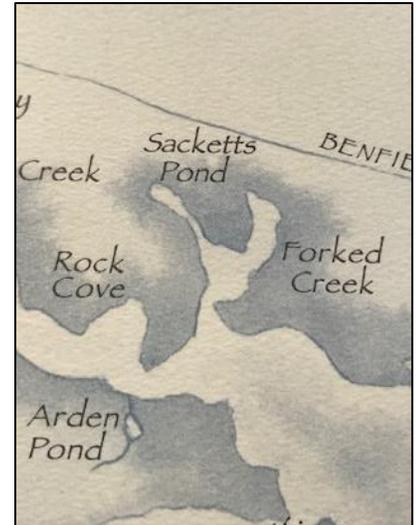


SRA Creek-by-Creek Report Forked Creek and The Narrows

2020 Water Column Dissolved Oxygen, Bottom Dissolved Oxygen,
Average Salinity, and Clarity Analysis
By Emi McGeady, Field Investigator



Abstract

Forked Creek and The Narrows experienced poor water quality in 2020. Dead zone occurred frequently from July to October, totaling over 65% of monitoring at all stations. The dead zone, when measured, took up the majority of the water column and occurred for 11 consecutive weeks in Forked Creek, and 12 weeks at The Narrows. Average salinity however was always in the expected mesohaline range of 5-18 ppt. Clarity ranged in moderate levels for most of the year, though bad clarity was measured a handful of times. Bad clarity was observed in Forked Creek more often than at the Narrows.



INTRODUCTION

Thanks to support from the Delaplaine Foundation, The Severn River Association (SRA) created a water quality program in 2018 to track conditions throughout the Severn River, a natural resource Maryland residents and communities enjoy for fishing, crabbing, swimming, and boating. Since 2019 the program has run weekly from late May to early November and tracks temperature, dissolved oxygen, pH, salinity, and clarity throughout the entire water column at 44 stations across the watershed.

This analysis focuses on dissolved oxygen (d.o.), salinity, and clarity, three important metrics of water quality, in Forked Creek and The Narrows. These two areas are located on the upper Severn River in Severna Park (figure 1). Forked Creek is home to the Bluff Point and Colchester communities. The Narrows is located along the shores of Fairwinds, Hollywood on the Severn, Whitneys Landing, and Carrollton Manor communities.

Studied in this report are SRA’s water quality monitoring stations known as Forked Creek #1 (FC1), Forked Creek #2 (FC2), and The Narrows (NA) (figure 1). Monitoring at these stations occurred weekly from May 27th to November 4th in 2020. This resulted in a total of 23 monitoring days and 226 volunteer hours.

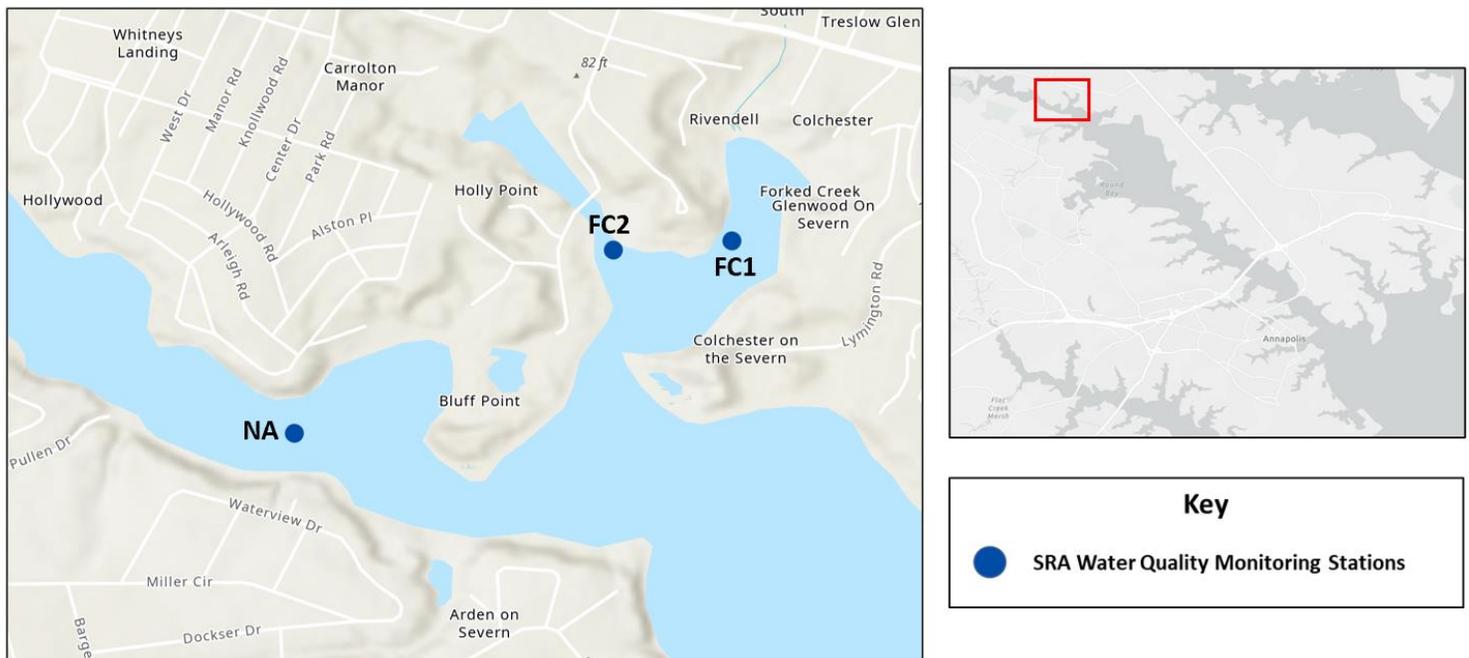


Figure 1. Water quality monitoring stations in Forked Creek and The Narrows.

EXECUTIVE SUMMARY

In 2020, dissolved oxygen in Forked Creek and The Narrows was similar and very poor. Both stations had very high d.o. on May 27th due to a river-wide mahogany tide algal bloom but then from late June to October dead zones (d.o. < 2.0 mg/L) devastated the majority of the water column. Dead zone was measured for 68% of monitoring at FC1, 73% at FC2, and 78% at NA.

Dead zones proved to be worse at The Narrows as dead zone was recorded more frequently at deeper depths. However, moderate and good oxygen (2-5 mg/L) was recorded more often in the upper half of the water column than in Forked Creek.

Average salinity fell within the mesohaline range of 5-18 ppt for the entire monitoring season at all stations. In the summer it was fresher and became saltier over time, growing from about 6.50 ppt to 13.60 ppt in Forked Creek and 6.67 ppt to 13.43 ppt at The Narrows. All stations experienced a sharp peak in average salinity on June 24th where salinity averaged 12.23 ppt at The Narrows and about 13.00 ppt in Forked Creek.

Average salinity was very similar at all stations. No clear difference existed by Forked Creek station, but average salinity was lower by 0.50-1.00 ppt at The Narrows occasionally.

Clarity at all stations fluctuated in moderate ranges, within 0.6-1.1 m, for the majority of 2020. However, clarity was bad more often at FC2. Clarity under 0.6 m was measured 6 times at FC2 compared to 3 times at FC1 and NA. Clarity never reached good levels of 1.6 m at any station but clarity tended to be higher in June and November.

ANALYSIS

Water Column Dissolved Oxygen

River life, including oysters, fish, and crabs, prefer dissolved oxygen (d.o.) levels above 5.0 mg/L (green line on the graphs below). Oxygen levels below 2.0 mg/L are insufficient for survival and are therefore designated as dead zone conditions (red line on the graphs below).

On each day of monitoring, dissolved oxygen measurements were taken with a YSI probe. The probe was lowered to the bottom where the first measurement was taken. The probe was then raised through the water column, taking measurements at every following half meter in Forked Creek, and meter at The Narrows. Total depth at Forked Creek #1 was usually 2.5-3.0 meters. Forked Creek #2 was typically 3.0-3.5 meters deep. The Narrows' total depth was 5.0 meters deep.

Each station's dissolved oxygen data is displayed on figures 2-4 below. The lighter bars represent d.o. content in surface water (0.5 m deep), with the darker bars representing d.o. at subsequent deeper depths. Bars above the red line indicate depths where moderate to good oxygen levels were measured, and bars that fall below the red line indicate depths exhibiting dead zone conditions.

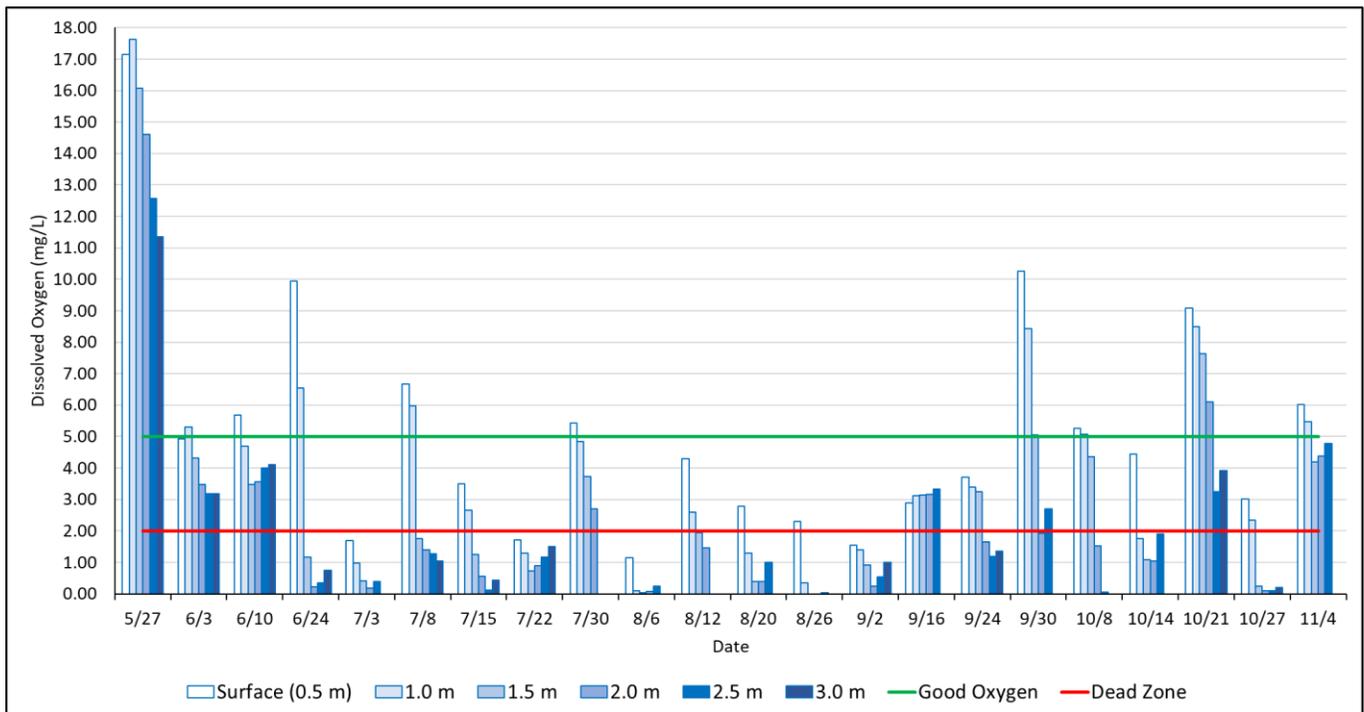


Figure 2. Dissolved oxygen levels through the water column at Forked Creek #1 (FC1) in 2020.

- Dissolved oxygen began very high on May 27th. The highest d.o. measured at this station was 17.62 mg/L at 1.0 m deep, and levels 11.35-17.15 mg/L were found at other depths. These high values are indicative of the river-wide mahogany tide algal bloom which was observed throughout May 2020 on the Severn.

- Dead zone conditions were measured at FC1 on 15 days of monitoring in 2020, approximately 68% of monitoring. These poor conditions began on June 24th and were measured frequently through summer and fall.
- When dead zone was measured, it afflicted the majority of the water column. Dead zone was found at multiple depths and even occurred at every depth on July 3rd and 22nd, and September 2nd.
- The lowest d.o. readings occurred on August 26th when from a depth of 1.0 m to 2.5 m only 0.00-0.36 mg/L was measured.
- On days that dead zone wasn't measured, d.o. was still not good. Dissolved oxygen was typically moderate ranging 2-4 mg/L. Only on few instances was good d.o. measured, usually in surface or 1.0 meter deep water.

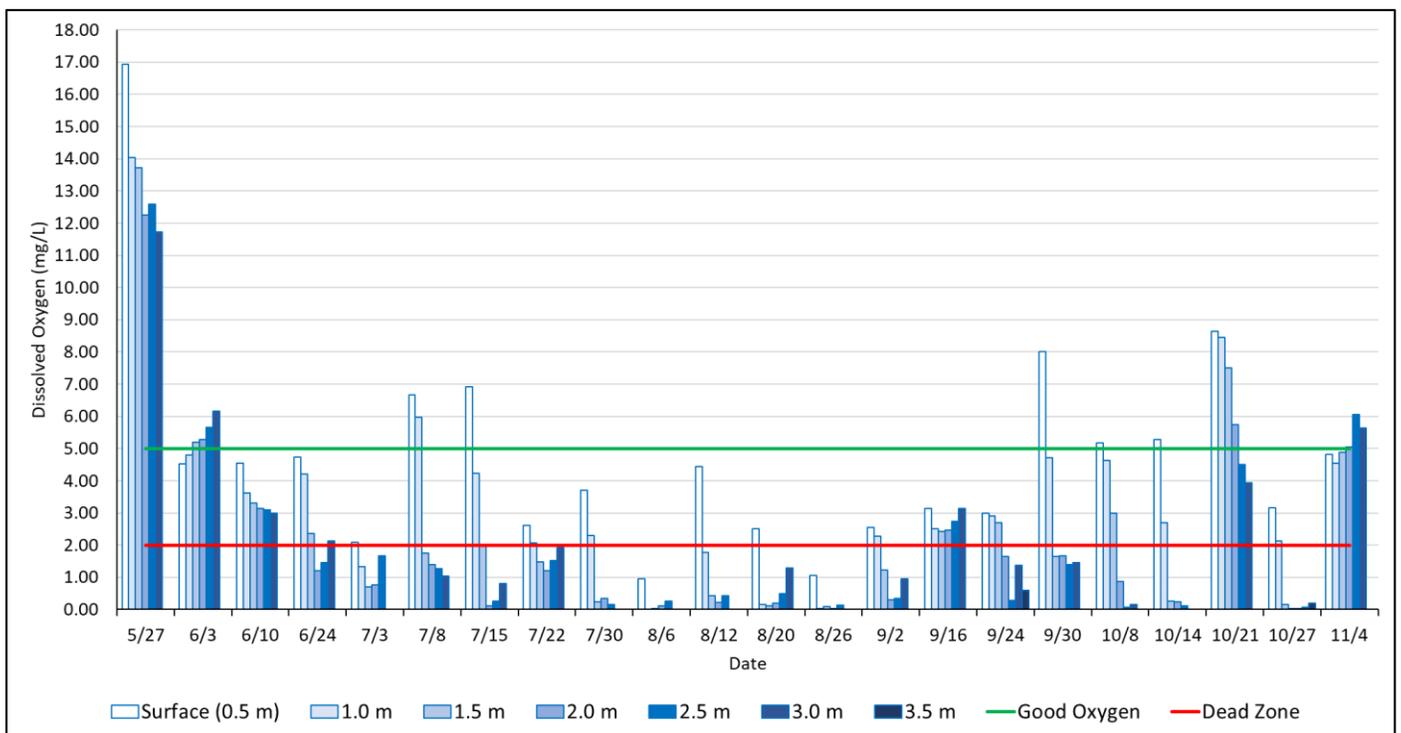


Figure 3. Dissolved oxygen levels through the water column at Forked Creek #2 (FC2) in 2020.

- Like at FC1, dissolved oxygen began very high on May 27th. The highest d.o. measured at this station was 16.94 mg/L at 0.5 m deep, and levels 11.72-14.04 mg/L were found at other depths. These high values are indicative of the river-wide mahogany tide algal bloom which was observed throughout May 2020 on the Severn.
- Dead zone was slightly worse at FC2 than FC1. Dead zone was measured on 16 days, totaling 73% of monitoring. Dead zone was measured for 11 consecutive weeks from June 24th to September 2nd, and was measured frequently in September and October as well.
- Dead zone also took up most of the water column when measured, and took up the full water column on August 6th and 26th. On August 6th the lowest d.o. measurement of 0.00 mg/L was recorded as well.
- Sufficient oxygen was seen in surface water typically but there were very few instances of good dissolved oxygen.

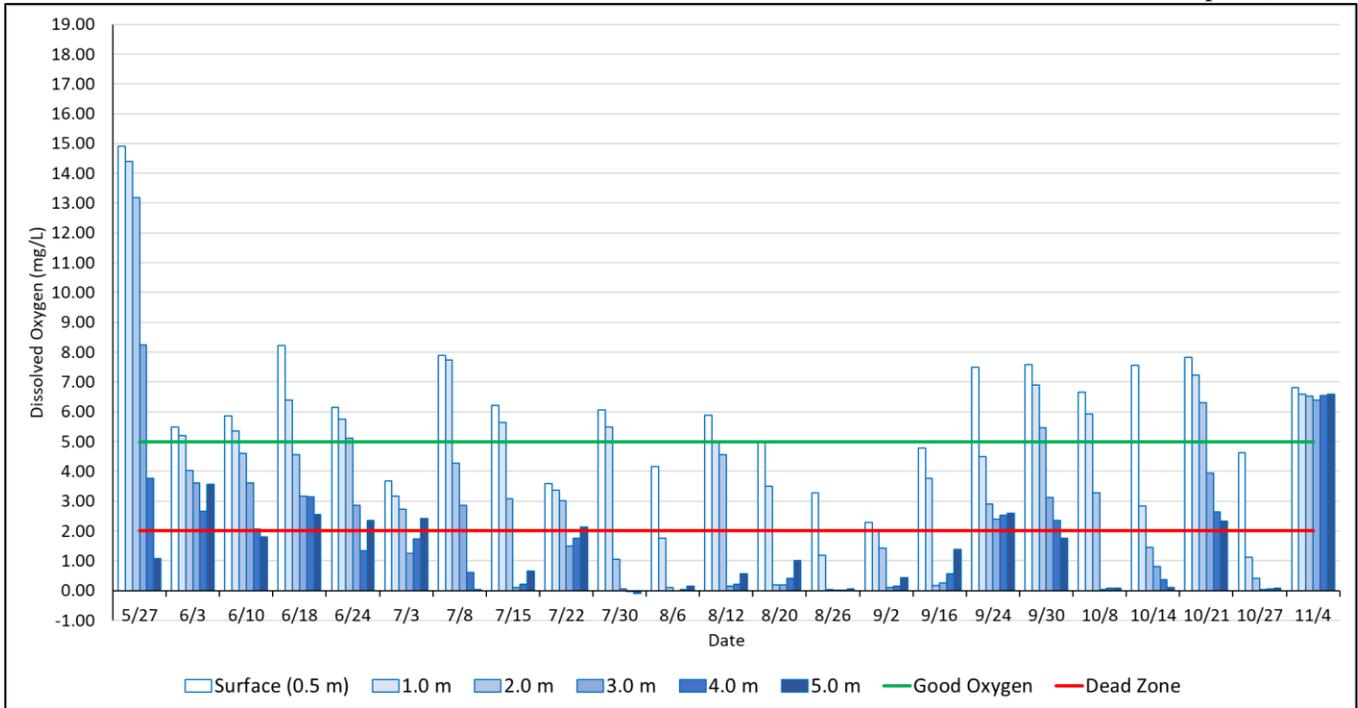


Figure 4. Dissolved oxygen levels through the water column at The Narrows (NA) in 2020.

- Outside of Forked Creek, at The Narrows, dissolved oxygen began very high on May 27th. The highest d.o. measured at this station was 14.90 mg/L at 0.5 m deep. This, along with dead zone measured on the bottom (1.07 mg/L) is indicative of the river-wide mahogany tide algal bloom which was observed throughout May 2020 on the Severn. Algae blooming at the surface then decomposes and depletes oxygen at deeper depths.
- Dissolved oxygen was better in shallower depths than Forked Creek stations, but dead zone afflicted the bottom half of the water column frequently. Dead zone was measured on 18 days here, totaling 78% of monitoring.
- Dead zone was measured for 12 consecutive weeks from June 24th to September 16th.
- Dead zone was measured at multiple depths, usually from 2 to 5 meters. Dead zone never took up the entire water column but came close on August 6th and 26th, and October 27th.
- The worse dissolved oxygen reading was -0.10 mg/L measured on the bottom (5.0 m) on July 30th. Negative d.o. readings indicate a near zero dissolved oxygen environment. The YSI instrument on this day was likely measuring slightly below the true value of dissolved oxygen, however this data still indicates a very low measure of d.o. at this depth.
- More good levels of d.o. were observed here than Forked Creek stations. Surface water usually contained 5-7 mg/L and intermediate depths displayed 3-4 mg/L of dissolved oxygen.

Bottom Dissolved Oxygen

Measuring dissolved oxygen on the bottom is important for understanding conditions experienced by sedentary/less mobile creatures that cannot escape dead zone conditions, such as oysters, mollusks, and other benthic organisms. Bottom d.o. measurements were taken with a YSI probe. The probe was lowered until the bottom was felt by slack in the cord. Then the probe was raised to the nearest 0.5 m depth as to not be in the mud. Bottom d.o. measurements are displayed for each station on figure 5 below.

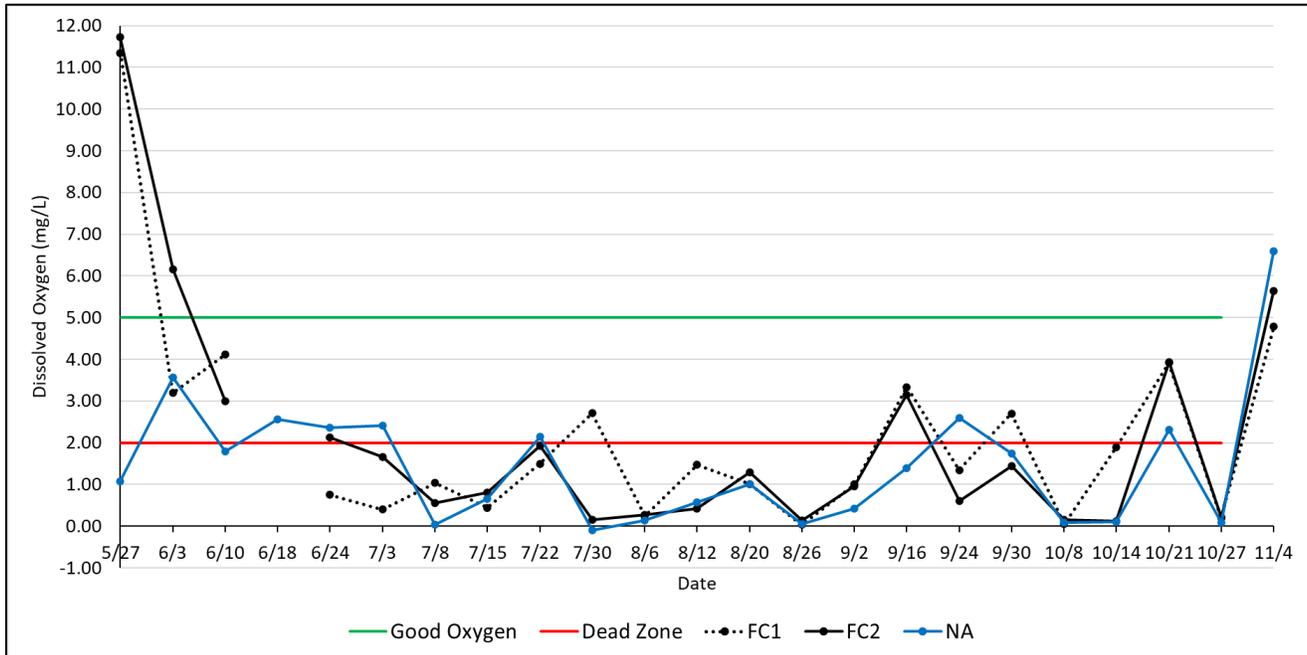


Figure 5. Bottom dissolved oxygen measured at Forked Creek and The Narrows stations in 2020.

- On May 27th we see the biggest difference in bottom dissolved oxygen. At both Forked Creek stations, very high d.o. was measured (11.35 and 11.72 mg/L). However at NA dead zone (1.07 mg/L) was measured. This is likely due to NA’s deeper depth of 5 meters. Temperature stratification likely occurred at NA, preventing mixign of surface and bottom water.
- Bottom d.o. crashed for all stations through the summer. Dead zone was measured frequently on the bottom from July to October for all stations: 14 times at FC1, and 15 times at FC2 and NA.
- All stations entered moderate or good d.o. levels again on November 4th (4.78 mg/L at FC1, 5.64 mg/L at FC2, and 6.60 mg/L at NA).
- The lowest bottom d.o. at FC1 was 0.03 mg/L on August 26th. The lowest d.o. at FC2 was 0.12 mg/L on October 14th. At The Narrows, the lowest bottom d.o. was -0.10 mg/L on July 30th. Negative d.o. readings indicate a near zero dissolved oxygen environment. The YSI instrument on this day was likely measuring slightly below the true value of dissolved oxygen, however this data still indicates a very low measure of d.o. at this depth.

Average Salinity

The Severn River is a brackish water body. This means that it is neither fully freshwater (0 ppt) or fully saltwater (35 ppt)¹. Instead the typical salinity range (amount of dissolved salt) of the Severn River is mesohaline (5-18 ppt)². Severn River organisms and underwater grasses are adapted to this range of salt in their environment. Prolonged exposure to salinity outside of this range can cause negative effects such as stress, depressed growth, and decreased survival.

Salinity measurements were taken with a YSI probe at each depth on each monitoring day. The measurements were then averaged for each monitoring day because salinity did not vary much by depth. On figure 6 below, points that fall between the green and red line indicate average daily salinity in the expected mesohaline range.

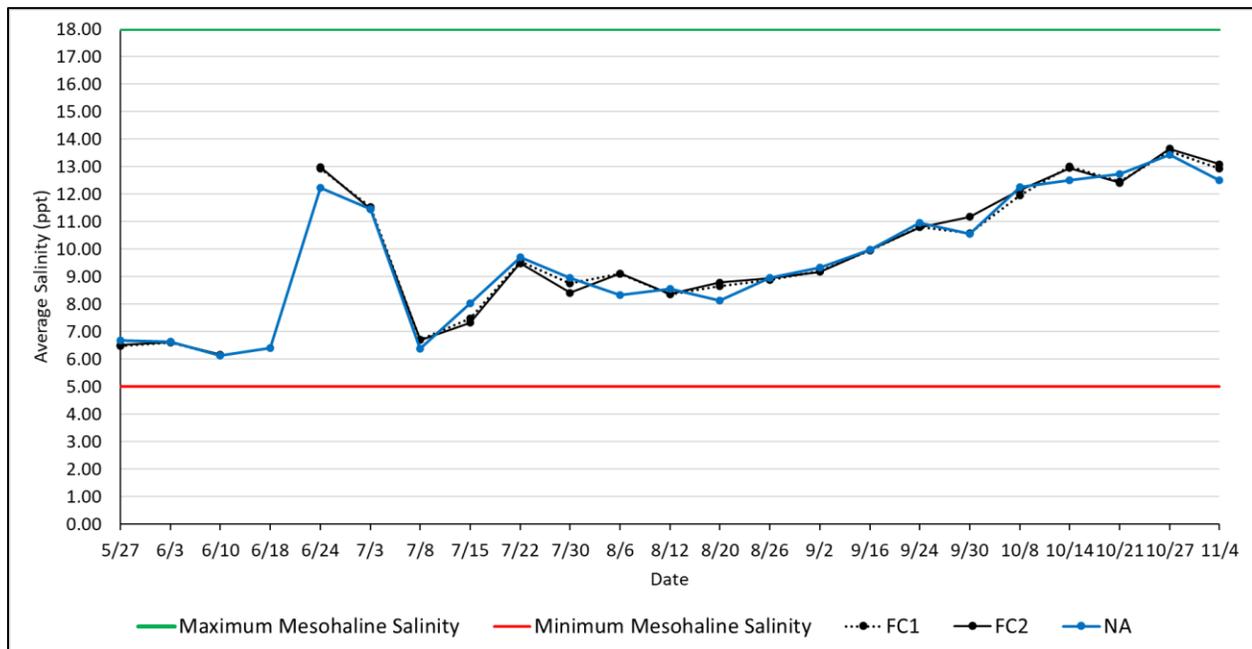


Figure 6. Daily average salinity measured at Forked Creek and The Narrows stations in 2020.

- Average salinity over the 2020 monitoring season fell within the mesohaline range of 5-18 ppt, and steadily increased from spring to fall at each stations, except for an abrupt peak on June 24th and July 3rd. This peak around 12-13 ppt was followed by a drop to 6.50 ppt the following week.
- Each Forked Creek station had very similar average salinity week to week. No clear difference exists. Average salinity at the Narrows fluctuated from Forked Creek stations few times, when it was about 0.50-1.00 ppt lower.
- Salinity was lowest at all stations on June 10th, averaging 6.14-6.16 ppt. Salinity was highest at all stations on October 27th, averaging 13.43-13.64 ppt.

¹ Chillrud, R. (2020, March 20). Is the Chesapeake Bay fresh or salty? Retrieved January 07, 2021, from https://www.chesapeakebay.net/news/blog/fresh_or_salty_bays_salinity_makes_a_big_difference_to_underwater_life

² Bergstrom, P., Murphy, R., Naylor, M., Davis, R., & Reel, J. (2006). *Underwater Grasses in Chesapeake Bay & Mid-Atlantic Coastal Waters*. College Park, MD: Maryland Sea Grant College.

Water Clarity

Water clarity is a measure of how far we can see down into the water column. High clarity is indicative of less suspended sediment, algal blooms, and other pollutants that cloud the water. Tracking clarity allows us to understand water quality conditions better, and aid in determining sites suitable for submerged aquatic vegetation (SAV) growth, that require sunlight to penetrate deeply into the water column.

To measure clarity, a Secchi disk was lowered into the water from the shady side of the boat until the pattern of the disk was no longer visible. The disk was then raised towards the surface of the water until barely visible. This depth was then recorded and displayed on figure 7 below. Secchi depths below 0.6 m and above 1.6 m are considered good and bad clarity in mesohaline environments, respectively.

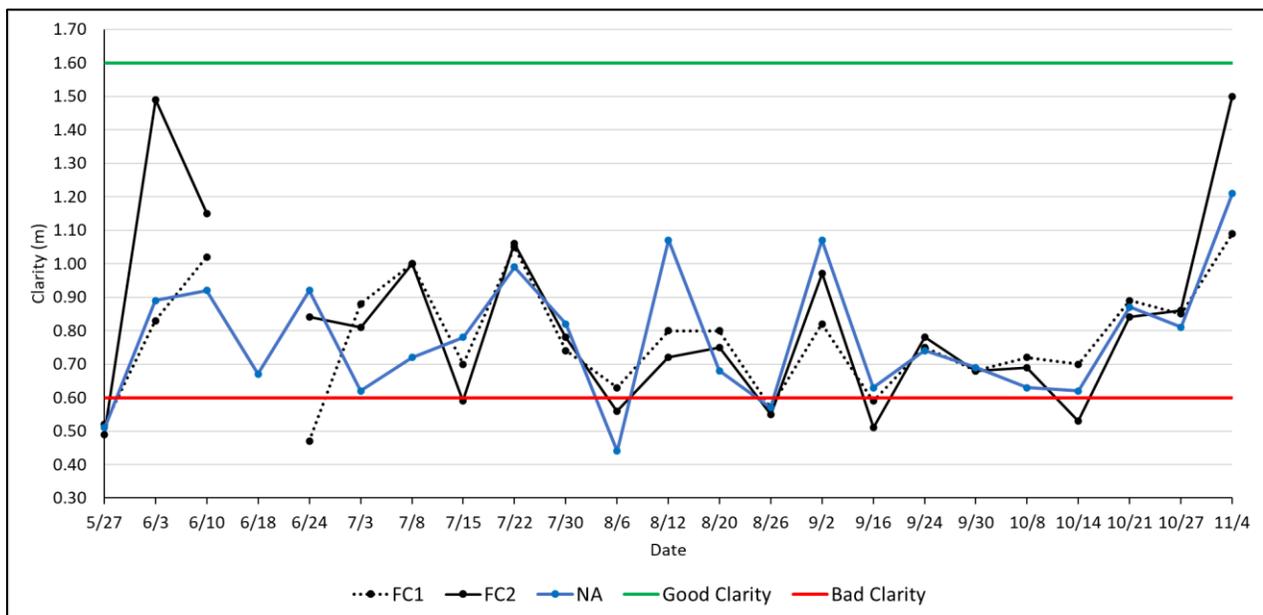


Figure 7. Water clarity at Forked Creek and The Narrows stations in 2020.

- Clarity fluctuated from poor to moderate for all stations in 2020. Clarity was more moderate than bad but fluctuated greatly from week to week seen by the zig-zag pattern above.
- On May 27th, clarity was bad at all stations due to the mahogany tide algal bloom. Clarity was 0.52 m at FC1, 0.49 m at FC2, and 0.51 m at NA.
- Clarity at FC2 was generally better than clarity at FC1 in May, June, and November. However, clarity at FC2 was bad more often, specifically 6 times in 2020. From July through October clarity was generally worse at FC2 than FC1. The worst clarity at this station, 0.51 m, was observed on June 24th.
- Clarity was only bad twice at FC1. 0.52 m on May 27th and 0.47 m on June 24th. Otherwise, clarity was moderate, typically ranging 0.70-1.00 m.
- Clarity was lowest at NA on August 6th (0.44 m). Clarity at NA tended to stay within 0.6-1.10 m.
- Clarity was never good (over 1.6 m) at The Narrows, or any Forked Creek stations in 2020.