

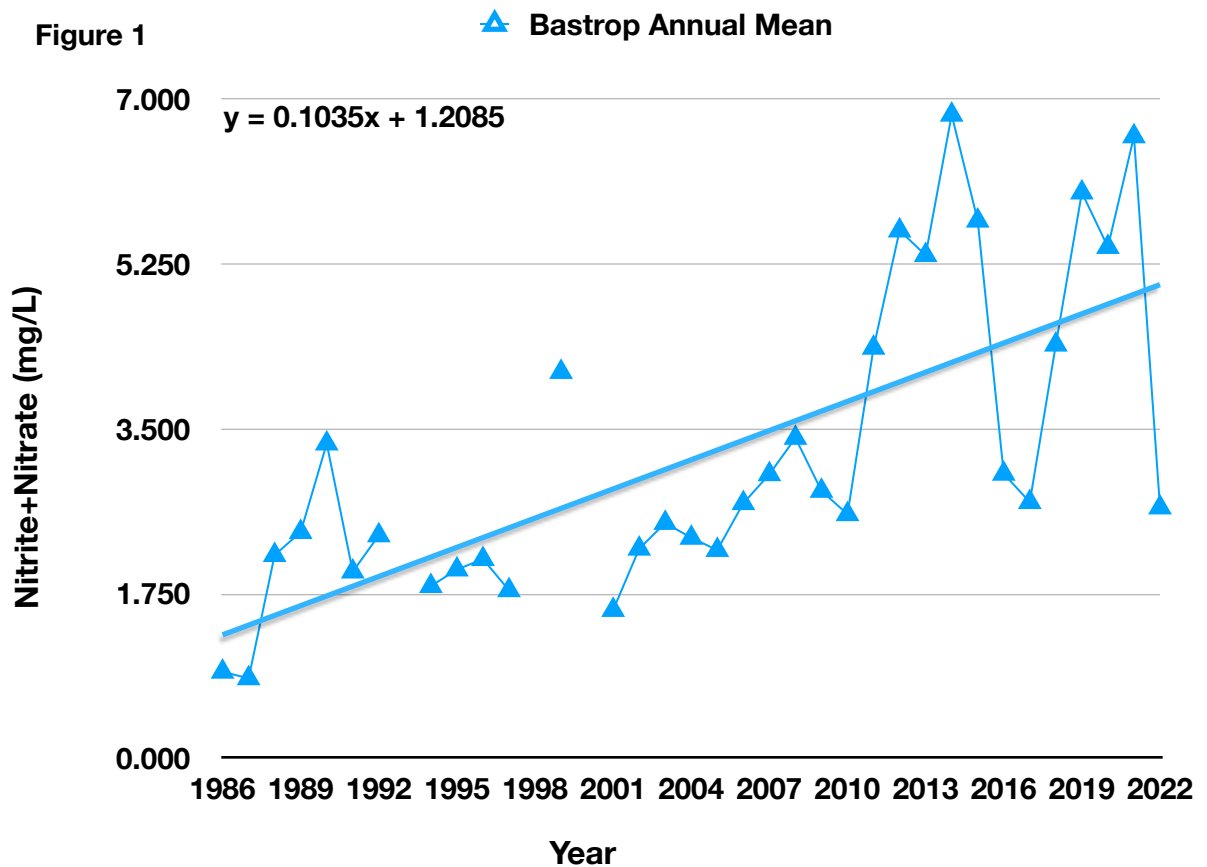
Is the Colorado River an Exceptional Aquatic-Life Use Waterway?
An Analysis of Data from the TCEQ Database
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Abstract

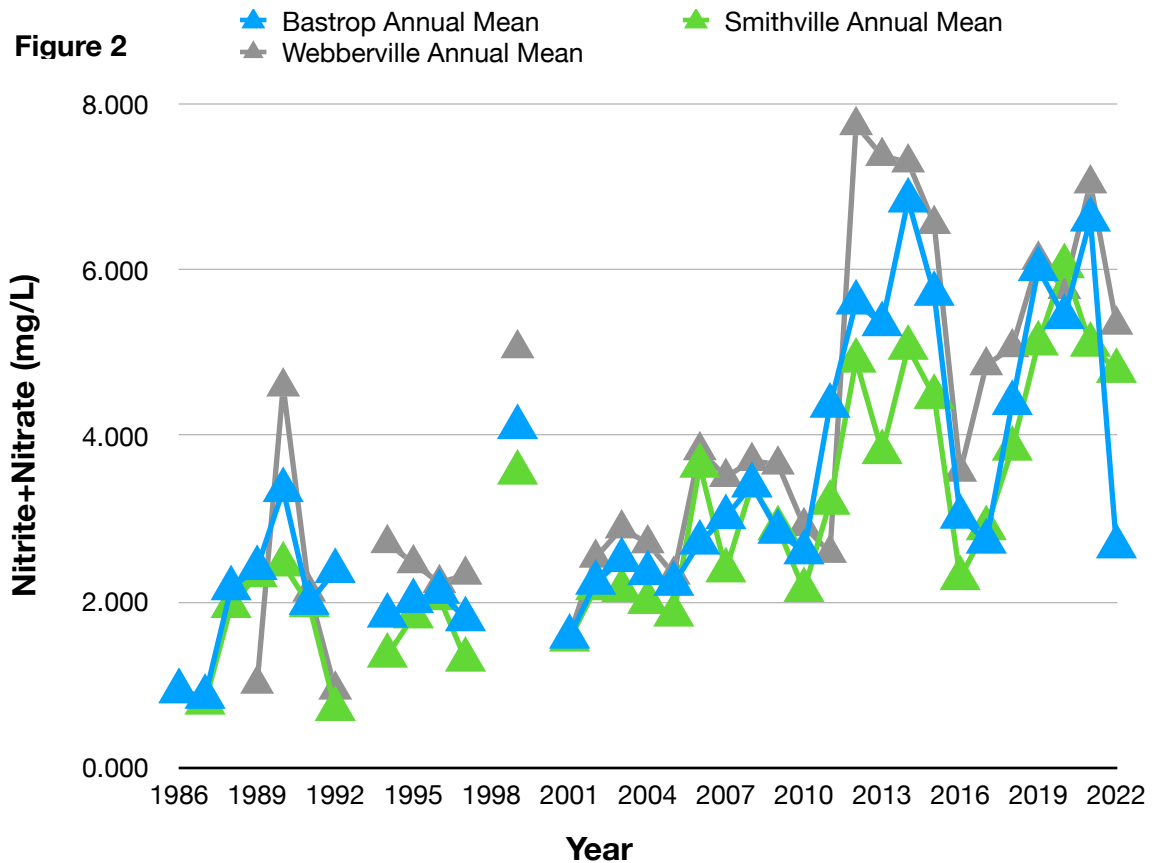
The Colorado River in segments downstream from Lady Bird Lake has long been given the designation “Exceptional Aquatic-Life Use” by TCEQ. However, as amply demonstrated at the Public Meeting held June 1, 2023 concerning the Corix application to amend a wastewater discharge system permit #WQ0013977001, an increasing number of users of the river have expressed concern that water quality has been seriously degraded in recent years. In order to illuminate this question, I have downloaded and analyzed data from the TCEQ-curated water quality database (<https://tceq.maps.arcgis.com/apps/webappviewer>). The results of these analyses, including both macronutrients that enhance bacterial and algal growth, and toxic chemical pollutants, do not fully support the designation “Exceptional Aquatic-Life Use” .

After the Public Meeting concerning the Corix application to amend wastewater discharge system permit #WQ0013977001, held June 1, 2023 in Bastrop County, I submitted a formal response expressing my concerns as to whether the Colorado River is still an exceptional waterway. Specifically, I asked for responses concerning the present and future levels of harmful macronutrients such as nitrate and phosphorus in the river, and the levels of toxic organic and heavy metal pollutants. These questions were not answered in the TCEQ response. Accordingly, I have downloaded water quality data from the TCEQ SWQMIS database and analyzed it for several macronutrients and a variety of toxicants. The following four points indicate that segments 1428 and 1434 of the Colorado River in Bastrop County are in fact not pristine.

1. I have analyzed data for (nitrate+nitrite, parameter code 630) from 3 stations in this stretch of the river: #12466 in Webberville, #12462 in the City of Bastrop, and #12293 in Smithville. (There are currently no active sampling stations closer to the McKinney Roughs site than the Webberville and Bastrop stations). To overcome seasonal bias in the data I have calculated the annual mean of this parameter from 1986 through 2022, leaving out years in which less than three measurements were reported (Table 1). The data from the Bastrop station are plotted in Figure 1, along with the least squares fit to a linear model. It can easily be seen that the concentration of (nitrate+nitrite) has been increasing over this time period at a rate of about 0.1 mg/L/year.



- In Figure 2, the levels for the three stations in this section of the Colorado (Webberville, Bastrop and Smithville) are plotted, showing that the apparent increase analyzed in Figure 1 at the Bastrop site is closely similar to results at all three sites. Preliminary analysis of data from the next nearest stations at Del Valle (#12469) and LaGrange (#12292) gave similar results (data not shown).

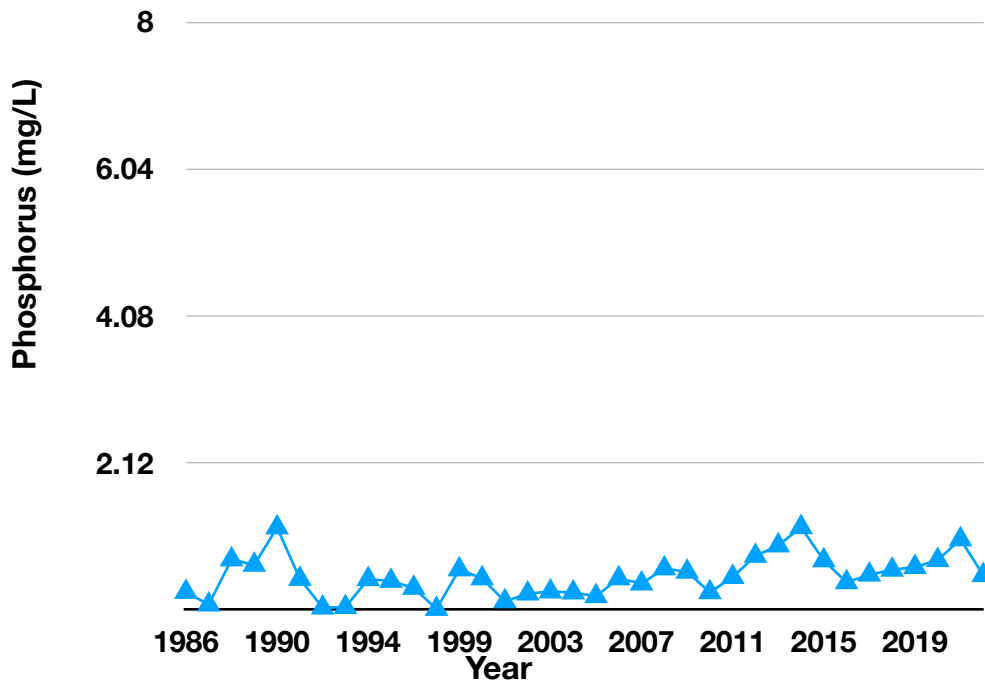


According to Table 2 (Criteria for Specific Toxic Materials, Human Health Protection) in Chapter 307 of the TCEQ’s “Texas Water Quality Standards” document, the maximal, non-toxic level of nitrate, called the criterion level, is 10.0 mg/L. The current overall mean level for the Bastrop station, calculated for the last 5 years (2018-2022), is 5.0 mg/L. Thus the current average level of nitrate in segments 1428 and 1434 is just about half of the criterion level. Indeed, when we look at the individual measurements at station 12462 in Webberville over the past 7 years, the level has exceeded the criterion level in 7 out of 40 assays (17.5%, Table 2). According to the TCEQ’s guidance, these data (greater than 10% of measurements not achieving the criterion) should be cause for listing this segment as “303(d)”. If the outfall of the Corix plant and other plants in the permitting pipeline contribute increased loads of (nitrate+nitrite), exceeding the criterion level will soon be commonplace.

3. I have analyzed (nitrate+nitrite) data for several other exceptional waterways in the region: the South Fork of the San Gabriel River (station 12115 downstream from the Liberty Hill Wastewater plant) and Middle Yegua Creek (Station 11840 at IH35). Looking at 70 South Fork San Gabriel River measurements in the database, covering the period 1987 -2023, the average concentration of (nitrate+nitrite) was 0.42 mg/L; for the last 5 years, the mean was about 1.1 mg/L. This is 5-fold lower than the average value for the same time period for the Colorado River at Bastrop given above. Indeed, (nitrate+nitrite) concentrations in Middle Yegua Creek are even lower. Although the available data are sparse, all 6 measurements in the period 2018-2020 were less than 0.1 mg/L, more than 10-fold lower than at the Colorado stations. Thus, it is not unreasonable to expect the “exceptional”Colorado River to be much cleaner than it is, and to take steps to decrease the rate of increase of this important algal nutrient immediately.
4. I have also analyzed phosphorus levels in the segments 1428 and 1434 of the Colorado River , and compared them to phosphorus levels in the South Fork of the San Gabriel River. Mean annual levels of phosphorus (parameter 665) at station #12462 in the City of Bastrop, are plotted in Figure 3. Phosphorus levels do not appear to be increasing or decreasing over the time period shown. Similar data were found at the other stations in segments 1428 and 1434 (data not shown). The average phosphorus level over the last 5 years (2018-2022) was 0.81 mg/L (n=29). However, over the same time period phosphorus concentrations at station 11840 on Middle Yegua Creek (n=6) and at station 12115 on the South Fork of the San Gabriel River (n=14) were all less than 0.02 mg/L . Thus, although phosphorus concentrations in the Colorado are fairly low and stable, there is clearly room for improvement.

Figure 3

▲ Bastrop Annual Mean



5. Measurements of toxic organic chemicals in segments 1428 and 1434 of the Colorado River have not been reported in the TCEQ database since 1991, almost 33 years ago. In 1990-1991, 13 such chemicals for which TCEQ has established a chronic freshwater benchmark maximum were assayed at the Webberville station (Table 3). For one of these chemicals (aldrin), the measured level was below the benchmark. For the remaining 11 compounds, the assays used were not sensitive enough to detect the compound at the level of the benchmark. For example, the limit of detection for chlordane was 0.4 ppb while the benchmark level was 0.004 ppb, a concentration 100-fold lower. The most extreme example of this kind of deficiency was toxaphene for which the detection limit (also called the limit of quantitation or LOQ) was 5 ppm and the benchmark was about 200,000-fold lower. Thus, with the exception of aldrin, there is no evidence in the TCEQ database that the water did **not** contain toxic levels of these compounds. Similarly, very few measurements of metals in the water at the Webberville station were reported for the period 1990-1996, over 25 years ago (Table 3). For 3 metals (cadmium, lead and silver) the assays used were not sensitive enough to detect the metal at the level of the benchmark. For a fourth metal, manganese, the measured value, 21 ppb, was more than 15-times higher than the benchmark (1.31 ppb). Although this was a single measurement, there does not seem to be any follow-up.

At a time when segments 1428 and 1434 of the Colorado River are being subjected to increased stress from wastewater treatment plants potentially adding large amounts of treated residential waste and industrial waste to the river and its tributaries, it is imperative to establish current baselines for toxic organics and metals, using assay methods that can actually detect the compounds at low but toxic levels. In addition, the data presented in Point # 2 and Table 2 above, indicate that pursuant to TCEQ rules (Texas Integrated Report Assessment Results, 2022, Basin 14, Colorado River, p.2) the Colorado River in segments 1428 and 1434 should be placed into Category 5 and a TMDL should be developed. In summary, TCEQ can no longer afford to assume that the river is exceptional, but needs to provide accurate, timely measurements and develop strategies to overcome deficiencies.

Table 1 Annual Mean Levels in Colorado River

Year	Station #12466 (Nitrite+Nitrate) (mg/L)	Station #12466 Phosphorus (mg/L)	Station #12462 (Nitrite+Nitrate) (mg/L)	Station #12293 (Nitrite+Nitrate) (mg/L)
1986		0.41	0.92	0.91
1987		0.24	0.85	0.78
1988		0.84	2.16	1.95
1989	1.01	0.77	2.41	2.32
1990	4.60	1.27	3.35	2.45
1991	2.12	0.58	1.99	1.96
1992	0.94	0.2	2.37	0.70
1994	2.71	0.58	1.83	1.35
1995	2.46	0.55	2.01	1.82
1996	2.22	0.46	2.12	2.04
1997	2.32	-	1.79	1.30
1999	5.06	0.71	4.11	3.56
2001	1.59	0.28	1.58	1.54
2002	2.53	0.39	2.23	2.16
2003	2.88	0.41	2.50	2.14
2004	2.70	0.4	2.34	2.00
2005	2.32	0.23	2.21	1.84
2006	3.83	0.59	2.71	3.64
2007	3.50	0.52	3.02	2.38
2008	3.70	0.72	3.41	3.40
2009	3.65	0.68	2.84	2.89
2010	2.91	0.4	2.60	2.14
2011	2.59	0.61	4.37	3.19
2012	7.75	0.89	5.61	4.91
2013	7.38	1.03	5.35	3.81
2014	7.30	1.27	6.84	5.07
2015	6.56	0.83	5.72	4.47
2016	3.57	0.54	3.03	2.28
2017	4.85	0.64	2.72	2.89
2018	5.07	0.7	4.40	3.85
2019	6.13	0.74	6.02	5.12
2020	5.77	0.83	5.44	6.05
2021	7.05	1.11	6.61	5.10
2022	5.34	0.63	2.67	4.79

Table 2 (Nitrite +nitrate) levels exceeding the criterion at station 12462

Date	Level (mg/L)			
12/6/17	11.2			
2/8/18	11.8			
10/14/19	11.6			
12/5/19	11.4			
12/14/2020	11.1			
2/2/21	11.6			
4/1/21	12.4			

Table 3 Assays of toxic chemicals at Station 12466			
Compound	TCEQ Chronic Freshwater Criterion Benchmark	Limit of Detection of Assay	Measured Value
	(ppb)	(ppb)	(ppb)
ORGANICS			
aldrin	0.3	–	0.2
chlordan	0.004	<0.4	–
DDD	0.011	<0.3	–
DDE	0.11	<0.2	–
DDT	0.001	<0.3	–
diazinon	0.17	<0.3	–
dieldrin	0.002	<0.1	–
endrin	0.002	<0.2	–
heptachlor	0.004	<0.02	–
heptachlor epoxide	0.0038	<0.06	–
malathion	0.01	<0.4	–
parathion	0.013	<0.25	–
toxaphene	0.0002	<5	–
METALS			
cadmium	0.15	<1 - <4	–
lead	1.17	<2 - <5	–
manganese	1.31	–	21
silver	0.1	<0.5 - <10	–

For aldrin and manganese, the measured value was within the limits of quantitation of the assay. For all other chemicals in the Table, the assay was not sensitive enough to detect samples at the criterion level.