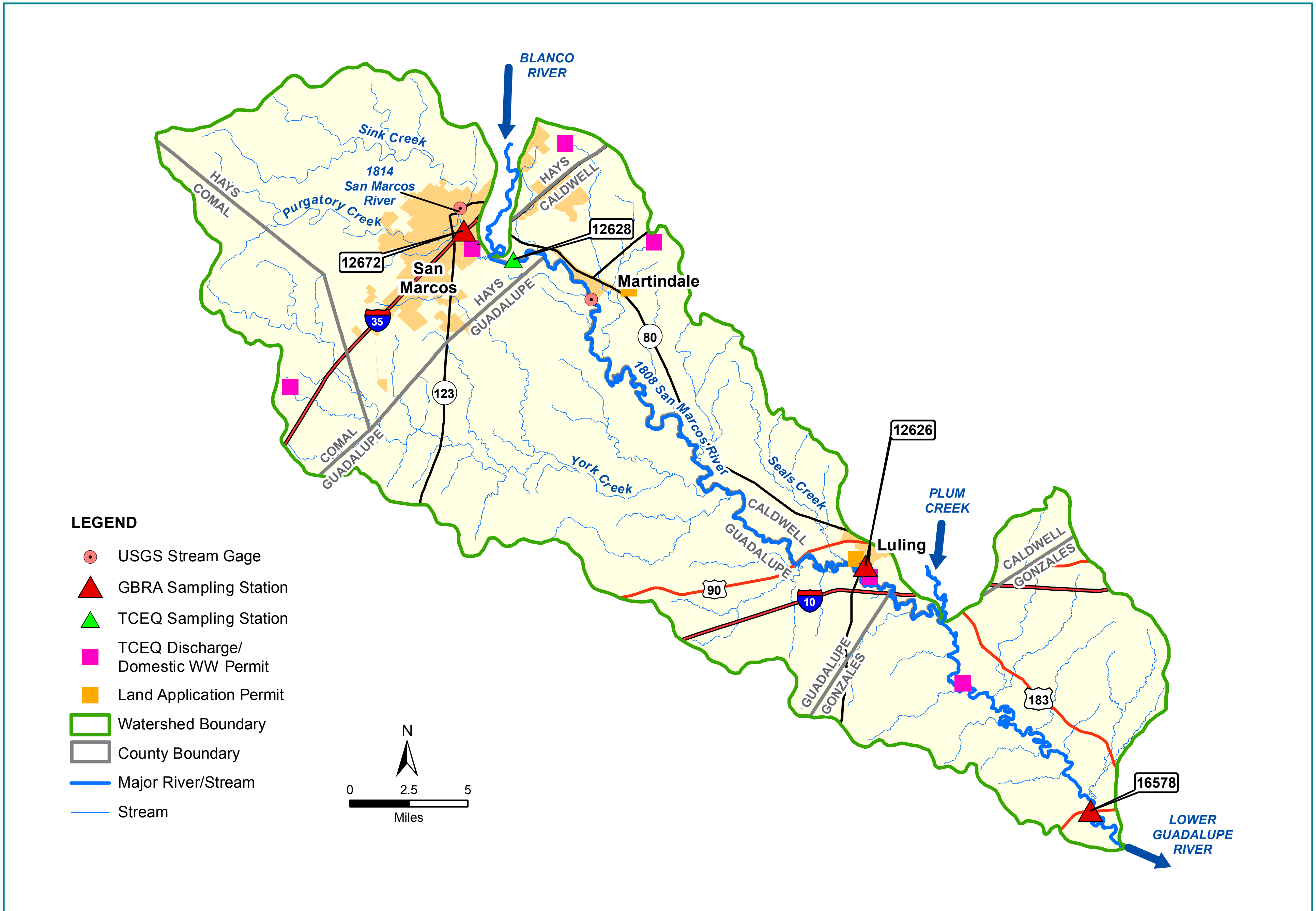

BLANCO RIVER
Sink Creek
1814 San Marcos River
Purgatory Creek
HAYS
COMAL
HAYS
CALDWELL
12628
12672
San Marcos
Martindale
HAYS
GUADALUPE
35
80
123
1808 San Marcos River
COMAL
GUADALUPE
York Creek
Seals Creek
12626
PLUM CREEK
CALDWELL
GUADALUPE
Luling
90
10
CALDWELL
GONZALES
GUADALUPE
GONZALES
183
16578
LOWER GUADALUPE RIVER
LEGEND
USGS Stream Gage
GBRA Sampling Station
TCEQ Sampling Station
TCEQ Discharge/ Domestic WW Permit
Land Application Permit
Watershed Boundary
County Boundary
Major River/Stream
Stream
N
0
2.5
5
Miles

SAN MARCOS RIVER

Segment 1814 (Upper San Marcos River) is a spring-fed stream that flows through the limestone substrates of the Edwards Plateau. The portion of the stream downstream of the springs is very clear and keeps a consistent temperature near 22 degrees Celsius, which makes it an ideal spot for recreational uses such as swimming and fishing. The Upper San Marcos is also home to a number of endangered species that are dependent upon the constancy of clean spring flow for their survival. This portion of the watershed is surrounded by rapidly urbanizing land and topics such as depletion of the springs, restoration of riparian habitat and non-point source runoff from the surrounding land are currently being addressed by concerned stakeholders.

Segment 1808 (Lower San Marcos River) transitions from a swift moving clear stream in the limestone of the Edwards Plateau to a slow, meandering, turbid river as it passes over through the black clays of the Texas Blackland Prairies Ecoregion. This segment of the San Marcos accepts the discharges from the Blanco River (1809) and Plum Creek classified tributaries. The cool, clear waters between the cities of San Marcos and Martindale are heavily trafficked by recreational users for swimming and tubing. As the river moves away from the influence of the urbanized areas along the IH 35 corridor, the stream is much more rural with land uses including the production of agricultural row crops, pasture hay, and livestock.

The San Marcos River is assessed by the TCEQ as two classified stream segments. Segment 1814 represents the 4.5 mile long upper portion of the San Marcos River before its confluence with the Blanco River. This portion of the San Marcos River is a spring fed system that provides a unique ecosystem that is home to a number of endangered species. The upper portions of the river provide habitat for the endangered Fountain Darter (Etheostoma fonticola), Texas Blind Salamander (Typhlomolge rathbuni), Texas Wild Rice (Zizania texana) and the likely extinct San Marcos Gambusia (Gambusia georgei). The San Marcos Salamander (Eurycea nana) is also found within this reach and is considered a threatened species. The spring flows that feed the San Marcos River originate from the Edwards Aquifer, which also feeds the springs at the headwaters of the Comal River. The conservation and recovery of these endangered species is highly dependent upon the continued consistency and purity of these spring flows. In order to protect these spring flows a number of efforts are being made to prevent the pollution and overuse of the groundwater during rapid development of the area. The USFWS approved an Edwards Aquifer Habitat Conservation Plan (EAHCP) to that introduced minimization and mitigation activities designed to protect the endangered species in 2013. This plan was developed by stakeholders in the Edwards Aquifer Recovery

CONTINUED ON PAGE 92

San Marcos River
Drainage Area: 522 square miles
Length: 75 miles
Tributaries: Sink Creek, Sessom Creek, Purgatory Creek, Willow Springs Creek, Blanco River (1809), Morrison Creek, Dickerson Creek, Callihan Creek, York Creek, Brushy Creek, Highsmith Creek, Plum Creek (1810), Mule Creek, Canoe Creek, Smith Creek
Aquifer: Edwards-Balcones Fault Zone, Carrizo-Wilcox
River Segments: 1814, 1808
Cities and Communities: San Marcos, Maxwell, Martindale, Fentress, Prairie Lee, Luling, Ottine, Gonzales
Counties: Hays, Guadalupe, Caldwell, Gonzales,
EcoRegion: Edwards Plateau, Texas Blackland Prairies, Post Oak Savannah

Climate: Average annual rainfall 35.75 inches, Average annual temperature 68.45°F
Vegetation Cover: Evergreen Forest 14.51%, Deciduous Forest 11.77%, Shrubland 33.49%; Grassland 12.19%; Woody Wetlands: 2.15% Cultivated Crops 5.61% ; Pasture Hay 13.22%
Land Uses: Urban, suburban sprawl, agricultural crops, cattle, hog and poultry production, oil production, and recreation
Development: Low Intensity 0.69% ; Medium Intensity 0.35%; High Intensity 0.14%; Open Space 4.49%
Water Body Uses: Aquatic life, contact recreation, general use, fish consumption, and public water supply
Soils: Thin limestone to black, waxy, chocolate and grey loam
Permitted Wastewater Treatment Facilities: Domestic 4, Land Application 0, Industrial 0

Implementation Program (EARIP). When the measures of this plan are fully implanted, they should provide a way to sustain spring flows in the San Marcos River during periods of increased water demand and drought. These measures focus on water conservation, alternative water supply and removal of non-native species. The ecosystem of the San Marcos River is especially susceptible to invasive species introduction from home aquariums. Removal activities focusing on Water Trumpet, Elephant Ears, and Water Hyacinth, along with limitations to recreational uses in State Scientific Areas designated by the Texas Parks and Wildlife Department, have substantially improved the outlook for the Texas Wild Rice and San Marcos Fountain Darter. The Texas Wild Rice Enhancement program undertaken by the city of San Marcos and Texas State University has been particularly successful at restoring this species and enhancing the riparian habitat by restoring native species in this portion of the San Marcos River. The city of San Marcos has also developed a Municipal Separate Storm Sewer System (MS4) permit with the TCEQ. This permit enhances the city's storm management plan to increase public awareness of runoff and nonpoint source pollution while improving storm water runoff controls. In a further effort to protect the water quality of this stream segment, the Meadows Center for Water and the Environment has organized a group of stakeholders to develop a watershed protection plan (WPP) for the Upper San Marcos River. This plan utilizes the 9 key elements WPP format provided by the EPA in order to become eligible for Clean Water Act section 319 funding. This plan characterizes and provides recommended best management practices (BMPs) for stakeholders in order to improve water quality, including additional public education regarding water conservation, aquatic habitat improvements and reduction of non-point source pollutant loading. This stream segment also receives the wastewater discharge from the city of San Marcos wastewater treatment facility (WWTF). This facility is permitted to discharge up to 9.0 million gallons per day (MGD) of treated wastewater effluent. This effluent meets permit limits not to exceed concentrations of carbonaceous biochemical oxygen demand (CBOD) of 5 mg/L, total suspended solids (TSS) of 5 mg/L, ammonia nitrogen of 2 mg/L, total phosphorus of 1 mg/L and E. coli of 126 MPN/100 mL.

Segment 1814 is divided in to four assessment units (AUs) by the TCEQ. AU 1814_01 represents the 1.5 mile flowing portion of the river from 0.6 miles upstream of the Blanco River. AU 1814_02 represents the portion of the river from 1814_01 to IH 35. AU 1814_03 represents the portion of the river between IH 35 and Spring Lake and contains the only current monitoring location at station 12672, which is upstream of the IH 35 crossing. This station has been historically monitoring by the TCEQ since 1992 until monitoring duties were transferred to the GBRA under the Clean Rivers Program in 1998. The final AU 1814_04 includes the portion of the stream upstream of Spring Lake to the headwaters of the river. In a previous 2010 Integrated Report the Upper San Marcos River was listed on the Texas 303(d) list of impaired water bodies, as required by Clean Water Act Sections 303(d) and 305(b) for average total dissolved solids (TDS) of 406 mg/L, which was above the TCEQ stream standard of 400 mg/L. This listing persisted in the 2012 Texas Integrated report, in which the average concentration for TDS was reduced to 402 mg/L. In the latest 2014 Texas Integrated Report average TDS concentrations were assessed below the criterion with an average concentration of 365 mg/L. In 2014, the TCEQ removed segment 1814 from the list of impaired water bodies as it was determined that it was meeting all of its designated uses. The TDS parameter serves as an estimate of dissolved constituents such as salt cations, anions and metals in the water column and is calculated by multiplying the in-situ specific conductance by a factor of 0.65. The GBRA began performing laboratory analysis for TDS from 2010 to 2013 at the IH 35 crossing (station 12672) in order to evaluate the effectiveness of the standard conversion factor for determining TDS in this segment. An analysis of the side by side comparison between the 34 laboratory data and field conductivities collected at this station over the same time period indicated that the calculated average TDS conversion factor of 0.53 would provide a value much closer to the laboratory methodology. TCEQ standards has not adopted a segment specific conversion factor in the upper San Marcos to date, but the additional laboratory data collected during this study significantly lowered the assessed TDS average and ultimately contributed to removal of the impairment. An analysis of the water quality data at station 12672 from 2002 to 2016 identified several interesting trends. The specific conductance and calculated TDS at this station did not show a significant change over time but this parameter does have a significant positive correlation with stream flow (Figures 1 & 2). Based on this analysis, TDS concentrations may increase above the water quality standard in the future if there is an increase in stream flows from additional runoff in the watershed. Dissolved oxygen at this station is significantly decreasing over time and nitrate nitrogen is significantly increasing over time (Figures 3 & 4). These trends may be related, as dissolved oxygen may be reduced in the water column through nitrification in order to form nitrates from other forms of nitrogen. The additional nitrogen in the segment may be a result of additional nonpoint source runoff as the precipitation increases following several years of drought conditions.

Segment 1808 represents the lower portion of the River from 0.6 miles upstream of the confluence with the Blanco River to the confluence with the Guadalupe River. No assessed impairments or concerns are currently known in this segment. This stream segment has been divided into five assessment units (AUs) by the TCEQ. AU 1808_01 comprises the lower 18 miles of the segment from the confluence with the Guadalupe River upstream to the confluence with Mule Creek. This segment has been monitored by the GBRA at station 16578 on the US Highway 90A road crossing since 1999. AU 1808_02 covers the portion of the segment from the confluence with Mule Creek upstream to the confluence with Plum Creek near the city of Luling. No surface water quality monitoring stations are present in this AU. AU 1808_03 represents the portion of the San Marcos River from the confluence with Plum Creek upstream to the Old Bastrop Highway (Guadalupe CR 239) road crossing. This segment contains one monitoring location at station 12626, which is upstream of the US highway 80 road crossing in the city of Luling. Station 12626 was first monitored by the TCEQ in 1968 and has been monitored by the GBRA on a monthly basis since 1990. The final AU in this segment is 1808_04, which comprises the portion of the river from Old Bastrop Highway to 1 kilometer upstream of the Blanco River confluence. This AU has been monitored by the TCEQ at station 12628 upstream of Guadalupe County Road 239 on a quarterly basis since 1973. All three active monitoring stations were analyzed by the GBRA to assess trends in water quality over time and several changes were identified. At the most downstream station 12678 stream flows was significantly decreasing over time and nitrate nitrogen concentrations were significantly increasing over time (Figures 5 & 6). Station 12626 shows a significant decrease in dissolved oxygen over time and a significant increase in nitrate nitrogen over time (Figures 7 & 8). Changes in the oxygen and nitrate concentrations over time may indicate additional nonpoint source nitrogen loading in this portion of river as dissolved oxygen used to produce additional nitrates through nitrification. At station 12628, near the upper end of the segment, the specific conductivity is significantly increasing over time and this parameter shows a significant inverse relationship with stream flow (Figures 9 & 10). This flow relationship is opposite of what was seen in the spring fed portion of the river upstream. The differences in flow effects from these two segments may indicate that the TDS concentrations in the upper San Marcos are associated with discharges from the springs, while the conductivity in the lower portion of the watershed is more greatly influenced by dilution from the larger drainage area.

SAN MARCOS RIVER

Table 1

Station 16578 – San Marcos River at US 90A 12/2002 – 10/2016					
AU 1808_01 General Use					
Parameter	Mean	Maximum	Minimum	# of Measurements	Screening Criteria
Temperature (°C)	22.2	30.8	9.4	57	32.20
pH	8.0	8.3	7.4	57	6.5 – 9.0
Chloride (mg/L)	40.8	115	11.6	56	60.00
Sulfate (mg/L)	36.6	116	12.7	56	50.00
Total Dissolved Solids (mg/L)	387	699	161	57	400.00
NH3-N (mg/L)	<0.10	0.67	<0.02	56	0.33
Total Phosphorus (mg/L)	0.10	0.83	<0.02	56	0.69
Chlorophyll-a (µg/L)	2.3	10.7	<1.0	56	14.10
Nitrate Nitrogen (mg/L)	0.92	1.58	0.38	56	1.95
TKN (mg/L)	0.41	2.23	<0.20	36	N/A
AU 1808_01 Recreational Use					
E. coli (MPN/100 mL)	87 Geomean	9,200	19	56	126 Geomean
AU 1808_01 Aquatic Life Use					
Dissolved Oxygen (mg/L)	8.3	11.3	5.6	57	≥3.0 Minimum & ≥5.0 Average

Table 2

Station 12626 – San Marcos River in Luling 12/2002 – 11/2016					
AU 1808_03 General Use					
Parameter	Mean	Maximum	Minimum	# of Measurements	Screening Criteria
Temperature (°C)	22.2	31.2	10.3	164	32.20
pH	7.9	8.3	7.5	164	6.5 – 9.0
Chloride (mg/L)	25.3	56.5	9.6	163	60.00
Sulfate (mg/L)	30.9	63.8	21.1	163	50.00
Total Dissolved Solids (mg/L)	358	488	255	164	400.00
NH3-N (mg/L)	<0.10	0.34	<0.02	81	0.33
Total Phosphorus (mg/L)	<0.05	0.51	<0.02	163	0.69
Chlorophyll-a (µg/L)	1.6	9.2	<1.0	162	14.10
Nitrate Nitrogen (mg/L)	1.05	1.84	0.08	162	1.95
TKN (mg/L)	0.28	0.91	<0.20	52	N/A
AU 1808_03 Recreational Use					
E. coli (MPN/100 mL)	71 Geomean	9,680	13	161	126 Geomean
AU 1808_03 Aquatic Life Use					
Dissolved Oxygen (mg/L)	8.4	14.5	5.2	164	≥3.0 Minimum & ≥5.0 Average

Table 3

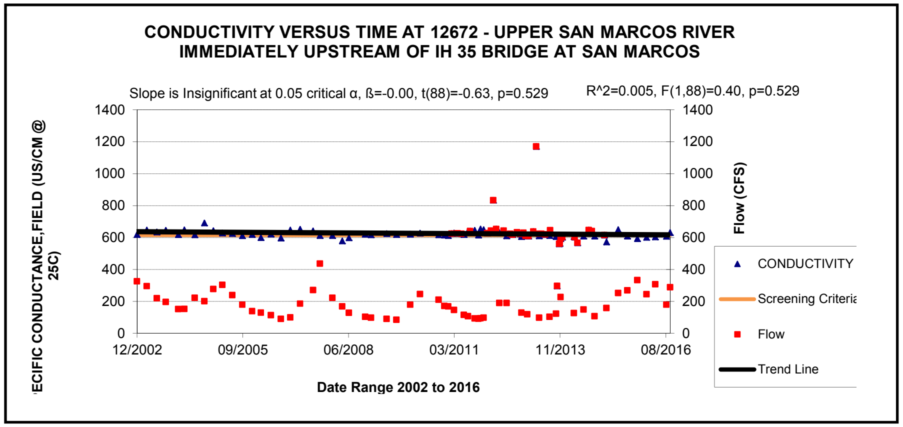
Station 12628 – San Marcos River at Old Bastrop Highway 12/2002 – 10/2016					
AU 1808_04 General Use					
Parameter	Mean	Maximum	Minimum	# of Measurements	Screening Criteria
Temperature (°C)	22.1	26.9	13.3	74	32.20
pH	8.0	8.6	7.3	74	6.5 – 9.0
Chloride (mg/L)	19.6	25.0	10.0	56	60.00
Sulfate (mg/L)	25.9	34.0	15.0	56	50.00
Total Dissolved Solids (mg/L)	385	433	294	73	400.00
NH3-N (mg/L)	N/A	N/A	N/A	N/A	0.33
Total Phosphorus (mg/L)	<0.05	0.24	<0.02	53	0.69
Chlorophyll-a (µg/L)	5.4	10.0	<1.0	33	14.10
Nitrate Nitrogen (mg/L)	1.52	2.20	0.66	56	1.95
TKN (mg/L)	0.24	0.64	<0.20	50	N/A
AU 1808_04 Recreational Use					
E. coli (MPN/100 mL)	109 Geomean	2,420	27	67	126 Geomean
AU 1808_04 Aquatic Life Use					
Dissolved Oxygen (mg/L)	9.3	12.1	7.4	70	≥3.0 Minimum & ≥5.0 Average

Table 4

Station 12672 – San Marcos River at IH 35 12/2002 – 10/2016					
AU 1814_03 General Use					
Parameter	Mean	Maximum	Minimum	# of Measurements	Screening Criteria
Temperature (°C)	22.4	25.2	19.2	57	26.70
pH	7.7	8.7	7.3	57	6.5 – 9.0
Chloride (mg/L)	18.7	24.1	15.0	54	50.00
Sulfate (mg/L)	26.5	33.6	23.0	54	50.00
Total Dissolved Solids (mg/L)	385	761	193	134	400.00
NH3-N (mg/L)	<0.10	0.51	<0.02	62	0.33
Total Phosphorus (mg/L)	<0.05	0.46	<0.02	60	0.69
Chlorophyll-a (µg/L)	1.4	5.0	<1.0	38	14.10
Nitrate Nitrogen (mg/L)	1.15	1.69	0.29	64	1.95
TKN (mg/L)	0.33	0.79	<0.10	43	N/A
AU 1814_03 Recreational Use					
E. coli (MPN/100 mL)	109 Geomean	2,420	27	67	126 Geomean
AU 1814_03 Aquatic Life Use					
Dissolved Oxygen (mg/L)	10.2	13.0	8.1	56	≥3.0 Minimum & ≥5.0 Average

SAN MARCOS RIVER

Figure 1



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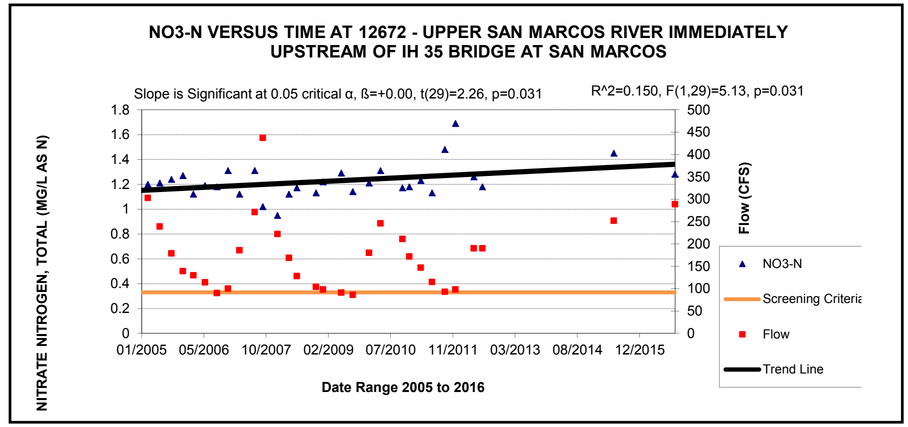

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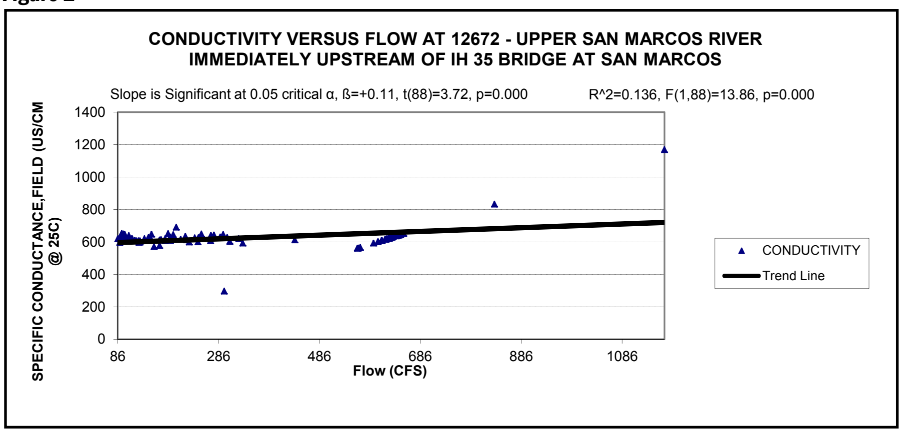

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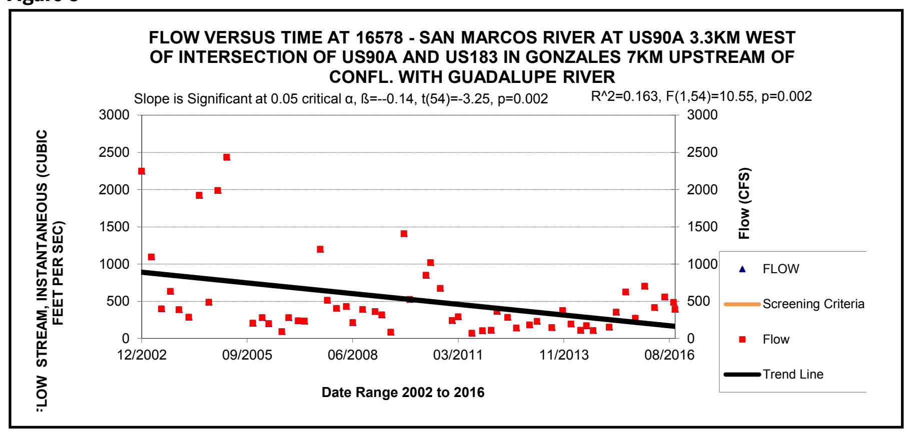
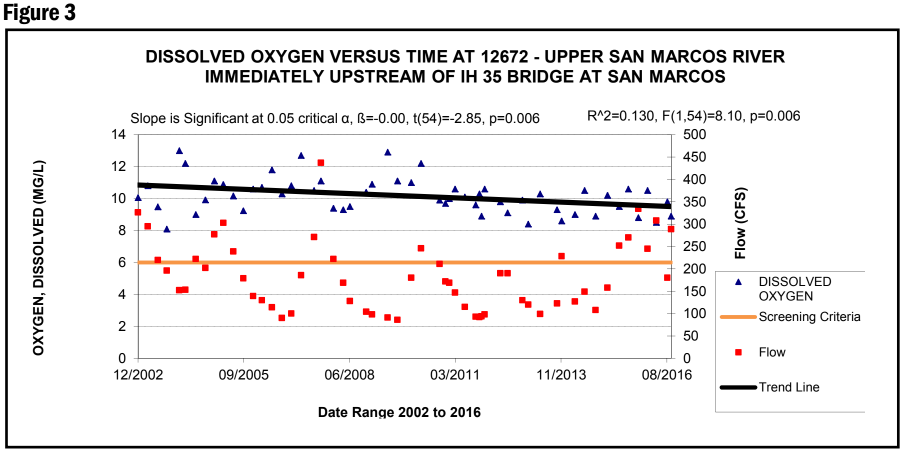


Figure 3



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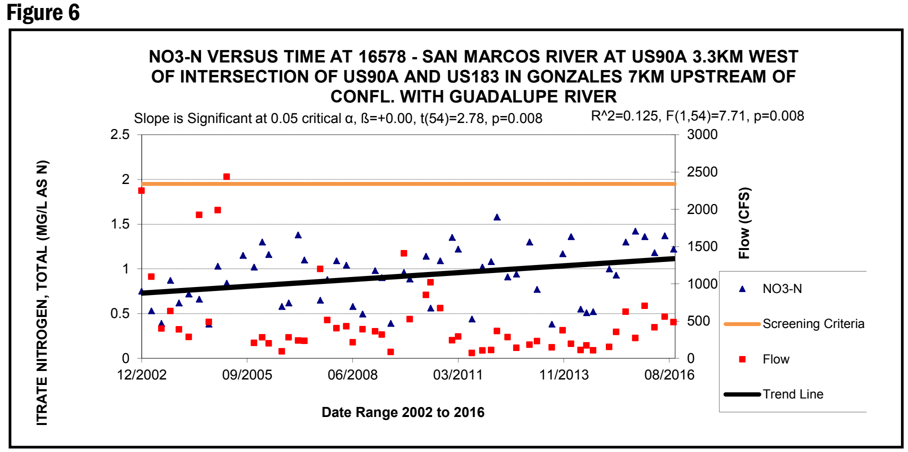
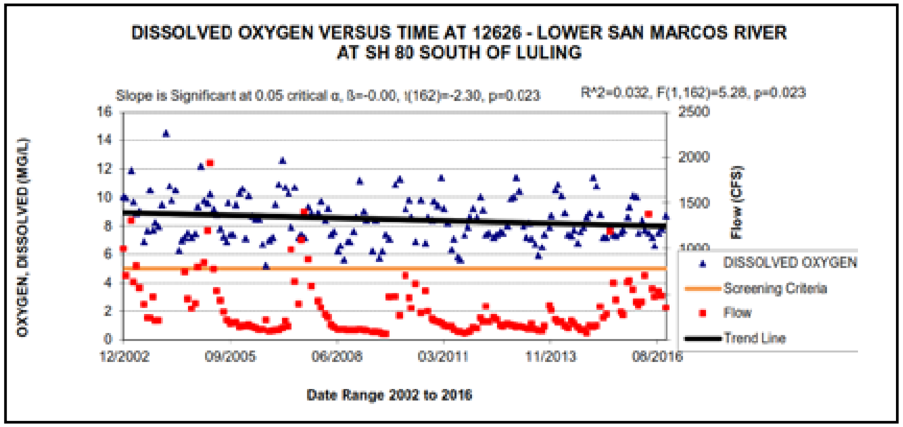


SAN MARCOS RIVER

Figure 7



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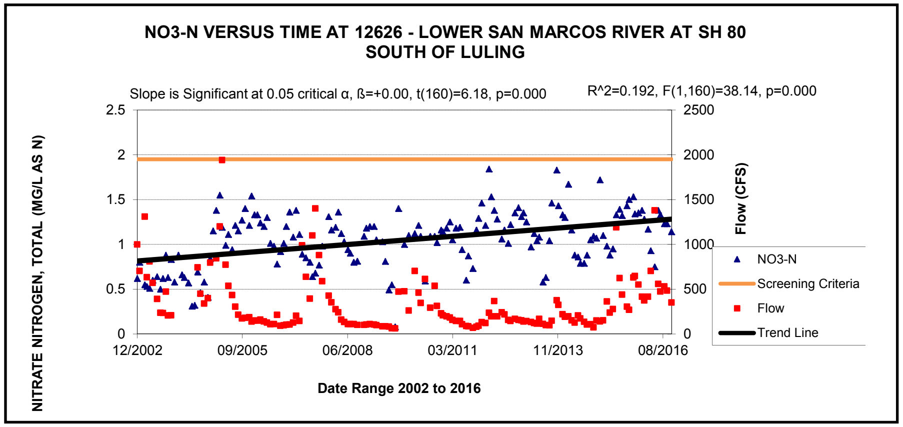

Figure 9

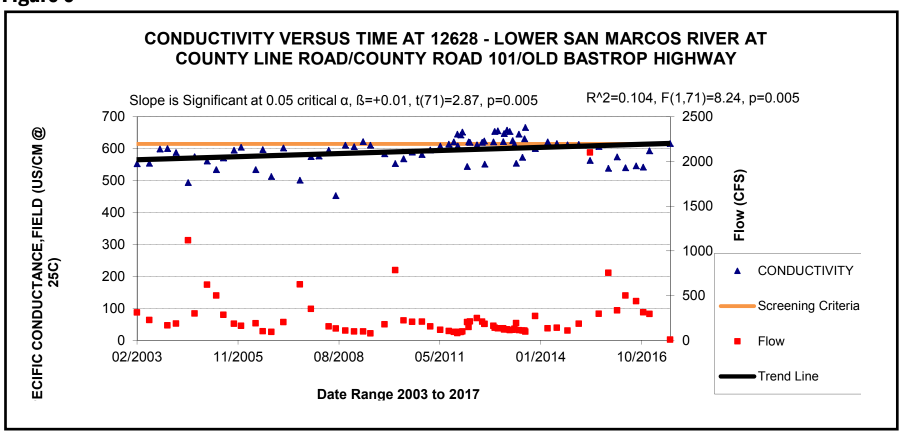

Figure 10