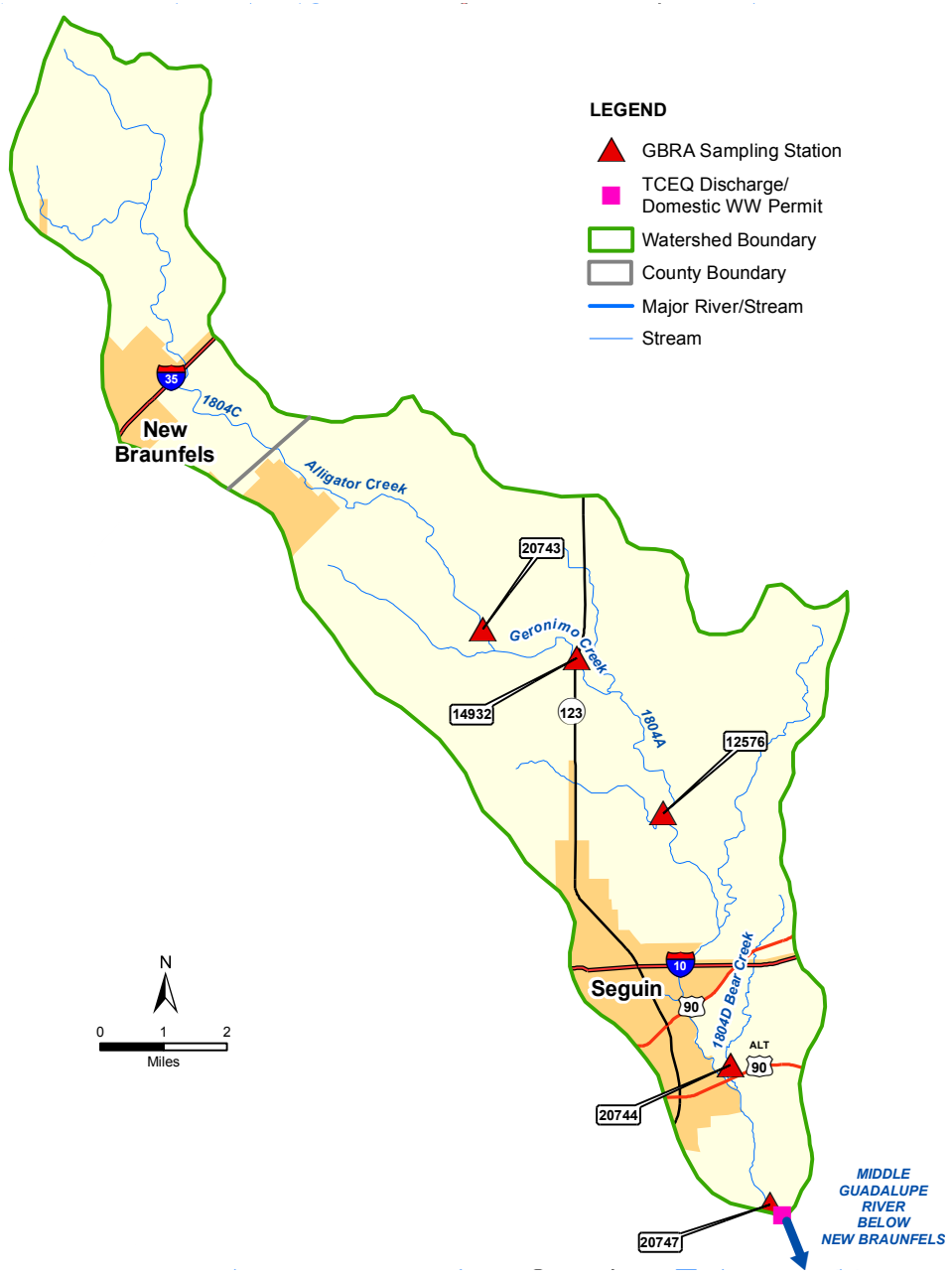
GERONIMO CREEK



GERONIMO CREEK

Segment 1804A (Geronimo Creek): Geronimo Creek and its tributary, Alligator Creek, are located in Comal and Guadalupe Counties, almost entirely within the Extra-territorial jurisdictions (ETJ) of the cities of New Braunfels and Seguin. ETJs are the unincorporated areas contiguous to the Cities, in which some municipal regulatory authority may be exercised. The almost 70-square mile watershed has its headwaters in southeastern Comal County. Alligator Creek is intermittent with pools. Geronimo Creek's flow is sustained by two major springs, the Timmermann Spring and an unnamed spring, coming from the Leona Aquifer and the alluvium. The creek flows through the Blackland Prairies Ecoregion. Land use in the watershed is transitioning from predominantly agriculture to urban development.

The GBRA began monitoring in Geronimo Creek near the confluence with Alligator Creek at State Highway 123 (station 14932) in October of 1996 for the Clean Rivers Program. Monitoring at station 14932 was discontinued in September of 2003, when the GBRA began monitoring at a new station approximately 4.0 miles downstream on Haberle Road (station 12576). GBRA monitoring activities were relocated to station 12576 in 2003 because the TCEQ designated this station as an ecoregion reference location. The GBRA continues to maintain routine monthly CRP monitoring at this station.

The Geronimo Creek Segment 1804A was listed on the Texas 303(d) list of impaired water bodies, as required by Clean Water Act Sections 303(d) and 305(b) in 2006. The entire water body was found to be impaired for contact recreation with an E. coli geometric mean of 162 MPN/100 mL. The stream was also noted to have concerns for Nitrate Nitrogen at this time because all measurements exceed the screening criteria of 1.95 mg/L. In 2008, the Texas State Soil and Water Conservation Board (TSSWCB), GBRA and Texas AgriLife Extension began working with local stakeholders to develop a Watershed Protection Plan (WPP) for the Geronimo Creek and contributing Alligator Creek tributary. The TSSWCB also funded additional water quality monitoring in the watershed to facilitate the development of the WPP by filling data gaps to supplement the existing CRP monitoring program. This plan was designed to address the known water quality impairments and concerns in the watershed. In September 2012, the WPP became only the third plan in the state of Texas to be accepted by the EPA as meeting all guidance requirements. The plan identified a number of implementation activities that could be voluntarily undertaken by stakeholders in order to reduce bacteria and nutrient loading in the watershed, including nutrient management training, pet waste management, and storm system convenience system assessments. Following the acceptance of the plan the TSSWCB has funded additional monitoring projects that have been used to quantitatively track the effectiveness of water quality restoration implementation activities over time. The latest 2014 Texas Integrated Report of Surface Water Quality lists a geometric mean of E. coli concentrations of 187

CONTINUED ON PAGE 76

Geronimo Creek
Drainage Area: 69 square miles
Length: 17 miles
Tributaries: Alligator Creek (1804C), Bear Creek (1804D),
Aquifer: Edwards Balcones Fault Zone, Carrizo Wilcox
River Segments: 1804A, 1804C, 1804D
Cities and Communities: New Braunfels, Seguin, Geronimo
Counties: Comal, Guadalupe
EcoRegion: Edwards Plateau, Texas Blackland Prairie
Climate: Average annual rainfall 34.48 inches, Average annual temperature 20.8°C

Vegetation Cover: Evergreen Forest 7.82%, Deciduous Forest 3.70%, Shrubland 13.06%; Grassland 21.25%; Woody Wetlands: 0.43% Cultivated Crops 40.45% ; Pasture Hay 6.34%
Land Uses: urban, suburban sprawl, light industry, and recreational.
Development: Low Intensity 0.79% ; Medium Intensity 0.41%; High Intensity 0.65%; Open Space 4.93%
Water Body Uses: aquatic life, contract recreation, general use, fish consumption, and agriculture.
Soils: Dark, calcareous clay, clay with rocky outrcrops,
Permitted Wastewater Treatment Facilities: Domestic 1, Land Application 0, Industrial 0

GERONIMO CREEK

MPN/100 mL. This value has increased from the initial impairment in 2006. Nitrate nitrogen also remains a concern with an assessed mean of 9.54 mg/L. The TSSWCB also funded a nitrate isotope study, in which the GBRA and USGS conducted monitoring of the surface water, shallow groundwater and springs from the contributing Leona aquifer in order to determine the sources of nitrate nitrogen in the watershed. The results of this study showed that the majority of nitrate nitrogen in this watershed resulted from a mixture of nitrogen fertilizers and septic waste.

The only domestic wastewater permit in the watershed is operated by the City of Seguin. The outfall for this plant is located immediately upstream of the confluence of the Geronimo Creek with the Guadalupe River. The Geronimo Creek WWTF is permitted to discharge up to 2.13 million gallons per day (MGD) of effluent water that has been treated to permitted limits of 20 mg/L of biochemical oxygen demand (BOD), 20 mg/L of total suspended solids (TSS) and 126 MPN/100 mL of E. coli. The Geronimo Creek WPP stakeholders determined that this facility was not a major influence on the water quality of the creek due to its location at the bottom of the watershed.

Water quality data was analyzed from the two historical Clean Rivers Program monitoring stations near the headwaters of the Geronimo Creek (station 14932 & 12576). Additional data analysis was also performed on the TSSWCB routine monitoring stations near the confluence with Guadalupe River (station 20747) and stations representative of the two major contributing tributaries of Alligator Creek (station 20743) and Bear Creek (station 20744). An analysis of the latest available data from these stations revealed that although the previously identified E. coli impairment was persistent throughout the Geronimo Creek watershed and its contributing Bear Creek tributary (185 MPN/100 mL), the Alligator Creek tributary was well below the contact recreation standard with a geometric mean of 69 MPN/100mL. The geometric mean for E. coli at the most upstream station (14932) was also more than twice the concentration (411 MPN/100 mL) of stations 12576 (182 MPN/100 mL) and 20747 downstream (194 MPN/100 mL). The nitrate nitrogen concentrations were highest at station 12576 (10.6 mg/L) and diminished near the confluence with the Guadalupe River (6.94 mg/L).

Several notable trends were identified at each of the monitoring stations analyzed. The dissolved oxygen levels at the most upstream station (14932) on Geronimo Creek are significantly decreasing with time and these concentrations are significantly correlated with changes in streamflow (Figures 1 & 2). The dissolved oxygen concentrations were also significantly decreasing over time at station 12576 downstream, which was also strongly correlated with stream flow (Figures 3 & 4). The most downstream station (20747) showed a significant increase in nitrate nitrogen over time (Figure 5) which was not explained by changes in stream flow, but may be an indicator of additional runoff in the area. The Bear Creek tributary at station 20744 is significantly increasing in conductivity over time (Figure 6). The Alligator Creek tributary at station 20743 on Huber Road is also significantly increasing in conductivity over time (Figure 7). The TKN concentration at station 20744 is also significantly decreasing over time (Figure 8). The decrease in TKN may be an early indicator that nutrient management implementation efforts associated with the WPP may be reducing fertilizer runoff in the upper agricultural dominant portions of the watershed. Additional implementation activities associated with WPP continue to be implemented throughout the watershed, but water quality improvements associated with these activities have been difficult to quantify due to the competing changes in water quality associated with rapid urbanization in the upper portion of the watershed.

GERONIMO CREEK

Table 1

Station 14932 – Geronimo Creek at SH 123 12/2002 - 06/2017					
AU 1804A_01 General Use					
Parameter	Mean	Maximum	Minimum	# of Measurements	Screening Criteria
Temperature (°C)	21.1	27.6	11.6	80	32.2
pH	7.6	8.3	7.2	80	6.5 – 9.0
Chloride (mg/L)	35.0	50.2	15.7	79	100.00
Sulfate (mg/L)	56.1	50.2	15.7	79	50.00
Total Dissolved Solids (mg/L)	508	590	255	80	400.00
NH3-N (mg/L)	<0.10	0.94	<0.02	71	0.33
Total Phosphorus (mg/L)	<0.05	0.34	<0.02	79	0.69
Chlorophyll-a (µg/L)	1.6	13.2	<1.0	74	14.1
Nitrate Nitrogen (mg/L)	7.90	11.3	0.09	66	1.95
TKN (mg/L)	<0.2	0.99	<0.2	77	N/A
AU 1804A_01 Recreational Use					
E. coli (MPN/100 mL)	411 Geomean	12,000	72	75	126 Geomean
AU 1804A_01 Aquatic Life Use					
Dissolved Oxygen (mg/L)	8.2	12.3	5.2	79	≥3.0 Minimum & ≥5.0 Average

Table 2

Station 12576 – Geronimo Creek at Haberle Road 12/2002 – 06/2017					
AU 1804A_01 General Use					
Parameter	Mean	Maximum	Minimum	# of Measurements	Screening Criteria
Temperature (°C)	21.3	28.9	8.8	168	32.2
pH	7.8	8.2	7.3	168	6.5 – 9.0
Chloride (mg/L)	36.2	48.9	4.7	159	100.00
Sulfate (mg/L)	62.1	85.0	7.4	159	50.00
Total Dissolved Solids (mg/L)	521	715	147	166	400.00
NH3-N (mg/L)	<0.10	1.13	<0.02	109	0.33
Total Phosphorus (mg/L)	<0.05	0.66	<0.02	160	0.69
Chlorophyll-a (µg/L)	1.6	12.5	<1.0	155	14.1
Nitrate Nitrogen (mg/L)	10.6	17.4	0.05	155	1.95
TKN (mg/L)	0.4	4.0	<0.2	87	N/A
AU 1804A_01 Recreational Use					
E. coli (MPN/100 mL)	182 Geomean	16,000	44	154	126 Geomean
AU 1804A_01 Aquatic Life Use					
Dissolved Oxygen (mg/L)	8.7	13.0	6.6	168	≥3.0 Minimum & ≥5.0 Average

Table 3

Station 20747 – Geronimo Creek at Hollub Road near Guadalupe Confluence 05/2009 – 06/2017					
AU 1804A_01 General Use					
Parameter Table 3	Mean	Maximum	Minimum	# of Measurements	Screening Criteria
Temperature (°C)	20.8	29.6	7.4	66	32.20
pH	7.8	8.1	7.1	66	6.5 – 9.0
Chloride (mg/L)	31.8	51.9	8.7	66	100.00
Sulfate (mg/L)	62.9	93.1	16.2	66	50.00
Total Dissolved Solids (mg/L)	455	610	188	66	400.00
NH3-N (mg/L)	<0.10	0.45	<0.10	66	0.33
Total Phosphorus (mg/L)	0.10	2.87	<0.02	66	0.69
Chlorophyll-a (µg/L)	1.6	17.2	<1.0	65	14.1
Nitrate Nitrogen (mg/L)	6.9	13.7	<0.05	66	1.95
TKN (mg/L)	0.3	1.5	<0.2	52	N/A
AU 1804A_01 Recreational Use					
E. coli (MPN/100 mL)	194 Geomean	11,000	24	66	126 Geomean
AU 1804A_01 Aquatic Life Use					
Dissolved Oxygen (mg/L)	8.1	13.8	4.7	65	≥3.0 Minimum & ≥5.0 Average

Table 4

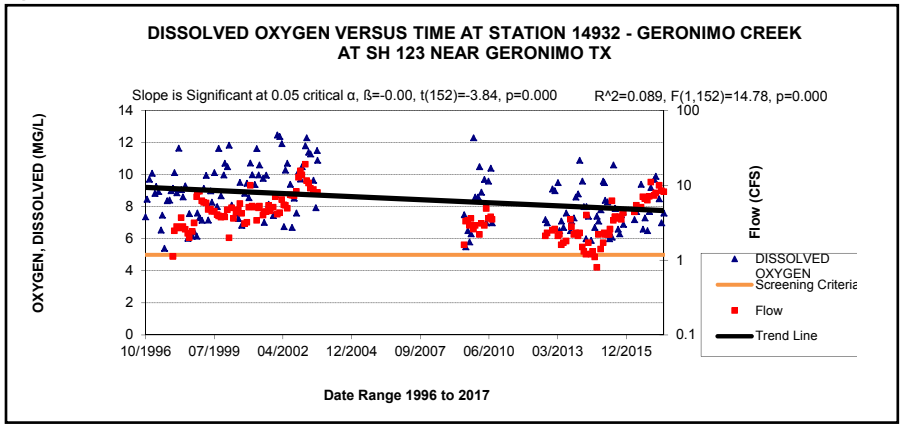
Station 20743 – Alligator Creek at Huber Road near Geronimo Confluence 05/2009 – 06/2017					
AU 1804C_01 General Use					
Parameter	Mean	Maximum	Minimum	# of Measurements	Screening Criteria
Temperature (°C)	21.5	34.0	6.5	66	32.20
pH	7.6	8.7	6.9	66	6.5 – 9.0
Chloride (mg/L)	12.3	25.6	3.2	66	100.00
Sulfate (mg/L)	23.0	84.9	3.4	66	50.00
Total Dissolved Solids (mg/L)	345	509	133	66	400.00
NH3-N (mg/L)	<010	0.94	<0.10	66	0.33
Total Phosphorus (mg/L)	<0.08	0.27	<0.05	66	0.69
Chlorophyll-a (µg/L)	68.8	30.8	<1.0	66	14.1
Nitrate Nitrogen (mg/L)	3.08	18.2	<0.05	66	1.95
TKN (mg/L)	0.8	1.8	<0.2	66	N/A
AU 1804C_01 Recreational Use					
E. coli (MPN/100 mL)	69 Geomean	24,000	<1	66	126 Geomean
AU 1804C_01 Aquatic Life Use					
Dissolved Oxygen (mg/L)	7.1	17.6	1.6	65	≥3.0 Minimum & ≥5.0 Average

GERONIMO CREEK

Table 5

Station 20744 – Bear Creek at East Walnut Street 05/2009 – 06/2017					
AU 1804D_01 General Use					
Parameter	Mean	Maximum	Minimum	# of Measurements	Screening Criteria
Temperature (°C)	18.9	28.3	7.5	37	32.20
pH	7.6	8.6	7.2	37	6.5 – 9.0
Chloride (mg/L)	46.8	148	4.1	37	100.00
Sulfate (mg/L)	73.6	272	6.6	37	50.00
Total Dissolved Solids (mg/L)	434	1,053	103	37	400.00
NH3-N (mg/L)	0.17	0.43	<0.10	37	0.33
Total Phosphorus (mg/L)	0.14	0.55	0.03	37	0.69
Chlorophyll-a (µg/L)	4.1	17.8	<1.0	36	14.1
Nitrate Nitrogen (mg/L)	0.50	8.36	<0.05	37	1.95
TKN (mg/L)	0.8	1.6	<0.2	24	N/A
AU 1804D_01 Recreational Use					
E. coli (MPN/100 mL)	185 Geomean	12,000	4	37	126 Geomean
AU 1804D_01 Aquatic Life Use					
Dissolved Oxygen (mg/L)	5.9	12.1	1.1	36	≥3.0 Minimum & ≥5.0 Average

Figure 1



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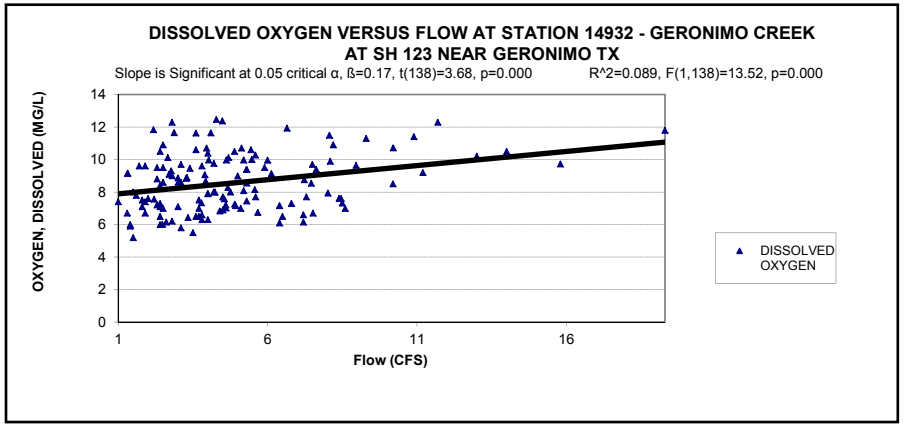

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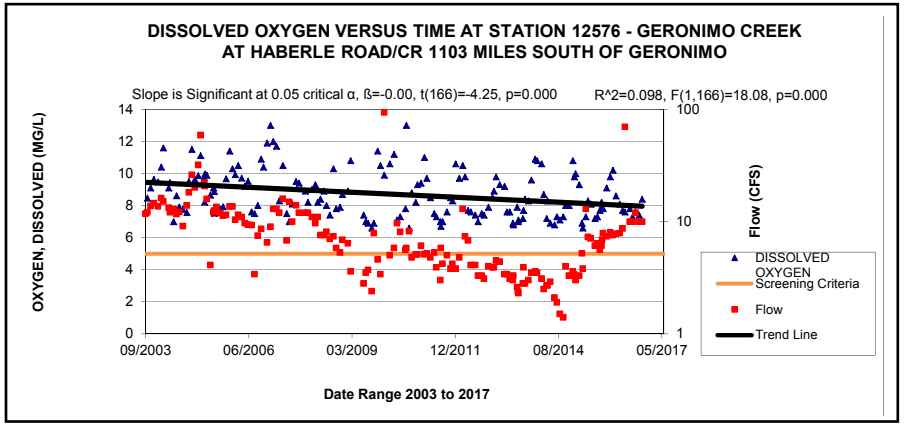
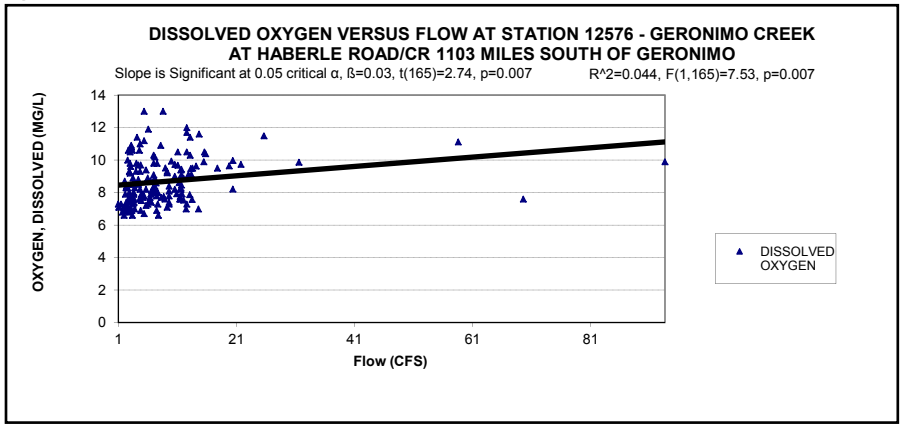


GERONIMO CREEK

Figure 4



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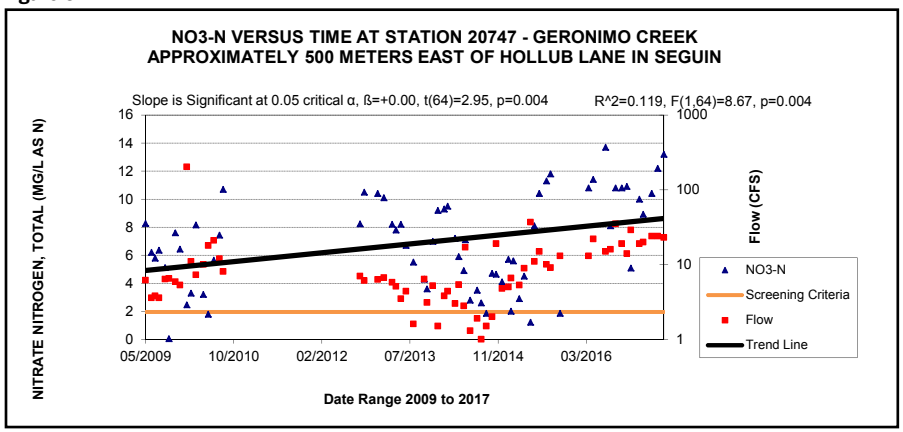

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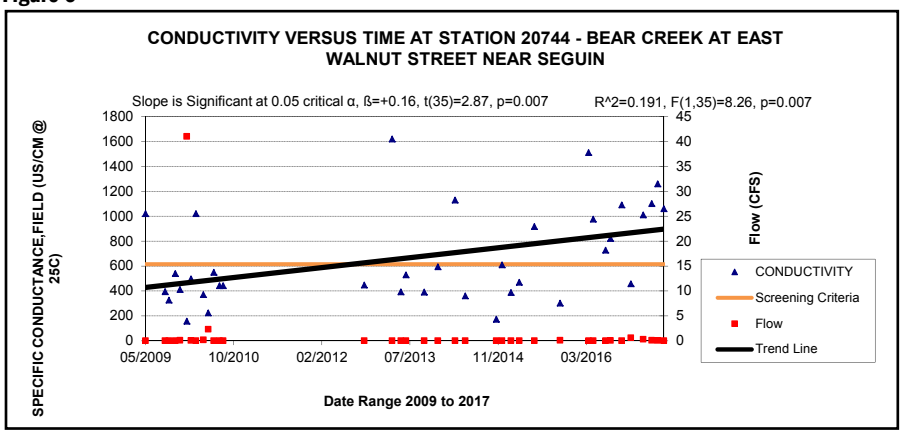

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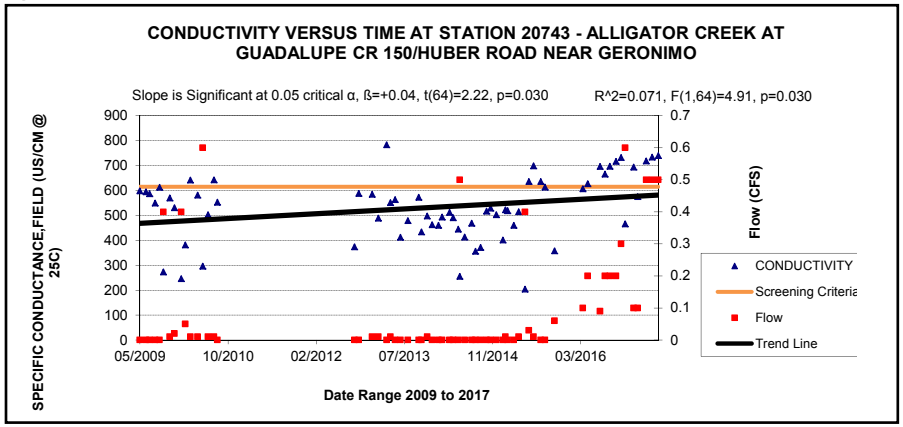

Figure 8