Arroyo Colorado Data Report

August 2011

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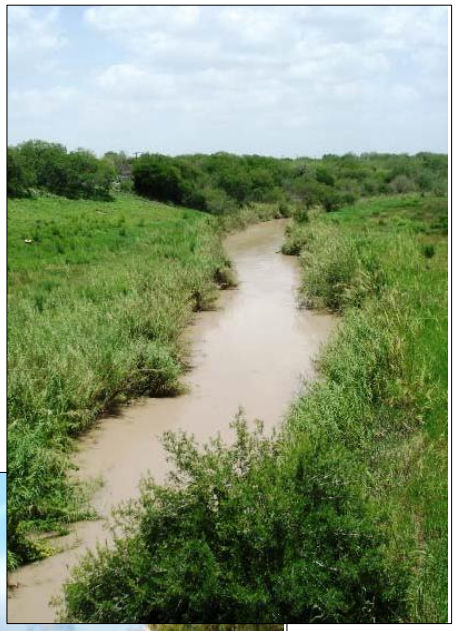
Water Body Introduction: The Arroyo Colorado is designated TCEQ stream Segment 2202 above tidal and Segment 2201 in the tidal portion. The water body has been largely modified as an engineered canal system for irrigation and flood control purposes since the early 1900s. These drastic changes to the watershed have allowed the Lower Rio Grande Valley to become an intensely agricultural region while removing much of the wildlife and plant diversity. The watershed is approximately 706 square miles and is bounded by drainage divides on all three inland sides. The water body flows nearly 90 miles from its headwaters southwest of the City of Mission to its confluence with the Lower Laguna Madre. Water flow in the Arroyo Colorado is sustained by wastewater discharges, agricultural irrigation return flows, urban runoff and base flows from shallow groundwater. The Arroyo Colorado is the primary source of fresh water inflows to the Lower Laguna Madre.



Photos courtesy of Laura De La Garza and the Arroyo Colorado Watershed Partnership

Segment 2202 of the Arroyo Colorado has been listed on the Texas Commission on Environmental Quality's (TCEQ) 303(d) List of Impaired Water Bodies for bacteria since 1996 and for mercury and PCBs (polychlorinated biphenyls) in edible fish tissue since 2008. The 2201 tidal portion has been listed for depressed dissolved oxygen since 1996, bacteria since 2006, and mercury and PCBs in edible fish tissue since 2008. In 2002, the TCEQ determined in a Total Maximum Daily Load study that a 90 percent reduction of nutrients and biochemical oxygen demand was needed to achieve healthy waters. The Arroyo Colorado Watershed Partnership was established to help restore the watershed and in 2007 the partnership published the Arroyo Colorado Watershed Protection Plan that identified and addressed impairments and concerns in the watershed. The Texas Water Resources Institute is currently coordinating six projects directed toward implementing the watershed protection plan (WPP) and restoring the Arroyo Colorado. For more information, visit the website at www.arroyocolorado.org.

The land uses in the watershed are dominated by intense agriculture and include the large urban areas of McAllen and Harlingen. The water body is used as a wastewater conveyance for most of its course and the lower section serves commercial barge traffic and recreational boating and fishing. Near the coast, it also is used as a nursery and foraging area for several species of fish, shrimp, and crab. Field observations reveal that there is an abundance of wildlife diversity in the basin including butterflies, dragonflies, turtles, red wing blackbirds, grackles, egret, kingfishers, as well as a host of other birds.

Photos courtesy of Laura De La Garza and the Arroyo Colorado Watershed Partnership

This report provides a summary of data taken at three sites along the Arroyo Colorado, for a total of 153 samples from June 2007 to March 2011 (see map on page six). These sites were chosen because they have a long and relatively complete data set and provide an overall geographic coverage of the Arroyo over both designated segments. For information on other monitoring sites in the Arroyo Colorado Watershed, please refer to the Texas Stream Team Volunteer Water Quality Monitoring Program 2009 Arroyo Colorado Data Summary, available at http://txstreamteam.rivers.txstate.edu/Data/Data-Reports.html.

Texas Stream Team: Texas Stream Team is a volunteer based water quality monitoring program. In alignment with Texas Stream Team's core mission, monitors collect surface water quality data that may be used in decision-making processes to promote and protect a healthy and safe environment for people and aquatic inhabitants. Citizen monitoring occurs at set monitoring sites roughly the same time of day once a month. Citizen monitoring data provides a valuable resource of information supplementing professional data collection efforts where resources are limited. The data may be used by professionals to identify water quality trends, target additional data collection, identify pollution events, identify sources and causes of pollution, and show effectiveness of management measures towards improving water quality.

Texas Stream Team volunteer data, however, is not used by the state to assess whether water bodies are meeting the designated surface water quality standards. The primary reason for this is that Texas Stream Team volunteers use different methods than the professional water quality monitoring community. Different methods are utilized by Texas Stream Team due to higher equipment costs, training requirements, and stringent laboratory procedures that are required of the professional community. The Texas Stream Team methods have been chosen because of relative ease of performing the methods in the field, while providing reliable results at low costs. As a result, Texas Stream Team data does not have the same accuracy or precision as professional data and is therefore not directly comparable. However, Texas Stream Team data are valuable records often collected in portions of water body that professionals are not able to monitor or monitor as frequently. This long-term data set is available to and may be considered by the surface water quality professional community to facilitate

management and protection of Texas' water resources. For additional information about water quality monitoring methods and procedures, see:

- Texas Stream Volunteer Water Quality Monitoring Manual
- Texas Commission on Environmental Quality (TCEQ) Surface Water Quality Monitoring Procedures for professional monitors

Information collected by Texas Stream Team volunteers is covered under a TCEQ approved quality assurance project plan (QAPP) to ensure a standard set of methods of known quality are used. All data used in data reports are screened by the Texas Stream Team for completeness, precision and accuracy where applicable, and scrutinized with data quality objective and data validation techniques.

The purpose of this report is to provide analysis of data collected by Texas Stream Team volunteers. The data presented in this report should be considered in conjunction with other relevant water quality reports prepared by the following programs in order to provide a holistic view of water quality in this water body:

- Texas Surface Water Quality Standards;
- Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)(or Texas Integrated Report; formerly the Texas Water Quality Inventory and 303(d) List);
- Texas Clean Rivers Program partners' reports such as Basin Summary Reports and Highlight Reports;
- TCEQ surface water quality special studies;
- TCEQ Total Maximum Daily Load reports;
- TCEQ and Texas State Soil and Water Conservation Board Nonpoint Source Program funded reports, including Watershed Protection Plans.

Questions about this report should be directed to the Texas Stream Team at (512) 245-1346.

Water Quality Parameters

The following paragraphs under this section provide general information about types of data collected by Texas Stream Team volunteers, along with the importance of these parameters for aquatic and human health.

Water Temperature

Water temperature, one of the simplest water quality measurements, is one of the most important to the health of an aquatic ecosystem (*A Guide to Freshwater Ecology*, TCEQ GI-034, August 2005). Water temperature influences physiological processes of aquatic organisms, and each species has optimum temperatures for survival. High water temperatures increase oxygen-demand for aquatic communities and can become stressful for fish and aquatic insects. Water temperature variations are most detrimental when they occur rapidly, leaving the aquatic community no time to adjust. Additionally, the ability of water to hold oxygen in solution (solubility) decreases as temperature increases.

Natural sources of warm water are seasonal as water temperatures tend to increase during summer and decrease in winter. Daily (diurnal) water temperature changes occur during normal heating and cooling patterns. Man-made sources of warm water include power plant effluent after it has been used for cooling or hydroelectric plants which release warmer water. Citizen monitoring may not identify fluctuating patterns due to diurnal changes or events such as power plant releases. While citizen data does not show diurnal temperature fluctuations, it may demonstrate the fluctuations over seasons and years.

Dissolved Oxygen

Oxygen is necessary for the survival of organisms like fish and aquatic insects. The amount of oxygen needed for survival and reproduction of aquatic communities varies according to species composition and adaptations to watershed characteristics like stream gradient, habitat, and available stream flow. The TCEQ Water Quality Standards list daily minimum dissolved oxygen criteria for specific water bodies, and presume criteria according to flow status (perennial, intermittent with perennial pools, and intermittent), aquatic life attributes, and habitat. These criteria are protective of aquatic life and can be used for general comparison purposes.

Dissolved oxygen concentrations can be influenced by other water quality parameters such as nutrients and temperature. High concentrations of nutrients can lead to excessive surface vegetation growth, which may starve subsurface vegetation of sunlight and limit the amount of dissolved oxygen in water produced as a product of photosynthesis. This process, known as eutrophication, is enhanced when the subsurface vegetation dies and is decomposed by oxygen-consuming bacteria.

Conductivity

Conductivity is measured to determine the amount of dissolved solids in the water. Conductivity is a measure of the ability of water to conduct electricity. The more dissolved solids a body of water has, such as inorganic salts (Ex. magnesium, calcium, chloride, and sulfate), the more electricity it conducts, or the more conductive it is. Conductivity is measured in microSiemens per centimeter (µS/cm). To determine total dissolved solids (TDS) in water, the Texas Surface Water Quality Monitoring Procedures call for a conversion of specific conductance by 65%. Sources of TDS can include agricultural runoff, domestic runoff, discharges from wastewater treatment plants, groundwater inflows, or naturally saline conditions resulting from the local geology and arid climate.

High concentrations of salt can inhibit water absorption and limit root growth for vegetation, lead to an abundance of more drought tolerant plants, and cause dehydration of fish and amphibians.

pH

pH is a measure of acidity or alkalinity. The scale measures the concentration of hydrogen ions on a range of 0 to 14 and is reported in standard units (su). The range is logarithmic; every 1 unit change means the acidity increased or decreased 10-fold. A pH of 7.0 is considered neutral. Values less than 7.0 are considered acidic; those greater than 7.0 are alkaline (basic).

The local geology in a watershed determines the general pH of water bodies. Underlying rock such as limestone dissolves and weathers easily, releasing minerals that buffer the water and cause a slight increase in pH (*A Guide to Freshwater Ecology*, TCEQ GI-034, August 2005). Harder, igneous bedrock tend to have less mineral content and lower pH. A typical pH range for buffered water bodies is 6.5 and 9. Regions of East Texas, with naturally acidic waters, have typical pH ranges from 5.5 to 9. Acidic contributions, indicated by a low pH level, can include runoff from acid-laden soils and acid rain. Sources that emit nitrogen oxide and sulphur dioxide into the atmosphere, such as car exhaust and coal power plants, contribute to acid rain.

Water Clarity

Water clarity is the ability of sunlight to penetrate the water column, and is measured by a Secchi disk. The ability of light to reach submerged plants is impeded by reduced clarity, and can effect populations of beneficial phytoplankton, algae, and aquatic plants. This reduces the dissolved oxygen in the water due to reduced photosynthesis. Reduced visibility can also harm predatory fish or birds that depend on good visibility to find their prey.

Water clarity can be affected by natural as well as human activities. Watershed characteristics such as the potential for flooding, and loose soils contribute to reductions in water clarity through increasing sedimentation. Sedimentation can result from sediment washing away from construction sites, erosion of farms, mining operations, and waterway (riparian) disturbance. Reduced water clarity can also occur during algae blooms, which can be episodic or part of a longer term aging process, particularly in reservoirs.

Bacteria

Pathogens are microorganisms, such as bacteria, viruses, and protozoans, that can cause illness in humans. Pathogens can be transmitted by drinking or swimming in water containing fecal waste of warm-blooded animals, primarily through ingestion. The EPA has determined E. *coli* bacteria to be the best indicator of the risk to human health from pathogens in fresh water. Water bodies naturally contain E. *coli*. E. *coli* levels are therefore monitored to determine if there is a significant risk to human health in relation to contact recreation. Sources of E. *coli* may include livestock, pets, failing septic systems and wastewater treatment plants, or wildlife around the water body. The EPA has determined Enteroccocci bacteria to be the best indicator in saltwater and coastal areas due to survival rates. However, the Texas Stream Team does not analyze water samples for Enterococci. There are currently no practical methods available for citizen water quality monitors to perform tests on Enterococci.

Arroyo Colorado
Volunteer Monitoring Stations

A. South Alamo Floodway
B. FM 493
C. Boatramp Downstream of Colorado Ave
● 2201 and 2202 dividing line

Stacy Bray
September 1, 2011
Texas Stream Team
Made from publicly available GIS layers

Data Analysis

This report summarizes data from citizen water quality monitoring in the Arroyo Colorado for three main channel sites (TCEQ Segments 2201 and 2202). Data reported here were collected between June 2007 and March 2011. Sites with assigned segment numbers have standards that specify the minimum or maximum level for various parameters such as water temperature, pH, and dissolved oxygen (see *Water Quality Parameters* above). In addition to assigned standards, some parameters may have screening level targets. These are not absolute standards but are included as a reference point to indicate when water quality parameters may be approaching levels of concern.

Table 1. TCEQ designated stream segments and standards, as applicable to volunteer water quality data in this report (other standards may exist for these water bodies).

		Aquatic Life Use		Recreation Use			General Use		
Segment No.	**Segment Name**	**Dissolved Oxygen grab screening level (mg/L)**	**Dissolved Oxygen grab minimum (mg/L)**	***E. coli* single sample (cfu/100mL)**	***E. coli* geometric mean (cfu/100mL)**	**Water Temp (°C)**	**High pH (SU)**	**Low pH (SU)**	**Conduc-tivity (µS/cm)[1]**
2201	Arroyo Colorado Tidal	4.0	3.0	N/A	N/A	35.0	9.0	6.5	N/A
2202	Arroyo Colorado Above Tidal	4.0	3.0	399	126	35.0	9.0	6.5	6,154

[1] TCEQ standards are given for total dissolved solids (max 4,000 mg/L), not conductivity. Because Stream Team monitors measure conductivity rather than total dissolved solids, the standard was converted following the TCEQ's 2010 Guidance for Assessing and Reporting Surface Water Quality in Texas: Conductivity standard = Total Dissolved Solids standard / 0.65.

For the above tidal segment of the Arroyo Colorado (2202), TCEQ has designated a maximum standard for water temperature of 95°F, a range of between 6.5 and 9.0 for pH, a minimum standard for dissolved oxygen at 3 mg/L, a dissolved oxygen concern screening level of 4 mg/L, a maximum standard for single samples of *E. coli* Bacteria at 399 cfu/100mL, and a maximum standard for total dissolved solids at 4,000 mg/L. For the tidal segment of the Arroyo Colorado (2201), TCEQ has assigned that same standards with the exception of *E. coli* and total dissolved solids, for which there is no *E. coli* standard assigned due to the saltwater influence. TCEQ has designated a geomean standard for Enterococci for Segment 2201. However, Texas Stream solely analyzes samples for *E.coli*. For Segment 2201, *E.coli* values are provided for informational purposes. Because Stream Team monitors measure conductivity rather than total dissolved solids (TDS), the TDS standard was converted following the TCEQ's 2010 Guidance for Assessing and Reporting Surface Water Quality in Texas: conductivity standard = TDS standard / 0.65. The resulting value of 6,154 µS/cm is used in the remainder of this report to compare to conductivity data, and is referred to as the "conductivity standard."

In this report, data are compared to state standards and screening levels to enable readers to have a reference point for amounts/levels of parameters which may be of concern. Data are summarized first for all sites, then by year to show annual variations for all sites. Next, data are

summarized by upstream to downstream trends to show variations across sites. Finally, data are summarized for each site sampled. Note: data collection events may not be evenly distributed over time (through seasons and years); sampling events may occur at different times of the day; sample collection and results documentation may have been completed by different monitors over time at each site; data summary information is subject to change.

The assessment performed by the TCEQ involves more complicated monitoring methods and oversight than are presented in this report. Citizen water quality monitoring data are not used in the assessment but are intended to inform stakeholders about general characteristics and assist professionals in identifying areas of potential concern.

The TCEQ determines a water body to be impaired for core parameters if 10% of at least 10 samples taken over the last 7 years exceed the standard for each parameter. For contact recreation, a water body is determined to be impaired when 25% of at least 7 samples taken over the last 10 years exceed the standard for *E. coli* Bacteria. When the observed value is over the standard, it is referred to as an exceedance. Similar rules exist for other standards to ensure that assessments are made using enough data to account for normal seasonal changes as well as variations in rainfall and other conditions from year to year.

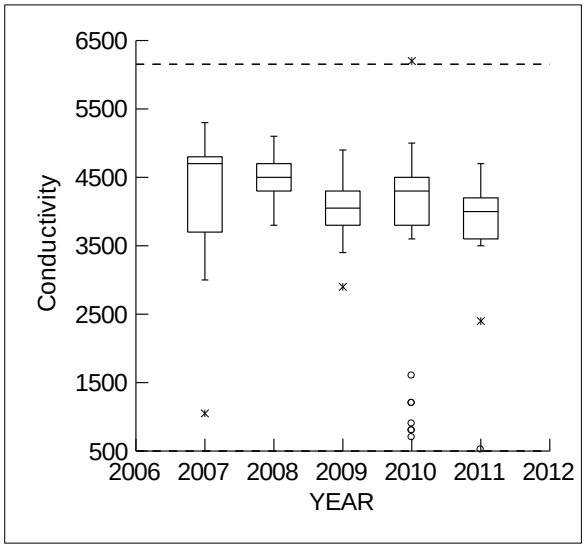
Arroyo Colorado Data Summary

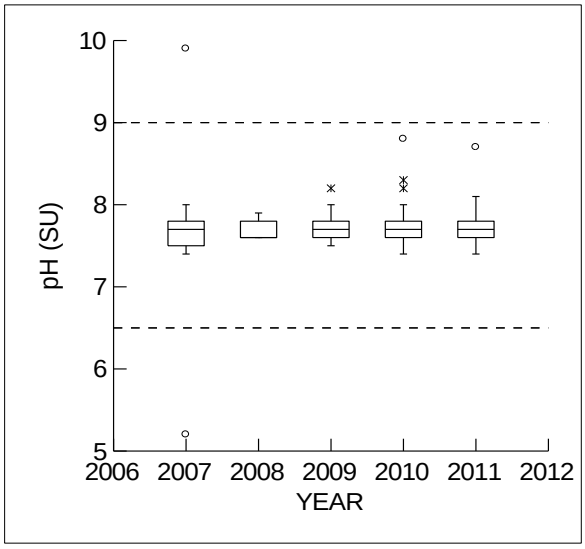
Arroyo Colorado (3 sites) June 2007 – March 2011						
Parameter	**#**	**% Complete**	**Min**	**Avg**	**Max**	**Std Dev**
Water Temperature (^{o}F)	151	99	51.8	74.5	101.3	9.1
Dissolved Oxygen (mg/L)	149	97	3.00	6.39	9.95	1.36
Conductivity (µS/cm)	141	92	520	4061	6200	945
pH	148	97	5.20	7.73	9.90	0.34
E. *coli* Bacteria (cfu/100mL)	127	83	<10	804	6900	1046
Secchi Disk Depth (m)	148	97	0.08	0.36	1.30	0.25
Total Depth (m)	12	8	1.00	1.90	4.00	1.04
Sample Time	150	98	7:30 AM	11:02 AM	7:00 PM	2:16

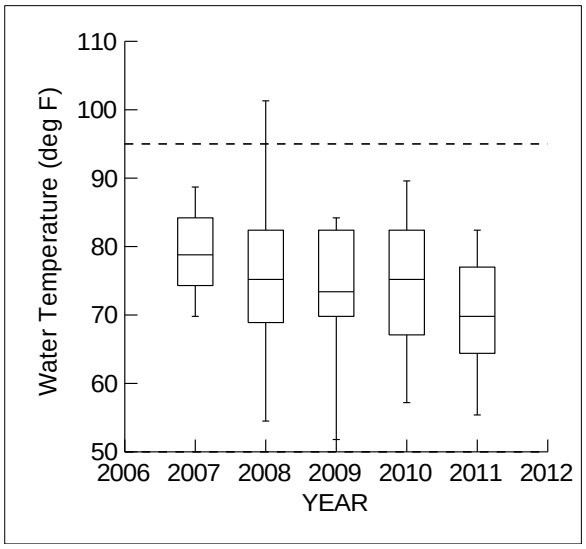
Arroyo Colorado Annual Trends

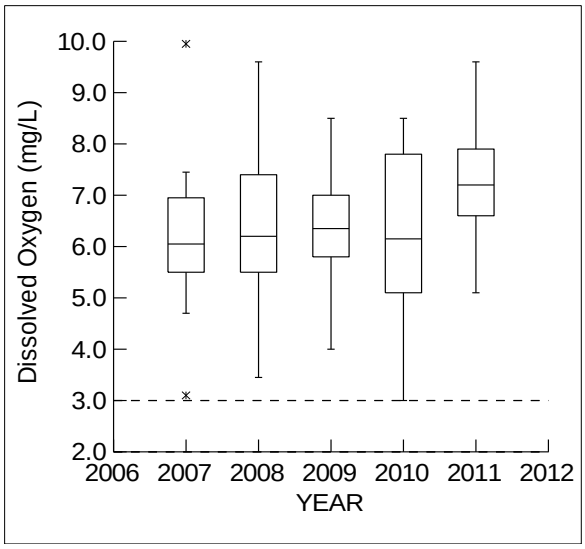
The following series of graphs show data collected from three stations in the Arroyo Colorado. These box plots show the distribution of data by year to assist the reader in determining any annual trends that may have occurred over the time period that these sites were sampled. The tops and bottoms of the boxes show the 75th and 25th percentile values, respectively, and the line through the middle of each box represents the median (50th percentile) value. Whiskers represent the 5th and 95th percentile values, and the dots are outliers. This means that the majority of values measured for each parameter fall within the boxes, while the whiskers are values that were more rarely observed.

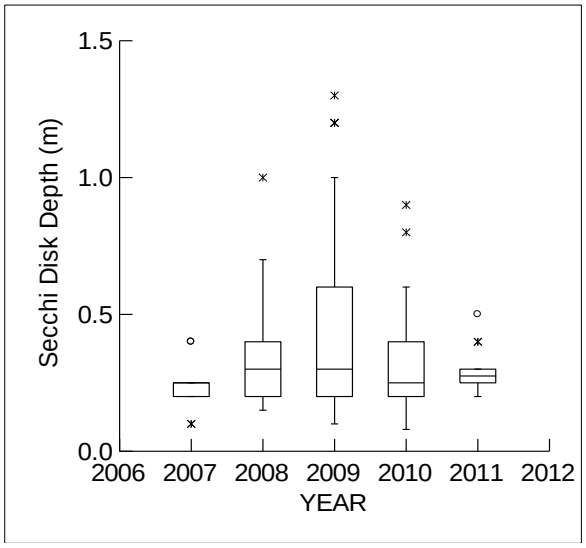
The data reveal the influence of annual climate variations, particularly with regard to conductivity, water temperature, dissolved oxygen, and Secchi Disk depth. pH, on the other hand, varies little from year to year across the three sites included here. The highest and lowest pH values were both observed in 2007. Since all values after 2007 have been within the standard range of 6.5 to 9, this may indicate special circumstances in 2007 rather than ambient conditions in the water body. *E. coli* data show a decreasing trend from 2008 to 2011. The highest *E. coli* values tend to occur in the summer months between June and August and in the winter between December and February. Note that the 2011 data includes only samples collected from January through March, which influences the spread of data for that year.

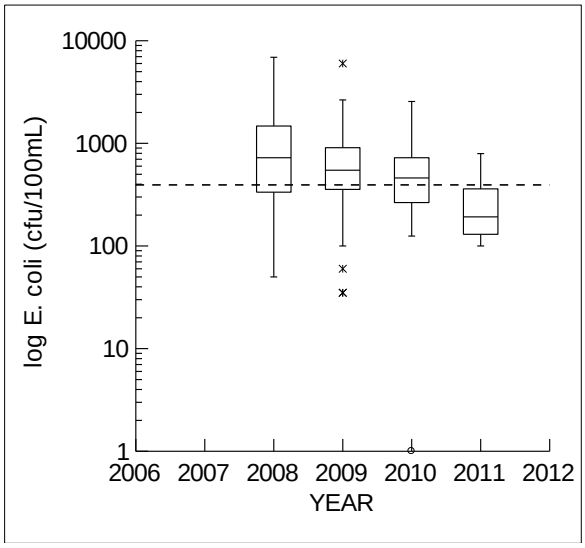








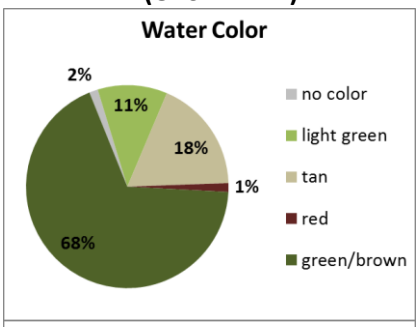
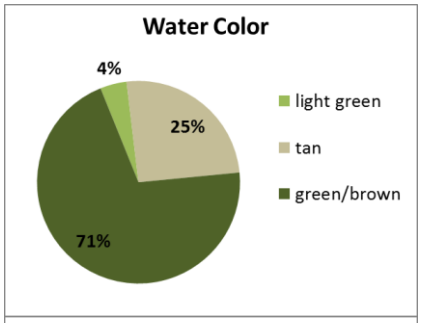
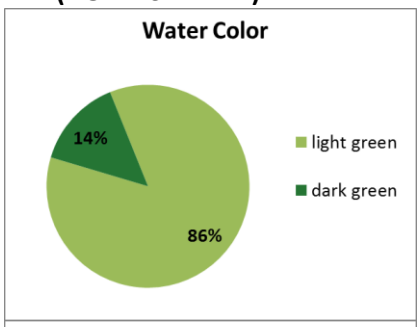
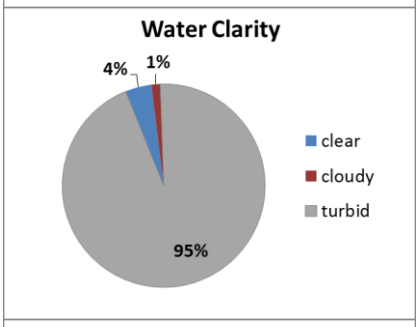
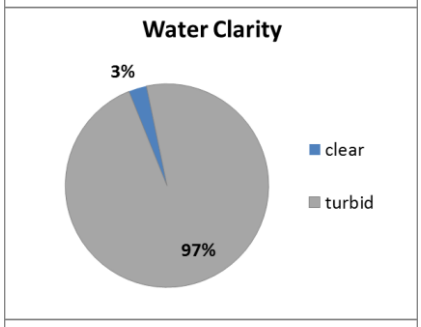
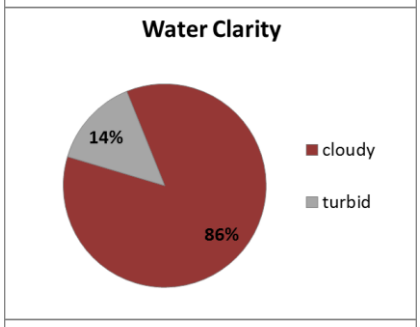
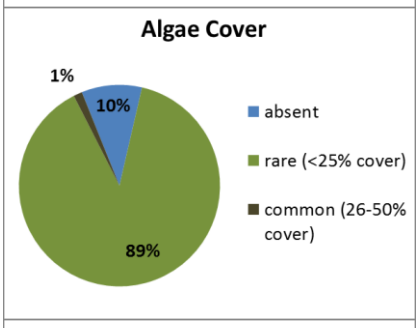
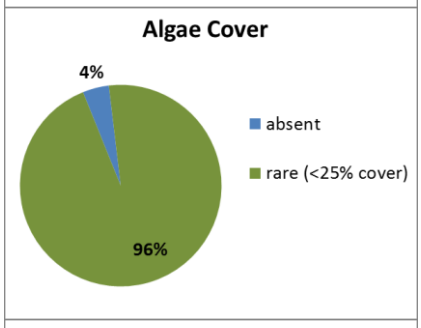
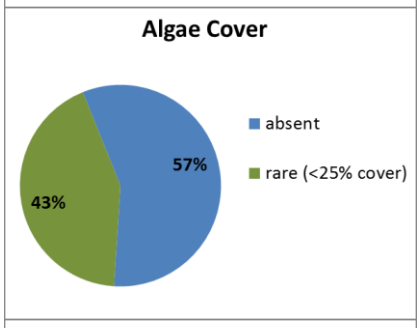
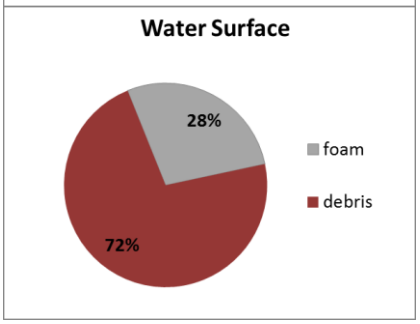
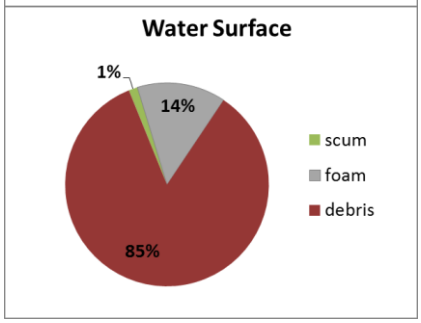
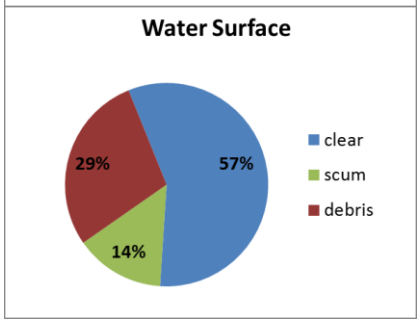




Arroyo Colorado Upstream to Downstream Trends

The following series of graphs show data collected from three stations on the Arroyo Colorado. The locations and distances between sites can be seen on the map on page six. Field observations show that the water color in the Arroyo Colorado changes from generally green-brown or tan to predominantly light green as you move downstream toward the lower Laguna Madre. Monitors recorded that the water was either cloudy or turbid water the majority of the time. In the upstream reaches, clear water was observed only 4% of the time. Algae cover, on the other hand, is more common at the most upstream site (at the South Alamo Floodway). Monitors noted an absence of algae only 10% of the time at that site, while downstream at the Boat Ramp Downstream of Colorado Ave. monitors noted an absence of algae on 57% of sample dates. Foam or debris are always present at the more upstream sites during sampling, while at the downstream site the monitors noted clear water on 57% of sample dates and the presence of scum and debris only 43% of the time.

Field Observations – Upstream to Downstream:

Arroyo Colorado at South Alamo Floodway **(UPSTREAM)**	Arroyo Colorado at FM 493	Arroyo Colorado at Boat Ramp Downstream of Colorado Ave. **(DOWNSTREAM)**
		
		
		
		

The box plots on page 14 show the distribution of data by site to assist the reader in determining any site-to-site trends. The tops and bottoms of the boxes show the 75th and 25th percentile values, respectively, and the line through the middle of each box represents the median (50th percentile) value. Whiskers represent the 5th and 95th percentile values, and the dots are outliers. This means that the majority of values measured for each parameter fall within the boxes, while the whiskers are values that were more rarely observed.

For the following graphs, sites are shown in order from upstream to downstream as follows:

1. Arroyo Colorado at South Alamo Floodway
2. Arroyo Colorado at FM 493
3. Arroyo Colorado at Boat Ramp Downstream of Colorado Ave.

Median conductivity generally decreases as you move downstream in the Arroyo Colorado and becomes more variable. Conductivity is most highly variable at site #3 (Arroyo Colorado at Boat Ramp Downstream of Colorado Ave.); however, it is important to note that this site has only seven samples over one year, while sites 1 and 2 each have over 70 samples that cover four years. pH generally increases as you move downstream, although the highest and lowest values have been recorded at site #1 (Arroyo Colorado at South Alamo Floodway). This is the only site where pH values have been recorded outside the range given by the standards (6.5 to 9). Both a very low and a very high pH have been observed there: the low value of 5.2 on 10/06/2007 and the high value of 9.90 on 06/03/2007. Both these high and low values are among the outer reaches of acceptable pH values with the reading of 9.9 actually outside the acceptable range for healthy aquatic life. pH values this high can cause a multitude of problems for aquatic life. The next highest recorded pH value is eight and is and within the acceptable range. Therefore, the 9.9 reading is likely an outlier and not indicative of ambient conditions.

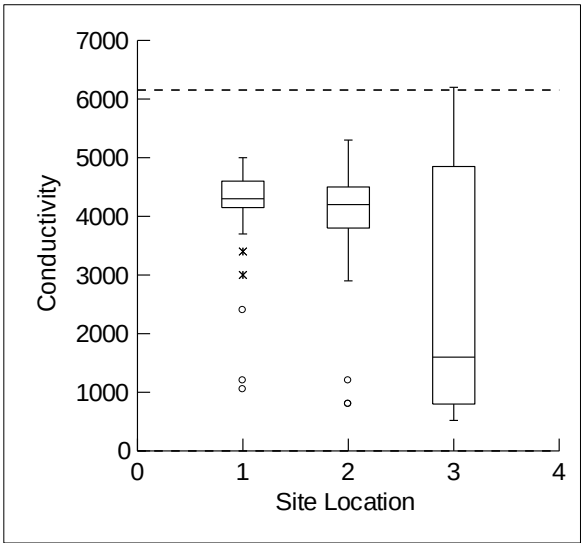
Median water temperature is fairly consistent across the three sites shown here. The highest temperatures have been recorded at site #2 (Arroyo Colorado at FM 493), with one value above the maximum standard of 95°F (101.3°F observed on 08/02/2008). Although this high temperature can cause problems for aquatic life and can impact the amount of dissolved oxygen available in the water, the data for the three sites show that water temperature generally falls within a range of 62°F to 84°F.

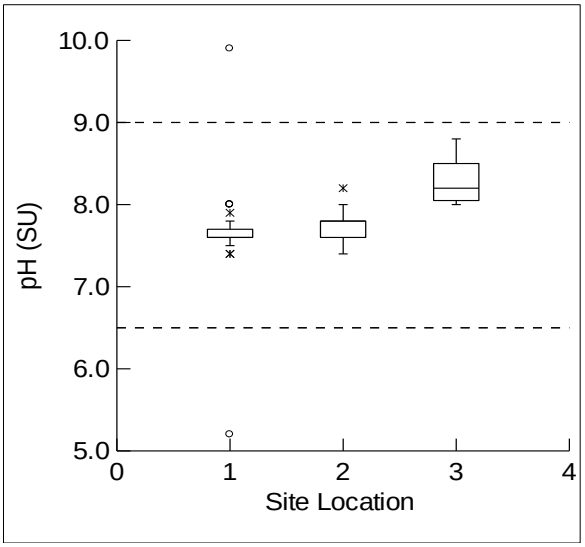
Median dissolved oxygen appears to increase as you move downstream, although the highest values have been observed at site #1 (9.95 mg/L on 08/08/2007), and the lowest values were observed at site #2 (3 on 07/10/2010). This low value is right at the minimum standard of 3 mg/L. DO values below the concern screening level of 4 mg/L have been observed at all three sites, representing 4% of samples overall.

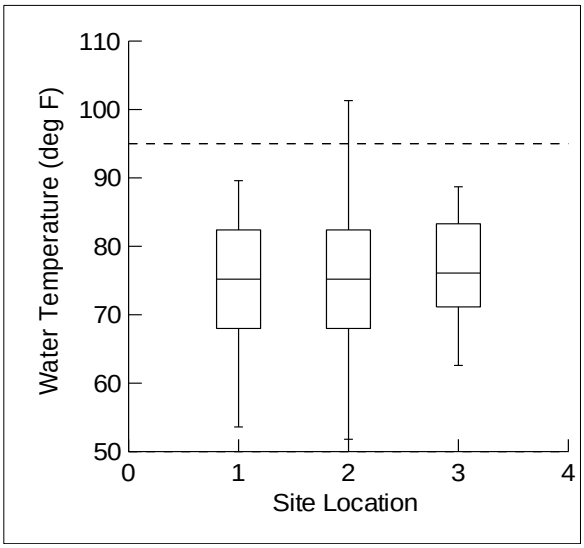
Secchi Disk depth measurements recorded were highly variable across all three sites, indicating that the water ranges from somewhat clear to fairly turbid. Median values range from 0.25 to 0.33 m, which taken along with field observations of water clarity (see above) indicate that the water is often cloudy or turbid with relatively low depth of visibility. A lack of water clarity can negatively impact aquatic life by interfering with photosynthesis by aquatic plants and also indicates the presence of significant sediment and/or algae that blocks light from reaching lower depths.

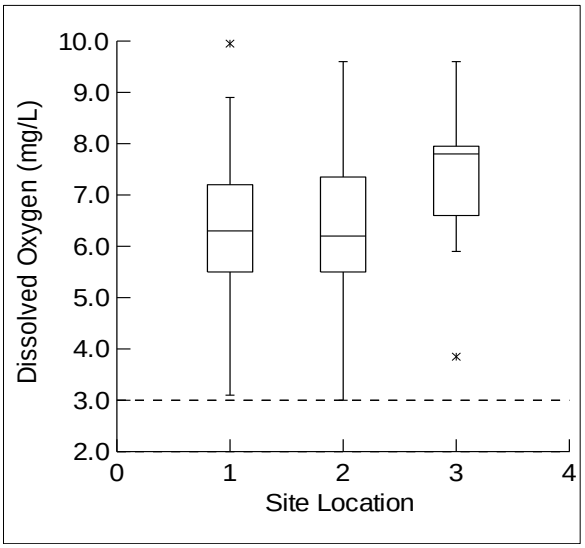
E. coli data show that all three sites have median values close to the maximum standard of 399 cfu/100mL (note log scale on *E. coli* graph). This standard does not apply to Segment 2201, where site #3 is located, but is included as a point of reference. *E. coli* colonies up to 6,900 cfu/100mL have been observed, with an overall exceedance rate of 61% for these three sites. Volunteer monitoring data therefore seems to support the listing of Segment 2202 on TCEQ's 303(d) list for high bacteria levels. Median *E. coli* values are lowest at site #3, but as this site represents only one year of data (other sites have four years), no definitive conclusions can be drawn about upstream to downstream trends in *E. coli* bacteria. Continued monitoring of bacteria is recommended at site #3 and other sites in the tidal segment of the Arroyo Colorado.

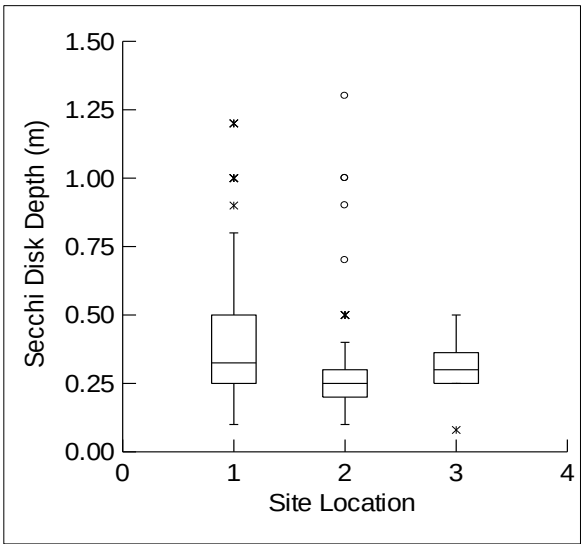
Sharon Slagle, who along with Richard Ramke, conducts monitoring on four of the sites presented in this report, stated that it is a well-known fact in the area that oil and septic trucks regularly are seen dumping into the Arroyo Colorado and other canals in the area. She believes this to be a misconception by the polluters that it is acceptable to dump into the waterways. The intentional lack of vegetation to assist the conveyance of floodwaters and the absence of signage leads some people to think of the Arroyo Colorado as a mere ditch. This behavior of dumping undoubtedly contributes to high bacteria levels, cloudy water, and the presence of other pollutants.

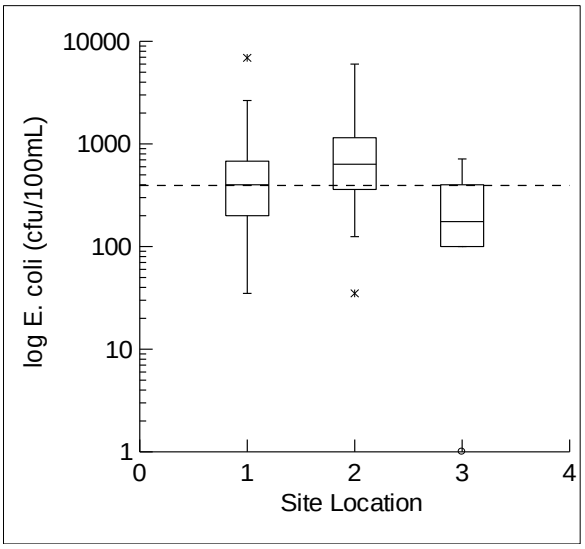












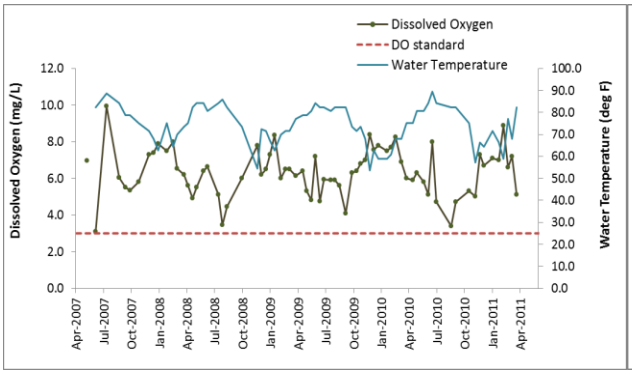
Site-by-Site Summaries

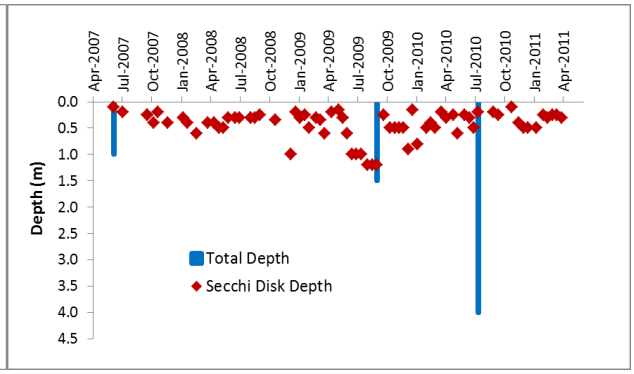
The 2010 Texas Surface Water Quality Standards for the Arroyo Colorado, where applicable, are shown in red on the graphs on the following page. The water temperature standard is a maximum level, the dissolved oxygen standard represents the minimum acceptable level, and the pH standard is a range. The conductivity standard is shown on the graphs as a reference point, but it does not apply to particular observations because it is a segment-wide average.

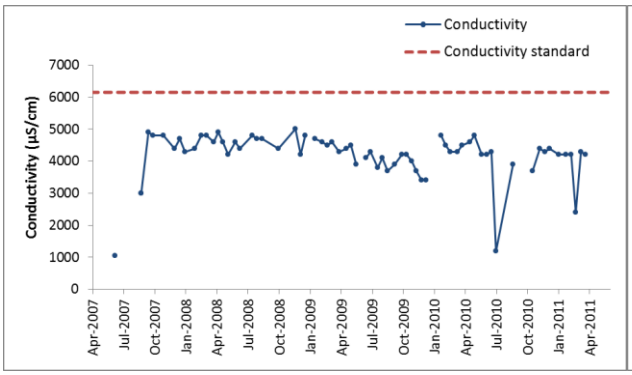
Arroyo Colorado at South Alamo Floodway

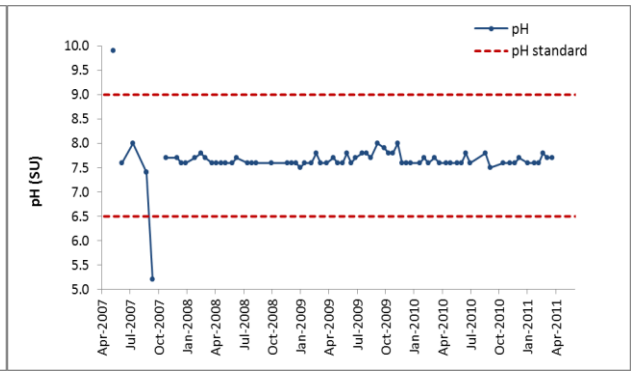
This site has been tested from June 2007 to March 2011 by Sharon Slagle and Richard Ramke.

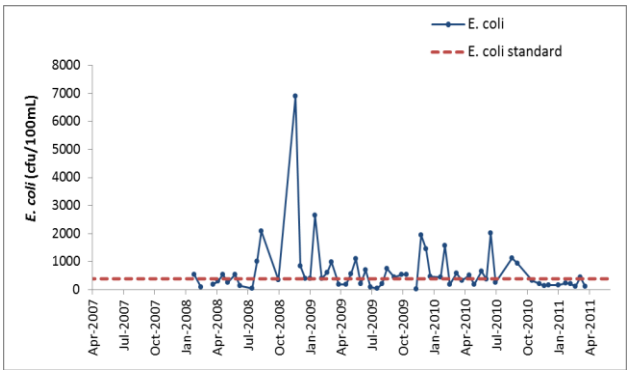
Data Summary **Arroyo Colorado at South Alamo Floodway (Segment 2202)**						
Parameter	**#**	**% Complete**	**Min**	**Avg**	**Max**	**Std Dev**
Water Temperature (^{o}F)	73	99	53.6	74.6	89.6	8.8
Dissolved Oxygen (mg/L)	73	99	3.10	6.32	9.95	1.29
Conductivity (µS/cm)	67	91	1050	4195	5000	726
pH	72	97	5.20	7.66	9.90	0.41
E. *coli* Bacteria (cfu/100mL)	60	81	35	669	6900	987
Secchi Disk Depth (m)	70	95	0.10	0.43	1.20	0.27
Total Depth (m)	3	4	1.00	2.17	4.00	1.61
Sample Time	72	97	8:00 AM	11:25 AM	7:00 PM	2:25


Dissolved Oxygen
DO standard
Water Temperature
Dissolved Oxygen (mg/L)
Water Temperature (deg F)


Depth (m)
Total Depth
Secchi Disk Depth


Conductivity
Conductivity standard
Conductivity (µS/cm)

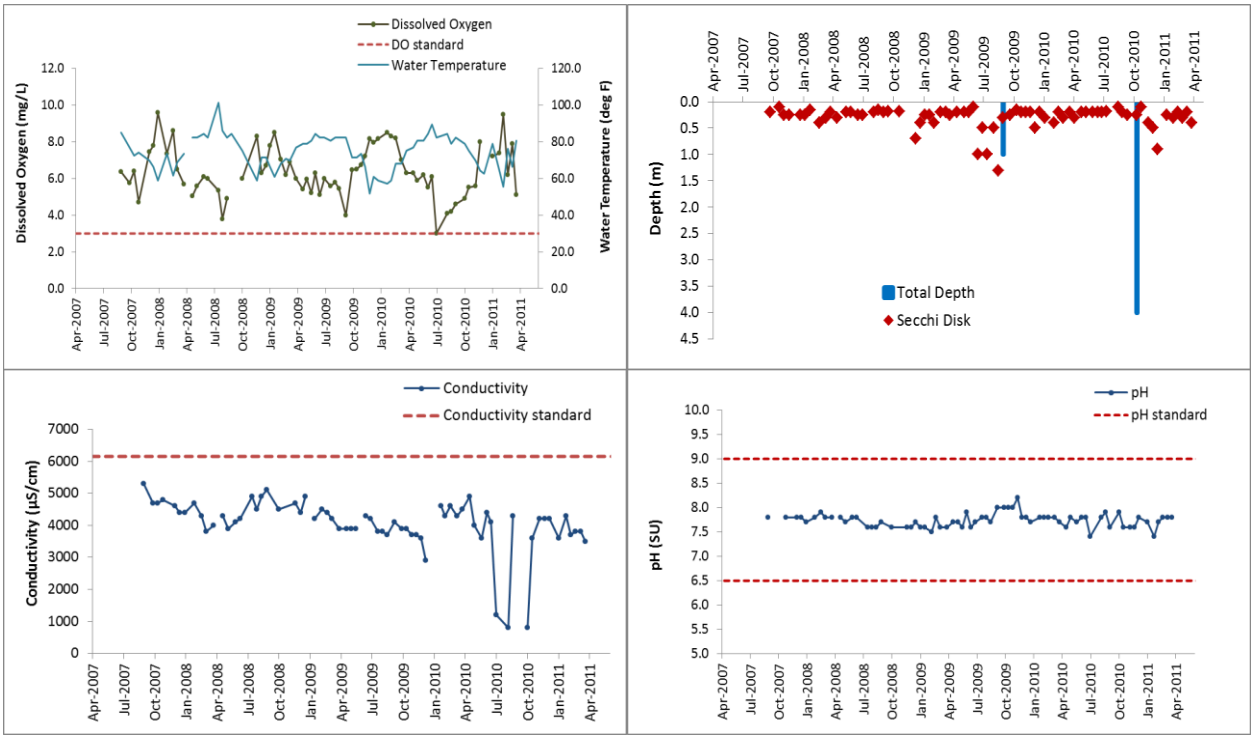

pH
pH standard
pH (SU)

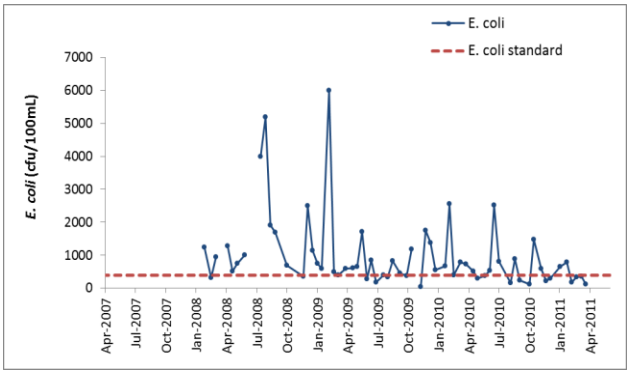

E. coli
E. coli standard
E. coli (cfu/100mL)

Arroyo Colorado at FM 493

This site was tested from September 2007 to March 2011 by Sharon Slagle and Richard Ramke.

Data Summary Arroyo Colorado at FM 493 (Segment 2202)						
Parameter	**#**	**% Complete**	**Min**	**Avg**	**Max**	**Std Dev**
Water Temperature (°F)	71	99	51.8	74.2	101.3	9.4
Dissolved Oxygen (mg/L)	69	96	3.00	6.38	9.60	1.37
Conductivity (µS/cm)	67	93	800	4058	5300	811
pH	69	96	7.40	7.74	8.20	0.14
E. *coli* Bacteria (cfu/100mL)	62	86	35	978	6000	1114
Secchi Disk Depth (m)	71	99	0.10	0.30	1.30	0.22
Total Depth (m)	2	3	1.00	2.50	4.00	2.12
Sample Time	71	99	7:30 AM	10:34 AM	5:05 PM	2:07

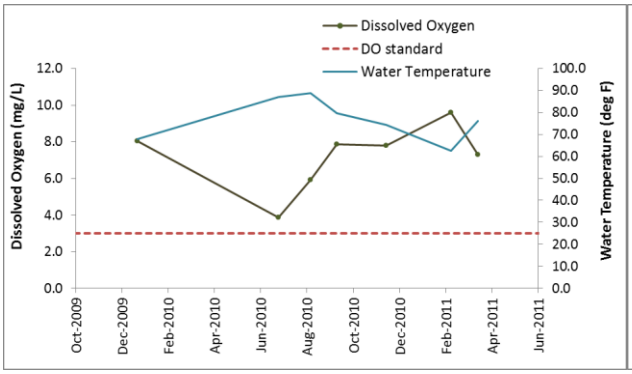


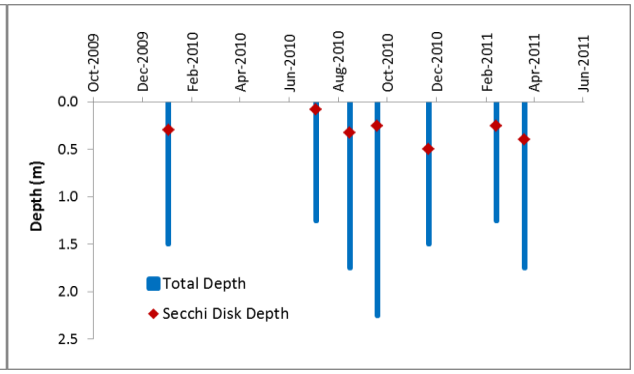


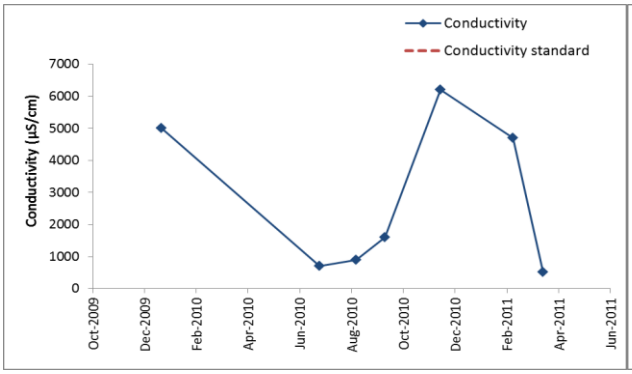
Arroyo Colorado at Boat Ramp Downstream of Colorado Ave.

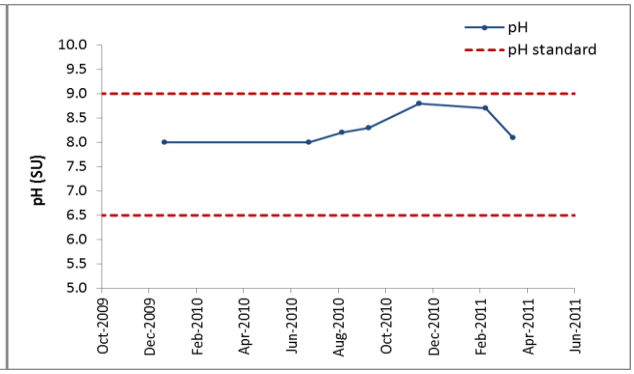
This site was tested from January 2010 to March 2011 by Ruben Saldana.

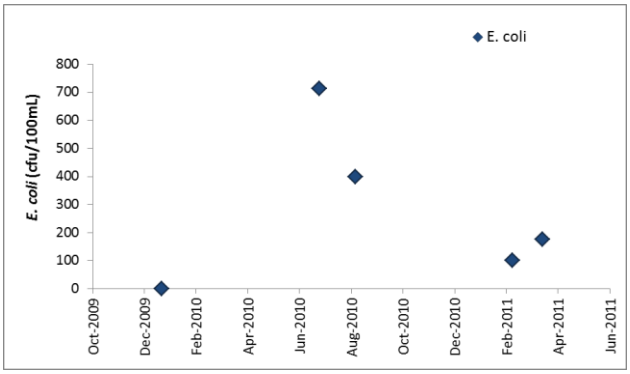
Data Summary Arroyo Colorado at Boat Ramp Downstream of Colorado Ave. (Segment 2201)						
Parameter	**#**	**% Complete**	**Min**	**Avg**	**Max**	**Std Dev**
Water Temperature (^{o}F)	7	100	62.6	76.6	88.7	9.5
Dissolved Oxygen (mg/L)	7	100	3.85	7.19	9.60	1.83
Conductivity (µS/cm)	7	100	520	2803	6200	2404
pH	7	100	8.00	8.30	8.80	0.33
E. *coli* Bacteria (cfu/100mL)	5	71	<10	278	714	285
Secchi Disk Depth (m)	7	100	0.08	0.30	0.50	0.13
Total Depth (m)	7	100	1.25	1.61	2.25	0.35
Sample Time	7	100	10:38 AM	11:51 AM	1:55 PM	1:10






Conductivity
Conductivity standard
Conductivity (µS/cm)
7000
6000
5000
4000
3000
2000
1000
0
Oct-2009
Dec-2009
Feb-2010
Apr-2010
Jun-2010
Aug-2010
Oct-2010
Dec-2010
Feb-2011
Apr-2011
Jun-2011


pH
pH standard
pH (SU)
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Oct-2009
Dec-2009
Feb-2010
Apr-2010
Jun-2010
Aug-2010
Oct-2010
Dec-2010
Feb-2011
Apr-2011
Jun-2011


E. coli
E. coli (cfu/100mL)
800
700
600
500
400
300
200
100
0
Oct-2009
Dec-2009
Feb-2010
Apr-2010
Jun-2010
Aug-2010
Oct-2010
Dec-2010
Feb-2011
Apr-2011
Jun-2011