

The upper Guadalupe River watershed above Flat Rock Dam consists of several segments including the North Fork (1817) and South Fork Guadalupe River (1818), Johnson Creek (1816), and a portion of the upper Guadalupe River segment (1806). This summary report will discuss the upper Guadalupe River segment 1806 as two sub-watersheds in order to better describe the effects of a TMDL implementation plan that has been put into place upstream of Flat Rock Dam in the City of Kerrville. The TCEQ has divided Segment 1806 into eight assessment units (AUs). The five AUs that describe the upper sub-watershed above Flat Rock Dam are 1806_07 which covers the upper 10 miles of segment, 1806_06 from FM 394 to 1 mile downstream, 1806_05 from the confluence with Camp Meeting Creek to 2 miles upstream, 1806_04 from 1 mile upstream Flat Rock Dam to the confluence with Camp Meeting Creek, and 1806_03 from Flat Rock Dam in Kerrville to 1 mile upstream. These five AUs represent only the upper 16 miles of this segment. For information regarding the remaining three AUs in this segment please refer to the section of this report covering the Guadalupe River below Flat Rock Dam.

High levels of E. coli bacteria prompted the Texas Commission on Environmental Quality (TCEQ) to add the Guadalupe River Above Canyon Lake (Segment 1806) to the state's 2002 Clean Water Act (CWA) section 303(d) list of impaired waters. Assessment units 1806_06 and 1806_04, had bacteria levels that exceeded the primary contact recreation standard geometric mean of 126 colony forming units of E. coli per 100 mL (cfu/100 mL) of water. The TCEQ assessed a geometric mean of 193 cfu/100 mL of E. coli at AU 1806_06

and 231 cfu/100 mL at AU 1806_04. Both of the listed assessment units were contained within the urbanized portions of the City of Kerrville. The 1806_04 AU is located downstream of the confluence with Goat Creek at FM 394 (Francisco Lemos Street) and receives the discharge from Town Creek. The 1806_06 AU is immediately downstream of the confluence with Camp Meeting Creek and flows into Flat Rock Lake. The two mile long AU 1806_05 that falls between the two impaired AUs was found to be fully supporting of primary contact recreation

standard. Since that time, the Upper Guadalupe River Authority (UGRA) has worked with TCEQ to develop a locally driven solution to reduce the bacteria concentrations to a level consistent with state standards for recreation.

In 2004, the TCEQ initiated a Total Maximum Daily Load (TMDL) project to conduct public outreach, identify sources, and establish loads. The TMDL and subsequent Implementation Plan (I-Plan) were adopted and approved by the TCEQ in 2007 and 2011 respectively. The TCEQ provided UGRA with CWA section 319(h) funding to implement the I-Plan in partnership with the City of Kerrville, Kerr County, and the Texas Department of Transportation (TXDOT). To address the bacteria impairment, the I-Plan included implementing best management practices to control bacteria from animal waste, improving infrastructure, and conducting education and outreach in the watershed. As a result of the collaborative effort of individuals and organizations, the water

CONTINUED ON PAGE 18

Guadalupe River Above Flat Rock Dam

Drainage Area: 537 square miles

Length: 17 miles

Tributaries: North Fork (1817) and South Fork (1818) of the Guadalupe River, Johnson Creek (1816), Kelly Creek, Indian Creek, Goat Creek (1806C), Bear Creek, Town Creek(1806E), Quinlan Creek (1806D), Camp Meeting Creek (1806A), Third Creek Aquifer: Trinity, Edwards Plateau River Segments: 1816, 1817, 1818, 1806, 1806A, 1806C, 1806D, 1806E Cities and Communities: Hunt, Ingram, Kerrville Counties: Kerr, Gillespie EcoRegion: Edwards Plateau Climate: Average annual rainfall 32.08 inches, Average annual temperature 65.1°F **Vegetation Cover:** Evergreen Forest 33.25%, Deciduous Forest 7.16%, Shrubland 52.81%; Grassland 2.11%; Woody Wetlands: 0.01% Cultivated Crops 0.02% ; Pasture Hay 0.06% **Land Uses:** ranching, farming, tourism, light manufacturing

Development: Low Intensity 0.8% ; Medium Intensity 0.3%; High Intensity 0.1%; Open Space 3.0%

Water Body Uses: aquatic life, contact recreation, general use, fish consumption, and public water supply

Soils: Dark and loamy over limestone to loam with clay subsoils **Permitted Wastewater Treatment Facilities:** Domestic 2, Land Application

6, Industrial 0

quality in AU 1806_04 and 1806_06 has improved and TCEQ removed these AUs from the state's impaired waters list in 2012 and 2014, respectively.

Many of the bacteria reduction strategies have been maintained and continue to be implemented. Routine water quality monitoring both through the Clean Rivers Program and UGRA funded efforts continue to track E. coli levels to ensure this restoration process remains a success. In FY18 UGRA received CWA section 319(h) funding to update and revise the Implementation Plan for the Upper Guadalupe River. This process has reengaged the original stakeholders to assess the progress done to date and possibly plan for the implementation of additional strategies to maintain the bacteria reductions.

UGRA performs routine sampling at 10 stations within the portion of 1806 above Flat Rock Lake. There are three USGS gages within this portion of 1806, one just below the confluence of the North and South Forks in Hunt, one near the Bear Creek Road Crossing immediately west of Kerrville, and one just downstream of Nimitz Dam in Kerrville. During the period of this report (2003-2016), a decreasing trend in flow influenced water quality at nearly all locations in segment 1806 due to the intense drought from 2011-2014. Average annual rainfall was only 21 inches during the drought compared to the long term annual average of 30 inches for Kerr County.

The 2014 Texas Integrated Report assessed a concern for impaired

biological habit in this AU. The data used to asses this concern was collected from four biological monitoring screening events conducted at station 15111. All four events were collected by the Guadalupe-Blanco River Authority (GBRA) and UGRA staff in the years of 2006, 2008, 2009, and 2010. The monitoring event collected in 2006 utilized historical Receiving Water Assessment (RWA) sampling protocols that were published by the TCEQ in 1999. The assessed monitoring events from 2008, 2009 and 2010 were collected utilizing the Aquatic Life Monitoring (ALM) protocols defined in the TCEQ Surface Water Quality Monitoring Procedures Manual Volume 2 that was published in June of 2007. In order to evaluate designated aquatic life uses, bioassessments of aquatic assemblages must be collected during a TCEQ defined Index Period that encompasses the period of time from March 15th to October 15th of a given year. An ALM event also includes monitoring during the TCEO defined critical period from July 1st to September 30th, when streamflow and dissolved oxygen levels are usually at their lowest levels. This segment of the Guadalupe River is assessed against the designated Excellent Aquatic Life Use. The TCEO utilizes an Index of Biotic Integrity (IBI) tool that was developed from multiple biological statistics to quantitatively assess the health of a biological community in an ecological region. The TCEQ averaged the index of biotic integrity (IBI) scores from each of the four collection events for the assessment categories of fish community, microbenthic community, and biological habitat. No concerns were noted for the fish community and macroinvertebrate community at this time. The average of the habitat IBI scores for these four events was assessed at 23.5 with a coefficient of variance of 2.45. This score was slightly below an exceptional habitat IBI score of 26. A more recent aquatic life monitoring event was conducted by GBRA and UGRA at station 15111 in 2015 utilizing the current iteration of SWQM Procedures updated in 2014. The 2015 event confirmed that the previously assessed habitat concern continues to persist with an average Habitat IBI score of 19.5 and a coefficient of variance of 3.63. These habitat IBI scores were particularly influenced by flow conditions at the time of the assessment. This event also found that the fish community IBI average of 38.5 with a coefficient of variance of 5.51 was below the designated exceptional IBI score of 52, but the average IBI of 37 for macroinvertebrate community was greater than the exceptional IBI criteria of 36. The 2015 ALM was heavily affected by drought conditions and the stream flows for both the critical period (15.4 cfs) and index period (3.7 cfs) events were well below the statistically determined low flow for seven consecutive days within a two year interval of recurrence (702) of 27.1 cfs for this segment. The stream flow conditions during the 2015 aquatic life monitoring event may indicate that it was not representative of normal conditions and further monitoring during moderate flows may be warranted to confirm any findings regarding designated aquatic life uses.

The next downstream station in AU 1806_07 is 12618 located on the Guadalupe River at Nimitz Lake Dam (formerly called UGRA Lake Dam). Data from May 2003 - August 2015 was evaluated and average stream flow during this time was 90 cfs with a decreasing trend over time. This station has the lowest E. coli geometric mean of any location in the Guadalupe River above Flat Rock Lake with a concentration of only 6 cfu/100 mL. Due to the long term excellent water quality at this location (Table 2) with little variability, UGRA discontinued Clean Rivers Program monitoring this station in FY16. The station is still included in a UGRA funded weekly summer E. coli sampling program.

Assessment Unit 1806 06 represents a reach in the City of Kerrville from the confluence of Town Creek to 1 mile downstream and includes 3 routinely monitored stations in Louise Havs Park. The 2014 Texas Integrated Report indicates no impairments or concerns for this AU. The most upstream station is 16244 at the Louise Hays Park Footbridge (Table 3), approximately 270 yards downstream is station 12617 at the SH 16 Bridge (Table 4), and approximately 175 vards further downstream is station 16243 at the Louise Hays Park Dam (Table 5). Analysis of the data from May 2003 to December 2016 show E. coli geometric mean concentrations below the contact recreation standard of 126 cfu/100 mL.

As mentioned previously, this AU was the focus of a multi-year Implementation Plan to address bacteria concentrations that did not meet standards. The 2014 Texas Integrated Report results showed the first time in over 10 years that this AU met bacteria standards. Challenges remain for this AU to continue to meet bacteria goals because it is adjacent to the most urbanized section of the City of Kerrville and receives stormwater runoff from the urban watershed. Additionally, non-native Egyptian geese populations continue to increase in Louise Hays Park. UGRA along with the City of Kerrville promote the message of "Don't feed the ducks and geese" through signs, public service announcements, and educational programs, but coordinated removal efforts may be necessary to control the waterfowl populations.

Assessment Unit 1806 05 represents a 2 mile reach from Louise Hays Park downstream to the confluence with Camp Meeting Creek and includes 1 routinely monitored station at G Street (12616). The 2014 Texas Integrated Report indicates no impairments or concerns for this AU and it is situated between the two AUs previously impaired for E. coli bacteria. A regression analysis of the data from May of 2003 to December of 2016 revealed several related water quality trends at this station. The average stream flow during this time at station 12616 was 85 cfs with a decreasing trend over time. This station has experienced decrease over time of Total Suspended Solids (Figure 4), Volatile Suspended

Solids, and Turbidity. The range in values of these parameters is quite small, but the observed decrease could be due to the reduction in stormwater runoff generating rain events during the period of this report. This station has a low E. coli geometric mean concentration of 45 cfu/100 mL. Overall, we continue to see excellent water quality at this location (Table 6).

Assessment Unit 1806 04 represents a 1 mile reach from the confluence with Camp Meeting Creek downstream into Flat Rock Lake and includes 1 routinely monitored station adjacent to Kerrville-Schreiner Park (12615). The 2014 Texas Integrated Report lists no impairments or concerns for this AU. Analysis of the data from February 2003 to December 2016 show E. coli geometric mean concentration of 83 cfu/100 mL and overall excellent water quality at this location (Table 7). Along with 1806 06, this AU was the focus of a multi-year Implementation Plan to address high bacteria concentrations. The 2012 Texas Integrated Report results showed for the first time in 10 years that this AU met bacteria standards and the standards attainment was confirmed in the 2014 Texas Integrated Report as well. Challenges similar to those previously described for 1806_06 also exist for 1806_04 and local stakeholders are working together to mitigate sources that could potentially lead to future increases in bacteria concentrations. Along with AU 1806 06, this section of the Guadalupe River supports a great deal of summertime contact recreation and tourism focused on the river.

Assessment Unit 1806_03 represents a 1 mile reach covering the portion of the Guadalupe River immediately upstream from Flat Rock Dam and there are no sites currently being monitored in this assessment unit.

TRIBUTARIES TO SEGMENT 1806

Segment 1806A, Camp Meeting Creek is an unclassified water body ranging from the confluence near Flat Rock Lake in Kerrville to the upstream perennial portion of the stream and is approximately 6 miles long. The stream contains two assessment units, but only one station (12546) in the lower AU (1806A 01) has been routinely monitored by UGRA. The 2014 Texas Integrated Report lists no impairments for this segment, but a concern for depressed dissolved oxygen was identified for 1806A_01. Station 12546 is located at the SH 173 crossing of Camp Meeting Creek. A regression analysis of the data from February 2003 to December 2016 revealed several water quality trends at this station. The average stream flow during this time at station 12546 was 1.3 cfs. The station experienced an increase in Sulfate (Figure 5) and on several occasions, the individual values exceeded the 50 mg/L screening criteria for Sulfate (Table 8). Many of the highest Sulfate values observed were associated with extremely low flows and no elevated Sulfate levels were observed at the closest station (12615) on the Guadalupe River directly downstream from the confluence with Camp Meeting Creek. A decrease in dissolved oxygen was also observed over time (Figure 6) and this could be linked to a decrease in flow during the period evaluated. A site specific criteria for dissolved oxygen is approved for Camp Meeting Creek and applies from July 1st to September 30th (minimum dissolved oxygen criterion of 2.0 mg/L and a 24hour average of 4.0 mg/L). Average and maximum Total Dissolved Solids (calculated from specific conductance measurement) values exceeded the screening criteria of 400 mg/L. The high concentrations of Total Dissolved Solids are most likely due to reduced flows as a result of drought conditions. The E. coli geometric mean from 2003-2016 was 130 cfu/100 mL which exceeds the contact recreation standard of 126 cfu/100 mL. An increasing trend in E. coli bacteria concentration was also observed during this time (Figure 7). The 2014 Texas Integrated Report showed a geometric mean value of 103 cfu/100 mL for this AU during that report's period, however. Currently, the site is not listed as impaired for elevated bacteria levels. however the geometric mean of the assessed data is expected to exceed the contact recreation standard during future iterations of the report. Camp Meeting Creek shares many of the same challenges as Town Creek and Ouinlan Creek that will be discussed

CONTINUED ON PAGE 20

in a subsequent section. All three watersheds are densely populated, and the streams have intermittent and overall very low flow. The watershed immediately upstream of sampling station 12546 on Camp Meeting Creek is a subdivision with a golf course that is home to an increasing number of Egyptian geese. The nuisance waterfowl and stormwater runoff concerns previously discussed in 1806_06 are factors that influence water quality in Camp Meeting Creek as well.

Segment 1806D, Quinlan Creek is an unclassified waterbody in the City of Kerrville with very intermittent flow and is approximately 8 miles long. The stream consists of one assessment unit (1806D_01) and one station that is routinely monitored by UGRA (12541). Many of the bacteria samples considered in the 2014 Texas Integrated Report were collected during times of extreme low flow from a stagnant pool. The 2014 Texas Integrated Report lists this segment as impaired for the bacteria geometric mean value exceeding the state standard for contact recreation. A concern for depressed dissolved oxygen was also identified. Station 12541 is located on Ouinlan Creek near the old Travis Street Bridge adjacent to Schreiner University in Kerrville. Data from February 2005 to December 2016 was examined to identify water quality trends at this station (Table 9). The average stream flow during this time at station 12541 was 0.8 cfs. This station has experienced an increase in Specific Conductance (TDS is calculated from this measurement) with several

of the most recent values exceeding the screening criteria (Figure 8). The E. coli geometric mean from 2003-2016 was 300 cfu/100 mL which exceeds the contact recreation standard of 126 cfu/100 mL. The 2010 Texas Integrated Report first listed this AU as impaired for elevated bacteria levels that do not meet the contact recreation standard and each subsequent Integrated Report has confirmed that impairment. Additionally, a concern for depressed dissolved oxygen was also identified in the 2014 Integrated Report.

Segment 1806E. Town Creek is an unclassified waterbody in the City of Kerrville with very intermittent flow and is approximately 9 miles long. The stream consists of one assessment unit (1806E 01) and one station that is routinely monitored by UGRA (12549). Many of the bacteria samples considered in the 2014 Texas Integrated Report were collected during time of extreme low flow. The 2014 Texas Integrated Report lists this segment as impaired for the bacteria geometric mean value exceeding the state standard for contact recreation. Station 12549 is located on Town Creek near the intersection of Lowry Street and Hamilton Street in Kerrville. A concern for depressed dissolved oxygen was also identified. Data from February 2005 to December 2016 was examined to identify water quality trends at this station (Table 10). The average stream flow during this time at station 12549 was 2.1 cfs. This station has experienced an increase in Specific Conductance (TDS is calculated from this measurement) with several of the most recent values exceeding the screening criteria (Figure 9). The E. coli geometric mean from 2003-2016 was 267 cfu/100 mL which exceeds the contact recreation standard of 126 cfu/100 mL. The 2010 Texas Integrated Report first listed this AU as impaired for elevated bacteria levels that do not meet the contact recreation standard and each subsequent Integrated Report has confirmed that impairment. Additionally, a concern for depressed dissolved oxygen was also first identified in the 2010 Integrated Report.

Many of the implementation measures put in place to address the bacteria impairment in 1806_06 and 1806_04 addressed pollution sources for the Quinlan and Town Creek watersheds. When both creeks were identified as impaired for bacteria through the Texas Integrated Report assessment process, development of their individual pollution loads was required. Therefore. a Technical Support Document for Total Maximum Daily Loads for Indicator Bacteria in Quinlan Creek and Town Creek was developed in 2017 and was included in the January 2018 update to the Texas Water Quality Management Plan. The Implementation Plan revision process currently underway by UGRA will reference this new report and continue to work to develop strategies to address high E. coli bacteria levels in Quinlan Creek and Town Creek.

Segment 1816, Johnson Creek extends from the confluence with the

Guadalupe River in Ingram to SH 41 in western Kerr County and is approximately 21 miles long. The segment consists of one assessment unit (1816_01) and one monitoring station that is routinely monitored by UGRA (12678). There is one USGS gage located in this AU, approximately 3.5 miles upstream from site 12678. The 2014 Texas Integrated Report has no impairments or concerns listed for Segment 1816. Station 12678 is located immediately upstream of the SH 39 Crossing in Ingram. A regression analysis of the data from February 2003 to December 2016 revealed several water quality trends at this station. The average stream flow during this time at station 12678 was 41 cfs and had a decreasing trend over time (Figure 10). The station experienced an increase in E. coli (Figure 11), Turbidity, Total Suspended Solids, and Chlorides over time. A decrease in Nitrate was also observed (Figure With the exception of E. coli, 12). all of the observed changes in water quality parameters showed significant correlations with stream flow and were most likely a result of drought conditions. This station has a low E. coli geometric mean concentration of 56 cfu/100 mL. Overall, this station has excellent water quality (Table 11) including low nutrient levels and little variation exhibited over time. The land use in the Johnson Creek watershed is rural with very low density residential development and some camps upstream of Ingram. The scenery and recreational opportunities attract many people to segment 1816. In fact,

site 12678 is a very popular swimming hole for local residents.

Segment 1817, North Fork Guadalupe River extends from the confluence with the Guadalupe River in Hunt to a point past Boneyard Draw in western Kerr County and is approximately 29 miles long. The segment consists of one assessment unit (1817_01) and one monitoring station that is routinely monitored by UGRA (12682). There is one USGS gage located in the AU, approximately 0.5 miles downstream from site 12682. The 2014 Texas Integrated Report has no impairments or concerns listed for Segment 1817. Station 12682 is located at the Waldemar Crossing on FM 1340 in Hunt approximately 6 miles upstream from the confluence with the South Fork. A regression analysis of the data from February 2003 to December 2016 revealed several water quality trends at this station. The average stream flow during this time at the associated USGS gage was 22 cfs and had a decreasing trend over time. The station experienced a decrease in Volatile Suspended Solids, Specific Conductance, and Nitrate (Figure 13) over time. An increase in Chloride and pH (Figure 14) was also observed. Significant correlations with stream flow were found for all these parameters, and the observed changes over time were most likely the result of drought conditions. This station has a low E. coli geometric mean concentration of 32 cfu/100 mL. Overall, this station has excellent water quality with little nutrient loading (Table 12) and the segment

maintains an exceptional aquatic life use designation. The North Fork Guadalupe River watershed is rural with very low density residential development. Many Hill Country summer camps are located in segment 1817 due to the beautiful scenery and numerous recreational opportunities.

Segment 1818, South Fork Guadalupe River extends from the confluence with the Guadalupe River in Hunt to a point upstream of FM 187 in western Kerr County and is approximately 27 miles long. The segment consists of five assessment units (1818 01 -1818_05), but only the most downstream AU (1818_01) contains a station (12684) that is routinely monitored by UGRA. There are no USGS gages located in the segment. The 2014 Texas Integrated Report identified a concern for depressed dissolved oxygen for this segment. However, more recent data suggests that this concern will not persist into the next assessment period, as stream flows return to normal following several years of drought conditions. Station 12684 is located at the SH 39 crossing in Hunt just upstream from the confluence with the North Fork Guadalupe River adjacent to Hunt Lion's Park. A regression analysis of the data from February 2003 to December 2016 revealed several water quality trends at this station. The average stream flow during this time at the associated USGS gage was 22 cfs and had a decreasing trend over time. The station experienced an increase in Turbidity, Total Suspended Solids, and



pH over time. This station has a low E. coli geometric mean concentration of 16 cfu/100 mL. Overall, this station has excellent water quality (Table 13) including low nutrient levels and little variation exhibited over time. The land use in the South Fork Guadalupe River

watershed is rural with very low density residential development. Much like the North Fork Guadalupe River, segment 1818 is home to numerous Hill Country summer camps promoting various recreational activities.

Table 1

•			General Lice	/2000-12/2010	
Parameter	Mean	Maximum	Minimum	# of Measurements	Screening Criteria
Temperature (° C)	20.7	29.6	9.1	59	30.00
pH	8.0	8.6	7.6	59	6.5 - 9.0
Chloride (mg/L)	16.8	22.2	10.0	55	50.00
Sulfate (mg/L)	10.6	16.3	6.6	55	50.00
Total Dissolved Solids (mg/L)	290	339	257	58	400.00
NH3-N (mg/L)	N/A	N/A	N/A	N/A	0.33
Total Phosphorus (mg/L)	<0.04	0.07	<0.04	55	0.69
Chlorophyll-a (µg/L)	1.2	2.1	<1	54	14.1
Nitrate Nitrogen (mg/L)	0.3	1.04	<0.04	48	1.95
TKN (mg/L)	0.27	0.46	<0.20	21	N/A
		AU 1806_07 Re	creational Use		
<i>E. coli</i> (MPN/100 mL)	31 Geomean	200	3	54	126 Geomean
		AU 1806_07 Ad	uatic Life Use		
Dissolved Oxygen (mg/L)	8.4	12.0	5.5	59	≥4.0 Minimum & ≥ 6.0 Average

Table 3

Station 1	L6244 - Guadaluj	pe River at Louise	Hays Park Footb	ridge 05/2003 - 12/2	016
		AU 1806_06	General Use		
Parameter	Mean	Maximum	Minimum	# of Measurements	Screening Criteria
Temperature (° C)	21.7	31.5	5.3	135	30.00
pН	8.2	8.5	7.9	134	6.5 - 9.0
Chloride (mg/L)	N/A	N/A	N/A	N/A	50.00
Sulfate (mg/L)	N/A	N/A	N/A	N/A	50.00
Total Dissolved Solids (mg/L)	278	346	229	135	400.00
NH3-N (mg/L)	N/A	N/A	N/A	N/A	0.33
Total Phosphorus (mg/L)	N/A	N/A	N/A	N/A	0.69
Chlorophyll-a (µg/L)	N/A	N/A	N/A	N/A	14.1
Nitrate Nitrogen (mg/L)	N/A	N/A	N/A	N/A	1.95
TKN (mg/L)	N/A	N/A	N/A	N/A	N/A
		AU 1806_06 Re	creational Use		
<i>E. coli</i> (MPN/100 mL)	97	>2400	3	207	126 Geomean
	Geomean				
		AU 1806_06 A	quatic Life Use		•
Dissolved Oxygen (mg/L)	8.4	14.0	3.9	135	\geq 4.0 Minimum & \geq

Table 2

		AU 1806_07	General Use		
Parameter	Mean	Maximum	Minimum	# of Measurements	Screening Criteria
Temperature (° C)	22.5	32.0	7.3	137	30.00
pН	8.2	9.0	7.8	135	6.5 - 9.0
Chloride (mg/L)	N/A	N/A	N/A	N/A	50.00
Sulfate (mg/L)	N/A	N/A	N/A	N/A	50.00
Total Dissolved Solids (mg/L)	278	390	228	137	400.00
NH3-N (mg/L)	N/A	N/A	N/A	N/A	0.33
Total Phosphorus (mg/L)	N/A	N/A	N/A	N/A	0.69
Chlorophyll-a (µg/L)	N/A	N/A	N/A	N/A	14.1
Nitrate Nitrogen (mg/L)	N/A	N/A	N/A	N/A	1.95
TKN (mg/L)	N/A	N/A	N/A	N/A	N/A
		AU 1806_07 Re	creational Use		
<i>E. coli</i> (MPN/100 mL)	6	210	<1	193	126 Geomean
	Geomean				
		AU 1806_07 Au	uatic Life Use		
Dissolved Oxygen (mg/L)	7.6	11.7	3.7	137	≥4.0 Minimum & ≥ 6.0 Average

Table 4

Station 12617	' - Guadalupe Rive	er at SH16 05/20	03 - 12/2016	
	AU 1806_06	General Use		
Mean	Maximum	Minimum	# of	Screening Criteria
			Measurements	
22.0	30.5	6.0	153	30.00
8.2	9.7	7.8	152	6.5 - 9.0
N/A	N/A	N/A	N/A	50.00
N/A	N/A	N/A	N/A	50.00
281	370	177	153	400.00
N/A	N/A	N/A	N/A	0.33
N/A	N/A	N/A	N/A	0.69
N/A	N/A	N/A	N/A	14.1
N/A	N/A	N/A	N/A	1.95
N/A	N/A	N/A	N/A	N/A
	AU 1806_06 Re	creational Use		
124	2419	5	216	126 Geomean
Geomean				
	AU 1806_06 Ad	juatic Life Use		
7.9	13.0	4.5	153	\geq 4.0 Minimum & \geq
				6.0 Average
	Station 12617 Mean 22.0 8.2 N/A N/A	Station 12617 - Guadalupe Rive AU 1806_06 Mean Maximum 22.0 30.5 8.2 9.7 N/A N/A MU 1806_06 Re 124 Geomean 4U 1806_06 Ac 7.9 13.0	Station 12617 - Guadalupe River at SH16 05/20 AU 1806_06 General Use Mean Maximum Minimum 22.0 30.5 6.0 8.2 9.7 7.8 N/A N/A N/A Segmean AU 1806_06 Recreational Use T.9 13.0 4.5 </td <td>Station 12617 - Guadalupe River at SH16 05/2003 - 12/2016 AU 1806_06 General Use M of Measurements 22.0 30.5 6.0 153 8.2 9.7 7.8 152 N/A N/A N/A N/A N/A N/A N/A N/A</td>	Station 12617 - Guadalupe River at SH16 05/2003 - 12/2016 AU 1806_06 General Use M of Measurements 22.0 30.5 6.0 153 8.2 9.7 7.8 152 N/A N/A N/A N/A N/A N/A N/A N/A

Table 5

Statio	n 16243 - Guada	alupe River at Loui	ise Hays Park Daı	n 05/2003 - 12/2010	6
		AU 1806_06	General Use		
Parameter	Mean	Maximum	Minimum	# of Measurements	Screening Criteria
Temperature (° C)	21.7	30.4	6.7	135	30.00
pH	8.2	8.6	7.8	134	6.5 - 9.0
Chloride (mg/L)	N/A	N/A	N/A	N/A	50.00
Sulfate (mg/L)	N/A	N/A	N/A	N/A	50.00
Total Dissolved Solids (mg/L)	283	355	235	135	400.00
NH3-N (mg/L)	N/A	N/A	N/A	N/A	0.33
Total Phosphorus (mg/L)	N/A	N/A	N/A	N/A	0.69
Chlorophyll-a (µg/L)	N/A	N/A	N/A	N/A	14.1
Nitrate Nitrogen (mg/L)	N/A	N/A	N/A	N/A	1.95
TKN (mg/L)	N/A	N/A	N/A	N/A	N/A
		AU 1806_06 Re	creational Use		
<i>E. coli</i> (MPN/100 mL)	82 Geomean	2000	3	207	126 Geomean
1		AU 1806_06 Ad	quatic Life Use	1	
Dissolved Oxygen (mg/L)	8.0	12.6	4.5	135	≥4.0 Minimum & ≥ 6.0 Average

Table 7

Statio	n 12615 - Guada	lupe River at Kerr	ville-Schreiner Pa	ark 02/2003 - 12/201	16
		AU 1806_04	General Use		
Parameter	Mean	Maximum	Minimum	# of	Screening Criteria
				Measurements	
Temperature (° C)	22.2	31.1	6.5	191	30.00
pН	8.2	7.5	8.7	190	6.5 - 9.0
Chloride (mg/L)	20.7	34.9	14.1	55	50.00
Sulfate (mg/L)	14.3	25.4	9.4	55	50.00
Total Dissolved Solids	292	390	230	191	400.00
(mg/L)					
NH3-N (mg/L)	N/A	N/A	N/A	N/A	0.33
Total Phosphorus (mg/L)	<0.04	0.24	<0.04	55	0.69
Chlorophyll-a (µg/L)	1.8	8.0	<1	54	14.1
Nitrate Nitrogen (mg/L)	0.35	1.04	<0.05	48	1.95
TKN (mg/L)	0.38	1.22	<0.2	21	N/A
		AU 1806_04 Re	creational Use		
<i>E. coli</i> (MPN/100 mL)	83	4800	3	243	126 Geomean
	Geomean				
	•	AU 1806_04 A	quatic Life Use		
Dissolved Oxygen (mg/L)	8.8	14.2	5.7	191	\geq 4.0 Minimum & \geq
					6.0 Average

Table 6

		AU 1806 05	General Use	,	
Parameter	Mean	Maximum	Minimum	# of Measurements	Screening Criteria
Temperature (° C)	21.9	31.8	6.8	162	30.00
pH	8.3	8.6	7.7	161	6.5 - 9.0
Chloride (mg/L)	18.9	37.6	12.3	54	50.00
Sulfate (mg/L)	12.9	32.7	7.4	54	50.00
Total Dissolved Solids (mg/L)	283	347	235	162	400.00
NH3-N (mg/L)	N/A	N/A	N/A	N/A	0.33
Total Phosphorus (mg/L)	<0.04	0.11	<0.04	54	0.69
Chlorophyll-a (µg/L)	1.5	9.0	<1	53	14.1
Nitrate Nitrogen (mg/L)	0.3	1.0	<0.05	48	1.95
TKN (mg/L)	0.34	0.55	<0.2	22	N/A
		AU 1806_05 Re	creational Use		
<i>E. coli</i> (MPN/100 mL)	45 Geomean	>2400	4	161	126 Geomean
		AU 1806_05 A	quatic Life Use		
Dissolved Oxygen (mg/L)	9.6	13.1	6.4	162	≥4.0 Minimum & ≥ 6.0 Average

Table 8

able o					
S	tation 12546 - 0	amp Meeting Cre	ek at SH 173 02,	/2003 - 12/2016	
		AU 1806A_01	General Use		
Parameter	Mean	Maximum	Minimum	# of	Screening Criteria
				Measurements	
Temperature (° C)	20.4	32	4.7	191	30.00
pH	7.5	8.2	6.8	187	6.5 - 9.0
Chloride (mg/L)	40.1	61.1	14.4	64	50.00
Sulfate (mg/L)	39.7	72.3	12.5	65	50.00
Total Dissolved Solids	467	1,106	150	190	400.00
(mg/L)					
NH3-N (mg/L)	<1	<1	<0.03	9	0.33
Total Phosphorus (mg/L)	0.05	0.71	<0.04	65	0.69
Chlorophyll-a (µg/L)	1.5	9.6	<1	64	14.1
Nitrate Nitrogen (mg/L)	0.65	2.5	<0.05	49	1.95
TKN (mg/L)	0.41	1.0	<0.05	29	N/A
		AU 1806A Rec	reational Use		
<i>E. coli</i> (MPN/100 mL)	130	>2400	3	166	126 Geomean
	Geomean				
		AU 1806A Aqı	iatic Life Use		
Dissolved Oxygen (mg/L)	6.7	13.0	1.8	189	\geq 4.0 Minimum (\geq 2.0
					Minimum Jul-Sep) \geq
					6.0 Average

Table 9

	Station 12541	- Quinlan Creek a	t Travis St. 02/2	005 - 12/2016	
		AU 1806A G	ieneral Use		
Parameter	Mean	Maximum	Minimum	# of Measurements	Screening Criteria
Temperature (° C)	21.8	34.0	5.0	120	30.00
рН	8.0	9.0	6.8	119	6.5 - 9.0
Chloride (mg/L)	N/A	N/A	N/A	N/A	50.00
Sulfate (mg/L)	N/A	N/A	N/A	N/A	50.00
Total Dissolved Solids (mg/L)	387	657	91	120	400.00
NH3-N (mg/L)	N/A	N/A	N/A	N/A	0.33
Total Phosphorus (mg/L)	N/A	N/A	N/A	N/A	0.69
Chlorophyll-a (µg/L)	N/A	N/A	N/A	N/A	14.1
Nitrate Nitrogen (mg/L)	N/A	N/A	N/A	N/A	1.95
TKN (mg/L)	N/A	N/A	N/A	N/A	N/A
		AU 1806A Rec	reational Use		
<i>E. coli</i> (MPN/100 mL)	300 Geomean	>4800	10	102	126 Geomean
ľ		AU 1806A Aqı	uatic Life Use		
Dissolved Oxygen (mg/L)	8.0	18.8	0.5	120	≥4.0 Minimum & ≥ 6.0 Average

	Station 1267	8 – Johnson Creek	at SH39 02/20	03 - 12/2016	
		AU 1816 G	eneral Use		
Parameter	Mean	Maximum	Minimum	# of	Screening Criteria
				Measurements	
Temperature (° C)	20.9	31.0	7.9	73	30.00
pH	8.1	9.4	7.6	72	6.5 - 9.0
Chloride (mg/L)	24.9	32.7	13.0	55	50.00
Sulfate (mg/L)	13.0	27.0	9.0	55	50.00
Total Dissolved Solids	304	390	234	73	400.00
(mg/L)					
NH3-N (mg/L)	N/A	N/A	N/A	N/A	0.33
Total Phosphorus (mg/L)	<0.04	0.12	<0.04	55	0.69
Chlorophyll-a (µg/L)	1.4	10.5	<1.0	54	14.1
Nitrate Nitrogen (mg/L)	0.48	1.18	<0.05	48	1.95
TKN (mg/L)	0.27	0.48	<0.20	21	N/A
	·	AU 1806A Rec	reational Use		
<i>E. coli</i> (MPN/100 mL)	56	345	4	125	126 Geomean
	Geomean				
		AU 1806A Aqı	uatic Life Use		
Dissolved Oxygen (mg/L)	8.2	11.7	5.8	73	\geq 4.0 Minimum & \geq
					6.0 Average

Table 13

Station 1268	34 – South Fork Gu	iadalupe River Ad	jacent to Hunt Lie	on's Park 02/2003 - 1	2/2016
		AU 1818_01	General Use		
Parameter	Mean	Maximum	Minimum	# of Measurements	Screening Criteria
Temperature (° C)	19.6	29.1	7.8	55	30.00
pН	7.9	8.1	7.4	55	6.5 - 9.0
Chloride (mg/L)	10.8	36.2	7.1	55	50.00
Sulfate (mg/L)	8.5	15.3	4.6	55	50.00
Total Dissolved Solids (mg/L)	276	330	239	55	400.00
NH3-N (mg/L)	N/A	N/A	N/A	N/A	0.33
Total Phosphorus (mg/L)	<0.04	0.06	<0.04	55	0.69
Chlorophyll-a (µg/L)	1.2	5.6	<1.0	54	14.1
Nitrate Nitrogen (mg/L)	0.20	0.74	<0.04	48	1.95
TKN (mg/L)	0.29	0.54	<0.2	21	N/A
		AU 1818_04 Re	creational Use		
<i>E. coli</i> (MPN/100 mL)	16 Geomean	310	<1	54	126 Geomean
		AU 1818_04 Au	quatic Life Use		
Dissolved Oxygen (mg/L)	7.9	10.9	4.8	55	≥4.0 Minimum & ≥ 6.0 Average

Table 12

Table 11

Statio	on 12682 - North	Fork Guadalupe I	River at Waldema	r 02/2003 - 12/2016	1
		AU 1817 G	eneral Use		
Parameter	Mean	Maximum	Minimum	# of Measurements	Screening Criteria
Temperature (° C)	19.9	28.2	8.4	55	30.00
pH	7.8	8.1	6.6	55	6.5 - 9.0
Chloride (mg/L)	9.9	12.0	6.1	55	50.00
Sulfate (mg/L)	6.5	13.0	4.4	55	50.00
Total Dissolved Solids	255	341	216	55	400.00
(mg/L)					
NH3-N (mg/L)	N/A	N/A	N/A	N/A	0.33
Total Phosphorus (mg/L)	<0.04	0.20	<0.04	55	0.69
Chlorophyll-a (µg/L)	1.6	23.6	<1.0	54	14.1
Nitrate Nitrogen (mg/L)	0.31	0.80	<0.05	48	1.95
TKN (mg/L)	0.33	0.68	<0.20	21	N/A
		AU 1806A Rec	reational Use		
<i>E. coli</i> (MPN/100 mL)	32	>2400	2	125	126 Geomean
	Geomean				
		AU 1806A Aqu	atic Life Use		
Dissolved Oxygen (mg/L)	7.8	11.2	5.0	55	\geq 4.0 Minimum & \geq
					6.0 Average

Table 13

5(40011200	- Jouri Fork du		ματοπτιν παπι επ	011 5 F alk 02/ 2003 - 1	2/2010
		AU 1818_01	General Use		
Parameter	Mean	Maximum	Minimum	# of Measurements	Screening Criteria
Temperature (° C)	19.6	29.1	7.8	55	30.00
pН	7.9	8.1	7.4	55	6.5 - 9.0
Chloride (mg/L)	10.8	36.2	7.1	55	50.00
Sulfate (mg/L)	8.5	15.3	4.6	55	50.00
Total Dissolved Solids (mg/L)	276	330	239	55	400.00
NH3-N (mg/L)	N/A	N/A	N/A	N/A	0.33
Total Phosphorus (mg/L)	<0.04	0.06	<0.04	55	0.69
Chlorophyll-a (µg/L)	1.2	5.6	<1.0	54	14.1
Nitrate Nitrogen (mg/L)	0.20	0.74	<0.04	48	1.95
TKN (mg/L)	0.29	0.54	<0.2	21	N/A
		AU 1818_04 Re	creational Use		
<i>E. coli</i> (MPN/100 mL)	16 Geomean	310	<1	54	126 Geomean
		AU 1818_04 Ad	quatic Life Use		
Dissolved Oxygen (mg/L)	7.9	10.9	4.8	55	≥4.0 Minimum & ≥ 6.0 Average

Figure 1



Figure 2









Figure 5



Figure 6



Figure 7



Figure 8



Figure 9





Figure 11







Figure 13



Figure 14

