407.25	-1.20	0.23	56.00	170.00	up
Sulfates	59.00	342.00	176.57	9.48	0.00	149.00	172.00	down
Chloride	40.00	220.00	117.13	8.65	0.00	100.00	115.00	down
Total Dissolved Solids	431.00	1840.00	625.31	4.15	0.00	544.00	592.00	down
Conductivity	94.00	1312.00	968.13	9.63	0.00	904.00	967.00	down
Nitrate + Nitrite	0.02	28.00	1.04	-1.14	0.26	0.28	0.38	up
DO	2.10	60.20	9.65	-0.06	0.95	7.60	9.25	none
Station 13664								
pH	6.61	8.74	7.90	18.23	0.00	7.80	7.90	down
Ammonia	0.02	0.32	0.06	-0.72	0.47	0.02	0.02	none
Chlorophyll-a	1.00	23.00	2.97	-2.58	0.01	1.00	1.00	up
Total Phosphorous	0.02	0.84	0.16	0.68	0.50	0.06	0.10	none
Orthophosphate	0.03	0.11	0.05	2.37	0.03	0.04	0.04	down
Temperature	10.40	34.50	24.23	1.75	0.08	19.70	25.63	down
Sulfates	114.63	440.00	246.74	10.37	0.00	212.00	245.00	down
Chloride	88.00	324.00	164.32	5.03	0.00	133.00	157.00	down
Total Dissolved Solids	300.00	1690.00	742.41	-0.73	0.47	631.00	691.00	none
Conductivity	597.00	1830.00	1162.37	-0.22	0.83	1030.00	1131.00	none
Nitrate + Nitrite	0.02	26.00	1.40	0.01	1.00	0.09	0.19	none
DO	5.61	12.81	8.76	3.37	0.00	7.49	8.22	down
Station 13835								
pH	6.83	8.50	8.02	3.60	0.00	7.90	8.10	down
Ammonia	0.02	0.20	0.05	0.01	0.99	0.05	0.05	none
Chlorophyll-a	1.00	14.90	1.97	1.50	0.15	1.00	1.00	down
Total Phosphorous	0.05	0.40	0.07	-0.35	0.73	0.05	0.05	none
Orthophosphate	0.04	0.40	0.07	0.35	0.73	0.04	0.06	none
Temperature	14.10	29.10	21.60	2.39	0.02	17.00	22.50	down
E. Coli	1.00	2.00	1.05	2.45	0.03	1.00	1.00	down
Fecal Coliforms	0.00	2.00	1.00	0.55	0.60	1.00	1.00	none
Sulfates	61.00	222.00	165.03	1.13	0.27	144.00	165.00	down
Chloride	46.00	150.00	112.28	1.19	0.24	98.00	113.00	down
Total Dissolved Solids	322.00	644.00	553.90	0.83	0.41	512.00	565.00	none
Conductivity	799.00	1077.00	953.59	2.26	0.03	895.00	965.00	down
Nitrate + Nitrite	0.04	0.68	0.18	1.59	0.13	0.10	0.14	down
DO	0.50	12.40	8.24	1.17	0.25	7.50	8.10	down

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 14465								
pH	7.40	9.75	8.30	0.09	0.93	8.06	8.24	none
Ammonia	0.01	4.38	0.37	3.01	0.00	0.05	0.12	down
Chlorophyll-a	1.00	110.00	15.40	-1.83	0.07	1.00	9.00	up
Total Phosphorous	0.08	2.50	0.72	-0.95	0.35	0.30	0.56	none
Orthophosphate	0.01	1.45	0.34	-1.35	0.18	0.07	0.23	up
Temperature	6.00	29.40	17.51	-2.20	0.03	11.86	16.70	up
E. Coli	4.00	2420.00	561.19	-2.37	0.02	37.00	185.00	up
Fecal Coliforms	1.00	38000.00	1173.43	-3.26	0.00	20.00	130.00	up
Sulfates	82.10	862.00	255.29	1.18	0.24	182.00	211.00	down
Chloride	45.60	443.00	158.44	-0.63	0.53	100.00	126.00	none
Total Dissolved Solids	298.00	2600.00	845.00	-1.04	0.30	619.00	736.00	up
Conductivity	161.00	3320.00	1412.62	-1.47	0.14	1024.00	1248.00	up
Nitrate + Nitrite	0.05	9.31	2.51	-3.30	0.00	0.74	1.78	up
DO	1.90	13.80	8.45	0.06	0.95	7.10	8.55	none
Station 14942								
pH	6.00	9.00	7.82	4.83	0.00	7.60	7.80	down
Ammonia	0.01	0.05	0.05	-3.03	0.01	0.05	0.05	up
Chlorophyll-a	1.00	3.31	1.17	3.01	0.01	1.00	1.00	down
Total Phosphorous	0.01	0.23	0.05	-0.34	0.74	0.05	0.05	none
Orthophosphate	0.01	0.10	0.06	3.03	0.01	0.04	0.06	down
Temperature	17.70	27.60	21.89	1.83	0.08	20.20	21.50	down
E. Coli	0.90	142.00	31.72	-1.01	0.34	10.00	12.00	up
Fecal Coliforms	1.00	30.00	9.00	-0.44	0.66	1.00	5.00	none
Sulfates	2.00	13.00	7.96	0.83	0.42	7.00	8.00	none
Chloride	7.00	17.00	13.69	3.49	0.00	13.00	14.00	down
Total Dissolved Solids	60.00	426.00	264.32	2.12	0.04	242.00	256.00	down
Conductivity	384.00	510.00	449.55	3.89	0.00	434.00	453.00	down
Nitrate + Nitrite	0.98	2.00	1.60	0.85	0.40	1.47	1.62	none
DO	6.30	12.90	9.75	3.42	0.00	8.90	9.50	down
Station 15114								
pH	7.60	8.80	7.86	10.67	0.00	7.80	7.90	down
Ammonia	0.01	0.12	0.05	-3.10	0.00	0.05	0.05	up
Chlorophyll-a	1.00	49.10	9.65	-3.51	0.00	1.00	5.53	up
Total Phosphorous	0.03	0.24	0.06	0.85	0.40	0.05	0.06	none
Orthophosphate	0.01	0.60	0.07	-0.49	0.63	0.04	0.06	none
Temperature	8.40	30.40	20.16	0.82	0.42	15.50	19.00	none
E. Coli	6.00	257.00	78.33	-1.35	0.22	12.00	26.00	up
Fecal Coliforms	4.00	440.00	57.30	-2.01	0.05	18.00	28.00	up
Sulfates	847.00	2750.00	1881.92	1.25	0.22	1230.00	2030.00	down
Chloride	927.00	5230.00	3309.10	1.81	0.08	2320.00	3450.00	down
Total Dissolved Solids	2820.00	12100.00	8220.43	1.65	0.11	6110.00	8750.00	down
Conductivity	4450.00	18400.00	12122.33	1.87	0.07	8660.00	12600.00	down
Nitrate + Nitrite	0.08	0.65	0.36	-1.24	0.22	0.26	0.33	up
DO	4.40	12.30	8.50	1.29	0.20	7.60	8.50	down

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 15274								
pH	7.70	8.70	8.11	5.89	0.00	7.90	8.10	down
Ammonia	0.03	0.29	0.07	-2.39	0.02	0.05	0.05	up
Chlorophyll-a	1.00	10.20	1.62	-0.88	0.39	1.00	1.00	none
Total Phosphorous	0.03	0.25	0.10	-2.95	0.01	0.08	0.08	up
Orthophosphate	0.04	0.70	0.10	1.42	0.17	0.06	0.06	down
Temperature	12.00	30.00	21.72	0.21	0.84	16.70	22.70	none
E. Coli	2.00	490.00	58.53	0.39	0.70	2.00	10.00	none
Fecal Coliforms	1.00	228.00	55.09	0.35	0.74	14.00	41.00	none
Sulfates	86.00	650.00	178.45	2.15	0.04	153.00	169.00	down
Chloride	49.00	461.00	116.59	1.94	0.06	99.00	110.00	down
Total Dissolved Solids	370.00	742.00	569.10	3.09	0.00	536.00	584.00	down
Conductivity	582.00	1134.00	905.54	2.90	0.01	791.00	962.00	down
Nitrate + Nitrite	0.23	1.95	0.53	1.09	0.29	0.37	0.42	down
DO	6.50	13.30	8.87	1.66	0.11	7.40	8.60	down
Station 15340								
pH	6.10	8.49	7.82	4.10	0.00	7.70	7.90	down
Ammonia	0.05	0.05	0.05	0.00	0.00	0.05	0.05	none
Chlorophyll-a	1.00	1.90	1.11	2.28	0.04	1.00	1.00	down
Total Phosphorous	0.01	0.06	0.04	-5.38	0.00	0.05	0.05	up
Orthophosphate	0.04	0.06	0.06	4.75	0.00	0.06	0.06	down
Temperature	11.70	21.80	17.33	0.49	0.63	16.20	16.80	none
E. Coli	1.00	55.00	19.44	-1.60	0.14	4.10	15.00	up
Fecal Coliforms	2.00	21.00	8.22	-3.01	0.01	2.00	5.00	up
Sulfates	146.00	235.00	185.89	2.68	0.02	168.00	187.00	down
Chloride	97.00	163.00	130.00	2.91	0.01	118.00	127.00	down
Total Dissolved Solids	508.00	712.00	605.58	2.78	0.01	568.00	602.00	down
Conductivity	854.00	1772.00	1079.76	2.03	0.06	976.00	1038.00	down
Nitrate + Nitrite	0.09	1.47	0.35	2.25	0.04	0.19	0.24	down
DO	4.60	11.40	8.35	0.85	0.41	6.60	9.40	none
Station 15528								
pH	6.48	9.97	8.31	-2.35	0.02	8.10	8.30	up
Ammonia	0.02	12.30	0.75	1.75	0.08	0.05	0.13	down
Chlorophyll-a	1.00	310.00	18.04	-1.29	0.20	1.00	7.00	up
Total Phosphorous	0.05	2.88	0.75	-0.89	0.38	0.20	0.53	none
Orthophosphate	0.01	2.01	0.31	0.13	0.90	0.06	0.08	none
Temperature	2.81	37.61	16.78	-0.41	0.68	10.20	17.00	none
E. Coli	5.00	2420.00	1013.86	-4.13	0.00	162.00	866.40	up
Fecal Coliforms	1.00	100000.00	2157.30	-0.90	0.37	100.00	310.00	none
Sulfates	91.20	809.00	293.30	-0.02	0.98	192.00	229.00	none
Chloride	50.70	603.00	173.89	-0.72	0.47	101.00	137.05	none
Total Dissolved Solids	206.00	2540.00	939.11	-1.92	0.06	628.00	800.00	up
Conductivity	323.00	5120.00	1585.72	-2.61	0.01	1072.00	1342.00	up
Nitrate + Nitrite	0.08	3.19	0.85	-0.42	0.68	0.30	0.50	none
DO	5.30	17.80	9.74	1.11	0.27	8.31	9.62	down

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 15529								
pH	7.39	9.90	8.32	0.73	0.47	8.10	8.26	none
Ammonia	0.02	13.20	0.43	-3.94	0.00	0.06	0.12	up
Chlorophyll-a	2.00	83.00	18.11	-1.76	0.09	5.00	13.00	up
Total Phosphorous	0.01	3.01	0.96	-0.22	0.83	0.26	0.60	none
Orthophosphate	0.01	2.00	0.25	-2.23	0.03	0.05	0.08	up
Temperature	3.00	27.70	15.70	-1.80	0.07	9.57	16.11	up
E. Coli	5.00	2420.00	950.38	-4.84	0.00	118.00	501.00	up
Fecal Coliforms	1.00	100000.00	2827.55	-0.45	0.65	190.00	570.00	none
Sulfates	83.40	828.00	298.37	0.39	0.70	194.00	220.00	none
Chloride	45.20	561.00	165.98	-0.83	0.41	98.00	117.00	none
Total Dissolved Solids	206.00	2540.00	929.60	-1.56	0.12	620.00	756.00	up
Conductivity	610.00	5110.00	1606.94	-1.92	0.06	1070.00	1284.00	up
Nitrate + Nitrite	0.18	1.50	0.63	2.55	0.05	0.21	0.52	down
DO	5.17	14.40	9.51	2.67	0.01	8.20	9.53	down
Station 15704								
pH	6.80	10.00	8.12	0.08	0.94	7.98	8.16	none
Ammonia	0.01	8.00	1.05	2.49	0.02	0.10	0.23	down
Chlorophyll-a	3.00	70.80	12.73	-1.85	0.07	3.00	12.30	up
Total Phosphorous	0.26	6.42	1.12	-1.07	0.29	0.61	0.88	up
Orthophosphate	0.07	2.08	0.80	0.74	0.47	0.46	0.69	none
Temperature	0.90	29.10	16.06	0.06	0.95	10.62	14.70	none
E. Coli	136.00	2419.20	891.98	0.18	0.86	238.20	480.00	none
Fecal Coliforms	60.00	2000.00	813.29	0.83	0.44	240.00	820.00	none
Sulfates	126.00	530.00	284.97	1.65	0.11	220.00	289.00	down
Chloride	70.00	564.00	268.45	1.86	0.07	201.00	270.00	down
Total Dissolved Solids	520.00	2120.00	1145.87	2.50	0.02	903.00	1164.00	down
Conductivity	750.00	3300.00	1818.95	3.12	0.00	1470.00	1870.00	down
Nitrate + Nitrite	0.02	23.60	2.21	-2.15	0.05	0.04	0.37	up
DO	3.75	15.05	8.69	-0.11	0.91	6.60	8.60	none
Station 15795								
pH	6.64	8.90	8.07	3.23	0.00	7.88	8.10	down
Ammonia	0.03	28.20	1.75	0.12	0.91	0.05	0.12	none
Chlorophyll-a	1.00	384.00	41.10	-2.50	0.02	2.95	18.70	up
Total Phosphorous	0.05	5.60	1.02	-0.04	0.97	0.45	0.76	none
Orthophosphate	0.04	5.83	0.71	-0.88	0.38	0.22	0.45	none
Temperature	4.98	31.16	15.99	0.20	0.84	10.28	15.71	none
E. Coli	12.00	2419.20	946.24	0.71	0.48	193.50	461.10	none
Fecal Coliforms	1.00	79000.00	2579.05	0.18	0.86	57.00	313.00	none
Sulfates	1.00	1190.00	351.25	2.39	0.02	254.00	356.00	down
Chloride	1.00	1440.00	322.44	1.01	0.32	191.00	283.00	down
Total Dissolved Solids	5.00	4400.00	1294.47	1.14	0.26	992.00	1250.00	down
Conductivity	880.00	6840.00	2207.13	0.13	0.90	1650.00	2094.00	none
Nitrate + Nitrite	0.04	6.27	1.49	0.29	0.77	0.10	0.89	none
DO	0.90	16.90	8.03	0.75	0.45	6.24	8.20	none

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 15808								
pH	6.73	8.30	7.90	8.60	0.00	7.77	7.97	down
Ammonia	0.02	0.71	0.11	2.18	0.03	0.05	0.07	down
Chlorophyll-a	1.00	32.70	4.36	-0.70	0.48	1.00	3.00	none
Total Phosphorous	0.02	10.60	0.45	3.05	0.00	0.06	0.10	down
Orthophosphate	0.01	0.20	0.07	2.29	0.03	0.05	0.06	down
Temperature	11.62	32.10	24.81	0.73	0.47	21.22	25.56	none
E. Coli	2.00	2419.20	234.96	1.73	0.09	25.00	68.00	down
Fecal Coliforms	1.00	19000.00	797.56	-1.91	0.06	50.00	200.00	up
Sulfates	117.00	383.00	212.53	1.63	0.11	183.00	217.00	down
Chloride	76.00	309.00	150.34	2.44	0.02	126.00	149.00	down
Total Dissolved Solids	288.00	1720.00	721.07	1.69	0.09	636.00	709.00	down
Conductivity	130.00	1890.00	1152.05	1.57	0.12	1024.00	1150.00	down
Nitrate + Nitrite	0.02	10.50	10.50	0.06	0.06	0.07	0.15	none
DO	2.83	13.48	8.15	3.45	0.00	6.90	8.10	down
Station 15813								
E. Coli	1.00	113.00	17.10	0.52	0.61	3.00	6.00	none
Fecal Coliforms	1.00	9000.00	242.68	0.91	0.37	10.00	20.00	none
Station 15814								
pH	7.73	8.50	8.09	4.80	0.00	7.90	8.10	down
Ammonia	0.02	0.46	0.10	-0.90	0.38	0.02	0.05	none
Chlorophyll-a	0.10	10.00	2.94	-0.51	0.61	1.00	3.00	none
Total Phosphorous	0.01	1.96	0.19	-1.63	0.12	0.06	0.12	up
Orthophosphate	0.01	0.12	0.06	-0.89	0.39	0.04	0.06	none
Temperature	15.47	31.25	25.77	0.70	0.49	24.26	27.80	none
E. Coli	23.90	2419.00	777.43	-2.86	0.01	205.10	689.30	up
Fecal Coliforms	20.00	43000.00	1597.14	-0.66	0.51	300.00	680.00	none
Sulfates	89.00	217.00	162.57	1.97	0.06	123.00	168.00	down
Chloride	55.00	141.00	104.60	2.40	0.02	83.00	107.00	down
Total Dissolved Solids	338.00	886.00	565.54	1.10	0.28	476.00	583.00	down
Conductivity	631.00	1220.00	894.59	2.66	0.01	768.00	872.00	down
Nitrate + Nitrite	0.02	8.80	1.10	-2.25	0.03	0.05	0.27	up
DO	7.10	11.41	8.94	1.47	0.15	8.10	8.71	down
Station 15815								
E. Coli	14.50	2419.00	700.89	-2.96	0.00	177.90	370.00	up
Fecal Coliforms	70.00	36000.00	1687.89	-0.87	0.39	280.00	510.00	none
Station 15816								
E. Coli	8.40	2419.00	594.08	-3.60	0.00	103.10	365.40	up
Fecal Coliforms	30.00	45000.00	2203.63	-0.57	0.57	220.00	400.00	none

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 15817								
pH	7.38	8.80	8.04	5.97	0.00	7.80	8.00	down
Ammonia	0.02	0.54	0.13	-1.31	0.19	0.05	0.10	up
Chlorophyll-a	1.00	28.20	4.13	0.38	0.70	3.00	3.00	none
Total Phosphorous	0.06	8.41	0.47	2.08	0.04	0.21	0.25	down
Orthophosphate	0.01	0.48	0.17	-2.08	0.04	0.06	0.16	up
Temperature	9.90	33.90	24.16	-0.37	0.71	19.75	25.05	none
E. Coli	1.00	2419.17	200.19	-0.77	0.44	10.80	27.80	none
Fecal Coliforms	1.00	2000.00	373.90	2.40	0.02	30.00	180.00	down
Sulfates	74.00	304.00	179.89	3.40	0.00	149.00	193.00	down
Chloride	48.00	162.00	113.81	4.48	0.00	93.00	120.00	down
Total Dissolved Solids	381.00	874.00	598.53	4.47	0.00	551.00	621.00	down
Conductivity	337.00	1380.00	950.53	6.70	0.00	836.00	992.00	down
Nitrate + Nitrite	0.04	26.00	1.42	-1.57	0.12	0.57	0.81	up
DO	4.90	14.53	8.81	0.82	0.41	7.80	8.68	none
Station 15818								
pH	7.40	8.30	7.89	3.06	0.01	7.64	7.90	down
Ammonia	0.02	0.40	0.12	-0.02	0.98	0.06	0.10	none
Chlorophyll-a	1.00	8.50	3.59	-1.69	0.11	3.00	3.00	up
Total Phosphorous	0.11	2.23	0.45	-1.26	0.22	0.21	0.27	up
Orthophosphate	0.04	0.35	0.15	-0.65	0.54	0.06	0.14	none
Temperature	19.60	31.60	26.48	-0.23	0.82	22.20	27.84	none
E. Coli	11.90	690.00	168.18	-1.38	0.20	28.60	55.00	up
Fecal Coliforms	1.00	2287.00	503.35	1.32	0.21	60.00	150.00	down
Sulfates	93.00	235.00	175.05	1.28	0.22	132.00	165.00	down
Chloride	75.00	153.00	115.34	1.62	0.12	93.00	108.00	down
Total Dissolved Solids	332.00	844.00	605.05	1.71	0.11	504.00	604.00	down
Conductivity	651.00	1240.00	976.53	2.14	0.05	854.00	952.00	down
Nitrate + Nitrite	0.04	6.07	1.25	-1.78	0.10	0.36	0.68	up
DO	4.10	11.40	7.94	1.46	0.16	6.90	7.63	down
Station 15820								
pH	7.00	8.05	7.47	6.18	0.00	7.30	7.50	down
Ammonia	0.02	0.05	0.04	-2.15	0.05	0.02	0.05	up
Chlorophyll-a	3.00	3.30	3.09	3.74	0.00	3.00	3.00	down
Total Phosphorous	0.05	0.06	0.05	-5.07	0.00	0.05	0.05	up
Orthophosphate	0.04	0.06	0.06	7.29	0.00	0.06	0.06	down
Temperature	7.80	28.90	22.69	-0.91	0.37	20.63	23.70	none
E. Coli	0.90	290.00	89.06	-1.95	0.08	26.60	44.30	up
Sulfates	8.00	32.00	15.74	-7.53	0.00	9.00	10.00	up
Chloride	10.00	31.00	16.00	-7.09	0.00	11.00	12.00	up
Total Dissolved Solids	230.00	14700.00	1040.84	0.79	0.44	260.00	292.00	none
Conductivity	393.00	573.00	493.67	-5.37	0.00	451.00	510.00	up
Nitrate + Nitrite	1.32	1.90	1.64	0.49	0.63	1.58	1.64	none
DO	5.80	11.33	8.22	-0.30	0.77	7.30	7.90	none

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 15821								
pH	6.80	7.60	7.36	1.20	0.26	7.30	7.40	down
Ammonia	0.02	0.55	0.08	-1.52	0.16	0.05	0.05	up
Chlorophyll-a	3.00	3.30	3.06	4.92	0.00	3.00	3.00	down
Total Phosphorous	0.05	0.06	0.05	-3.82	0.00	0.05	0.05	up
Orthophosphate	0.04	0.06	0.05	4.84	0.00	0.04	0.06	down
Temperature	12.70	25.40	22.61	-0.37	0.72	22.10	23.30	none
E. Coli	0.90	648.00	131.92	-1.90	0.10	22.60	31.80	up
Sulfates	9.00	23.00	13.54	2.20	0.05	11.00	12.00	down
Chloride	10.00	19.00	13.08	2.85	0.02	12.00	12.00	down
Total Dissolved Solids	222.00	282.00	259.38	0.31	0.77	254.00	260.00	none
Conductivity	433.00	517.00	466.08	2.07	0.06	449.00	464.00	down
Nitrate + Nitrite	1.50	1.87	1.69	5.02	0.00	1.56	1.70	down
DO	5.50	8.90	7.88	-1.09	0.30	7.30	8.20	up
Station 15839								
pH	7.70	8.50	8.11	3.93	0.00	8.00	8.09	down
Ammonia	0.01	0.26	0.05	-0.97	0.34	0.02	0.05	none
Chlorophyll-a	1.00	5.00	2.70	-1.54	0.14	1.96	3.00	up
Total Phosphorous	0.03	0.52	0.12	-1.54	0.14	0.07	0.08	up
Orthophosphate	0.01	0.80	0.10	-1.55	0.14	0.04	0.06	up
Temperature	15.60	38.87	25.07	-1.16	0.26	21.00	25.52	up
E. Coli	1.00	866.00	28.73	0.25	0.80	5.00	9.70	none
Fecal Coliforms	1.00	650.00	72.78	-0.74	0.46	10.00	30.00	none
Sulfates	75.00	214.00	157.83	4.04	0.00	115.00	163.00	down
Chloride	49.00	145.00	107.80	3.77	0.00	82.00	116.00	down
Total Dissolved Solids	370.00	912.00	599.21	1.71	0.10	542.00	596.00	down
Conductivity	627.00	1210.00	915.50	4.13	0.00	762.00	876.00	down
Nitrate + Nitrite	0.04	6.80	0.67	-1.46	0.16	0.11	0.19	up
DO	7.20	11.00	8.76	1.87	0.07	7.90	8.40	down
Station 15892								
pH	7.20	8.60	8.05	21.75	0.00	7.90	8.10	down
Ammonia	0.04	0.06	0.05	1.31	0.20	0.05	0.05	down
Chlorophyll-a	1.00	3.91	2.62	-2.80	0.01	2.31	3.00	up
Total Phosphorous	0.01	0.06	0.05	-7.51	0.00	0.05	0.05	up
Orthophosphate	0.01	0.06	0.05	2.93	0.01	0.04	0.06	down
Temperature	12.20	30.10	22.34	2.46	0.01	17.30	23.60	down
E. Coli	1.00	5.20	1.52	-0.71	0.49	1.00	1.00	none
Fecal Coliforms	0.00	3.00	1.50	-0.30	0.77	1.00	2.00	none
Sulfates	155.00	260.00	205.81	4.78	0.00	187.00	204.00	down
Chloride	87.00	178.00	131.70	3.77	0.00	114.00	135.00	down
Total Dissolved Solids	524.00	1940.00	687.75	2.65	0.01	602.00	652.00	down
Conductivity	749.00	1730.00	1115.61	12.74	0.00	1056.00	1104.00	down
Nitrate + Nitrite	0.04	1.34	0.31	2.59	0.02	0.19	0.26	down
DO	0.30	13.70	7.62	4.89	0.00	6.77	7.80	down

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 15893								
pH	6.80	8.40	7.91	14.28	0.00	7.70	8.00	down
Ammonia	0.05	0.10	0.06	1.27	0.21	0.05	0.05	down
Chlorophyll-a	1.00	10.00	7.68	-4.70	0.00	5.19	10.00	up
Total Phosphorous	0.01	0.06	0.05	-6.45	0.00	0.05	0.05	up
Orthophosphate	0.01	0.08	0.06	2.10	0.05	0.06	0.06	down
Temperature	12.10	30.90	22.16	1.96	0.05	17.10	22.60	down
E. Coli	1.00	64.00	6.81	-0.66	0.52	1.00	1.00	none
Fecal Coliforms	0.00	15.00	2.91	-1.47	0.17	2.00	2.00	up
Sulfates	20.00	124.00	67.05	0.41	0.69	43.00	73.00	none
Chloride	16.00	185.00	53.41	1.32	0.20	33.00	54.00	down
Total Dissolved Solids	208.00	493.00	347.81	1.12	0.27	280.00	364.00	down
Conductivity	166.00	1109.00	648.01	1.51	0.13	498.00	641.00	down
Nitrate + Nitrite	0.05	1.26	0.57	1.90	0.07	0.35	0.54	down
DO	0.20	12.80	7.04	2.56	0.01	6.20	7.60	down
Station 16272								
pH	7.30	8.90	8.07	0.95	0.35	7.77	8.00	none
Ammonia	0.02	2.82	0.39	-0.36	0.72	0.08	0.29	none
Chlorophyll-a	3.00	34.60	8.90	-0.05	0.96	3.00	3.00	none
Total Phosphorous	0.06	4.00	0.69	-1.78	0.08	0.34	0.47	up
Orthophosphate	0.04	3.78	0.58	-1.98	0.06	0.24	0.39	up
Temperature	5.80	31.49	16.81	1.00	0.33	12.60	16.66	ND
E. Coli	48.00	980.40	425.63	-0.22	0.82	178.20	299.00	none
Fecal Coliforms	36.00	410.00	212.80	-0.05	0.96	48.00	171.00	none
Sulfates	5.00	502.00	283.00	2.64	0.01	244.00	276.00	down
Chloride	5.00	438.00	270.79	2.74	0.01	218.00	289.00	down
Total Dissolved Solids	10.00	1760.00	1121.00	3.07	0.00	1010.00	1180.00	down
Conductivity	903.00	2760.00	1805.89	3.10	0.00	1530.00	1900.00	down
Nitrate + Nitrite	0.04	7.45	1.21	-1.53	0.14	0.06	0.22	none
DO	2.00	12.62	8.41	0.73	0.47	7.04	8.20	none
Station 16288								
pH	6.40	10.20	7.99	0.23	0.82	7.70	7.99	none
Ammonia	0.02	0.57	0.16	0.61	0.55	0.05	0.11	none
Chlorophyll-a	5.00	111.00	32.10	1.03	0.32	10.00	18.00	down
Total Phosphorous	0.24	1.88	0.54	0.29	0.78	0.32	0.43	none
Orthophosphate	0.08	0.38	0.25	0.00	1.00	0.20	0.24	none
Temperature	18.80	32.70	26.85	-0.57	0.58	24.90	26.40	none
E. Coli	80.00	920.00	449.40	-1.00	0.35	109.00	465.00	ND
Sulfates	48.50	295.00	219.90	-0.12	0.90	180.00	243.00	none
Chloride	112.00	794.00	221.00	-0.05	0.96	154.00	154.00	none
Total Dissolved Solids	572.00	1770.00	861.93	-0.29	0.78	748.00	823.00	none
Conductivity	930.00	11400.00	1922.13	0.91	0.38	1000.00	1270.00	down
Nitrate + Nitrite	0.02	13.90	2.05	-1.83	0.11	0.31	0.68	up
DO	5.50	10.75	8.36	0.28	0.78	6.90	8.00	none

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 16379								
pH	6.39	8.60	7.96	3.11	0.01	7.80	8.10	down
Chlorophyll-a	3.00	19.20	4.98	-0.76	0.46	3.00	3.00	none
Total Phosphorous	0.05	0.35	0.09	1.58	0.14	0.06	0.06	up
Orthophosphate	0.04	0.30	0.08	1.79	0.10	0.06	0.06	up
Temperature	11.20	33.00	21.58	0.96	0.35	15.00	21.60	none
E. Coli	1.00	30.10	9.19	2.29	0.05	1.00	4.50	down
Fecal Coliforms	1.00	92.00	46.38	0.02	0.98	8.50	48.00	none
Sulfates	192.00	484.00	325.44	1.73	0.11	249.00	332.50	down
Chloride	84.00	789.00	476.25	3.13	0.01	336.00	450.00	down
Total Dissolved Solids	668.00	2190.00	1396.50	2.77	0.02	1150.00	1400.00	down
Conductivity	987.00	3561.00	2352.24	2.38	0.03	2070.00	2257.00	down
Nitrate + Nitrite	0.07	0.98	0.40	-1.62	0.14	0.15	0.36	up
DO	5.60	13.90	9.03	1.89	0.08	7.60	8.60	down
Station 16730								
pH	7.40	8.89	7.83	3.26	0.00	7.67	7.80	down
Ammonia	0.01	0.94	0.11	1.47	0.15	0.02	0.02	down
Chlorophyll-a	3.00	117.00	14.54	-0.70	0.49	3.00	10.00	none
Total Phosphorous	0.02	18.30	1.14	0.03	0.98	0.08	0.15	none
Orthophosphate	0.01	4.14	0.29	-0.86	0.40	0.04	0.04	none
Temperature	11.22	33.11	21.36	-0.08	0.93	17.30	22.80	none
E. Coli	3.00	721.50	64.99	0.46	0.65	18.00	24.00	none
Fecal Coliforms	1.00	455.00	99.93	-0.20	0.84	5.00	42.50	none
Sulfates	30.00	818.00	524.71	-0.58	0.57	465.00	556.50	none
Chloride	7.00	620.00	247.72	0.61	0.54	104.00	220.00	none
Total Dissolved Solids	200.00	2096.00	1342.04	0.19	0.85	985.50	1411.50	none
Conductivity	663.00	2900.00	2085.93	1.33	0.19	1640.00	2202.00	down
Nitrate + Nitrite	0.02	9.30	0.57	-0.55	0.58	0.04	0.06	none
DO	2.40	12.46	7.68	2.39	0.02	6.40	7.60	down
Station 17000								
pH	7.00	8.00	7.48	3.52	0.00	7.20	7.50	down
Temperature	5.50	28.00	17.94	-0.85	0.40	12.00	16.50	none
E. Coli	27.00	2419.20	639.02	0.04	0.97	60.00	178.20	none
Fecal Coliforms	40.00	4950.00	1351.04	2.53	0.01	275.00	900.00	down
Conductivity	1119.00	3880.00	2825.51	2.16	0.04	2420.00	2900.00	down
DO	5.90	11.40	7.84	1.27	0.21	6.90	7.60	down
Station 17001								
Temperature	5.50	28.00	17.85	-1.09	0.28	11.25	16.75	up
E. Coli	10.70	2419.20	279.92	-1.52	0.14	22.30	76.10	up
Fecal Coliforms	13.00	2225.00	208.59	-1.06	0.30	60.00	113.00	up
Conductivity	1020.00	3910.00	2836.71	2.08	0.04	2465.00	2887.50	down
DO	5.10	11.30	7.77	1.12	0.27	6.90	7.80	down

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 17247								
pH	7.10	8.30	7.69	2.33	0.03	7.50	7.60	down
Ammonia	0.09	1.64	0.48	-2.90	0.01	0.22	0.30	up
Chlorophyll-a	10.00	43.20	13.11	-1.30	0.21	10.00	10.00	up
Total Phosphorous	0.16	0.58	0.29	-0.84	0.41	0.22	0.26	none
Orthophosphate	0.07	9.96	0.67	-1.13	0.27	0.14	0.20	up
Temperature	11.50	31.60	24.15	1.41	0.17	22.10	24.30	down
E. Coli	4.00	420.00	66.10	0.43	0.67	14.50	34.00	none
Sulfates	151.00	358.00	217.09	-0.92	0.37	187.00	208.50	none
Chloride	102.00	269.00	158.45	-0.74	0.47	137.00	146.00	none
Total Dissolved Solids	560.00	1100.00	732.55	-1.37	0.19	632.00	696.00	up
Conductivity	700.00	6010.00	1425.74	1.66	0.11	1082.00	1120.00	down
Nitrate + Nitrite	0.27	0.83	0.50	1.24	0.24	0.42	0.46	down
DO	3.80	13.20	6.70	0.39	0.70	4.55	6.30	none
Station 17410								
pH	7.90	8.50	8.14	4.21	0.00	8.00	8.14	down
Ammonia	0.02	0.40	0.08	-0.29	0.77	0.02	0.04	none
Chlorophyll-a	1.00	10.00	4.36	-0.62	0.54	3.00	3.30	none
Total Phosphorous	0.05	0.64	0.14	-1.85	0.08	0.08	0.10	up
Orthophosphate	0.03	0.09	0.06	1.73	0.11	0.05	0.06	down
Temperature	16.00	31.00	25.08	0.37	0.72	22.55	27.20	none
E. Coli	3.00	72.00	18.53	-0.27	0.79	7.35	12.15	none
Fecal Coliforms	20.00	520.00	112.75	0.61	0.55	26.50	64.50	none
Sulfates	81.00	215.00	162.22	1.52	0.14	107.00	170.00	down
Chloride	52.00	134.00	105.65	2.19	0.04	85.00	121.00	down
Total Dissolved Solids	383.00	688.00	576.83	2.02	0.06	537.00	590.00	down
Conductivity	629.00	1240.00	867.74	0.82	0.43	748.50	828.00	none
Nitrate + Nitrite	0.04	6.80	1.03	-1.75	0.10	0.15	0.24	up
DO	6.00	11.30	8.91	1.37	0.19	7.75	8.99	down
Station 17596								
pH	7.80	8.66	8.23	4.68	0.00	8.05	8.22	down
Ammonia	0.02	0.30	0.06	0.47	0.64	0.02	0.02	none
Chlorophyll-a	1.00	10.00	5.99	2.83	0.01	3.00	5.00	down
Total Phosphorous	0.05	96.00	5.58	-0.15	0.88	0.06	0.12	none
Orthophosphate	0.01	0.70	0.11	-1.47	0.17	0.04	0.04	up
Temperature	12.00	30.90	21.80	0.60	0.56	16.40	22.50	none
E. Coli	3.10	2419.00	133.88	0.93	0.37	6.65	10.90	none
Fecal Coliforms	1.00	210.00	34.89	-1.77	0.09	17.50	20.00	up
Sulfates	39.90	349.00	156.66	0.81	0.43	101.00	158.00	none
Chloride	36.90	168.00	95.87	0.62	0.54	64.80	109.00	none
Total Dissolved Solids	10.00	652.00	511.56	-0.83	0.42	485.00	545.00	none
Conductivity	480.00	1060.00	884.40	1.32	0.20	820.00	940.00	down
Nitrate + Nitrite	0.04	25.00	2.02	-0.30	0.77	0.07	0.34	none
DO	5.80	10.20	7.29	1.37	0.19	6.45	6.70	down

Station Number	Min	Max	Mean	T ratio	P value	25th	50th	Trend
Station 18792								
pH	7.00	8.60	8.08	13.33	0.00	8.00	8.10	down
Ammonia	0.01	0.84	0.13	-3.07	0.00	0.05	0.09	up
Chlorophyll-a	1.00	10.00	4.38	-7.66	0.00	1.00	2.40	up
Total Phosphorous	0.01	0.25	0.09	-6.51	0.00	0.05	0.08	up
Orthophosphate	0.01	0.70	0.07	-1.71	0.09	0.03	0.06	up
Temperature	11.50	30.10	21.22	0.93	0.35	16.40	21.80	none
E. Coli	1.00	4600.00	547.22	-0.55	0.59	14.90	81.50	none
Fecal Coliforms	2.00	2000.00	230.48	-0.50	0.62	54.00	108.00	none
Sulfates	29.00	291.00	185.06	5.91	0.00	164.00	186.00	down
Chloride	28.00	200.00	118.59	5.42	0.00	102.00	116.00	down
Total Dissolved Solids	260.00	880.00	621.15	7.61	0.00	572.00	608.00	down
Conductivity	466.00	1400.00	993.46	6.37	0.00	937.00	990.00	down
Nitrate + Nitrite	0.11	1.30	0.46	0.58	0.56	0.31	0.44	none
DO	6.50	15.80	9.22	2.48	0.02	7.70	8.64	down
Station 18795								
pH	6.96	8.60	7.86	-0.90	0.37	7.57	7.92	none
Ammonia	0.02	0.40	0.14	0.00	1.00	0.02	0.10	none
Chlorophyll-a	3.00	12.20	6.23	1.89	0.07	3.30	5.00	down
Total Phosphorous	0.06	3.00	0.25	-0.43	0.67	0.12	0.15	none
Orthophosphate	0.04	2.90	0.21	-1.09	0.28	0.07	0.11	up
Temperature	9.90	29.80	21.53	-0.70	0.49	16.40	21.45	none
E. Coli	1.00	2419.70	1216.70	-1.16	0.25	270.50	1011.10	up
Fecal Coliforms	4.00	6500.00	1701.18	-1.68	0.10	330.00	817.00	up
Sulfates	22.00	507.00	159.85	0.00	1.00	132.00	156.00	none
Chloride	31.00	164.00	98.45	1.31	0.20	85.00	107.00	down
Total Dissolved Solids	337.00	1500.00	569.05	-0.53	0.60	511.00	571.00	none
Conductivity	570.00	1216.00	900.04	2.69	0.01	802.00	921.50	down
Nitrate + Nitrite	0.02	32.00	2.16	-0.53	0.60	0.25	0.40	none
DO	4.07	15.40	7.69	2.47	0.02	6.10	7.40	down