March 3, 2017

SOUTH FORK OF THE EDISTO RIVER AND POND BRANCH MONITORING RESULTS (FEBRUARY 2015 TO JANUARY 2017)

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Abstract

In February, 2014, a team of volunteers began monitoring water quality at two locations on the South Fork of the Edisto River in Aiken County, SC. In July, 2014, the team added a location on Pond Branch, a tributary to the Edisto. This report presents data obtained between February 2015 and January 2017. 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 of monitoring, sampling results show good water quality at all three sampling points. Dissolved oxygen content was high, the pH was in the range expected for a slightly tannic stream, chemical pollutants were low or absent, and settleable solids were present at trace levels. Temporary increases in turbidity have been observed each spring, but are not severe. Bacteria monitoring at Pond Branch and Keadle Bridge began in April 2015 and the results indicate *E. coli* populations are low.

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. Edisto River, prompted by the proposed construction of a poultry farm in the vicinity. Monitoring performed monthly includes both chemical (3 sites), physical (3 sites), and bacteria measurements. 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 2015 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 on-line (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.

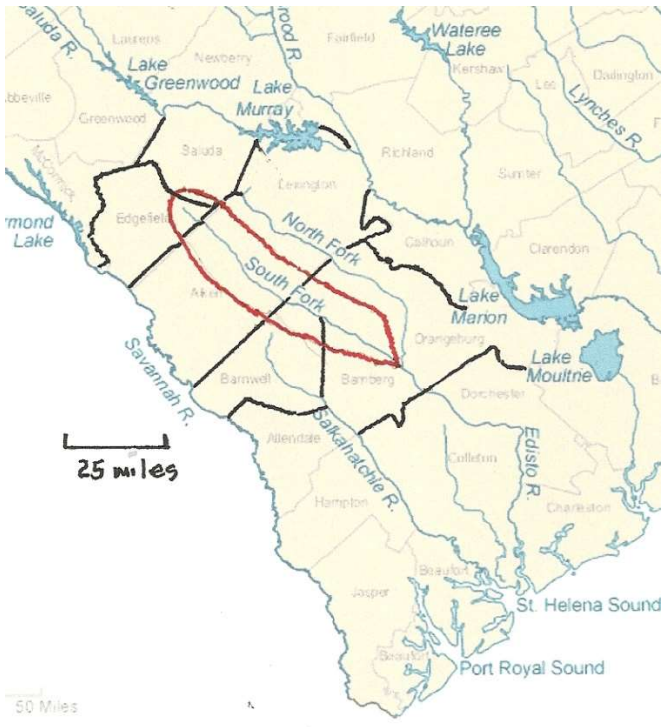

FIGURE 1. The drainage basin for the South Fork of the Edisto River is outlined in red.

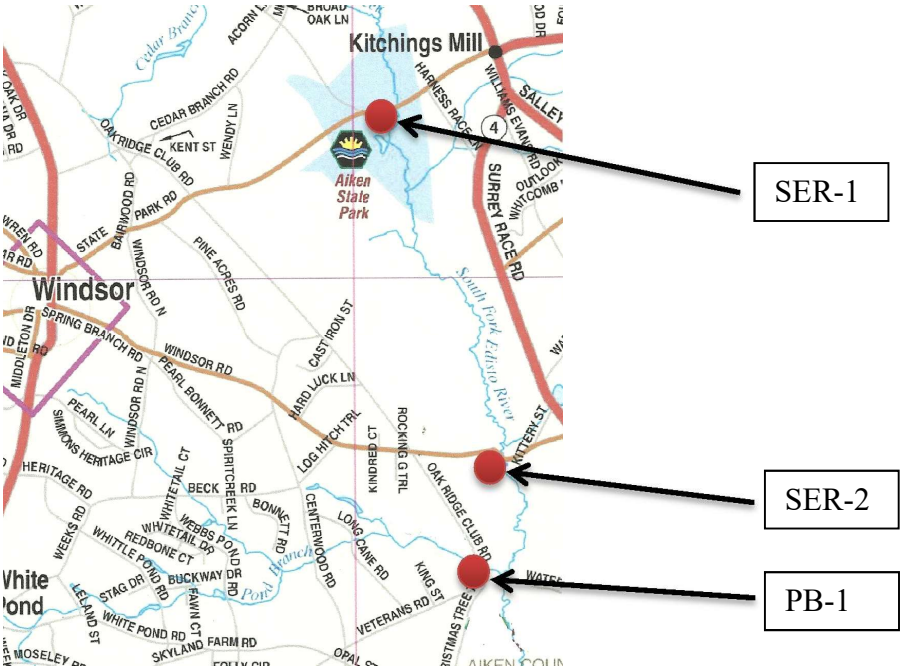

FIGURE 2. Map of the Windsor area showing the locations of the sampling points on the South Fork of the Edisto River and Pond Branch. SER-1 is located in Aiken State Park, SER-2 is located at Keadle Bridge, and PB-1 is located where Pond Branch crosses Oak Ridge Club Road.

Results and Discussion

Table I (parts a, b, and c) lists test results for February 2015 through January 2017. These two years of sampling results show consistently good water quality at all three sampling points. Dissolved oxygen levels (5.6 to 9.9 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 each spring we have seen the transparency drop to 95-110 cm. Bacteria monitoring began in April 2015 and bacteria counts have been variable but below levels that require further action.

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												
3/2/2015	16.0	15.5	15.2	7.5	7.5	10.5	9.8	10.0	9.4	6.0	6.0	5.5
3/26/2015	22.2	20.0	20.0	17.0	16.5	17.0	7.4	6.7	7.7	6.0	6.0	6.0
4/28/2015	18.0	18.0	18.8	16.5	16.0	16.5	7.0	6.4	7.8	6.0	6.0	6.0
5/28/2015	24.2	25.2	24.2	22.2	22.2	20.0	5.2	5.2	6.2	6.0	6.0	6.0
6/22/2015	26.0	29.0	26.5	25.0	24.0	22.5	5.5	5.4	6.6	6.0	6.0	6.0
7/30/2015	27.5	28.5	27.0	25.0	25.0	22.5	5.8	6.0	6.9	6.0	6.0	6.0
8/26/2015	23.0	24.0	25.0	23.5	23.0	21.0	5.6	5.6	6.8	6.5	6.5	6.0
9/24/2015	17.5	18.5	20.0	20.0	20.0	19.5	5.9	5.5	5.9	6.5	6.5	6.0
10/12/2015	18.0	17.5	18.0	17.0	17.5	17.0	5.8	5.8	7.2	5.5	5.5	6.0
11/23/2015	7.5	6.0	8.0	11.0	11.5	12.0	8.0	7.6	8.2	6.0	6.0	6.0
1/26/2016	11.0	8.0	7.0	4.5	4.5	8.0	11.1	11.0	9.8	6.5	6.5	6.0
2/21/2016	14.5	15.5	17.5	10.0	10.0	13.0	9.2	9.2	8.9	6.0	6.0	5.5
3/23/2016	15.5	15.0	15.5	11.5	12.0	12.5	8.4	7.9	10.7	6.5	6.5	6.5
4/26/2016	21.0	20.0	21.5	18.0	18.5	18.0	6.7	6.2	7.5	6.5	6.5	6.5
5/26/2016	23.5	22.0	24.0	19.5	20.0	19.5	6.4	5.8	7.2	6.5	6.5	6.5
6/28/2016	26.0	27.0	27.0	25.0	24.5	22.5	5.8	5.7	6.6	6.5	6.5	6.5
7/28/2016	28.0	26.5	28.0	26.0	25.0	23.0	5.8	5.8	6.8	6.5	6.5	6.5
8/31/2016	26.0	24.0	24.2	23.5	23.5	21.5	6.5	6.3	7.2	6.5	6.5	6.5
9/27/2016	23.0	23.5	23.0	22.0	22.0	20.5	6.4	6.2	7.1	6.5	6.5	6.5
11/3/2016	23.0	20.0	23.5	17.0	16.5	16.0	7.4	7.2	7.8	6.5	6.5	6.3
12/1/2016	15.0	12.5	15.0	13.5	14.0	15.0	6.5	6.9	7.4	6.5	6.5	6.5
12/30/2016	7.8	5.2	7.2	10.0	11.0	11.0	8.6	8.0	9.2	6.5	6.5	6.5
1/31/2017	11.3	11.0	12.0	7.0	7.0	9.0	10.0	9.8	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									
3/2/2015	0	0	0	0	0	0	0	0	0
3/26/2015	0	0	0	0	0	0	0	0	0
4/28/2015	0	0	0	0	0	0	0	0	0
5/28/2015	0	0	0	0	0	0	0	0	0
6/22/2015	0	0	0	0	0	0	0	0	0
7/30/2015	0	0	0	0	0	0	0	0	0
8/26/2015	0	0	0	0	0	0	0	0	0
9/24/2015	0	0	0	0	0	0	0	0	0
10/12/2015	0	0	0	0	0	0	0	0	0
11/23/2015	0	0	0	0	0	0	0	0	0
1/26/2016	0	0	0	0	0	0	0	0	0
2/21/2016	0	0	0	0	0	0	0	0	0
3/23/2016	0	0	0	0	0	0	0	0	0
4/26/2016	0	0	0	0	0	0	0	0	0
5/26/2016	0	0	0	0	0	0	0	0	0
6/28/2016	0	0	0	0	0	0	0	0	0
7/28/2016	0	0	0	0	0	0	0	0	0
8/31/2016	0	0.09	0	0	0	0	0	0	0
9/27/2016	0	0	0	0	0	0	0	0	0
11/3/2016	0.03	0	0	0	0	0	0	0	0
12/1/2016	0.05	0.05	0	0	0	0	0	0	0
12/30/2016	0.04	0	0	0	0	0	0	0	0
1/31/2017	0.05	0	0	0	0	0	0	0	0

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											
3/2/2015	Tr	Tr		>120	>120	>120	25	22	7	9 ft 7.5 in	9 ft 8.5 in
3/26/2015	Tr	Tr		>120	>120	>120	24	22	7	9 ft 5 in	9 ft 3.5 in
4/28/2015	Tr	Tr		>120	>120	>120	26	24	7	9 t 0 in	8 ft 7 in
5/28/2015	0.05	0.05		>120	100	>120	20	20	6	8 ft 4 in	6 ft 10 in
6/22/2015	Tr	Tr		>120	>120	>120	23	20	6	6 ft 7.5 in	5 ft 5.5 in
7/30/2015	Tr	Tr	Tr	>120	>120	>120	18	16	6	6 ft 4 in	5 ft 0.5 in
8/26/2015	Tr	Tr	0.1	>120	>120	>120	18	20	6	7 ft 9 in	6 ft 10.5 in
9/24/2015	Tr	Tr	Tr	>120	>120	>120	17	16	7	6 ft 10 in	5 ft 10 in
10/12/2015	Tr	0.00	Tr	>120	>120	>120	25	26	7	10 ft 4.5 in	9 ft 4.5 in
11/23/2015	Tr	Tr	Tr	>120	>120	>120	21	19	6	9 ft 10.5 in	9 ft 10 in
1/26/2016	Tr	Tr	Tr	>120	>120	>120	24	20	8	9 ft 4.5 in	9 ft 2 in
2/21/2016	Tr	Tr	Tr	>120	>120	>120	24	20	6	9 ft 1.5 in	9 ft 0 in
3/23/2016	Tr	Tr	Tr	>120	110	>120	25	22	6	8 ft 10 in	8 ft 5 in
4/26/2016	Tr	Tr	Tr	>120	95	>120	24	23	6	8 ft 7 in	7 ft 5.5 in
5/26/2016	Tr	Tr	Tr	>120	108	>120	24	21	5	8 ft 0 in	6 ft 9.5 in
6/28/2016	Tr	Tr	Tr	>120	>120	>120	20	20	5	6 ft 7 in	5 ft 2 in
7/28/2016	Tr	Tr	Tr	>120	>120	>120	20	20	6	6 ft 9.5 in	5 ft 5 in
8/31/2016	Tr	Tr	0.1	>120	>120	>120	17	17	6	6 ft 9.5 in	5 ft 4 in
9/27/2016	Tr	Tr	Tr	>120	>120	>120	20	19	8	7 ft 6.5 in	6 ft 3 in
11/3/2016	Tr	Tr	Tr	>120	>120	>120	17	17	6	7 ft 10.5 in	6 ft 6 in
12/1/2016	Tr	Tr	Tr	>120	>120	>120	19	19	7	8 ft 7.5 in	7 ft 3 in
12/30/2016	Tr	0.00	Tr	>120	>120	>120	18	17	6	8 ft 9 in	7 ft 2 in
1/31/2017	0.00	0.00	Tr	>120	>120	>120	22	22	6	8 ft 0 in	9 ft 2 in

*Maximum transparent depth measureable in the transparency tube is 120 cm. For a recorded reading of 120 cm, the actual transparent depth may be greater.

** SER-1 measured at the gauge in the Aiken State Park located at the upper canoe launch.
SER-2 measured at the gauge attached to Keadle Bridge.

Dissolved Oxygen

As seen in Table I, dissolved oxygen concentrations in the river and stream varied between 5.2 and 11.1 mg/L. Figure 3 shows the results in graphical form. The two river sampling points averaged 7.2 mg/L (miniumum 5.2 mg/L) at Aiken St. Park (SER-1)), and 7.0 mg/L (minimum 5.2 mg/L) at Keadle Bridge (SER-2). Pond Branch (PB-1) averaged 7.8 mg/L (minimum 5.9 mg/L). 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.

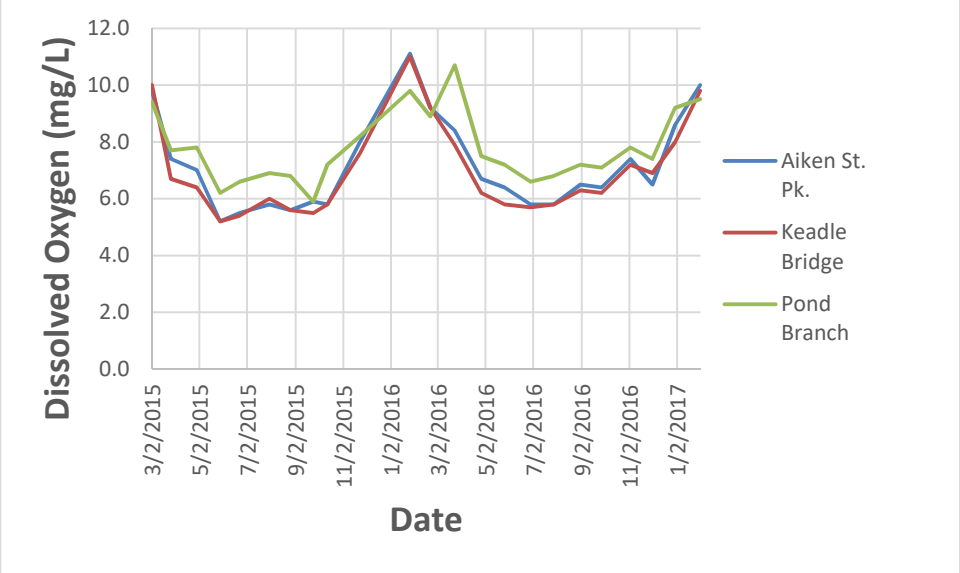

FIGURE 3. Results of dissolved oxygen measurements.

Observe that the graph in Figure 3 shows a strong variation between winter and summer months. 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.

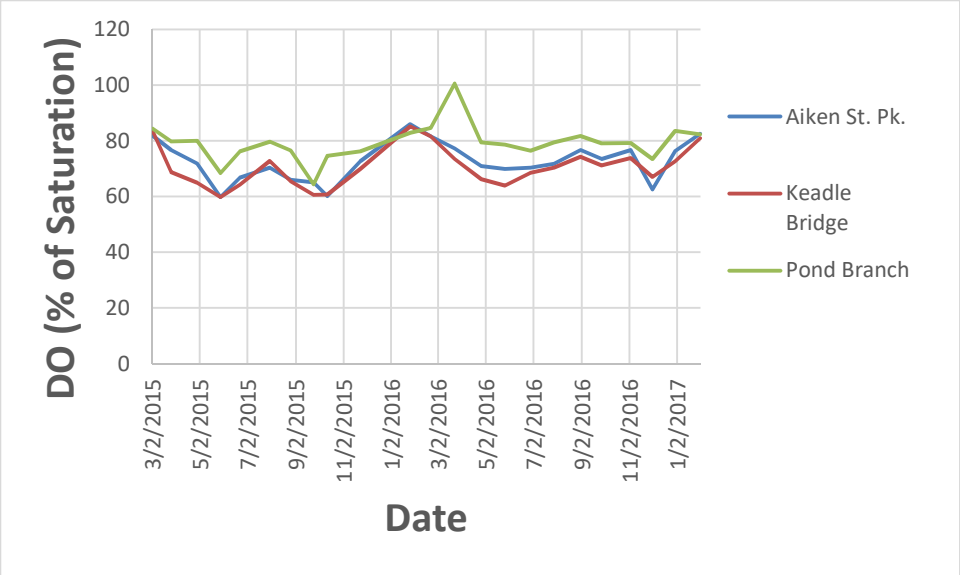

FIGURE 4. Dissolved oxygen (as % of saturated) results for three sampling locations.

The average of the percentage saturation values and their range are shown in Table II. Pond Branch averages a little higher than the two river sites. This may be the result of its smaller size and rapidity of movement relative to the river. The stream will have better mixing and more surface area per volume of flow, allowing more oxygen to diffuse into the water, and resulting in oxygen concentrations closer to saturation.

Table II. Dissolved Oxygen Results (% of Saturation)

	Aiken St. Pk.	Keadle Bridge	Pond Branch
Avg (std dev)	72% (±7%)	70% (±7%)	79% (±7%)
Range	60-86%	60-85%	64-101%

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

Chemical pollutants (nitrate, ammonia, and phosphate) were not detected above levels of concern.

Nitrate values above detection limit were found in six 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. No nitrate was ever detected in Pond Branch. Nitrate contamination can occur from excessive use of agricultural fertilizers.

Ammonia concentrations were below detection limit (≤ 0.3 mg N/L) at all times at all sampling points. The presence of ammonia can be due to fertilizers, animal waste, or improperly treated sewage. Phosphate was never detected in the river (detection limit equaled 0.2 mg PO4/L). 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 four samples during 2015-17. Rain events likely explain the occasional positive results.

Water Transparency

Transparency of the river water and Pond Branch exceeded the 120-cm length of the transparency tube on all but seven occasions since we began monitoring (i.e., the water was very transparent). Occasionally the transparency decreases (or turbidity increases), although not drastically and not for long. The measurements during turbid events are listed in Table III. The transparency in Pond Branch (PB-1) was always greater than 120 cm. The transparency at Aiken State Park (SER-1, the upstream sampling site) fell below 120 cm on only one occasion (Dec 2014). However, at Keadle Bridge (SER-2, the downstream sampling site), transparency decreases occurred each spring (March-May) in the years we monitored. The change in transparency between the upper and lower sites suggests a source along the river between the two sites. Monitoring along the river via canoe could possibly identify the source of the turbidity.

TABLE III. Turbidity Events in the Edisto River

Year	Month	Sampling Point	
		Aiken St. Park (SER-1)	Keadle Bridge (SER-2)
2014	April		108
	May		106
	Dec	113	
2015	May		100
2016	March		110
	April		95
	May		108

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 17 and 29 µS/cm in the river, and 5-8 µS/cm in Pond Branch, which is quite low. No trends or spikes have been observed in 2015-17.

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 the chicken farming operation, 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 are listed in Table IV.

Bacteria colony counts are reported in units of "CFU" (colony forming units) per 100 mL of sample. Our results ranged from 0 to 433 CFU/100 mL. Pond Branch results averaged somewhat higher than the Edisto River, 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. Chicken farming began in early 2016 (possibly February) and there was no significant increase in the *E. coli* counts until late in 2016. We cannot be sure the chicken farm caused the increase, and the levels observed, though greater than prior to startup of chicken farming, are not alarming. The GAAS procedure and training suggest action is warranted when *E.coli* bacteria counts exceed 1000 CFU/100 mL. After a particularly high count in December 2016, suggesting an increasing trend in E. coli, additional samples were taken on January 18, including a sample at Aiken State Park. The results of the second set, during a particularly wet month, were as low as found during 2015 and the first half of 2016.

TABLE IV. Results of Bacteria Counts

	***E. coli* count (CFU/100mL)**		
Sampling location	**Pond Branch PB-1**	**Keadle Bridge SER-2**	**Aiken St. Pk. SER-1**
Date			
4/28/2015	67	0	
6/22/2015	67	0	
8/26/2015	133	33	
10/12/2015	0	67	
1/26/2016	67	0	
3/23/2016	33	0	
4/26/2016	133	33	
5/26/2016	200	33	
6/28/2016	133	67	
7/28/2016	33	0	
8/31/2016	100	67	
9/27/2016	233	0	
11/3/2016	267	100	
12/1/2016	333	367	
12/30/2016	433	233	
1/18/2017	0	33	67

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 good water quality in the South Fork of the Edisto River and in its tributary, Pond Branch. These data provide a baseline to monitor for changes in the river's water quality as development and changes in water usage occur in the vicinity of the two sampling points.

We initiated bacteria monitoring in April 2015 and have not measured *E. coli* amounts that suggest problems. Some of our data preceded the installation of a chicken farm on Pond Branch, but no significant change in bacteria levels was found following the start of farming operations.

We have measured a temporary increase in water turbidity each spring during three years of monitoring. However, the decrease is not very great and may be related to heavy rains and agricultural practices between Aiken State Park and Keadle Bridge. Additional transparency monitoring during high turbidity events is recommended.

At present we intend to continue monitoring through January of 2018 based on funding by the Augusta-Aiken Audubon Society. Monitoring beyond that date will depend on the availability of additional funding.

Acknowledgements

We appreciate the encouragement and funding for our monitoring program that we received from Audubon South Carolina and the Augusta-Aiken Audubon Society. We thank Ruth Mead (Phinizy Center for Water Sciences) for training the team members in Physical/Chemical Monitoring. We also appreciate the Georgia Adopt-A-Stream program for providing procedures and a web site where we can post our results.

References

1. Alice Walker, Doug Walker, and John Demko, “South Fork of the Edisto River and Pond Branch Monitoring Results (February 2014 to January 2015), February 28, 2015 (available from the Silver Bluff Audubon Center and Sanctuary, 4542 Silver Bluff Road, Jackson, SC 27831).

2. Georgia Adopt-A-Stream website and database can be found at:
www.georgiaadoptastream.org/ or http//aesl.ces.uga.edu/aascd/home.html

3. Georgia Adopt-A-Stream, Department of Natural Resources, Environmental Protection Division, 2 Martin Luther King Jr. Drive, Suite 1462 East Tower, Atlanta, GA 30334, *Macroinvertebrate and Chemical Stream Monitoring*, Summer 2015.

4. City of Aiken, *Annual Drinking Water Quality Report*, System Number 0210001, 2013.

5. Georgia Adopt-A-Stream, Department of Natural Resources, Environmental Protection Division, 2 Martin Luther King Jr. Drive, Suite 1462 East Tower, Atlanta, GA 30334, *Bacterial Monitoring*, Spring 2014.

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 2. 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 1 ¾ 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±1ºC 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).

Distribution

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3. Kathy Rawls, Aiken County Council.
4. Tim Rogers, Friends of the Edisto.
5. Paul Koehler, Silver Bluff Audubon Center and Sanctuary, Jackson, SC
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