Baylor University

Nutrient and biological assessment of the Blanco River, 2019

Ryan S. King, Ph.D.

Professor and Graduate Program Director
Department of Biology
Center for Reservoir and Aquatic Systems Research
Baylor University, Waco, TX
www.baylor.edu/aquaticlab

Public comment prepared for Blanco City Council, August 2020

CRASR
Center for Reservoir & Aquatic Systems Research

Dr. Ryan S. King: Credentials

- PhD, Duke University, 2001
- Ecologist, Smithsonian Institution, 2001-04
- Professor (Full), Biology, Baylor University
- Outstanding Professor Award, Baylor, 2014
- Expert witness in 8 Federal cases involving environmental pollution
- Published ~100 journal articles and reports
- Research focused primarily on nutrient criteria in streams, with several projects in Texas and surrounding states

Nutrient criteria research in Texas

Linking observational and experimental approaches for development of numerical nutrient criteria for wadeable streams. 2009. Section 104(b)(3) Water Quality Cooperative Agreement #CP-966137-01 **U. S. EPA Region 6**, Dallas, TX.

https://www.baylor.edu/content/services/document.php/95606.pdf

Development of biological indicators of nutrient enrichment for application in Texas streams. 2009. 106 Water Pollution Control Grant # 98665304, **Texas Commission on Environmental Quality**, Austin, TX.

https://www.baylor.edu/content/services/document.php/107739.pdf

Streams < 15 ug/L total phosphorus (TP)

- Very low levels of nuisance filamentous green algae
- High dissolved oxygen
- Exceptional diatom and macroinvertebrate communities
- Exceptional fish communities

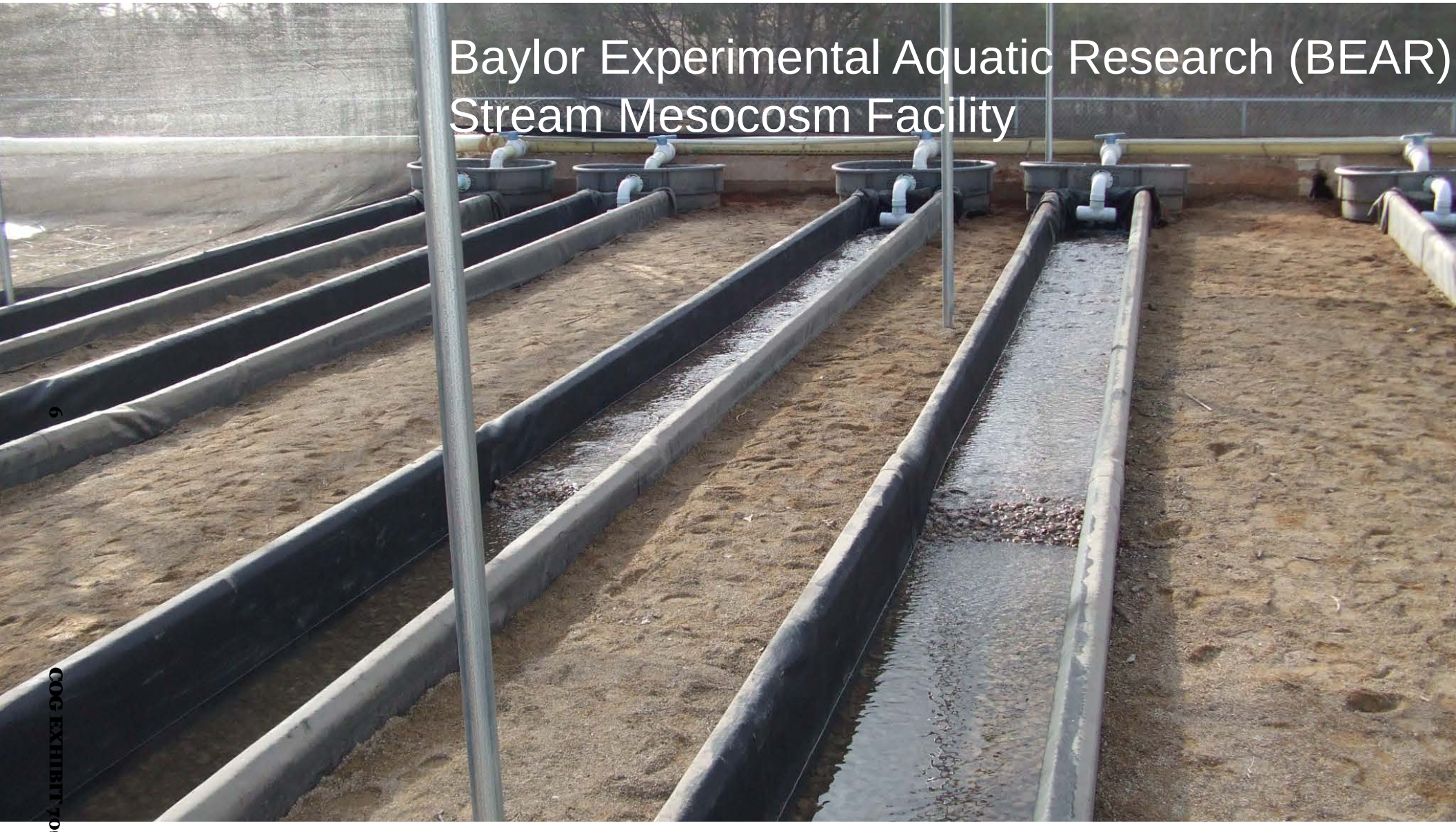
Salado Creek upstream of Salado, TX, 2008

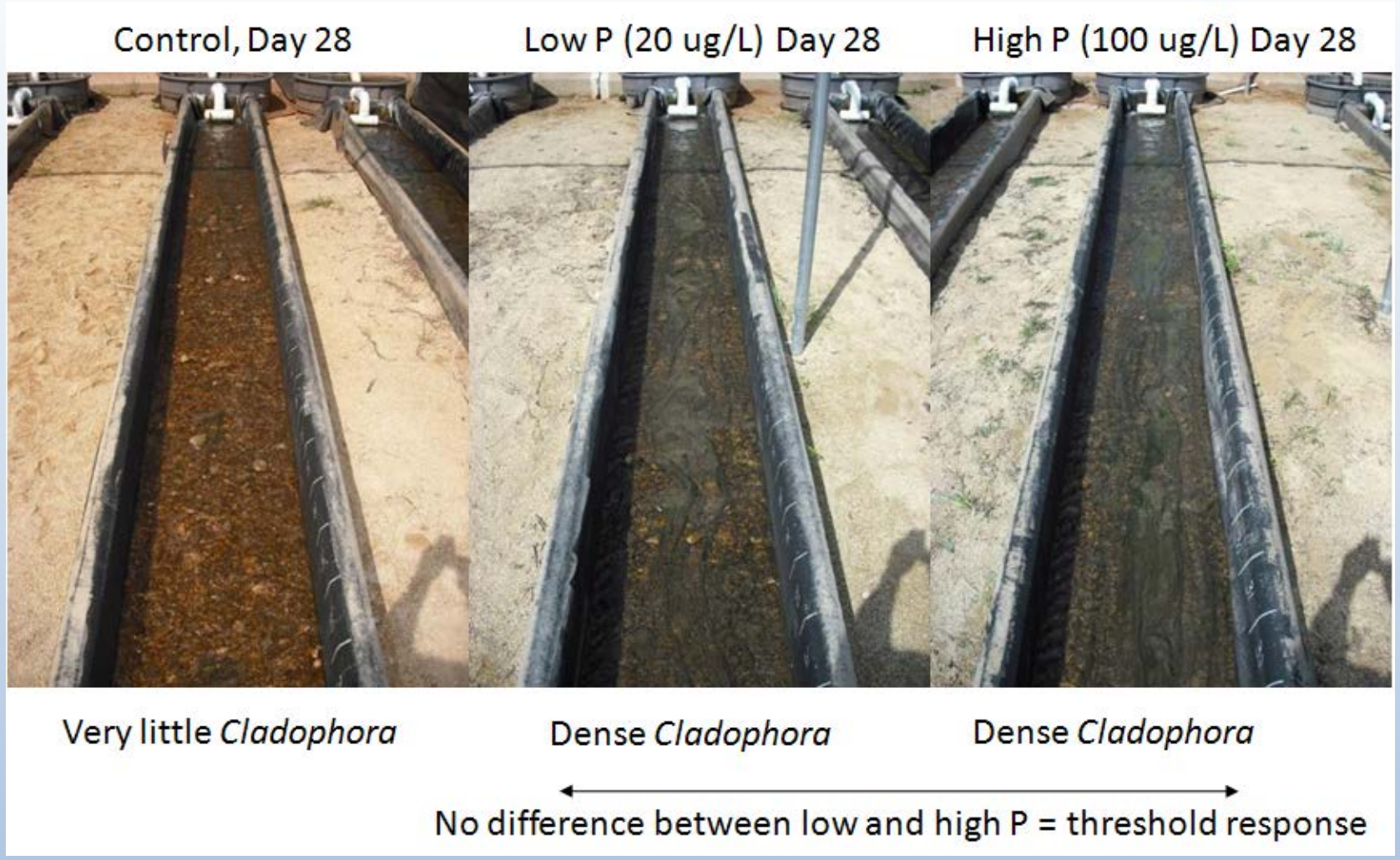
Streams > 20 ug/L total phosphorus

- High levels of nuisance filamentous green algae
- Low dissolved oxygen at night
- Diatom and macroinvertebrate communities typical of overenriched streams
- Fish communities dominated by carp, red shiners

North Bosque River near Stephenville, TX, 2008

Baylor Experimental Aquatic Research (BEAR) Stream Mesocosm Facility





Experiment confirmed that >20 ug/L P caused nuisance algal growth

Cladophora=nuisance green algae

Other nutrient criteria research

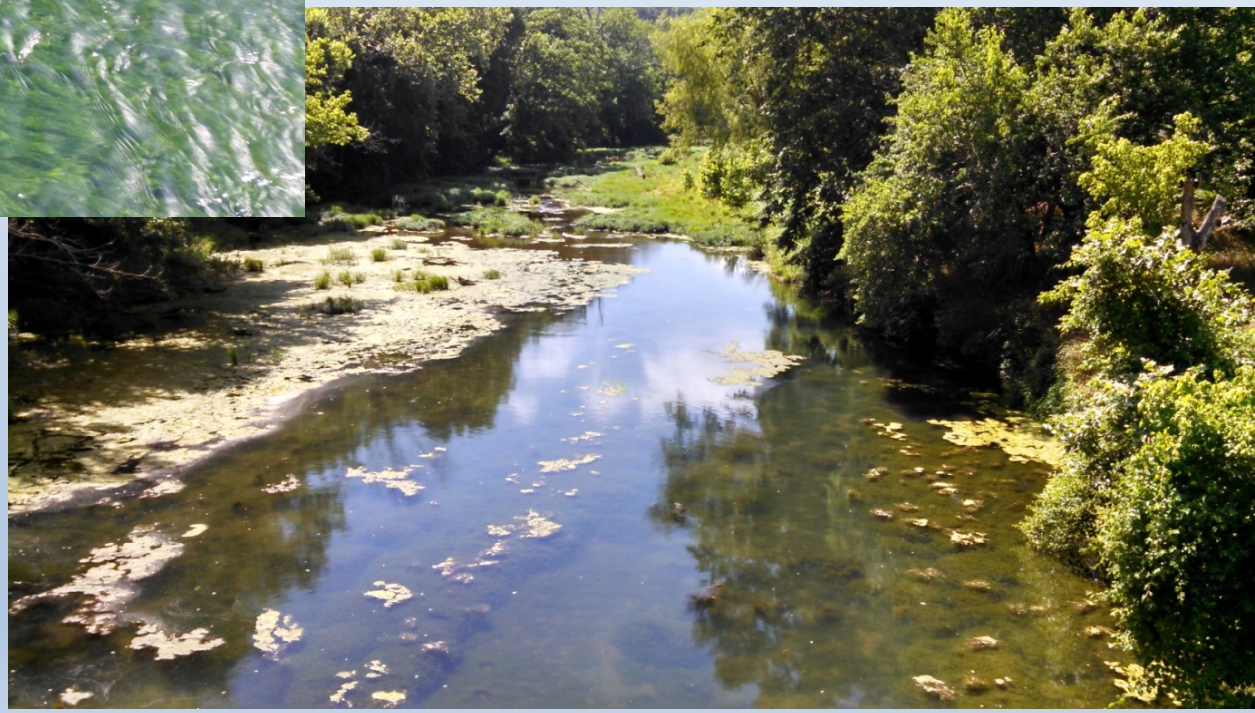
- *Oklahoma-Arkansas Scenic Rivers Joint Phosphorus Study*. Final Report to the Governors from the Joint Study Committee and Scientific Professionals.
- Study based on landmark Supreme Court case
- After 30 years of litigation, this study resulted in unanimous support for a numeric P criterion

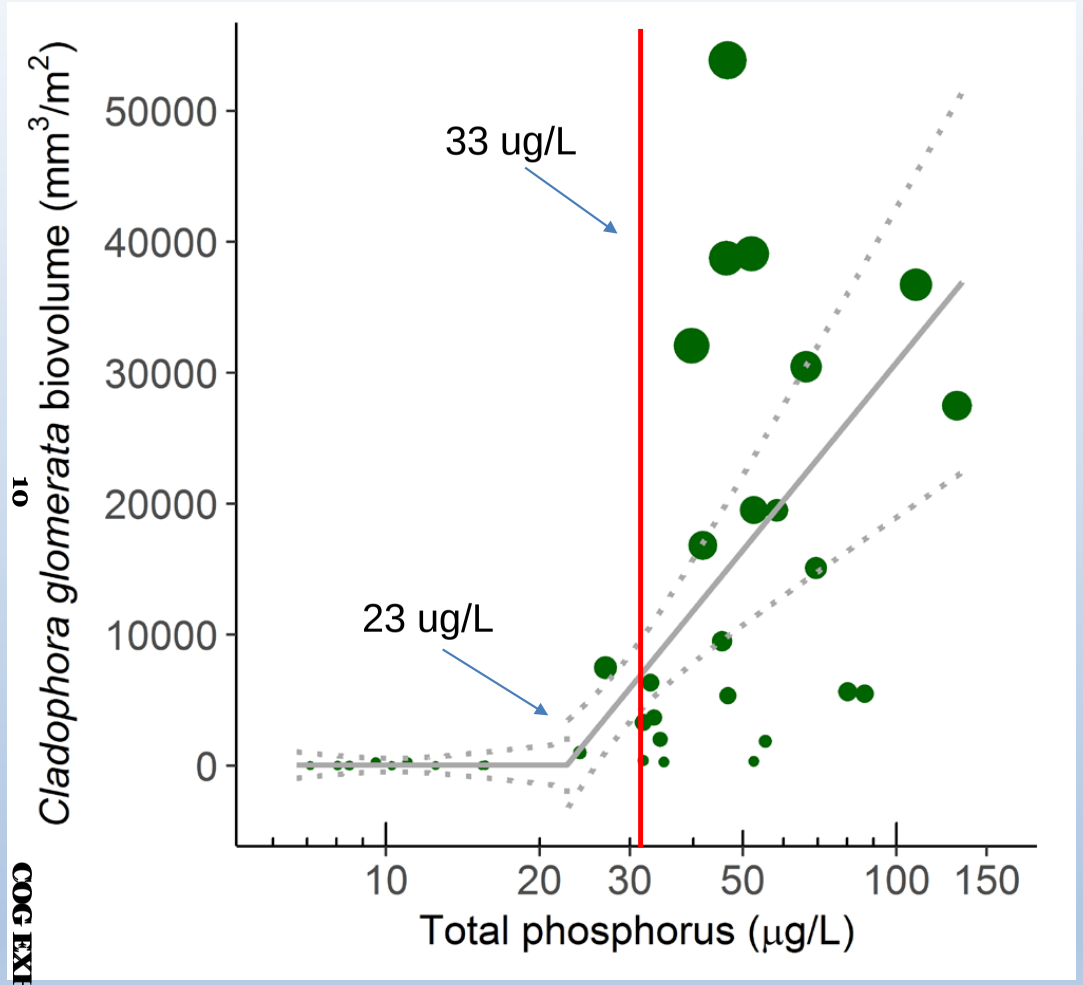
US Supreme Court, 1992

https://www.baylor.edu/aquaticlab/doc.php/302701.pdf

Oklahoma-Arkansas Joint Phosphorus Study focused on “nuisance algae”

Predominantly *Cladophora glomerata*





Segmented regression threshold: 23 ug/L

Threshold Indicator Taxa Analysis (TITAN) taxa threshold: 33 ug/L

Bottom line: Nuisance algae proliferated between **20 and 35 ug/L TP**, and was virtually absent below 15 ug/L TP.

This result is very similar to TX studies.

LIVE

75°
Austin, TX

LOCAL

Algae infestation is causing an upset among residents along the Blanco River

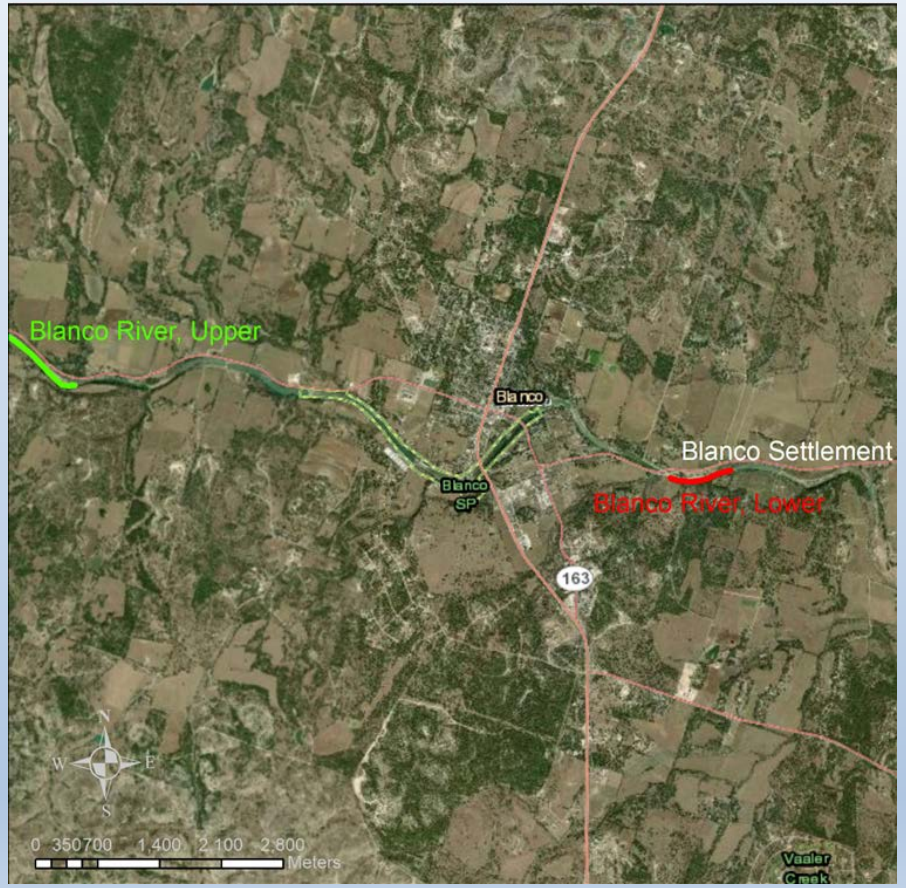
Residents near the Blanco River say the algae problem has gotten a lot worse in only a few week's time.

https://www.kvue.com/video/tech/science/environment/homeowners-concerned-about-algae-in-blanco-river/269-240853a9-276d-4af7-a8b3-3a0fde041950?jwsource=cl

EXHIBIT 106

Blanco River Study

- Two locations:
  - Upstream of City of Blanco, adjacent to Smith property on Goldwin-Smith Road
  - Downstream of 165 @ Blanco Settlement
- Sampling during early summer high flows (April-May) and late summer low flows (August-Sep)

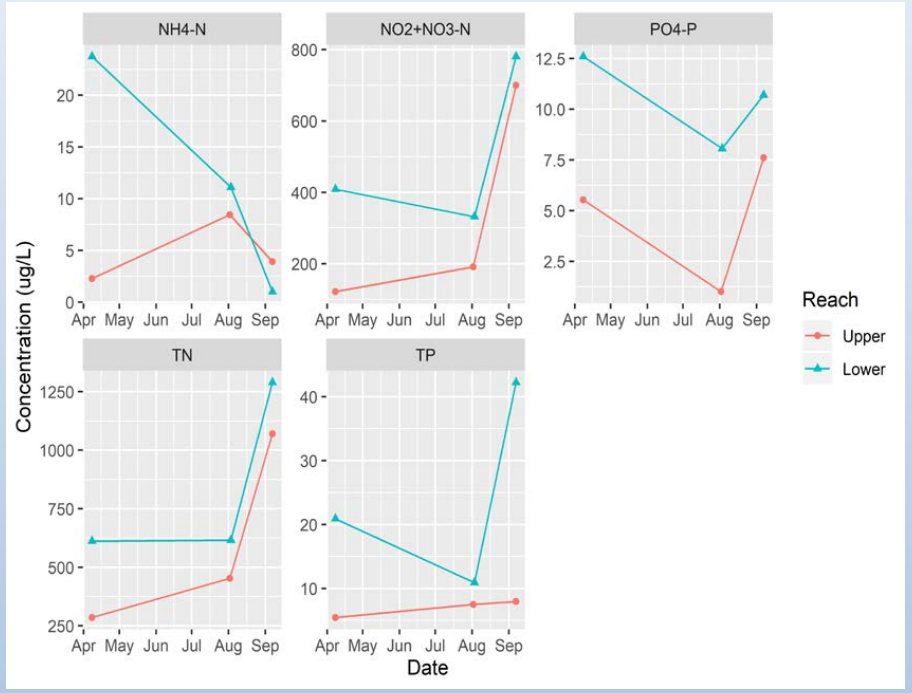


Blanco River at Goldwin-Smith Road, April 2019

Blanco River at Blanco Settlement, April 2019

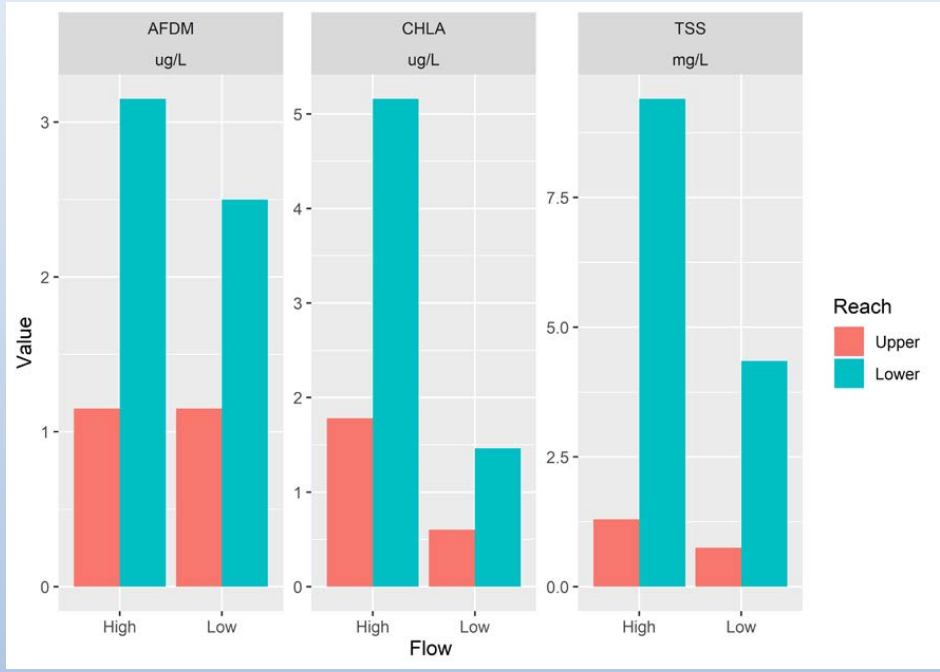
Blanco River: Nutrients

- Total phosphorus (TP) exceeded 20 ug/L April and over 40 ug/L during low flow (Sep) at lower reach
  - Note: These are levels that correspond to nuisance algal blooms in TX and OK/AR studies
- TP was always <10 ug/L at the upper reach
- Other nutrients also trended higher at lower reach



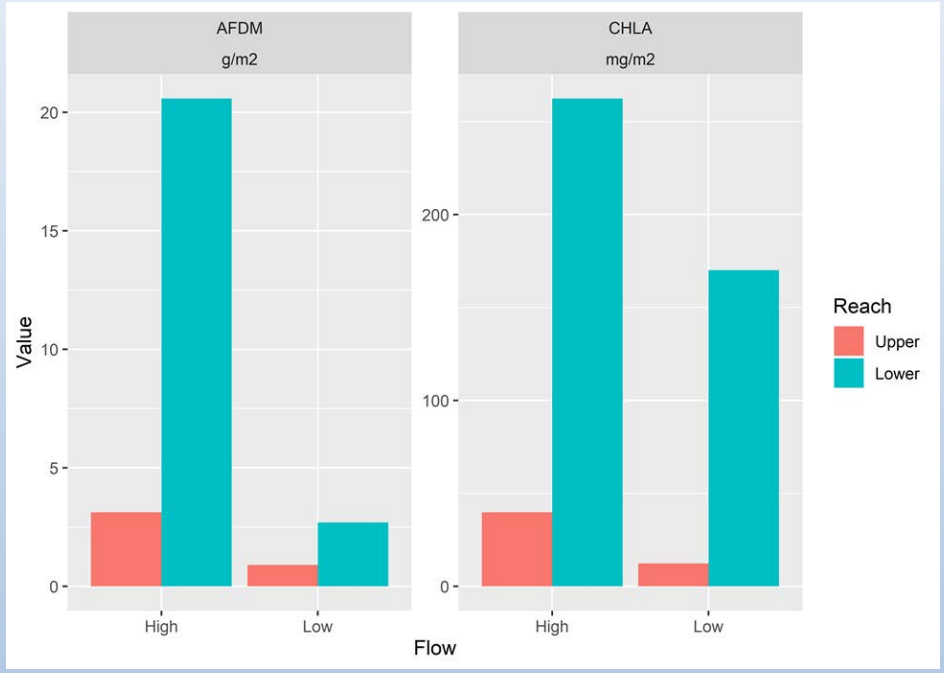
Blanco River: Particles in the Water

- Organic matter (AFDM), algal biomass (CHLA), and all types of particles (TSS) were always higher at the lower reach (Blanco Settlement) than the upper reach (Goldwin-Smith)
- The data suggest most of the cloudiness in the water at Blanco Settlement **was related to algae in the water**



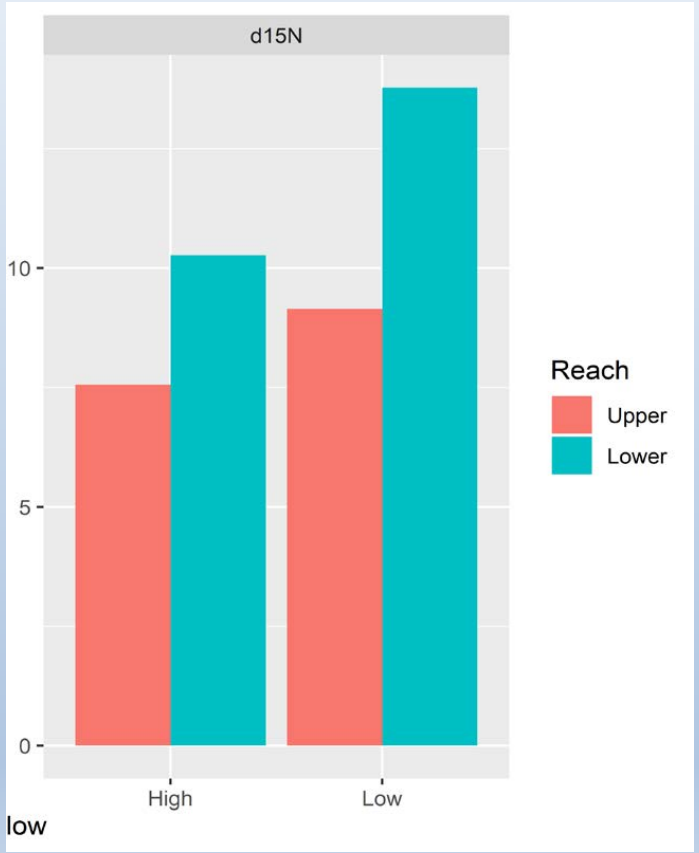
Blanco River: Algae on the Stream Bottom

- Total biomass of organic matter (AFDM) and algae biomass (CHLA) was several times greater at Blanco Settlement than at the upstream reference site **during both seasons.**
- The level of CHLA at Blanco Settlement during exceeded what is widely considered to be a threshold for nuisance levels of algae (150 mg/m2), which was evident from photographs and casual observation as well.



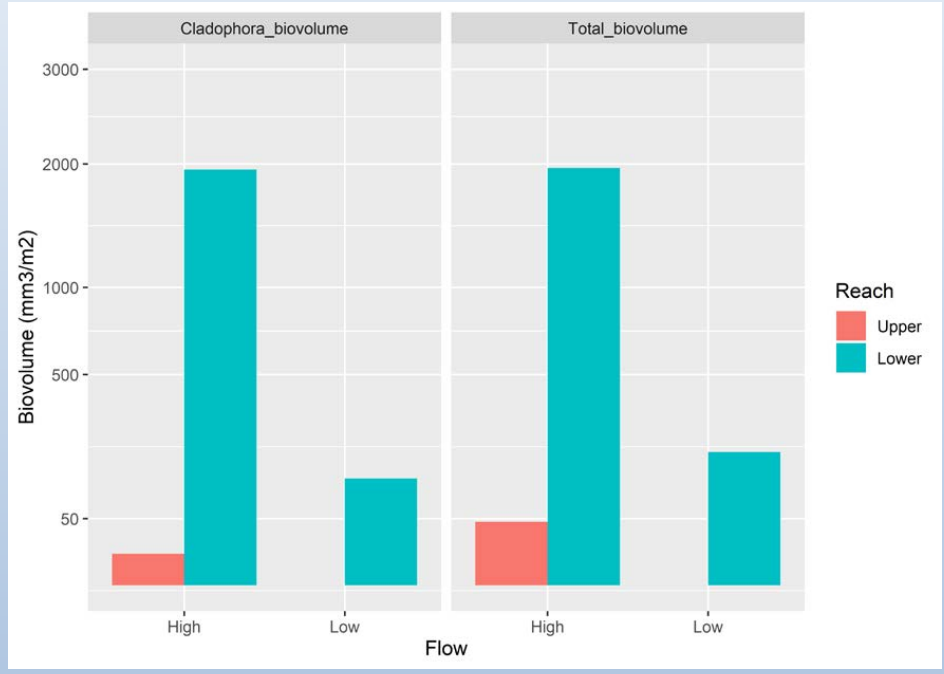
Blanco River: Nitrogen Isotopes in Algae

- d15N in algae is an indicator of SOURCES of nutrients. The higher the value, the more nitrogen is coming from municipal wastewater.
- d15N was markedly higher at Blanco Settlement when compared to the upstream site. Levels of d15N above 10 are highly indicative of wastewater, which was evident from both sampling events at the lower site.



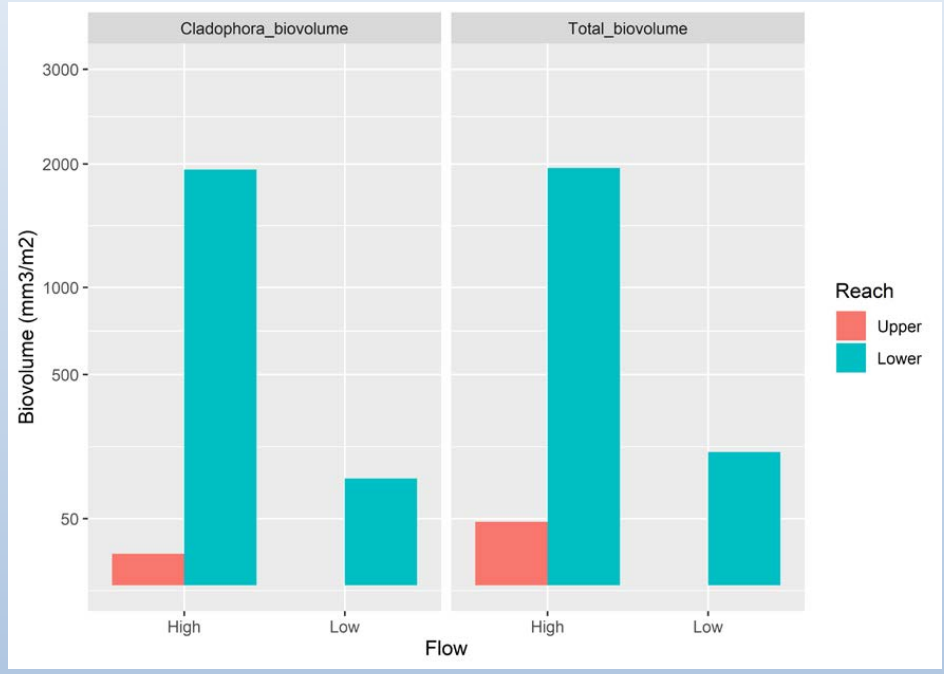
Blanco River: Biovolume of Algae

- Biovolume is a way another way to estimate the amount of algae on the stream bottom.
- Barbara Winsborough, a world-class taxonomist, estimated biovolume for all species of algae from samples we collected from the stream bottom.
- *Cladophora*, the most common nuisance species of green algae, was many times more abundant at Blanco Settlement than at the upstream site.
- *Cladophora* contributed almost all of the biovolume of algae at the lower site.



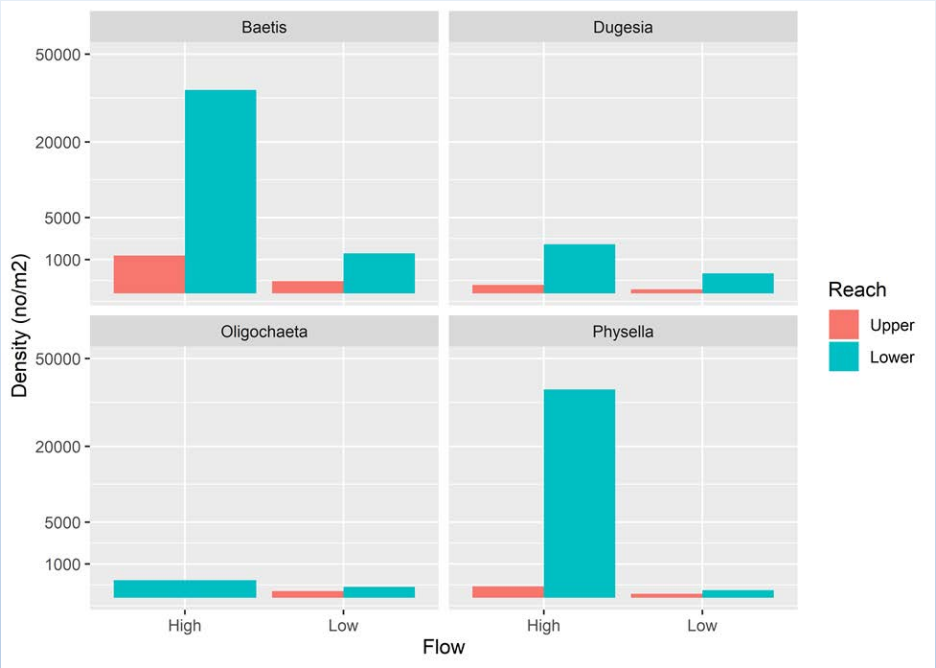
Blanco River: Biovolume of Algae

- Biovolume is a way another way to estimate the amount of algae on the stream bottom.
- Barbara Winsborough, a world-class taxonomist, estimated biovolume for all species of algae from samples we collected from the stream bottom.
- *Cladophora*, the most common nuisance species of green algae, was many times more abundant at Blanco Settlement than at the upstream site.
- *Cladophora* contributed almost all of the biovolume of algae at the lower site.



Blanco River: Macroinvertebrates

- Aquatic macroinvertebrates are key indicators of water quality
- We found that densities of macroinvertebrate taxa typically found near wastewater treatment effluent discharges were higher, sometimes many times higher, at Blanco Settlement than at the upstream site
- Overall densities of macroinvertebrates were several times higher at the lower site, but again, dominated by weedy taxa that are indicators of poor water quality



Baetis=tolerant mayfly
Dugesia=flatworm
Oligochaeta=segmented worm
Physella=lunged snail

Blanco River: Fish

- Fish were more abundant at Blanco Settlement, but dominated by stonerollers (a fish that eats algae), juvenile sunfish (longears, bluegill), and blacktail shiners.
- Fewer, but larger fish were collected at the Goldwin-Smith site, including redear sunfish and largemouth bass.

Summary

- Nutrients, esp phosphorus, were elevated at Blanco Settlement
- Nuisance algae was much more abundant at Blanco Settlement
- Nitrogen isotopes showed that nutrients were coming from wastewater at Blanco Settlement
- Macroinvertebrates associated with wastewater proliferated at Blanco Settlement
- Fish were dominated by small “baitfish” and juvenile sunfish at Blanco Settlement, whereas larger gamefish were found at upstream site.

Conclusion

- Blanco River study results consistent with multiple published research papers concluding that total phosphorus must be kept below 15 to 20 micrograms/L in order to protect native aquatic communities and prevent excessive algae growth

Massive aggregation of filamentous green algae (Cladophora) at Blanco Settlement, April 2019