REVIEW OF THE NATURE CONSERVANCY MONITORING DATA COLLECTION IN ATCHAFALAYA BASIN, 2016 to 2019.

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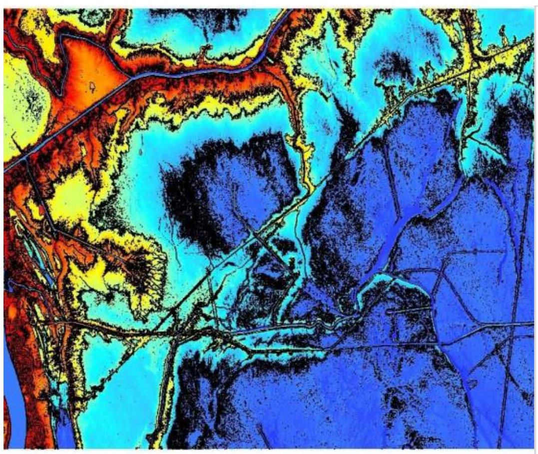
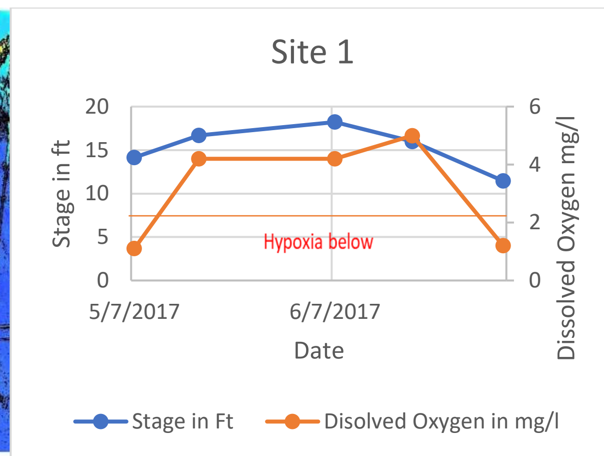
ON BEHALF OF ATCHAFALAYA BASINKEEPER ET AL





14th December 2020

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Introduction

The Nature Conservancy (TNC) have since 2017 collected water quality data for the Louisiana Department of Natural Resources (LaDNR) and now Coastal Protection and Restoration Authority (CPRA) in the East Grande Lake (EGL) project area of the Atchafalaya Basin. Some of these TNC sites are close to those where Kong (2017) collected data and as such allow some comparisons. Figure 1 depicts the location of TNC data collection sites, but they do not supply any description of the sites nor GPS or elevation data or records of any severe weather events, boat traffic, or other events that could have impacted the data sequence. Figure 2 is a Google Image depicting the Kong sample sites for the 2016 and 2017 Atchafalaya River floods. Kong also does not supply any explanations as to why her sites were chosen other than ease of access, and the environment or elevation at each site. There is no GPS position data so as to decide where the sites were located, was it on a levee or was it in an open pond or in a forested swamp? There is no weather data either. Strong winds, rain, other boat traffic etc. before or during a sample event can markedly change the readings. The assumption as she was collecting crawfish implied that there was enough water depth to move by boat. Figure 3 is an attempt to superimpose the Kong (2017) data collection locations (Figure 2) on the TNC map.

Members of the Atchafalaya Basinkeeper, with years of working in the Basin, tried unsuccessfully to find some of the TNC sites. The whole value of a scientific study impinges on the quality of the data collected, done in such a way as to allow duplication of results and allow duplication of equipment deployments. Before discussing the data further, it is important to point out there are some potential flaws in the data that has been collected, namely an apparent lack of QA/QC.

The use of continuous reading Sonde instruments.

There are a number of issues in the use of YSI Exo2 sondes as utilized by TNC, namely:

1. Figure 4 reveals very low DO levels of 0.05 to 0.06 from 5/16/17 to 5/23/17 at Site AU6. A ‘flat’ line while the Butte La Rose stage is rising from 4.2 to 5.6 m as the flood peak advances (Figure 5); both the turbidity and water depth at Site AU 6 are also climbing in sympathy with the rising river. So why the DO flat line? Over the same time period Kong’s (2017) Site 1 shows the DO climbing from about 1.0 to 4.6; Site 6 climbing from 0.5 to 4.0 (Figure 6); Site 7 shows the DO declining from 0.4 to 0.3 before it shoots up after 5/20/17 (Figure 7); and Site 8 indicates a fall from 3.0 to 1.4 before it also rises rapidly (Figure 8). This TNC data record revealing flat lining suggests to me that there is an instrument malfunction or a cable connectivity issue. There are other examples of flat lining, some also in the 2018 data such as site T3 where the DO seems to be flat lining from 2/20/18 to 3/12/18 while the water level is rising some 1.7 m or about 6 feet! From 03/13/18 the DO jumps up. Again, one needs more information to truly assess the data and to interpret what is happening at each site.

2. There is a very real need to calibrate sonde equipment regularly https://www.ysi.com/File%20Library/Documents/Tips/YSI-Calibration-Maintenance-Troubleshooting-Tips-6-Series-Sondes-2-8-10.pdf and https://www.ysi.com/ysi-blog/water-blogged-blog/2015/04/5-tips-to-prevent-costly-mistakes-with-your-sondes-tip-1-of-5 for example. No calibration information is presented in any of the TNC reports.
3. The United States Geological Survey (USGS) showed that turbidity measurements could be 25% off. Did TNC take this into account?https://www.ysi.com/ysi-blog/water-blogged-blog/2015/04/5-tips-to-prevent-costly-mistakes-with-your-sondes-tip-1-of-5.
4. The USGS also stated that some of the test results did not meet manufacturing specifications and suggest that the manufacturing specifications for accuracy and detection range may be exaggerated.
5. Another major issue with the Sonde is the propensity for its sensors and its casing to collect sediment during highly turbid peak flows. Debris or sediment that gets stuck in or around the sensor casing have an impact on the accuracy of the water quality readings. Without proper maintenance procedures in place, the Sonde will not provide accurate data. Because of this, many researchers conduct maintenance visits on a weekly basis and especially after high-flow events to check the Sonde for any debris accumulation or sediment clogging within the sensors. There is no record of any field maintenance.
6. Detailed records of calibration and maintenance must be kept. The calibration should be conducted using standards in the range of values expected to be encountered in the field. This is particularly important when calibrating electrical conductivity for use in fresh, tidal, or marine waters. The calibration must be performed and recorded before the start of a field trip and should be checked at the conclusion of each field trip; it is advisable in very turbid locations to re-check calibration daily during an extended period of field use. These in-field checks should be recorded in a notebook and later transcribed into the calibration logbook for the instrument
7. If manufacturer's procedures do not refer to temperature calibration, manual temperature readings taken using a thermometer should be compared to the instrument temperature readings.
8. There is a major data bust in the 2018 data. On page 16 (TNC Figure 9) on 05/05/2018 the temperature of the TNC stations varies around 17 deg C, having been between
9. N 13 and 17 deg C for the past two months. But, on page 17 (TNC Figure 14) the temperature 05/20/2018 is 25 deg C. How did the temperature suddenly rise 10 deg C in a couple of weeks? The temperature then stays around 25 deg C for the rest of the record. This is a real data bust and places all the data collected at the TNC stations under suspect! A major flaw.

TNC do not supply any calibration information. Such is useful if included in an Appendix. Information of who, when, which laboratory did the calibrations.

Dissolved Oxygen and its relation to Water Temperature.

Integral to any study of water quality, eutrophication and hypoxia is the correct measurement of dissolved oxygen and understanding its characteristics such as water temperature changes. This is totally lacking from any TNC report. In face scientific discussion is minimal to say the least. Dissolved Oxygen (DO) refers to the level of free, non-compound oxygen present in water or other liquids. It is an important parameter in assessing water quality because of its influence on the organisms living within a body of water. In limnology (the study of lakes), dissolved oxygen is an essential factor second only to water itself. A dissolved oxygen level that is too high or too low can harm aquatic life and affect water quality.

Non-compound oxygen, or free oxygen (O_2), is oxygen that is not bonded to any other element. Dissolved Oxygen is the presence of these free O_2 molecules within water. The bonded oxygen

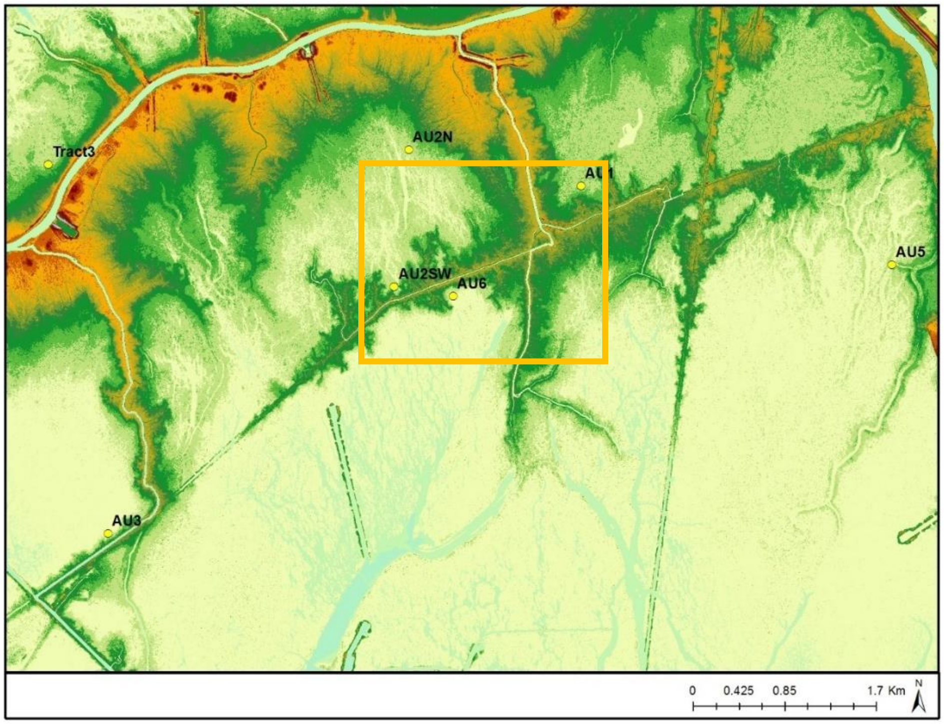

Figure 1. Location of TNC data sites (TNC Personal Comm.) Review sites in orange box. From van Heerden 2020.

molecule in water (H_2O) is in a compound and does not count toward dissolved oxygen levels. One can imagine that free oxygen molecules dissolve in water much the way salt or sugar does when it is stirred.

Dissolved Oxygen is necessary to many forms of life including fish, invertebrates, bacteria, and plants. These organisms use oxygen in respiration, similar to organisms on land. Fish and crustaceans obtain oxygen for respiration through their gills, while plant life and phytoplankton require dissolved oxygen for respiration when there is no light for photosynthesis. The amount of dissolved oxygen needed varies from creature to creature. Bottom feeders, crabs, oysters, and worms need minimal amounts of oxygen (1-6 mg/L), while shallow water fish need higher levels (4-15 mg/L) (www.fondriest.com).

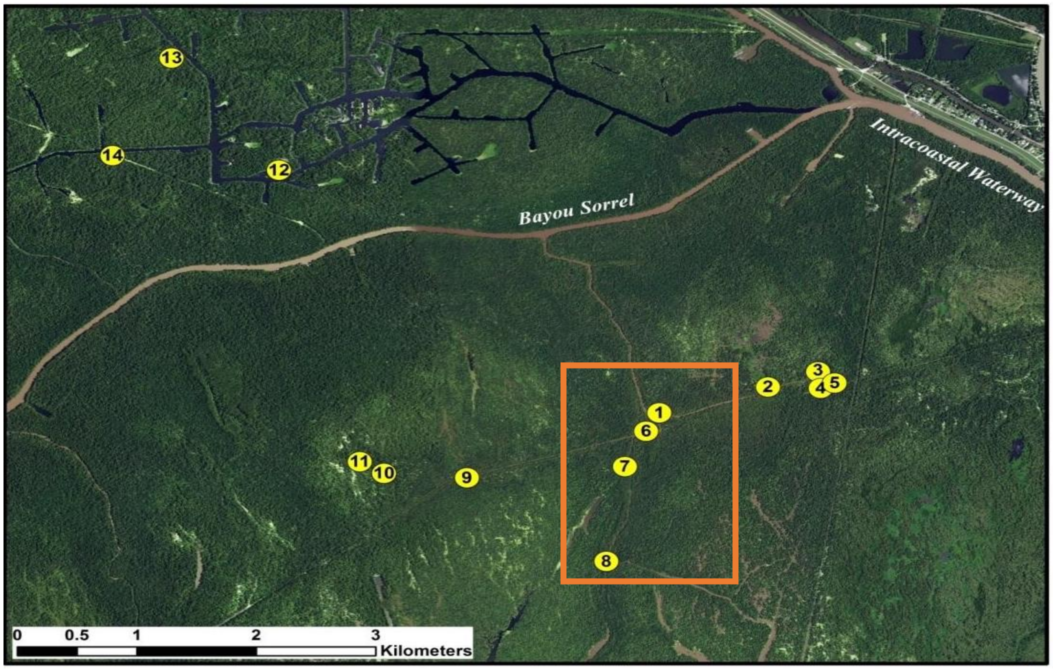

Figure 2. Location of Kong (2017) intensive sample sites. Review sites in orange box. From van Heerden 2020.

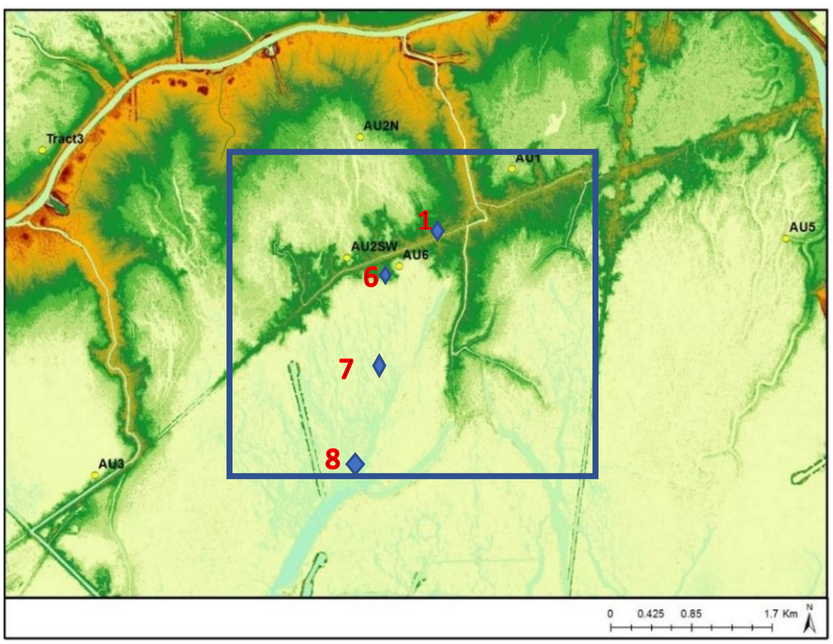

Figure 3. Four of Kong's 2016 sampling sites, namely sites 1, 6, 7, and 8, that are in the same region of the Basin as data collected by TNC at sites AU1, AU6, and AU2SW in 2017 and 2018. Note this is a LiDAR image and the richer the color the higher the elevations. Thus, all the TNC sites and Kong's 1, 6, and 7 are on the edges of levees even if they are subaqueous, at higher elevations that the interior backswamp in this portion of the Basin. Kong's site 8 is more of a backswamp location.

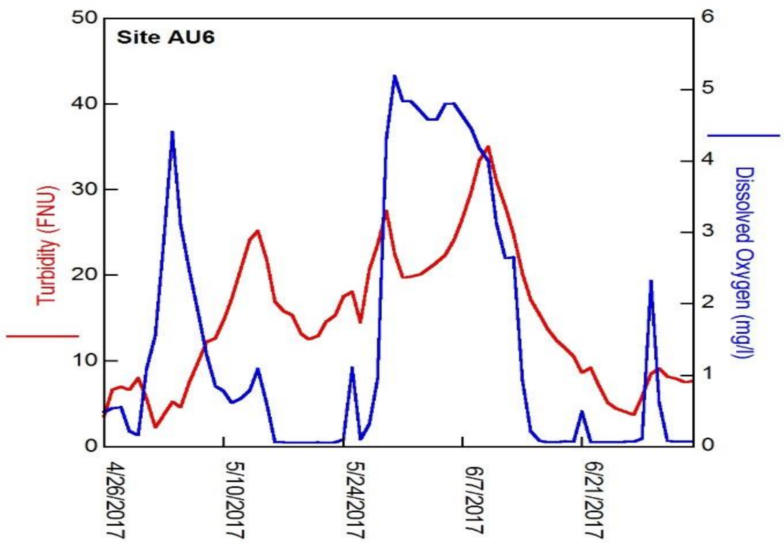

Figure 4. Turbidity and dissolved oxygen from April to July 2017. TNC Site AU6.

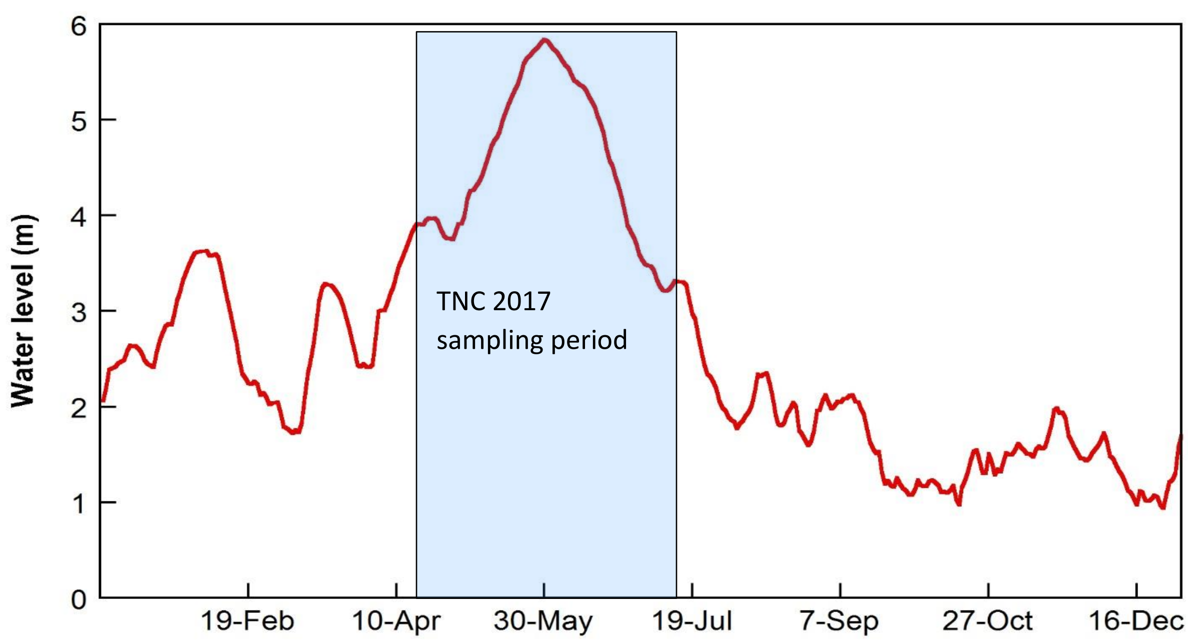

Figure 5. Daily mean water levels at Butte La Rose during 2017. Preliminary data from USGS gage 07381515 Atchafalaya River at Butte La Rose, LA.

Microbes such as bacteria and fungi also require dissolved oxygen. These organisms use DO to decompose organic material at the bottom of a body of water. Microbial decomposition is an important contributor to nutrient recycling. However, if there is an excess of decaying organic material (from dying algae and other microorganisms), in a body of water with infrequent or no turnover (also known as stratification), the oxygen at lower water levels will get used up quicker.

Dissolved oxygen enters water through the air or as a plant byproduct. From the air, oxygen can slowly diffuse across the water's surface from the surrounding atmosphere, or be mixed in quickly through aeration, whether natural or man-made. The aeration of water can be caused by wind (creating waves), rapids, waterfalls, ground water discharge or other forms of running water.

A waste product of photosynthesis from phytoplankton, algae, seaweed, and other aquatic plants, DO is also produced. While most photosynthesis takes place at the surface (by shallow water plants and algae), a large portion of the process takes place underwater (by seaweed, sub-surface algae and phytoplankton). Light can penetrate water, though the depth that it can reach varies due to dissolved solids and other light-scattering elements present in the water. Depth also

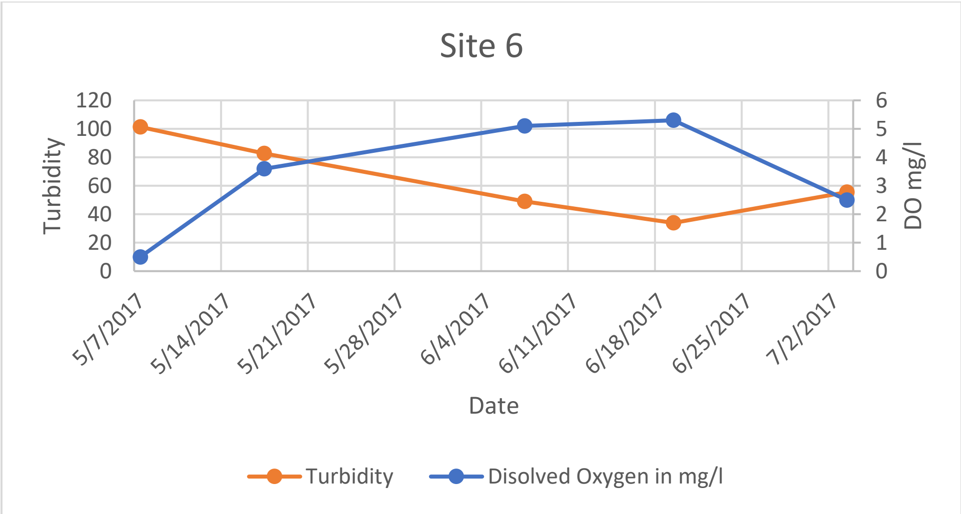

Figure 6. Plot of Dissolved Oxygen from Kong (2017) and Turbidity from Morgan City over the time data was collected for Site 6 in 2017.

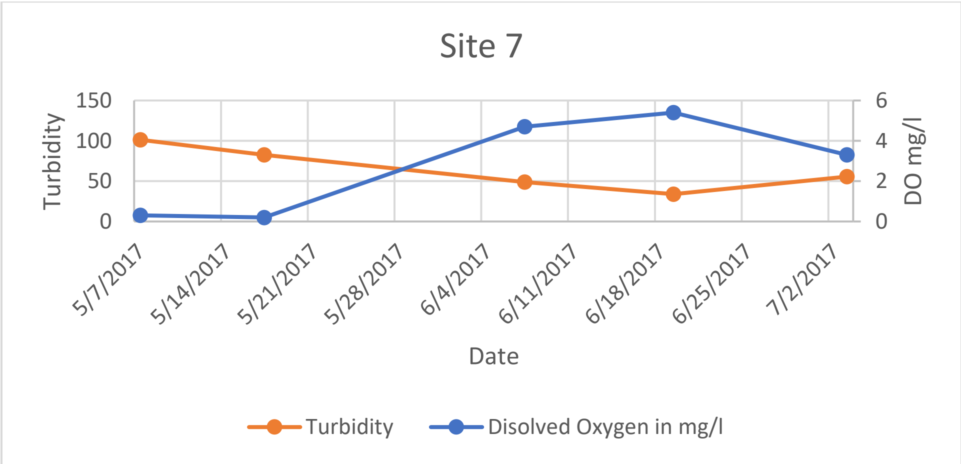

Figure 7. Plot of Dissolved Oxygen from Kong (2017) and Turbidity from Morgan City over the time data was collected for Site 7 in 2017.

affects the wavelengths available to plants, with red being absorbed quickly and blue light being visible past 100 m. In clear water, there is no longer enough light for photosynthesis to occur beyond 200 m, and aquatic plants no longer grow. In turbid water, this photic (light-penetrating) zone is often much shallower.

Regardless of wavelengths available, the cycle does not change. In addition to the needed light, CO2 is readily absorbed by water (it is about 200 times more soluble than oxygen) and the

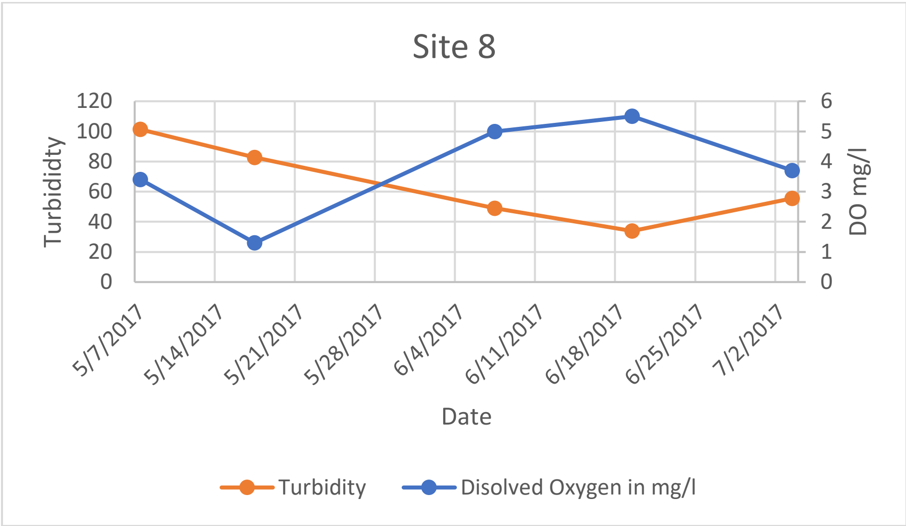

Figure 8. Site 8. Plot of Dissolved Oxygen from Kong (2017) and Turbidity from Morgan City over the time data was collected for Site 8 in 2017.

oxygen produced as a byproduct remains dissolved in water. As aquatic photosynthesis is light-dependent, the dissolved oxygen produced will peak during daylight hours and decline at night.

In a stable body of water with no stratification, dissolved oxygen will remain at 100% air saturation. 100% air saturation means that the water is holding as many dissolved gas molecules as it can in equilibrium. At equilibrium, the percentage of each gas in the water would be equivalent to the percentage of that gas in the atmosphere – i.e., its partial pressure. The water will slowly absorb oxygen and other gasses from the atmosphere until it reaches equilibrium at complete saturation. This process is sped up by wind-driven waves and other sources of aeration.

Two bodies of water that are both 100% air-saturated do not necessarily have the same concentration of dissolved oxygen. The actual amount of dissolved oxygen (in mg/L) will vary depending on temperature, pressure, and salinity (Figure 9).

The solubility of oxygen decreases as temperature increases. This means that warmer surface water requires less dissolved oxygen to reach 100% air saturation than does deeper, cooler water. For example, at sea level (1 atm or 760 mmHg) and 4°C (39°F), 100% air-saturated water would hold 10.92 mg/L of dissolved oxygen. But if the temperature were raised to room temperature, 21°C (70°F), there would only be 8.68 mg/L DO at 100% air saturation.

In his 2020 study van Heerden considered this temperature related property of dissolved oxygen in the results discussion, but it is important to note that a literature search concerning Eutrophication in the Atchafalaya Floodway has revealed no realization of this temperature relationship of collected data in management decisions or project justifications! This is a real failing in many management decisions of the past where low dissolved oxygen levels have been used to justify swamp 'infilling' projects.

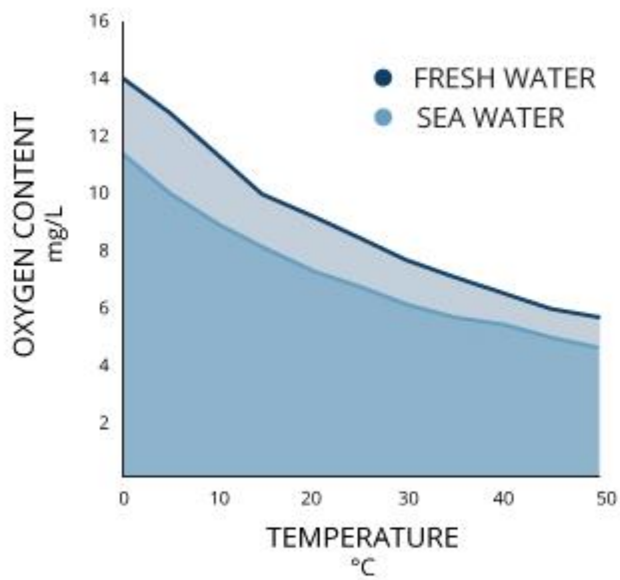

Diagram 9. Dissolved Oxygen content as a function of temperature

Use of Appropriate Gauging Stations

TNC exclusively rely on the Butte La Rose gauging station which is 15 miles away and 'up' the Basin. So why not rely on a USGS station (Bayou Sorrel Gauge) close to the EGL site where they have their monitoring stations? In fact, there are two close gauging stations, namely Bayou Sorrel Lock and Bayou Sorrel Gauge: the latter with a Datum of 0.0 ft NGVD. The USGS point out that there is "no datum" for the Bayou Sorrel lock so its reliability is suspect. Figure 10 shows the location of the Bayou Sorrel Gauge and data for 2018 and 2019 (Figure 11). One could argue that the water levels at all EGL elements would be more reflective of the Bayou Sorrel gauge. Figure 12 is a plot of Bayou Sorrel (FWS) gauge superimposed on the Butte la Rose gauge, using the same axes for the period 12/10/2018 through 03/31/2020. What is strikingly obvious is the Butte La Rose gauge stages are not representative of the Bayou Sorrel - EGL project area, at all. In the flood of 2019, the Butte la Rose gauge was up to 13 feet higher than that at Bayou Sorrel and during low flows is only a few feet higher than at Bayou Sorrel (Figure 12).

Figure 10. Location of Bayou Sorrel gauging station.

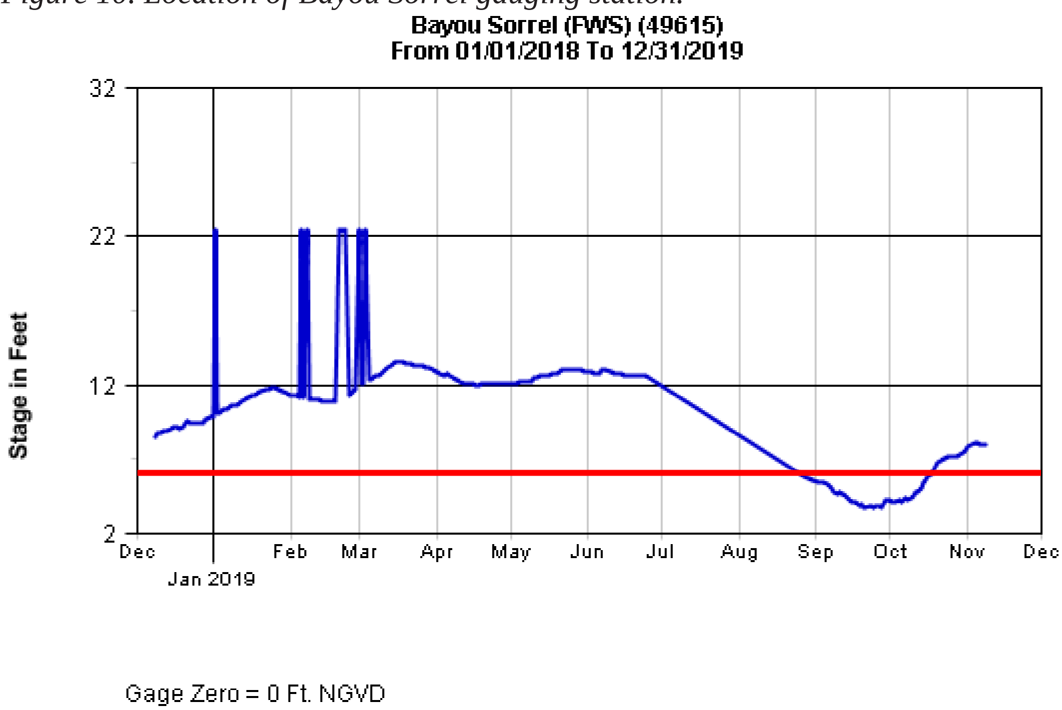

Figure 11. Bayou Sorrel gauge for 2018 and 2019. Plus 6.0 feet in red. As far as I could ascertain there is no correction to NAVD 88 for this location in Basin. The Corps river data available on web says that at Butte la Rose the two are equal.

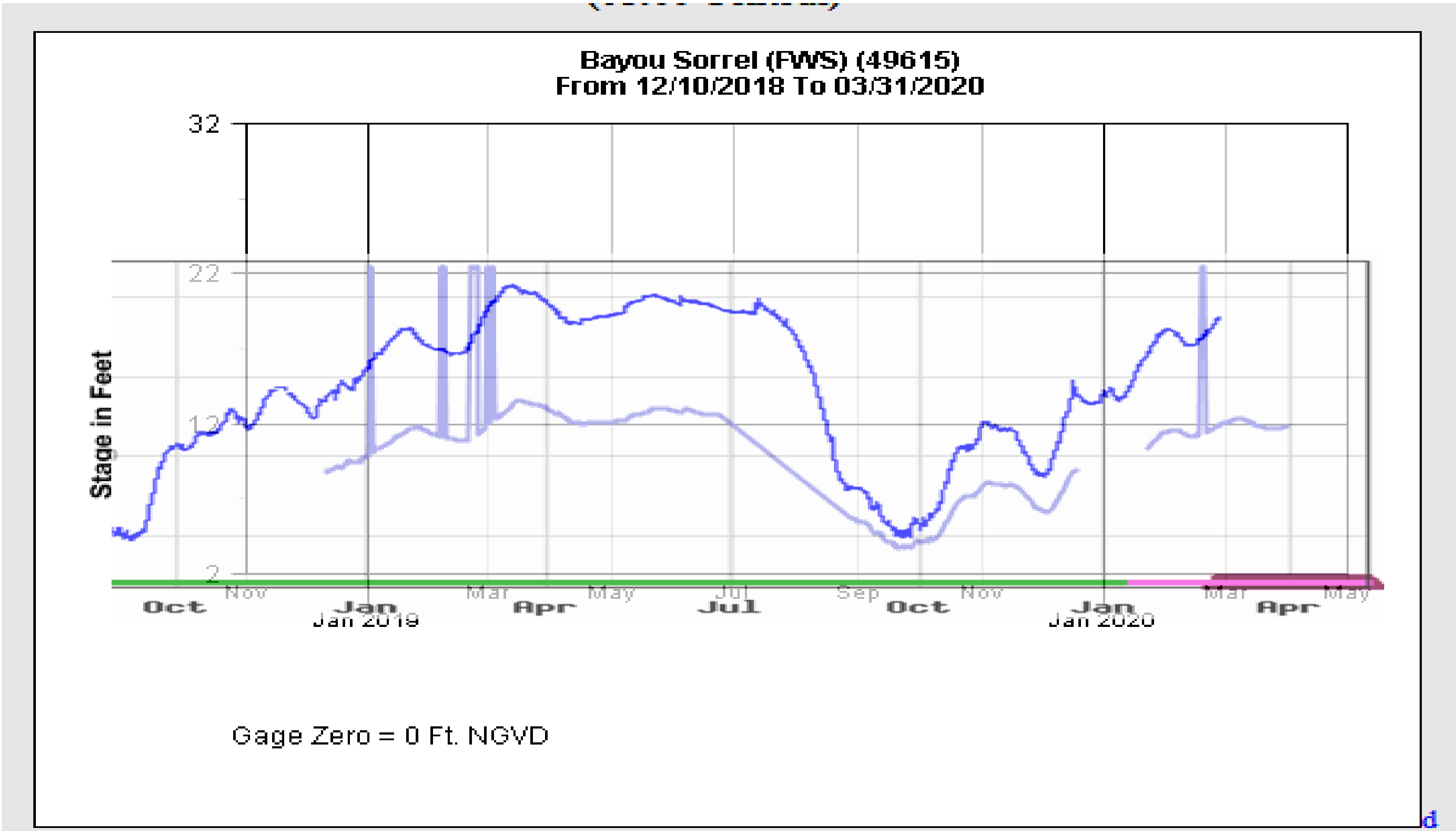

Figure 12. Butte La Rose gauge overlaid on Bayou Sorrel (FWS) late 2018 through early 2020. Butte La Rose the upper darker blue

The TNC Data for 2017

The TNC data was collected from 04/22/2017 till 07/19/2017 – a 3-month period that included the time Kong (2017) was sampling around the same flood peak (van Heerden, 2019). A comparison is thus possible between the two data sets. Figure 13 reveals that the flood rose to its peak on 28th May 2017, during the sampling period, and then fell thereafter. TNC state "During the passage of the flood pulse dissolved oxygen levels increased at all sites, but the magnitude and duration of that response varied from site to site" (TNC 2017). This is a result that matches Kong data and strengthens the argument that a low turbidity flood is far better for the system than a high turbidity flood which is the norm; the former being a 1 in 100 event.

a. Synoptics of DO levels at the 2017 TNC sites.

The TNC data do reveal that there is a marked temporal fluctuation in the DO against the background of a general rise during the flood (Figure 14 and 15). The sites displayed in Figure 12 CHECK, AU6 and AU2SW are close together being on either side of a pipeline canal. Depending on prevailing wind direction; major windstorms; major rainfall events; and, the stage of river flooding; water flow direction at these sites could be from all points of the compass and vary almost from day to day and as these waters flow back and forth, here and there, they occasionally bring in pockets of low DO waters from stagnant areas. Stagnation possibly due to impoundment, or biological degradation of submerged plant matter, or both. However, the overall DO picture, as TNC stated, is for the DO to increase as the 2017 flood progressed.

b. Comparison of TNC Site AU6 to Kong's Sites 6, 7, and 8 For 2017 (Figures 14 to 19).

The turbidity at TNC AU6 (Figure 14) is lower than that in the Atchafalaya River (Figure 16) around 05/07/17 but rises up to the same level as the River at its peak of 34 FNU mid-June and then falls rapidly thereafter. The River turbidity at the lower end of the Basin for the period is almost a reverse mirror image, being highest (100 FNU) in early May falling to a low of 34 FNU around 20 June 2017 and thereafter rising again to the end of the record. Kong's data was not measured daily by rather fortnightly, so it lacks the synoptics of the TNC data. But comparisons of the two data sets are permissible. Notably the DO rises faster at Kong 6 (Figure 17) as compared to AU6 (Figure 14) as the 2017 flood progresses.

Kong 7 (Figure 18) and Kong 8 (Figure 19) more resemble AU 6 as they appear to be in the same general water body.

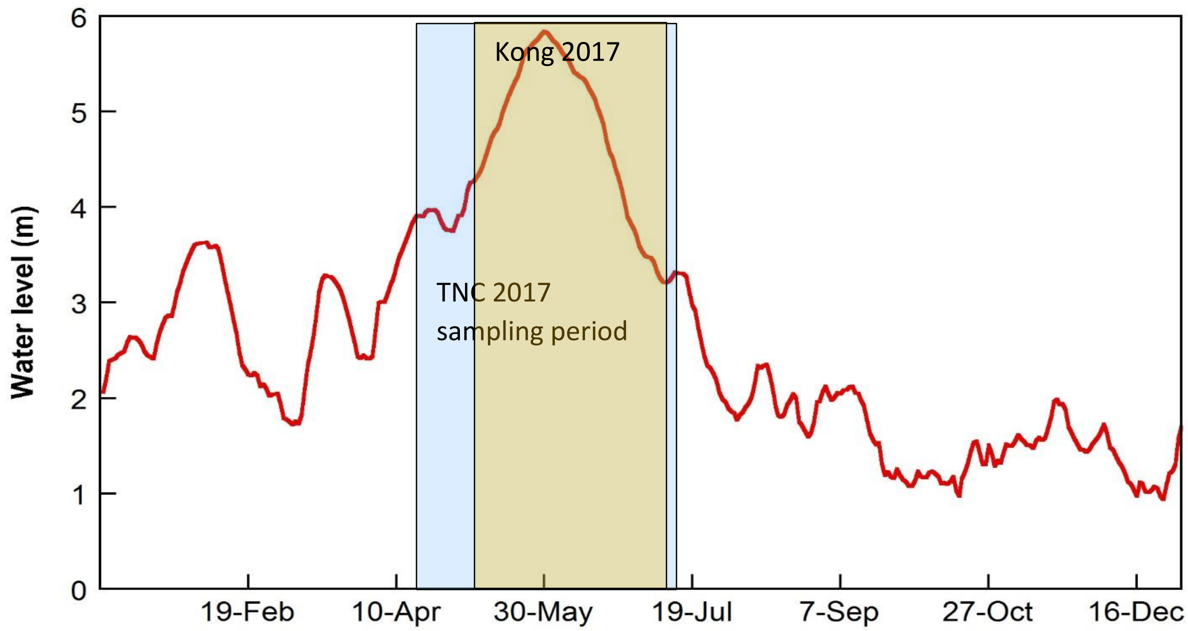

Figure 13. Daily mean water levels at Butte La Rose during 2017. Preliminary data from USGS gage 07381515 Atchafalaya River at Butte La Rose, LA.

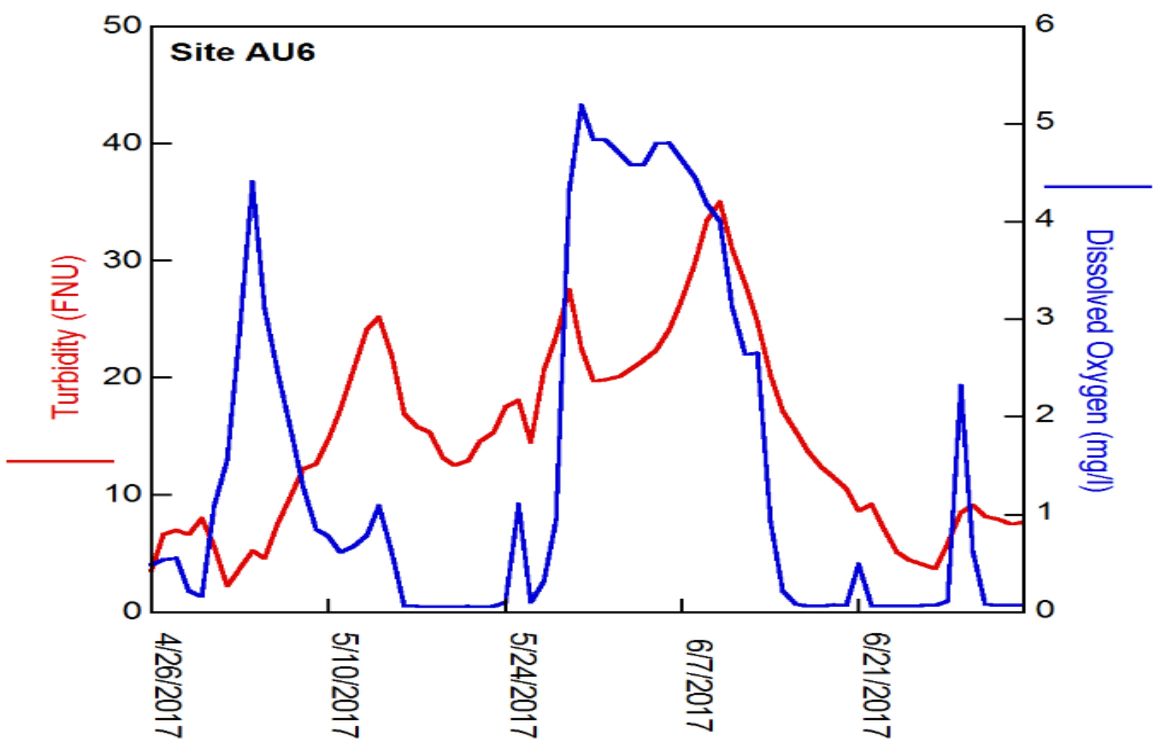

Figure 14. Turbidity and dissolved oxygen from April to July 2017. TNC Sites AU6

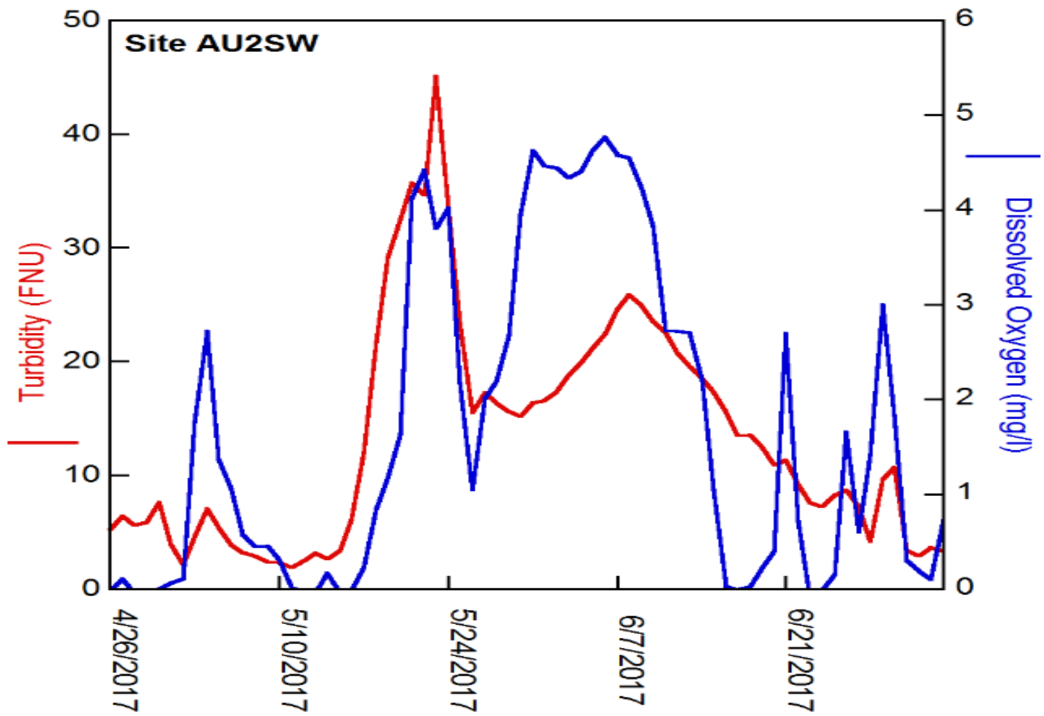

Figure 15. Turbidity and dissolved oxygen from April to July 2017. TNC Sites AU2SW

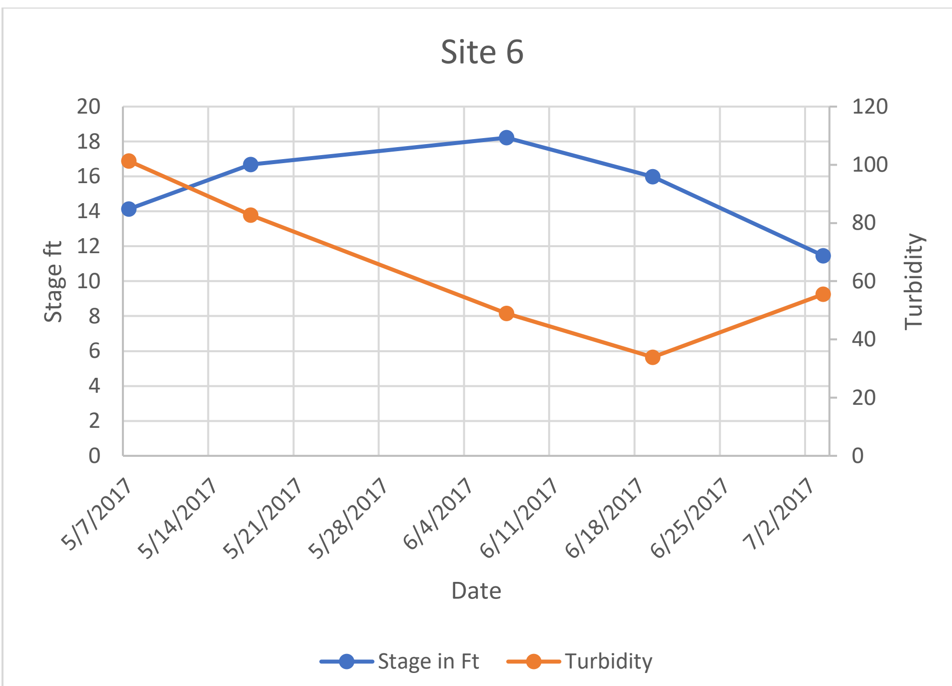

Figure 16. Kong 6. Stage in feet at Butte La Rose and Morgan City Turbidity for duration of 2017 study

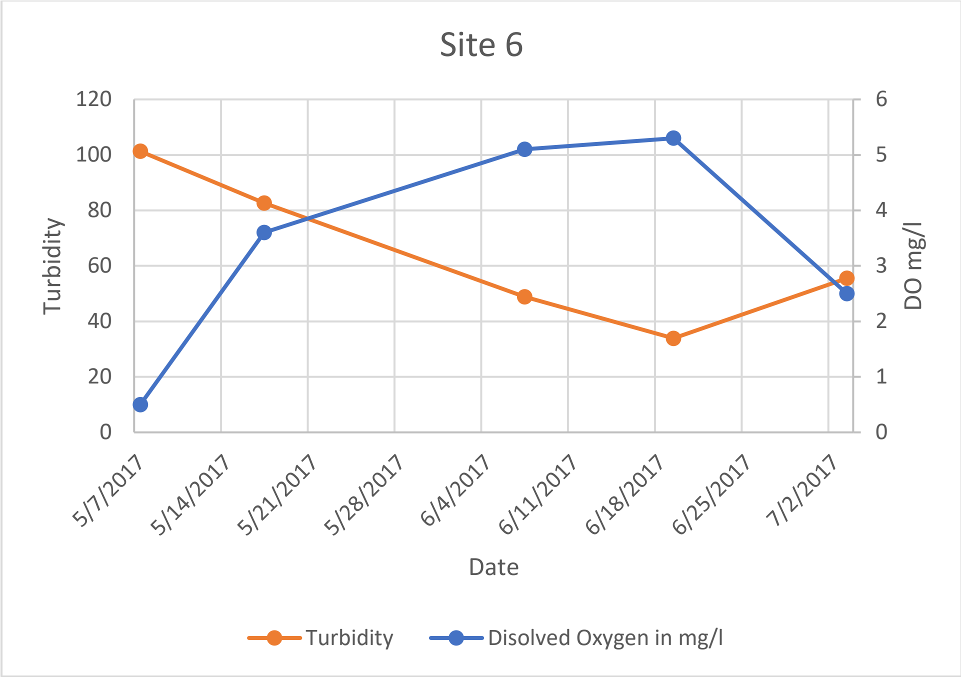

Figure 17. Site 6 Plot of Dissolved Oxygen from Kong (2017) and Turbidity from Morgan City over the time data collected in 2017.

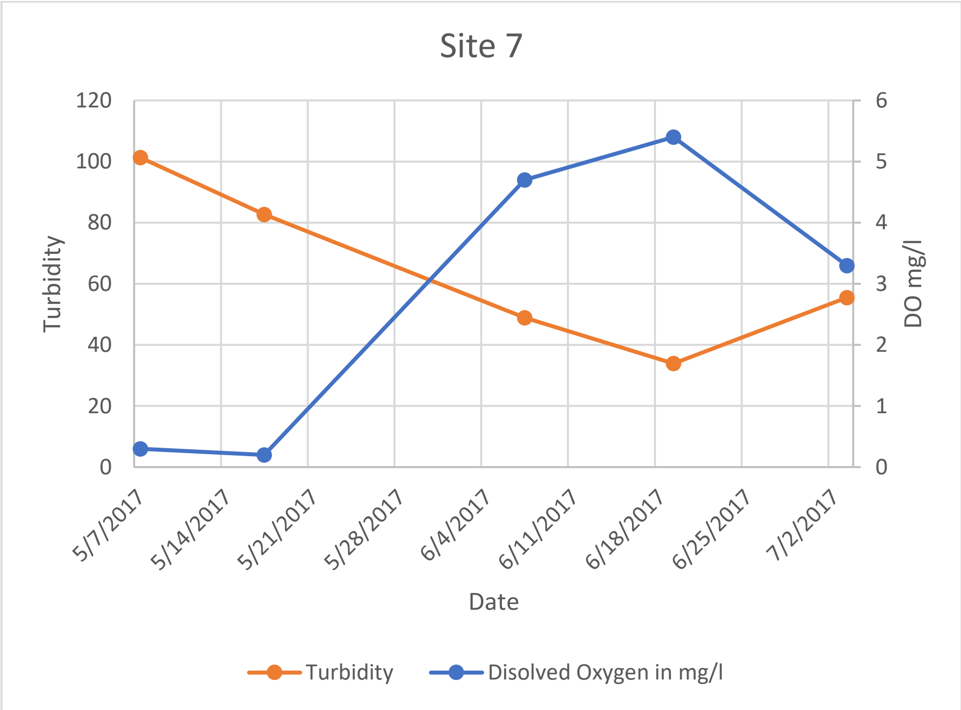

Figure 18. Site 7 Plot of Dissolved Oxygen from Kong (2017) and Turbidity from Morgan City over the time data was collected in 2017.

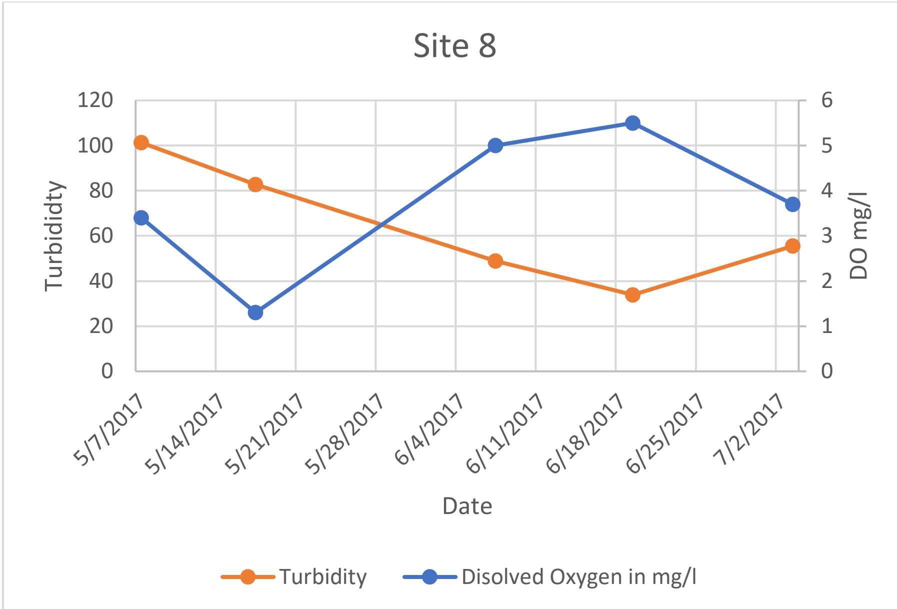

Figure 19. Site 8. Plot of Dissolved Oxygen from Kong (2017) and Turbidity from Morgan City over the time data was collected for Site 8 in 2017.

So, in summary, 2017 was a rain-induced flood with much lower turbidity than a regular flood such as 2016 (van Heerden 2020). Kong's data for the flood peak in 2017 reveal that the DO levels rose as the flood progressed, reflecting a low turbidity rainfall induced flood peak. During the flood eutrophication and hypoxia were not an issue. The TNC 2017 data support and parallel the Kong data. Suffice to say, Low turbidity floods (unique, rare since 1973) drive up the DO in contrast to high turbidity floods (the norm) where often Hypoxia results due to the rapid reduction in DO, as microorganisms feast on the abundant nutrients especially N, and consume the DO (van Heerden 2020).

TNC do not discuss their Oxygen data in any detail (TNC, 2018) nor do they try to assess the nature or characteristics of the Mississippi River flood. A fundamental of environmental science is that if you want to understand 'response' then one must study 'process' first.

c. The TNC Data for 2018

The Butte la Rose stage data indicate that there were only about three months of low water (less than 3 m or 9.8 ft) (Figure 20). Initial review of flood literature suggests the early flood from February through mid-June was a Mississippi Catchment flood with an apparent strong contribution from the Upper Mississippi and Missouri Rivers. For ease of discussion this will be referred to as the 5-month duration "Spring" flood while that from October through the end of the year the "Fall" flood. Turbidity data from Morgan City (Figure 21) supports this view in that turbidities peaked at about 320 and were high for most of the early flood and rose again with the late flood. An eyeball average of about 100 appears fair for both floods. So, the 2018 flood from early February through mid-June was carrying high suspended sediment loads as well as nutrients.

Figure 22 from TNC (2018) shows that at most of the TNC sites the DO rose in sympathy with the Spring flood but at half the sites the DO fell precipitously after a month (AU5, AU6, T3), started falling at the time the flood peak. So, if fresh flood water is improving DO; why did the DO levels fall while the flood was still going strong? The rest of the TNC sites stayed elevated until end of April for another month (A1, AU2S, AU3). Can this discrepancy be explained? The upper DO sites, AU1, AU2S and AU3, are aligned along the Florida Gas pipeline canal a major flood feeder into these swamp areas (Figure 1). The close proximity would have maintained higher DO levels (for a month longer) until the consequences of eutrophication due to nutrient

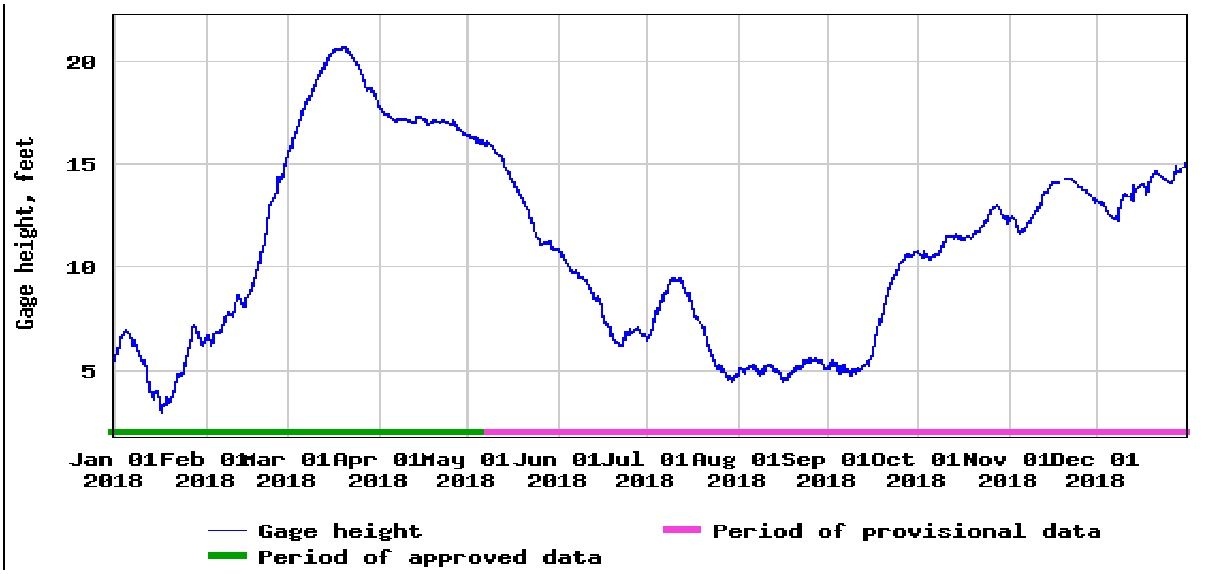

Figure 20. Atchafalaya River water levels at Butte La Rose (USGS Gage 07381515) in 2018

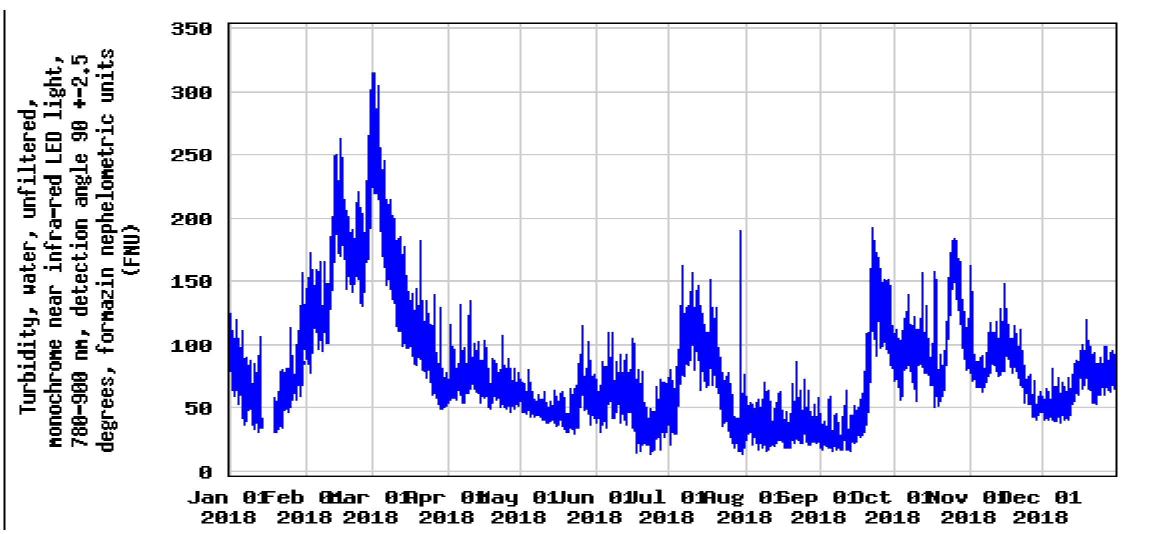

Figure 21. Turbidity data for Morgan City for the year 2018.

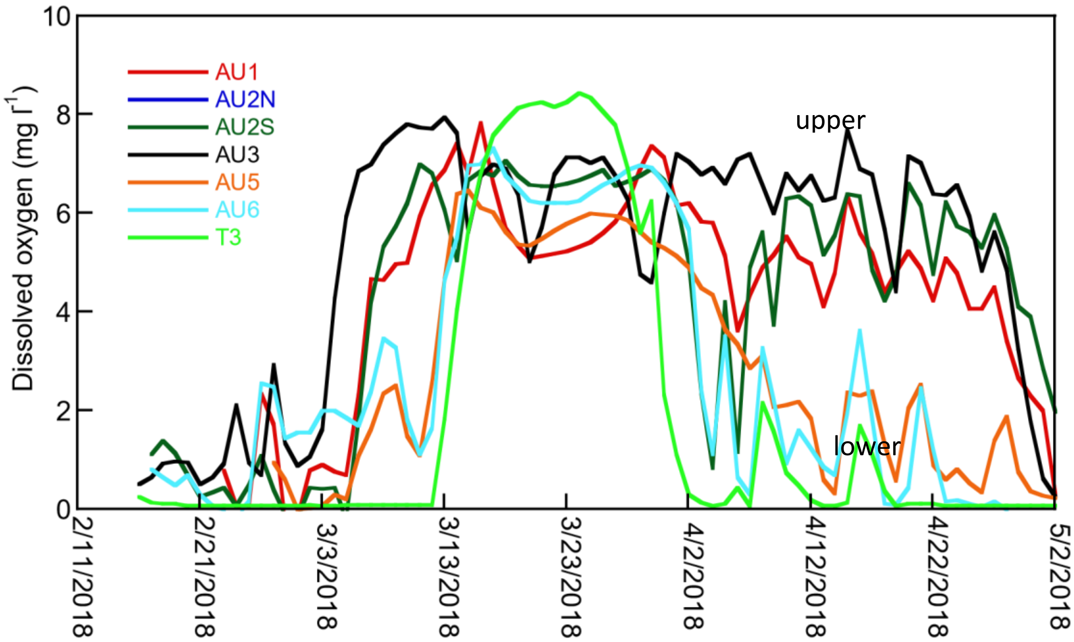

Figure 22. Mean daily dissolved oxygen concentrations at the backswamp monitoring stations for three months from February to May 2018. (From TNC 2018).

loading took its toll on the DO. TNC present evidence of algal blooms at site AU1, a reflection of the nutrient loading. The rest of the sites (AU5, AU6, T3) appear show a dramatic reduction in DO late March even though there is still about 3 feet of water over the bottom of the sites. Why? Site AU2N is not shown on Figure 22 but review of the data collected at this site shows that from 4/10/18 to 6/23/18, when the site became dry, it was Anoxic. It joins the lower group above. The data difference between the 'upper' and 'lower' group reveal that location is important in trying to understand the data and that the upper group are closer to a direct source of river flood water. The lower group, because of the flood induced nutrient loading, become Anoxic very rapidly. TNC failed to explain this difference. In fact, there is virtually no explanation of the data, other than a claim that flooding with river water, in their opinion, improves Oxygen levels. <u>If flooding with river water was healthy for the maintenance of oxygen levels in the swamps, then this precipitous fall in DO should not occur.</u>

Figure 23 is a plot of turbidity for the whole of 2018 (12 months) for sites AU2S (upper) and AU6 (lower) while Figure 24 is a plot for the two same stations of DO. What is readily apparent in Figure 24 is that towards the end of the year the DO at AU6 (lower group) is better than AU2S (upper group), why one might ask? On 1 March 2019, an ABK crew went to try to find these two sites but were not successful. However, they did spend some time in the general area of these two instrument sites and reported that there was a strong south wind and waves were breaking on water areas south of the Florida Gas canal that were not heavily vegetated. Anyone who has spent any time in the Basin knows that wind causes ripples at the very least but can be rough when the wind is strong. They also noticed that near to AU2S water was flowing north into the Florida Gas canal, possibly being pushed by the wind.

Site AU2S is located north of the Florida Canal, which is lined by high spoil banks, while AU6 is south of the is canal (Figure 1). The canal has an SW-NE orientation and south of it are a number of open water bodies with a fetch of about 4 miles before the next pipeline canal. A quick review of local weather data indicates that October through December were wet months with a total rainfall in excess of 18 inches, about 4 inches above normal, reflecting that a number of cold fronts crossed the area. Such would have produced strong south to southeasterly to east winds, so the raindrop splatter and the wind waves would have enhanced the dissolved oxygen content of these areas resulting in the DO measurements being non-Anoxic for those three months. If this increase in DO was due to flood waters, then the AU2S site would have had a similar DO response.

This very quick initial review and attempt to interpret the TNC data reveal two especially important aspects of the Basin. Firstly, flood water will locally improve DO for a short period but then the nutrient loading leads to eutrophication and eventually anoxic conditions develop. Secondly, other factors such as storm and wind events can have a dramatic impact on DO, raising levels above the anoxic condition.

TNC do not give an explanation why the turbidity at site AU1 has spikes of up to 350 from 4/7/2018 to at least 5/2/2018 (Figure 25). Was this an instrument problem or was there some external process forcing this extremely high turbidity. Boat traffic maybe?

The bottom line is that this quick initial review shows the complexity of the Basin and that introduction of flood waters even with moderate floods will enhance Eutrophication and lead to anoxic conditions.

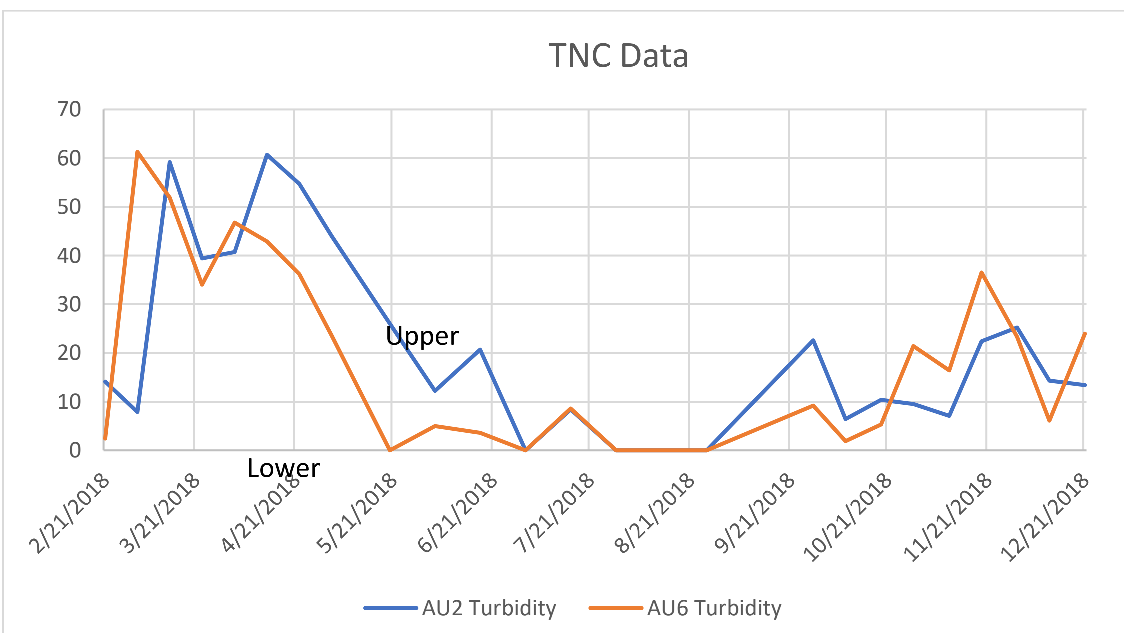

Figure 23. Turbidity plots for sites AU2S and AU6 for the 2018-year (Source TNC 2018). Upper and Lower based on Fig 37 for period 2/2018 to 5/2018 – 3 months.

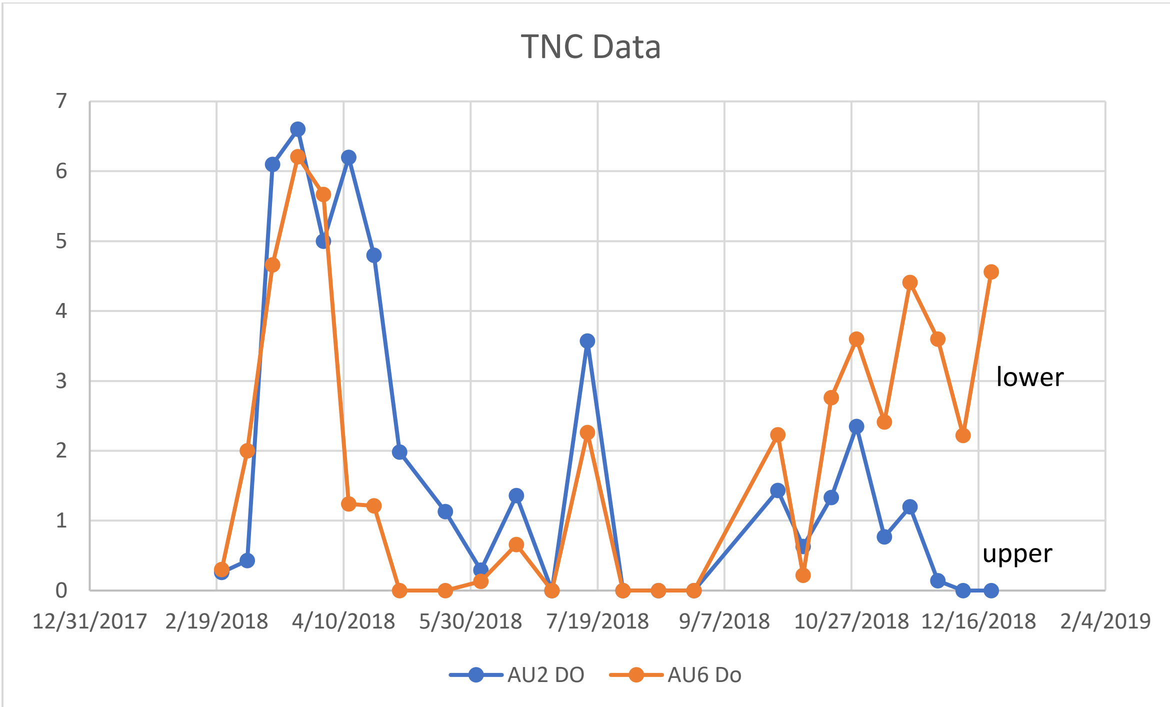

Figure 24. Dissolved oxygen plots for sites AU2S and AU6 for the 2018 year.(Source TNC 2018). Upper and Lower based on Fig 37 for period 2/2018 to 5/2018 – 3 months.

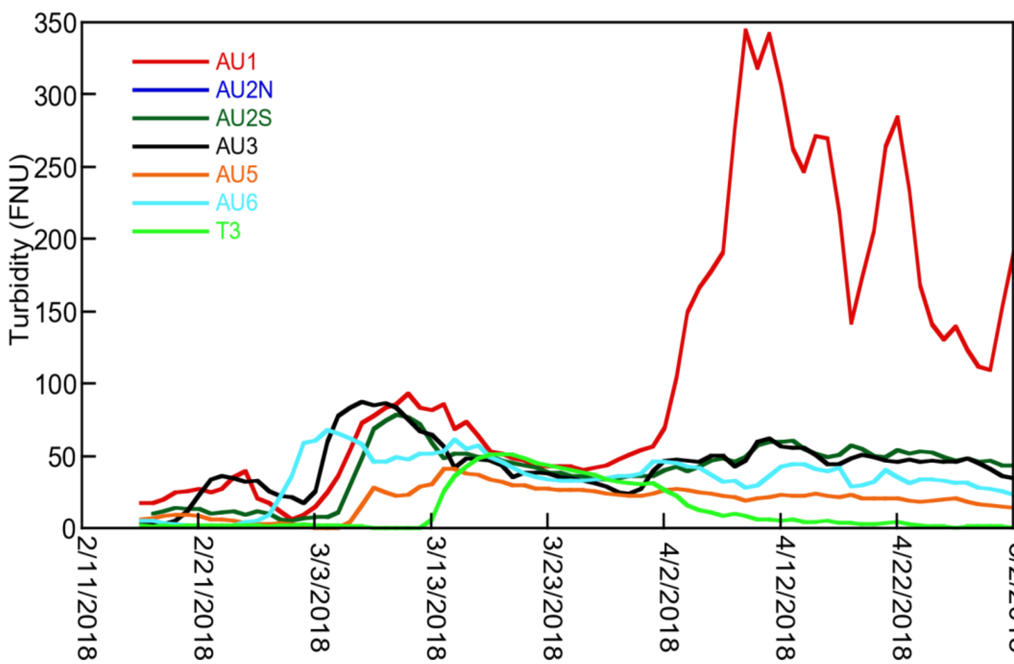

Figure 25. Mean daily turbidity at the backswamp monitoring stations from February to May 2018.

d. The TNC 2019 Data.

As previously discussed, the 2019 Mississippi flood was of long duration (Figure 41) and precipitated two openings of the Bonnie Carre' Spillway.

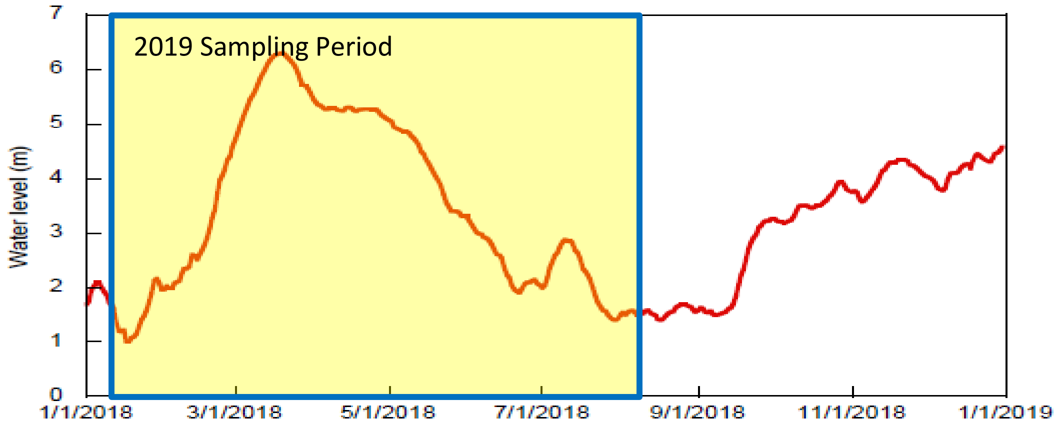

Figure 26. Atchafalaya River water levels at Butte La Rose 2019.

Data was apparently collected from Early January through December but the only data forthcoming from the state covered the period from Mid-January 2019 to the first week of August 2019. Nevertheless, the data are beneficial to this discussion.

Figure 27 reveals locations of the TNC monitoring stations while Figure 28 displays the mean daily water levels at the TNC monitoring stations.

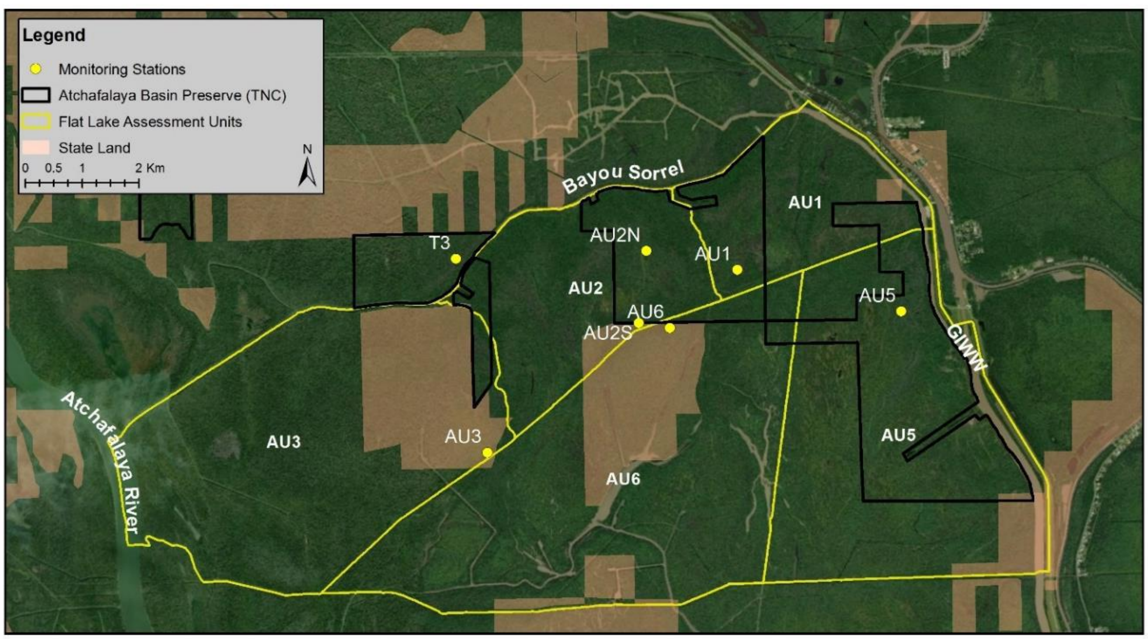

Figure 27. The TNC 2019 monitoring sites.

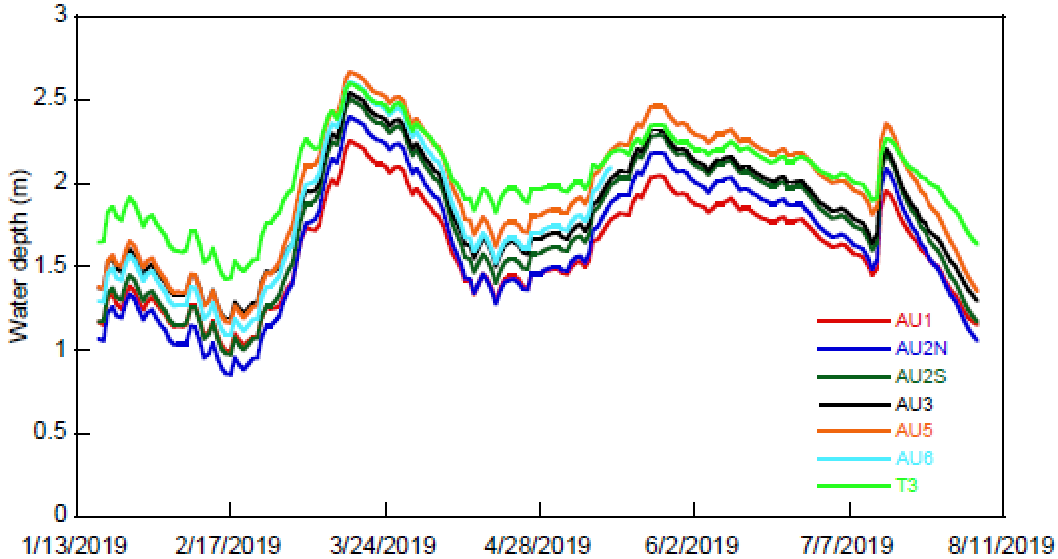

Figure 28. Mean Daily water levels at TNC monitoring stations 2019.

What is obvious from Figure 28 is that the monitoring sites were being well flushed with flood water; the depth, including instrument offset above ground, ranging from about 1.15 m to a high of about 2.65 m. Figure 29 displays the mean daily DO concentrations in mg/l for the swamp stations that TNC has monitored and are comparable to their previous data (TNC 2017, 2018). What is glaringly obvious it that the DO concentration drops throughout the study period and in many ways mirrors that of the Atchafalaya River at its Morgan City outlet for 2019 (van Heerden 2020). Many sites start at about 10 mg/l and fall to a low of less than 2.0 mg/l by early August 2019. Considering seasonal temperature differences as measured by TNC at their sites (winter 10 C; summer 27 C, Figure 30), the seasonality in the drop of Oxygen levels can be explained but not the much lower dissolved Oxygen levels as compared to the source Mississippi waters. If all things are equal, then the Oxygen levels should exactly follow the trend and values of Oxygen in the Mississippi River (van Heerden 2020).

During the summer warmth the Oxygen levels should be about 8 mg/l, not the less than 2.0 mg/l as displayed in Figure 29. Why this huge difference in Oxygen levels in the flow in these swamp and levee locations sampled by TNC? Why are the Oxygen levels at the end of the data collection period, namely early August, Mid summer, less than 2.0 mg/l? Something is ‘sucking’ the oxygen out of the water. In the shallow waters of the Basin swamps and lakes photosynthesis is taking place so one would expect, as explained in the introduction, that Oxygen levels would be helped by Photosynthesis. But nevertheless the Oxygen levels in this major flood drop way below what can be explained by the temperature rising as the sampling period progressed.

The only explanation is the extremely high nutrient levels, three times what characterized river floods prior to 1973, is the cause. The DO levels in Atchafalaya, as evidenced where the waters leave the Basin at its southern end, are at times half that of the basically saturated DO Missisppi flow inputs to the Basin. The drop in DO levels cannot be explained by seasonal temperature differences. Instead this is classical eutrophication. Microorganisms and such are having a huge feast due to the heavy nutrient loads of the Mississippi River precipitating marked lowering of DO as they consume the DO.

The TNC 2019 data very strongly show the impact of nutrient loading and consequential eutrophication and hypoxia even when there is a long duration flood and the swamp is being well flushed. Again, and again, these 2019 data strongly support that flushing of swampland channels and channel cuts is not the mamangement solution to eutrophication. Rather it adds and abets the eutrophication problems.

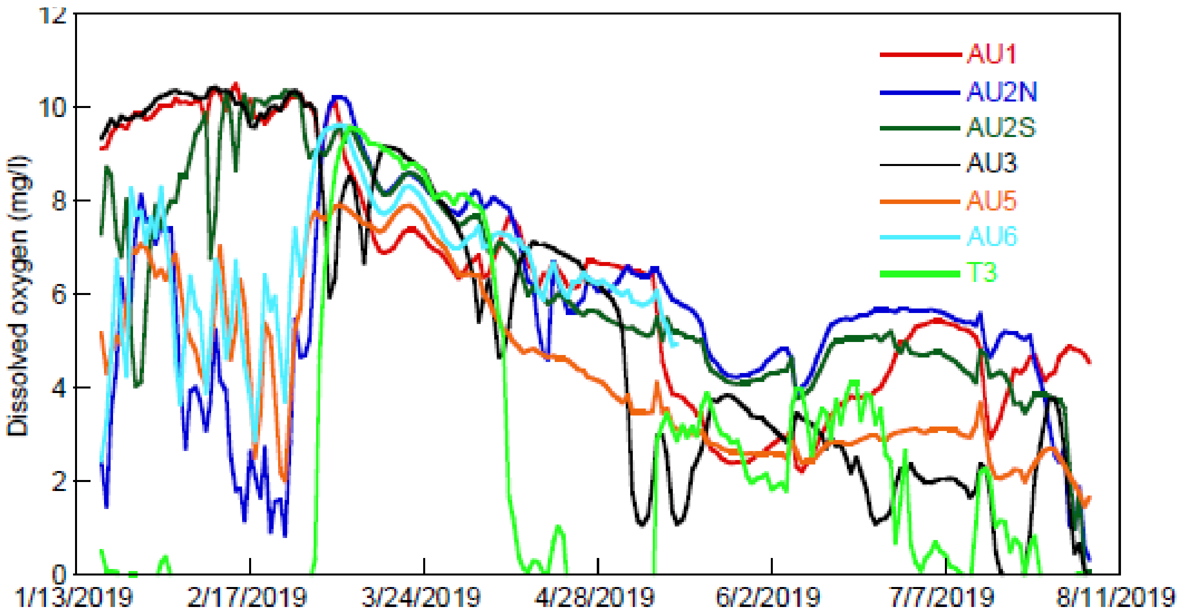

Figure 29. Mean daily dissolved oxygen concentrations at the TNC monitoring stations. For locations see Figure 34.

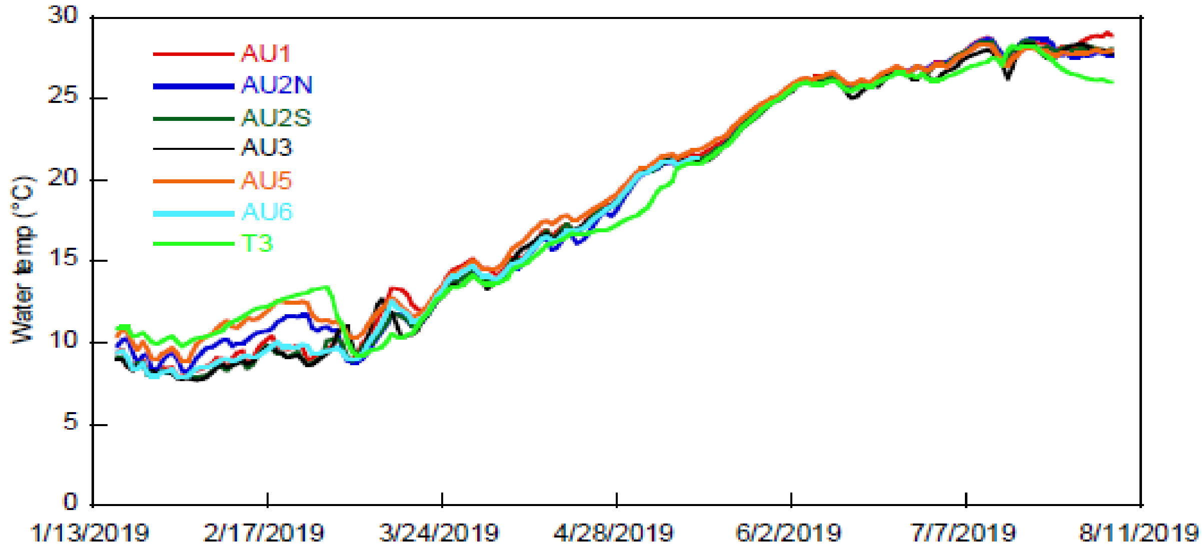

Figure 30. Mean daily temperatures at the TNC monitoring sites Jan to August 2019.

Conclusions

The Nature Conservancy has been collecting monitoring data in the East Grande Lake area of the Atchafalaya Basin under contract to the State of Louisiana. A review of this data collection program was undertaken at the request of the Atchafalaya Basinkeeper. The conclusion of this review are as follows:_

1. The TNC data reports do not supply the basics on the calibration or Quality Control/Quality Assessment of the data collected. At the very least either in the main body of each report or as an Appendix should be a discussion of the quality of the data with relevant calibration. Without such the data could be way off and not suitable to make management decisions. In other words, these data should be treated with caution by any agency using this data.
2. The TNC do not address concerns that Federal Agencies have expressed about the equipment they chose to use, nor do they discuss any site-specific maintenance such a cleaning of sensors that are subject to fouling.
3. The TNC supply no sampling location data as to GPS coordinates, elevation, nature of substrate, environment, proximity to boat traffics and so on. This seriously underlies the repeatability of the data even if the QAQA was properly performed.
4. The TNC report does not address the solubility of Dissolved Oxygen based on water temperature nor seem to recognize that rising water temperatures in the summer decreases DO compared to saturated winter waters. This especially important aspect of DO concentrations is not recognized anywhere in their reports. A fatal flaw in my opinion. Additionally, there is a 10 deg C data bust in the 2018 data.
5. The TNC use a gauging station that is some 15 miles away from their study site at Butte La Rose, that has no relation in terms of water level elevation at their sites. They do not explain why they do not utilize a USGS maintained gauge close to the EGL study area.
6. The TNC have not tried to ascertain the nature of characteristics of each of the floods that sampled (See van Heerden 2020, for instance). No two floods are the same in the Mississippi drainage as it depends where the precipitation is mostly falling or where the snow falls where most prevalent. If you don't know what the flood source is (i.e., turbidity), how can you try to interpret what is actually happening in the Basin. A classic example of process – response not being considered
7. There is no discussion of their data in any detail at all. Why does some of the data flat line? Why does some of the data have strange exaggerated peaks, why do some sites show different trends to those that are almost adjacent? The TNC reports are purely descriptive with no scientific interpretation of the data other than a blanket statement that freshwater flushing improves DO. This TNC conclusion is in line with, it would appear, the large corporations and landowner interests that fund TNC.
8. It is my opinion that this data does not stand the muster, and especially the conclusions, on which to base multimillion dollar decisions on management of the Atchafalaya Basin, which is infilling at such a rate as to be losing the public safety benefit as a Floodway to take pressure of serious flooding from communities such as New Orleans during Major Mississippi River floods.