SOUTH FORK OF THE EDISTO RIVER AND POND BRANCH MONITORING RESULTS (FEBRUARY 2017 TO JANUARY 2019)

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Abstract

A team of volunteers from the Augusta-Aiken Audubon Society began monitoring water quality at two locations on the South Fork of the Edisto River in Aiken County, SC, in February 2014 and added a location on Pond Branch, a tributary to the Edisto in July 2014. This report presents data obtained between February 2017 and January 2019. The monitoring program assesses the water quality at the three locations with the intent of detecting impacts from agricultural development near Aiken State Park and Keadle Bridge (where Spring Branch/Windsor Road crosses the river), and from a newly constructed chicken farm on Pond Branch. Monitoring consists of measurements of chemical and physical properties of the water, and bacteria counts for *E coli*. During the past two years, sampling results show generally good water quality at all three sampling points. Dissolved oxygen content was high, the pH was in the range expected for a slightly tannic river or stream, chemical pollutants were low or absent, and settleable solids were present at trace levels. Temporary increases in turbidity have been observed in both river and stream. Bacteria monitoring at Keadle Bridge and Pond Branch indicate *E. coli* populations are generally low, but on two occasions (Keadle Bridge, 4/25/17, and Pond Branch, 9/18/18) they exceeded Adopt-a-Stream guidelines. Authorities were notified after the Keadle Bridge incident. Our follow-up testing two days after the Pond Branch event showed the high bacteria concentration was a short-term change due to a recent intense rain shower.

Introduction

The South Fork of the Edisto River drainage basin covers approximately 800 square miles in Saluda, Edgefield, Aiken, Barnwell, Bamberg, and Orangeburg counties (Figure 1.) Most of the watershed is rural and farming is the major land use category. The river supplies water to local farmers and is used for recreational purposes, such as fishing and boating. In January of 2014, public attention focused on the river when South Carolina Department of Health and Environmental Control (SC DHEC) approved an agricultural request from Walther Farms to remove 805 million gallons of surface water per month (later reduced to 400 million gallons/month). Local citizens, both farmers and recreational users, became concerned that the approved withdrawals would adversely affect their use of the river, particularly during times of low rainfall. To address citizens' concerns, SC DHEC held an informational meeting in Aiken, during which they explained that SC state law did not allow them to deny the request. From the discussion, it seemed that little information was available to assess the impact of the water withdrawal. No information was provided on the river monitoring on the South Fork of the Edisto River in the vicinity of the planned withdrawals, except for a few references to the river gauge downstream at Denmark, SC.

Concerned members of the Augusta-Aiken Audubon chapter formed a volunteer group to monitor the water quality above and below the Walther Farms water withdrawal site (see Figure 2). Several months later, a third sampling point was added on Pond Branch, a tributary of the S.

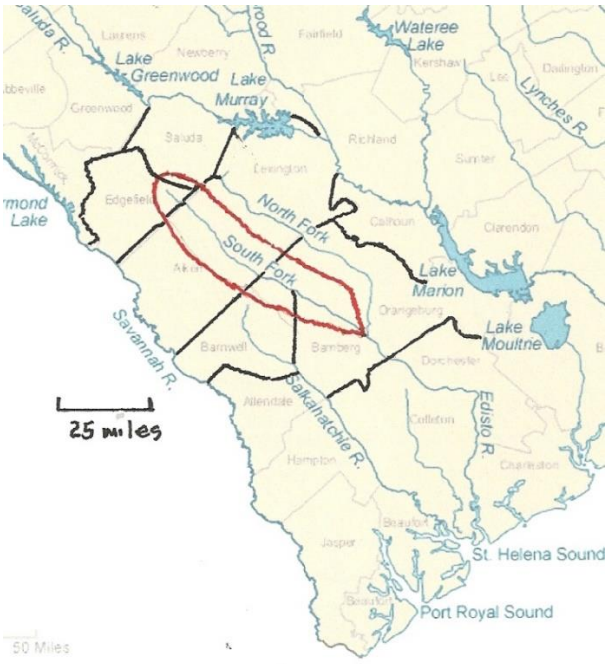

FIGURE 1. The drainage basin for the South Fork of the Edisto River is outlined in red.

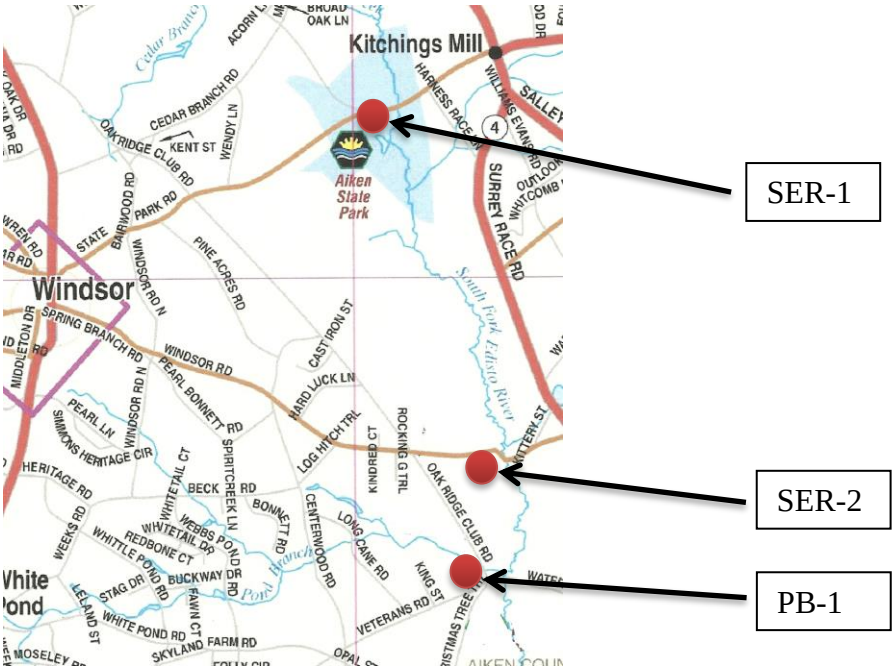

FIGURE 2. Map of the Windsor area showing the locations of the sampling points on the South Fork of the Edisto River and Pond Branch. SER-1 is located in Aiken State Park, SER-2 is located at Keadle Bridge, and PB-1 is located where Pond Branch crosses Oak Ridge Club Road.

Edisto River, prompted by the proposed construction of a poultry farm in the vicinity. Monthly monitoring includes both chemical (3 sites), physical (3 sites), and bacteria measurements (2 sites). Monitoring allows assessment of current water quality and provides baseline data to gauge the effects of future development. Monitoring results from February 2014 to January 2017 have been reported previously (Ref. 1).

Figure 2 shows the locations of the three monitoring sites used in this study. The sites are located on or near the South Fork of the Edisto River in Aiken County near the town of Windsor, SC. The upstream sampling point (SER-1) is within the Aiken State Park. The downstream sampling point (SER-2) is located at the boat landing adjacent to Keadle Bridge. The Pond Branch sampling point (PB-1) is located where Pond Branch crosses Oak Ridge Club Road. See Appendix A for the site names, map coordinates, photographs of each site, and description of the habitat.

Procedures

The Edisto River monitoring effort forms part of the Georgia Adopt-A-Stream program. The volunteers received GAAS training, including annual retraining, and follow GAAS sampling and data collection protocols. These are accessible through the GAAS website (Ref. 2) or through their publications (Ref. 3). At least two GAAS-trained and qualified monitors participated in each monitoring event. The results from sampling the South Fork of the Edisto River are entered in the GAAS database and are available online (Ref.2). The team's identification number is AAS-G-1087 and its name is "AAAS Stream Stompers". Appendix B contains details of the equipment and methods. The only significant change from GAAS procedures is the use of a transparency tube in place of the Secchi disk.

Results and Discussion

Table I (parts a, b, and c) lists chemical test results for February 2017 through January 2019. Table II lists bacteria counts for the same period. These two years of sampling results show consistently good water quality at all three sampling points. Dissolved oxygen levels (4.0 to 10.3 mg/L) will support most aquatic life forms; the pH was consistently in the range 5.5 to 6.5; chemical pollutants (e.g., nitrate, ammonia, and phosphate) were low or absent; settleable solids were low (≤0.1 mL/L); and conductivity was low (<30 mS/cm). Transparency was normally very good (>120 cm), although 12 samples out of 73 fell below 120 cm, to as low as 68 cm. Bacteria counts have been variable but below levels of concern (<500 CFU/100 mL), except in two instances: 1270 CFU/100 mL at Keadle Bridge in April 2017, and 2700 CFU/100mL at Pond Branch in September 2018.

<u>Dissolved Oxygen</u>

As seen in Table Ia, dissolved oxygen concentrations in the river and stream varied between 4.0 and 10.3 mg/L. Figure 3 shows the results in graphical form. To put these values in perspective, Georgia state standards require an average concentration of 5 mg/L with a minimum of 4 mg/L to provide adequate oxygen for most aquatic life forms (Ref. 2). Thus, the dissolved oxygen levels we found indicate a healthy aquatic environment.

Table Ia. Results of Chemical Monitoring

	Air Temperature (ºC)			Water Temperature (ºC)			Dissolved Oxygen (mg/L)			pH		
Location	SER-1	SER-2	PB-1	SER-1	SER-2	PB-1	SER-1	SER-2	PB-1	SER-1	SER-2	PB-1
Date												
2/28/2017	20.5	22.0	22.0	13.0	13.0	15.0	8.5	8.2	8.5	6.5	6.5	6.5
3/14/2017												
3/26/2017	19.0	25.0	26.5	16.0	16.0	17.0	8.0	7.6	8.3	6.5	6.5	6.0
4/25/2017	16.5	15.0	16.0	17.0	17.0	17.0	6.3	5.7	5.5	6.0	6.5	5.5
5/31/2017	22.0	22.0	22.5	21.5	22.0	21.0	6.2	6.0	6.9	6.5	6.5	6.5
6/29/2017	25.5	24.0	23.5	22.0	22.0	20.5	6.1	6.3	7.2	6.0	6.0	6.0
8/1/2017	25.0	21.5	20.0	22.0	22.0	19.5	6.0	5.8	7.3	6.0	6.0	6.0
8/29/2017	21.0	20.5	21.5	22.0	22.0	20.5	6.2	6.2	7.0	6.0	6.0	6.0
10/5/2017	24.0	22.0	21.0	21.0	21.0	18.0	6.8	6.9	7.8	6.5	6.5	6.5
11/7/2017	22.0	21.5	21.0	17.5	18.0	17.0	7.0	7.0	7.4	6.5	6.5	6.5
12/5/2017	17.0	15.5	17.0	13.0	12.5	14.0	8.6	8.4	8.6	6.5	6.5	6.5
12/28/2017	3.5	3.5	3.0	8.5	8.5	10.5	9.8	9.4	9.5	6.5	6.5	6.5
1/30/2018	8.5	5.2	6.2	9.5	10.0	11.0	8.8	8.7	9.0	6.5	6.5	6.5
2/22/2018	24.5	25.0	24.0	19.0	19.5	19.5	6.8	6.9	7.6	6.5	6.5	6.5
3/29/2018	23.0	22.5	23.0	15.0	15.8	16.0	8.0	8.0	8.1	6.5	6.5	6.5
4/26/2018	21.0	21.0	21.0	18.0	18.0	18.0	6.4	6.0	7.4	6.5	6.5	6.5
5/29/2018	25.0	27.0	26.0	23.5	24.0	23.0	5.0	4.8	5.9	6.5	6.5	5.8
6/26/2018	26.0	29.0	24.0	25.0	25.0	24.0	5.6	5.6	6.1	6.5	6.5	6.5
7/31/2018	26.0	25.5	25.5	24.5	25.0	24.0	5.5	5.5	6.0	6.5	6.5	6.0
9/18/2018	26.5	26.0	26.5	24.5	24.5	24.0	4.4	4.4	4.0	6.5	6.5	5.5
9/20/2018												
10/31/2018	17.5	12.5	15.0	13.0	13.5	14.0	8.0	7.7	8.5	6.5	6.5	6.5
11/27/2018	7.0	5.0	6.0	9.5	10.0	11.5	8.8	8.6	8.8	6.5	6.5	6.5
1/2/2019	18.5	18.5	20.0	15.5	16.5	17.0	7.4	7.2	7.2	6.5	6.5	6.5
1/28/2019	10.8	9.0	9.0	7.0	7.5	10.0	10.3	10.2	9.5	6.5	6.5	6.5

TABLE Ib. Results of Chemical Monitoring (continued)

	Nitrate Ion (mg N/L)			Ammonia (mg N/L)			Phosphate (mg PO4/L)		
Location	SER-1	SER-2	PB-1	SER-1	SER-2	PB-1	SER-1	HC-2	PB-1
Date									
2/28/2017	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3/14/2017									
3/26/2017	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4/25/2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5/31/2017	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6/29/2017	0.03	0.03	0.05	0.00	0.00	0.00	0.00	0.00	0.00
8/1/2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8/29/2017	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10/5/2017	0.05	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11/7/2017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12/5/2017	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12/28/2017	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1/30/2018	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2/22/2018	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3/29/2018	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4/26/2018	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5/29/2018	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6/26/2018	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7/31/2018	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9/18/2018	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9/20/2018									
10/31/2018	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11/27/2018	0.08	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1/2/2019	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1/28/2019	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE Ic. Results of Chemical Monitoring (continued)

	Settleable Solids (mL/L)			Transparency Tube (cm)*			Conductivity (µS/cm)			River Depth**	
Location	SER-1	SER-2	PB-1	SER-1	SER-2	PB-1	SER-1	SER-2	PB-1	SER-1	SER-2
Date											
2/28/2017	Tr	Tr	Tr	>120	>120	>120	23	22	6	8 ft 9.5 in	8 ft 1 in
3/14/2017											
3/26/2017	Tr	Tr	Tr	>120	>120	>120	22	22	6	8 ft 10.5 in	8 ft 4.5 in
4/25/2017	Tr	Tr	Tr	94	85	86	16	15	9	9 ft 8.5 in	9 ft 6.5 in
5/31/2017	Tr	Tr	Tr	>120	>120	>120	20	19	6	8 ft 7 in	6 ft 11 in
6/29/2017	Tr	Tr	Tr	>120	>120	>120	25	24	6	7 ft 7.5 in	6 ft 5.5 in
8/1/2017	Tr	Tr	Tr	>120	>120	>120	24	24	5	8 ft 4 in	7 ft 9.5 in
8/29/2017	Tr	Tr	Tr	>120	>120	>120	18	18	5	7 ft 1.5 in	5 ft 11 in
10/5/2017	Tr	Tr	Tr	>120	>120	>120	19	19	5	7 ft 6 in	6 ft 1 in
11/7/2017	Tr	Tr	0	>120	>120	>120	19	19	5	8 ft 5 in	7 ft 2.5 in
12/5/2017	0	Tr	Tr	85	87	>120	20	18	5	8 ft 6.5 in	7 ft 7 in
12/28/2017	Tr	0	Tr	>120	>120	>120	21	21	4	8 ft 9 in	8 ft 1.5 in
1/30/2018	Tr	Tr	Tr	>120	>120	>120	16	16	6	9 ft 4 in	8 ft 7 in
2/22/2018	Tr	Tr	Tr	>120	>120	>120	24	27	5	8 ft 8.5 in	7 ft 11 in
3/29/2018	Tr	Tr	Tr	>120	>120	>120	24	21	4	8 ft 7 in	7 ft 7 in
4/26/2018	Tr	Tr	Tr	108	99	>120	18	16	5	9 ft 6.5 in	9 ft 1 in
5/29/2018	Tr	Tr	Tr	>120	>120	98	18	18	9	9 ft 6 in	9 ft 1 in
6/26/2018	Tr	Tr	Tr	>120	>120	78	20	23	8	7 ft 3 in	6 ft 1 in
7/31/2018	Tr	Tr	Tr	92	>120	110	18	20	8	8 ft 7.5 in	NA
9/18/2018	Tr	Tr	0.1	>120	>120	68	24	24	19	8 ft 11 in	NA
9/20/2018			Tr			>120			6		
10/31/2018	Tr	Tr	Tr	>120	>120	>120	22	20	5	8 ft 7 in	NA
11/27/2018	Tr	0	Tr	>120	>120	>120	24	21	10	9 ft 3 in	NA
1/2/2019	Tr	0	0.05	>120	>120	>120	26	24	8	9 ft 7.5 in	NA
1/28/2019	Tr	0	Tr	>120	>120	>120	22	22	4	9 ft 10 in	NA

*Maximum transparent depth measureable in the transparency tube is 120 cm. For a recorded reading of 120 cm, the actual transparent depth is greater by an unknown amount.

** SER-1 measured in Aiken St. Pk at the upper canoe launch. SER-2 measured at Keadle Br.

TABLE II. Results of Bacteria Monitoring

	E.coli count (CFU/100mL)	
Location	SER-2 Keadle Bridge	PB-1 Pond Branch
Date		
2/28/2017	33	133
3/14/2017	133	200
4/25/2017	**1270**	200
5/31/2017	167	200
6/29/2017	67	100
8/1/2017	100	100
8/29/2017	67	200
10/5/2017	33	100
11/7/2017	167	267
12/5/2017	167	200
12/28/2017	33	100
1/30/2018	400	200
2/22/2018	67	233
3/29/2018	100	33
4/26/2018	233*	33*
5/29/2018	300	100
6/26/2018	33	367
7/31/2018	67	133
9/18/2018	133	**2700**
9/20/2018	--	133, 167
10/31/2018	100	33
11/27/2018	67	67
1/2/2019	0	200
1/28/2019	0	33

*The blank sample was contaminated so these results may be high.

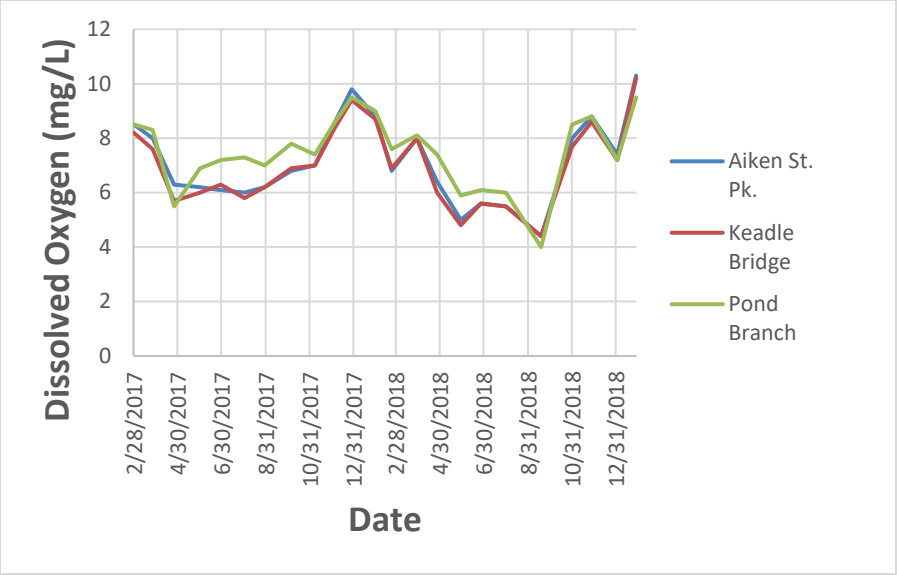

FIGURE 3. Results of dissolved oxygen measurements.

The graph in Figure 3 shows a strong seasonal variation. Much of the seasonal variation in DO results from changes in water temperature. In the summer, the water temperature is higher and the solubility of oxygen decreases, and, conversely, in the winter, the water temperature is lower and oxygen solubility increases. Figure 4 shows the same data recalculated as "% of saturation" based on the saturation limit of pure water at the temperatures of the samples (Ref. 3). The dissolved oxygen concentration as a percentage of saturation is relatively constant through the seasons, generally measuring 60 to 80%. Two of the low values (4/25/17 and 5/29/18) came during rapid increases in river depth from recent rains. The third low value on 9/18/18 does not correspond to a recent increase in river flow, but does correlate with other anomalous measurements (see below under Bacteria Monitoring).

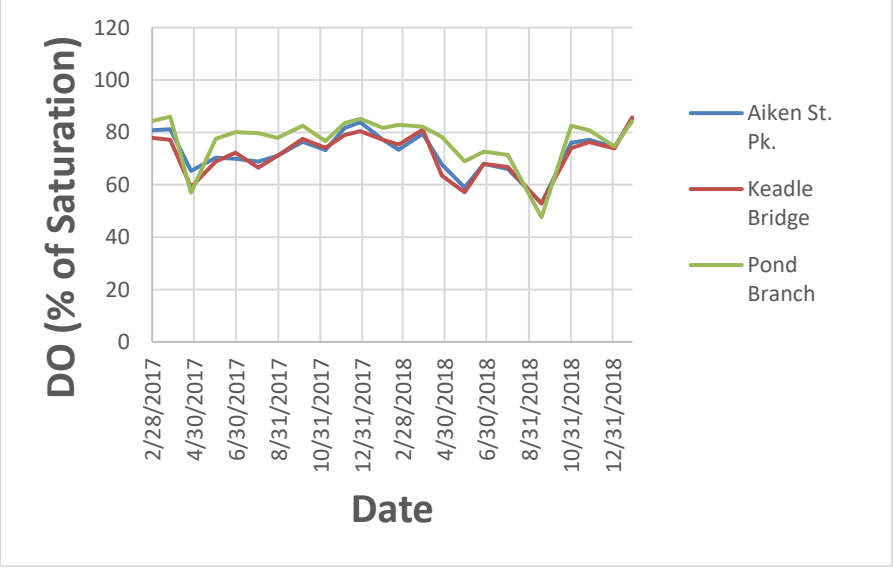

FIGURE 4. Dissolved oxygen (as % of saturated) results for three sampling locations.

pH

The pH showed little variation with a range of 5.5 to 6.5. This pH range is relatively high for a slow moving, blackwater river. The tannic nature of such rivers can produce pH values as low as 3.5. A pH of 5.5 to 6.5 is closer to the range for fast-moving mountain streams (pH 6.0 to 8.0). The reason for the low acidity is not known, but there appears to be no significant difference in pH between the three sampling points.

Nitrate/Ammonia/Phosphate

Nitrate values above detection limit were found in sixteen of 46 samples from the Edisto River (Table I), but these values (all less than 0.1 mgN/L) are not considered a cause for concern. The City of Aiken maximum contaminant level goal (MCLG) for nitrate in drinking water is <10 mg N/L (Ref.4). The river water at both sampling points was safely within this limit. Nitrate was detected once at 0.05 mg N/L in Pond Branch. Although we have never detected nitrogen previously, this single instance is not considered significant.

Other chemical contaminants (ammonia with a detection limit of ≤ 0.3 mg N/L, and phosphate with a detection limit of 0.2 mg PO4/L) were below their detection limit at all times at all sampling points. The presence of ammonia can be due to fertilizers, animal waste, or improperly treated sewage. Levels of phosphate above 0.3 mg/L can stimulate plant growth sufficiently to surpass natural eutrophication rates and lead to oxygen depletion.

Settleable Solids

The river did not contain significant amounts of settleable solids as measured by Imhoff cones. On all but a few occasions, only trace amounts, or no visible amount of settleable solids were found. Measureable amounts occurred in only two samples during 2017-19, which is a decrease from the four occurrences in the previous two years.

Water Transparency

Transparency of the river water and Pond Branch usually exceeded the 120-cm length of the transparency tube. However, twelve of seventy measurements during the past two years yielded transparency readings less than 120 cm. As noted previously (Ref. 1), many of the low readings occur in March or April, and usually correlate with recent heavy rains and increase in river depth. Turbidity events at the two river sampling points vary with some being more turbid at the upstream location (Aiken State Park) and some being more turbid at the downstream location (Keadle Bridge). Table III lists the number of time per year that transparency drops below the

Table III. Annual Total Low Transparency Events

Time Period	**Aiken St. Park (SER-1)**	**Keadle Bridge (SER-2)**	**Pond Branch (PB-1)**	**Total**
	(number of low values/number of samples)			
Feb. 2014 to Jan. 2015	1/11	2/11	0/6	3/28
Feb. 2015 to Jan. 2016	0/11	1/11	0/11	1/33
Feb. 2016 to Jan. 2017	1/12	3/12	0/12	4/36
Feb. 2017 to Jan. 2018	2/12	2/12	1/12	5/36
Feb. 2019 to Jan 2019	2/11	1/11	4/12	7/34

120-cm value. The frequency at Pond Branch appears to be increasing, although the data are far from conclusive.

During the past two years we have detected our first instances of low transparency in Pond Branch. The first time was during a spring high water event (4/25/17). We happened to sample on a day when the river water level peaked after two days during which the river rose almost two feet. The transparency returned to >120 cm the next month. However, a more serious decrease in transparency occurred over a period of five months in 2018 (May to September). It is not clear what caused this extended turbidity, but some of it is likely due to heavy rainfall. River depth was high in April and May, dropped in June, but was again high in July and September (See Table Ic).

Conductivity

Conductivity proved quite low, indicating very low concentrations of dissolved ions. Certain forms of pollution, or salt water intrusion (near the coast), can cause very high conductivity (>500 µS/cm). Measured conductivity ranged between 15 and 27 µS/cm in the river, and 4-10 µS/cm in Pond Branch, which is quite low. There was one exception to this range at Pond Branch. In September 2018, the conductivity doubled to 19 µS/cm. Other test results are anomalous for that sampling date and are discussed in the Bacteria Monitoring section (see below).

Bacteria Monitoring

Our team began taking water samples for *E. coli* monitoring in April 2015. Bimonthly sampling occurred through March 2016 when monthly sampling was initiated. The samples came from Pond Branch (PB-1) downstream of a chicken farm, and from the South Fork of the Edisto River at Keadle Bridge (SER-2) upstream of the point where Pond Branch joins the river. Results of the bacteria counts for this reporting period are listed in Table II.

Bacteria colony counts are reported in units of "CFU" (colony forming units) per 100 mL of sample. All but two results were below levels of concern and ranged from 0 to 400 CFU/100 mL. Pond Branch results averaged somewhat higher than the Edisto River (260 vs 170 CFU/100 mL), possibly because of horse pastures which abut the creek for a quarter of a mile above our sampling point. The location of the chicken farm is about four miles upstream. It is too early to say conclusively whether or not bacteria levels are increasing. Table IV lists the one year averages of our bacteria counts. There may be an upward trend in Pond Branch and more data should clarify this.

Table IV. Annualized Average Bacteria Counts

Date Range	Number of Measurements	Keadle Bridge (SER-2)	Pond Branch (PB-1)
April 2015 to Jan. 2016	5	20	67
Feb. 2016 to Jan. 2017	11	85	173
Feb. 2017 to Jan. 2018	12	219	170
Feb. 2019 to Jan 2019	11	100	360

Two high bacteria counts prompted us to take further action. The first high count of 1270 CFU/100 mL occurred at Keadle Bridge in April 2017. The GAAS procedure and training suggest action is warranted when *E.coli* bacteria counts exceed 1000 CFU/100 mL. We reported the high result to SCDHEC staff who followed up by their own bacteria count a short time later. The DHEC sample did not show high bacteria levels. Our sampling occurred after heavy rain in the area when the river level peaked. The high count was likely caused by runoff from the rain.

The second high bacteria count of 2700 CFU/100 mL occurred at Pond Branch in September 2018. It was accompanied by low transparency (high turbidity), increased conductivity, and low dissolved oxygen concentrations. The unusual results also followed a local rain event. The stream level was high and a resident about four miles upstream of our sampling point told us they had received two inches of rain the previous day. In this case, the rain was localized in the Pond Branch drainage basin and was not reflected in the river levels. Our team returned two days later to find the stream water level had returned to its normal range, the turbidity was gone, the conductivity was low, and a repeat bacteria count at our sampling point was normal (133 CFU/100 mL). We also sampled about two miles upstream, where Centerwood Road crosses Pond Branch, and the bacteria count was also low (167 CFU/100 mL).

Site Cleanup Events

The Keadle Bridge sampling site is a gathering point for fishing and loitering on the river. These gatherings result in garbage and trash accumulation at the boat landing. Therefore, the authors organized an initial cleanup of the site on June 5, 2014, followed by monthly cleanups when taking water samples. The continuing effort forms part of the Palmetto Pride campaign (a 501(c)3 non-profit organization which is a public-private partnership comprised of South Carolina state agencies, concerned citizens, corporate sponsors, and community and civic organizations).

Summary

The results of the past two years of sampling indicate normally good water quality in the South Fork of the Edisto River and in its tributary, Pond Branch. Occasionally, the water quality temporarily decreases as shown by the lower transparency and higher bacteria measurements. It is not clear whether or not these constitute long-term trends, but future sampling should clarify this. These data provide a baseline to monitor for changes in the river's water quality as development and changes in water usage continue to occur in the vicinity of the three sampling points. We intend to continue monitoring through January of 2020 based on funding by the Augusta-Aiken Audubon Society. Monitoring beyond that date will depend on the availability of additional funding.

Acknowledgements

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2. Georgia Adopt-A-Stream website and database can be found at www.adopastream.georgia.gov.

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APPENDIX A.
South Edisto Monitoring Sites

Sampling Location Used in this Study.

TABLE A1. Sampling Points

Identifier	Aiken State Park	Keadle Bridge	Pond Branch
GPS coordinates	N 33.5528˚ W -81.4826˚	N 33.5199˚ W -81.4103˚	N 33.5014º W -81.3964º
Location	lower boat landing within Aiken State Natural Area	boat landing at the bridge where S-3-53 (Windsor Road) crosses the South Fork of the Edisto River	culvert entrance where Pond Branch passes under Oak Ridge Club Road
Description	dock on the South Fork of the Edisto River at the canoe takeout within Aiken State Park	boat ramp at Keadle Bridge, approximately 8 miles downriver from the sampling point in Aiken State Park	wooded area about 1.5 mi. south of Keadle Bridge and 0.3 mi. northwest of Davis Bridge
Habitat	mixed hardwood/pine lowland	mixed hardwood/pine lowland	mixed hardwood/pine lowland
GAAS site identifier	S-3296	S-3295	S-3408
Site ID for this report	SER-1	SER-2	PB-1

(a) (b) (c)

FIGURE A1. Sampling points on the South Edisto River: (a) downstream canoe take-out at Aiken State Park, (b) Keadle Bridge boat ramp, and (c) Pond Branch.

APPENDIX B
Experimental Methods

Physical/Chemical Methods.

Air and water temperatures were measured using alcohol-in-glass general purpose thermometers, 0-50 ºC, purchased from Ben Meadows Co., Janesville, WI (Catalogue #8JB-111052) or similar models.

Dissolved oxygen was measured using a field test kit purchased from the LaMotte Company, Chestertown, MD (Catalogue #5860). The kit uses the Winkler method (Ref. 5) for oxygen concentrations in the range 0-15 ppm. In this method, dissolved oxygen reacts with Mn(II) in base to form Mn(IV), followed by reduction of the Mn(IV) with I^- to form I_3^-. The I_3^- is titrated with sodium thiosulfate in the presence of starch to detect the endpoint (loss of blue color).

Nitrate was measured using a test kit purchased from Hach Company, Loveland, CO (Hach Nitrate Kit, Model N1-14, Catalogue #14161-00). The procedure measures the sum of nitrate and nitrite concentrations in the range 0-10 mg/L. Sample preparation includes first reducing nitrate to nitrite with cadmium metal, followed by reaction with sulfanilic acid to form a diazonium salt, followed by reaction of the diazonium salt with chromatropic acid to form a pink colored compound. The concentration is determined by comparison of the sample color to a color wheel.

Ammonia was measured using a test kit purchased from Hach Company, Loveland, CO (Hach Ammonia Kit, Model N1-SA, Catalogue #24287-00). The test kit measures the sum of ammonium ion and aqueous ammonia concentrations in the range 0 to 2.5 mgN/L (0-3.0 mg NH_3/L). The method is based on the hypochlorite oxidation of ammonia to chloramine, followed by reaction of chloramine with salicylate to form 5-aminosalicylate, followed by the nitroprusside catalyzed reaction of 5-aminosalycilate to indosalicylate. The green indosalicylate concentration is determined by comparison of the sample to a color wheel.

Phosphate ion was measured using a test kit purchased from Hach Company, Loveland, CO (Hach Ortho Phosphate Kit, Model 10-19, Cat. No. 2248-00). The kit measures phosphate concentrations in the range 0-50 mg/L. The test instructions suggest a lower limit of 0.06 mg/L, although the color wheel does not allow eyeball estimates below 0.2 mg/L of phosphate. The method is based on the reaction of phosphate with molybdate in acid to form a phosphomolybdate complex that is reduced using ascorbic acid to a molybdenum blue complex. The concentration is determined by comparison of the blue solution to a color wheel.

Conductivity was measured using a Hanna Instruments Model DiST-5 hand-held conductivity meter with temperature compensation (Catalogue #88230). Calibration using a 1413µS/cm KCl/NaCl standard (Catalogue #23759) occurred prior to use. Both items were purchased from Ben Meadows, Jamesville, WI.

Imhoff cones were used to measure settleable solids. Samples (1.0 L) were allowed to settle for 45 minutes before measuring the volume of the settled solids. The quantification limit was

approximately 0.1 mL solids/L sample. If settled solids were visible but less than 0.1 mL in volume, the result was recorded as "trace".

Water transparency was measured with a 120-cm transparency tube purchased from Ben Meadows. The 1¾ inch diameter clear plastic tube has a black and white Secchi pattern at the bottom. The tube is filled to 120-cm with sample, and sample is drained from the bottom until the Secchi pattern becomes visible when looking down the tube. The height of the remaining water column is recorded to the nearest centimeter. In most cases, the Secchi pattern is visible with the tube completely filled (120 cm).

Bacterial Monitoring

Bacterial monitoring followed the protocol of the Georgia Adopt-A-Stream (Ref.5). Stream samples were taken in Whirl-pak® bags (Cole Parmer #EW-06499-80). One-mL aliquots were transferred to 3M Petrifilm™ *E. coli*/Coliform Count Plates (Nelson-Jameson, Marshfield, WI) using a calibrated 1-mL pipette (Cole-Parmer, Vernon Hills, IL, #EW21600-06). The plates were incubated at 35±1°C for 24±1 hr in a Genesis Model 1588 Hova-Bator incubator (GQF Manufacturing Co., Savannah, GA). The temperature of the incubator was monitored with a Traceable® Big-Digit Memory Thermometer (VWR, Suwanee, GA, #61161-324).