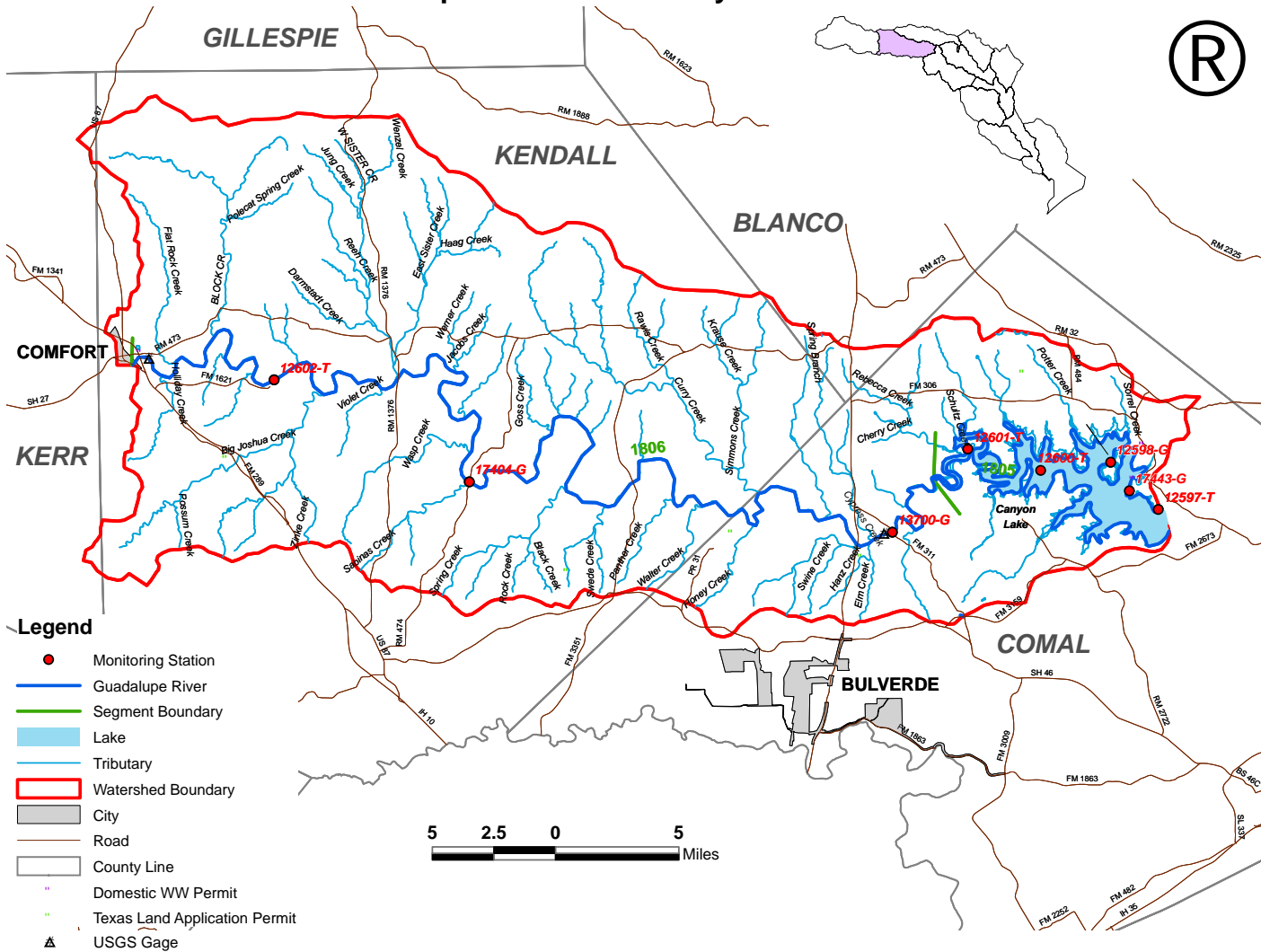


Guadalupe River Above Canyon Lake



12602-T	Guadalupe River at FM 1621 in Waring
17404-G	Guadalupe River at FM 474
13700-G	Guadalupe River at FM 311 in Spring Branch
12601-T	Canyon Lake at Cranes Mill Park (upper reservoir)
12600-T	Canyon Lake at Potter's Creek Park (mid-reservoir)
12598-G	Canyon Lake near the Canyon Lake Marina
17142-G	Canyon Lake at the Jacob's Creek Park
12567-T	Canyon Lake at the dam (lower reservoir)

Sampling sites are labeled in red followed by the letter G (GBRA), T (TCEQ), U (UGRA) or W (Wimberley) indicating who is the monitoring entity.

Guadalupe River Above Canyon Lake

Drainage Area: 596 square miles

Streams and Rivers: Guadalupe River from Comfort to Canyon Lake, Joshua Creek, Flat Rock Creek, Rebecca Creek, Block Creek, West Sister Creek

Lake: Canyon Lake

Aquifer: Trinity

River Segments: 1805, 1806

Cities: Comfort, Kandalia, Bergheim, Bulverde, Canyon City, Spring Branch, Startzville

Counties: Kerr, Comal, Kendall, Blanco

EcoRegion: Edwards Plateau

Vegetation Cover:

Evergreen Forest - 43.6% Shrublands - 11.0%
Grass/Herbaceous - 31.3%

Climate:

Average annual rainfall: 32 inches
Average annual temperature: January 38° July 95°

Land Uses: Urban, Unincorporated Suburban Sprawl, Cattle, Goat and Sheep Production, Light and Heavy Industry, and Recreational

Water Body Uses: Aquatic Life Use, Contact Recreation Use, General Use, Fish Consumption Use, and Public Water Supply Use

Soils: Dark and loamy over limestone to loam with clay subsoils

Permitted Wastewater Treatment Facilities: Domestic: 3, Land Application: 1, Industrial: 0

Segment 1806, the Guadalupe River above Canyon Lake, extends from the lake in Comal County, through Kendall County, to the confluence with the north and south forks of the Guadalupe River in Kerr County. For ease in discussing the historical data and understanding the contributing watershed, the segment is separated into two parts in this report. The lower subsegment, which begins below the city of Comfort is separated into three assessment units: the lower 25 miles in Comal County; from the lower 25 miles to the confluence with Big Joshua Creek in Kendall County; and, from the confluence with Big Joshua Creek to the monitoring site near the city of Comfort. (Refer to the Upper Guadalupe River above Comfort for discussion on the water quality of the upper portion of Segment 1806.)

The satellite image (figure 1) of the segment near FM 474 shows the diversity of the land use which is made up of unimproved brush, improved pasture and row crops, and urbanization, in the form of new subdivisions. Some of the large ranches are used for cattle and goat grazing, but many are leased for hunting. Guadalupe River State Park is located in this segment.



Figure 1 is a satellite image of segment near FM 474 (17404).

Several entities have been monitoring the lower portion of Segment 1806 since the 1990s. GBRA has two monitoring sites within the lower subsegment, the Guadalupe River at FM 311 in Spring Branch (13700), which has been monitored monthly since 1996 and the Guadalupe River at FM 474 (17404), in Kendall County, which has been a quarterly monitoring location since October 2001. Each of the monitoring sites is located in the two lower assessment units. TCEQ has a routine site in the upper assessment unit, located at the Guadalupe River at Waring, that they have been monitoring quarterly since 1999. The US Geologic Survey collected water quality data in this subsegment in the 1990s. GBRA added a quarterly, systematic site on the Big Joshua Creek, in 2001 through 2003, in response to concerns of local stakeholders that a shooting range may be having an impact on water quality in the creek. The Upper Guadalupe River Authority sampled the Guadalupe River at the IH10 crossing in Comfort as part of their "swimability" study

from 2002 until 2006. As part of that study, UGRA collected fecal coliform bacteria, and then switched to *E. coli*, along with turbidity, weekly, during the summer months of each year. The median instantaneous **flow** at the Spring Branch site during the historical record of sampling events was 232 cubic feet per second (cfs) and 127 cfs at the FM 474 site. At Waring, the median flow was 154 cfs, slightly higher than at FM 474.

The Kendall County Water Control and Improvement District operates the wastewater treatment plant for the city of Comfort. The plant is the only wastewater discharge to this portion of Segment 1806, and is located at the most upstream part of the subsegment. The permitted discharge is for 0.35 million gallons per day, with high quality effluent standards of 5 milligrams per liter (mg/L) biochemical oxygen demand, 5 mg/L total suspended solids, 2 mg/L ammonia-nitrogen and 1 mg/L total phosphorus. The plant has been operating under a 210 authorization for beneficial reuse of the effluent on a nearby golf course since 2002.

The 2008 draft Texas Water Quality Inventory listed the middle assessment unit as impaired for bacteria because the geometric mean for *E. coli* at the FM 474 site was 140 organisms per 100 milliliters. The stream standard for contact recreation is a geometric mean of 126 organisms per 100 milliliters. Only two sampling events recorded *E. coli* concentrations over the single sample concentration of 394 organisms per 100 milliliters. Further downstream, the geometric mean for *E. coli* at the Spring Branch site was 45 organisms per 100 milliliters, and in the period of record, four samples were collected that exceeded the single sample *E. coli* standard. Upstream of the FM 474 site, at Comfort, the geometric mean for fecal coliform was 100 organisms per 100 milliliters (stream standard = 200 organisms per 100 milliliters) and the geometric mean for *E. coli* was 55 organisms per 100 milliliters. The TCEQ site located at Waring had a geometric mean for *E. coli* of 56 organisms per 100 milliliters and exceeded the single sample grab criteria two times. The only tributary that was monitored between the Waring site and the FM 474 site was the Big Joshua Creek. The geometric mean for *E. coli* during the 2 year systematic sampling project on the Big Joshua Creek was 58 organisms per 100 milliliters, with no single sample concentrations that exceeded the standard. Figure 2 shows the relationship between flow and *E. coli* at the FM 474 site. When

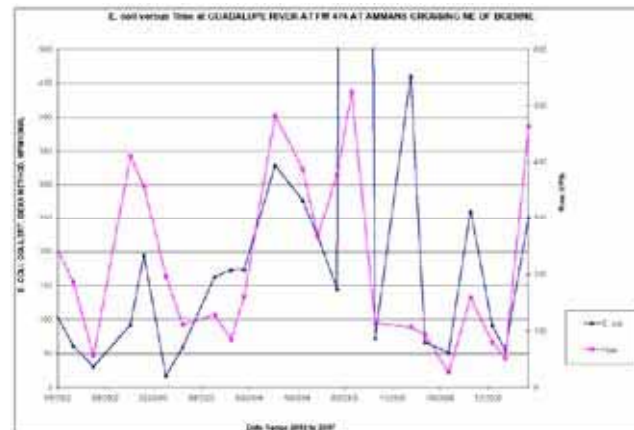


Figure 2. Relationship of *E. coli* and flow at FM 474 (17404).

the site was sampled during high flows there were corresponding elevated bacteria concentrations, pointing to runoff as a source of the contamination. The satellite image of the land use in the area of the sampling site, figure 1, shows that there are improved pastures and land clearing with a thin riparian buffer along the creek and main stem. It is unclear what the land improvements are for but it is apparent that dirt has been moved. Pastures with livestock grazing, land without established grasses (increasing the potential for erosion) and urbanization with impervious cover are possible sources of the nonpoint bacteria loads associated with sediment in runoff.

The median concentrations for dissolved oxygen, beginning at the downstream site at Spring Branch and moving upstream to the Comfort site are 8.9, 9.4 and 9.1 (mg/L), respectively, ranging from a minimum of 6.4 mg/L at the Spring Branch site to a maximum of 13.1 mg/L also at the Spring Branch site. At no time in the period of record did the dissolved oxygen drop below the standard for the minimum dissolved oxygen concentration (4.0 mg/L). The temperature varied between 8.4°C to 31.6°C, with median temperatures of 22°C, 20.9°C and 20.6°C at the three monitoring locations, from downstream to upstream. The **specific conductance** ranged between 178 to 990 micromhos per centimeter, with median conductivities of 500, 545 and 518 micromhos per centimeter. The median pH of the three monitoring sites, from downstream to upstream, were 8.05, 7.92 and 8, ranging from 6.4 to 8.8 standard pH units, falling outside the stream standard range of 6.5 to 9.0 standard units one time at the Spring Branch site (pH of 6.4 measured in June 1993 near median flow). The median concentrations for chloride and sulfate, from downstream to upstream, were 18.6, 18.6 and 21.5 and 21.4, 22.4 and 21.5 mg/L respectively. At no time did the concentration of these dissolved constituents exceed the stream standard of 50 mg/L.

The Big Joshua Creek has comparable pH, temperature, dissolved oxygen and conductivity, with median values that fall in the same range as the three main stem monitoring sites. The creek has slightly lower chloride concentrations but slightly higher sulfate concentrations as compared to the main stem sites.

Nitrate nitrogen, ammonia nitrogen and total phosphorus, were analyzed at the three main stem sites. Over the period of record, nitrate nitrogen was reported under three storet codes, as nitrate nitrogen and in combination with nitrite nitrogen. The median concentrations for all three cited storet codes ranged from 0.38 to 0.83, with the highest median at the upper most main stem site at Waring. Only one monitoring event had a nitrate nitrogen concentration that exceed the screening criteria of 1.95 mg/L. The median ammonia nitrogen concentration at all three sites was below detection limits. The concentration of ammonia nitrogen measured at the main stem sites never exceeded the screening concentration of 0.33 mg/L. The median total phosphorus concentrations were below the limit of quantification for the method at all of the main stem sites. On one occasion, at the Spring Branch site, total phosphorus exceeded the screening concentration of 0.69 mg/L (measured 1.48 mg/L). During that monitoring event the flow was over 12,000 cubic feet per second (median **flow** is approximately 184 cubic feet per second) and the turbidity was 98 nephelometric turbidity units (NTU) (median turbidity is 4.75 NTU). The elevated total phosphorus concentration was most likely due to organically-bound phosphorus in the sediment brought in by rainfall runoff.

The substrate in the main stem transitions from a gravel to bedrock substrate. The water is clear and shallow in the majority of locations along the segment, with very few pools. The suspended solids (TSS) ranged from less than 1 to 278 mg/L, with median concentrations ranging from 3.3 to 10 mg/L at the main stem sites. In most instances, the TSS correlate positively with flow, meaning that the TSS rises when there is elevated flow (figure 3). Since the site is only monitored monthly and is not targeted for stormwater, sampling could have occurred immediately after a rainfall event or several days or weeks after the initial flush of runoff, explaining why there were instances of high flows but no corresponding spike of total suspended solids.

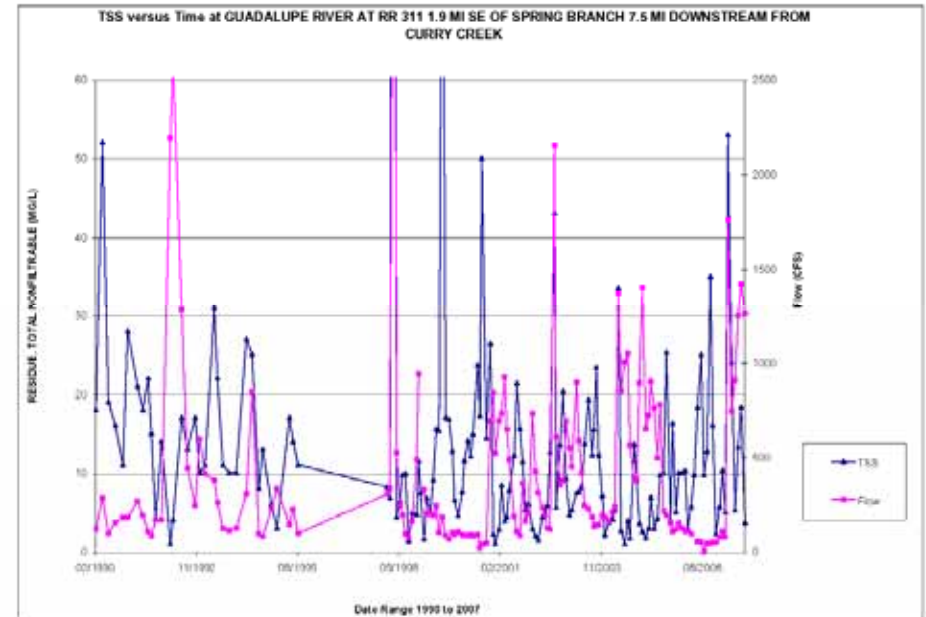


Figure 3. Total suspended solids and flow through the period of historical data collected on the Guadalupe River at Spring Branch.

The median chlorophyll a concentration is less than detection and there was never a measured value above the screening concentration of 14.1 micrograms per liter.