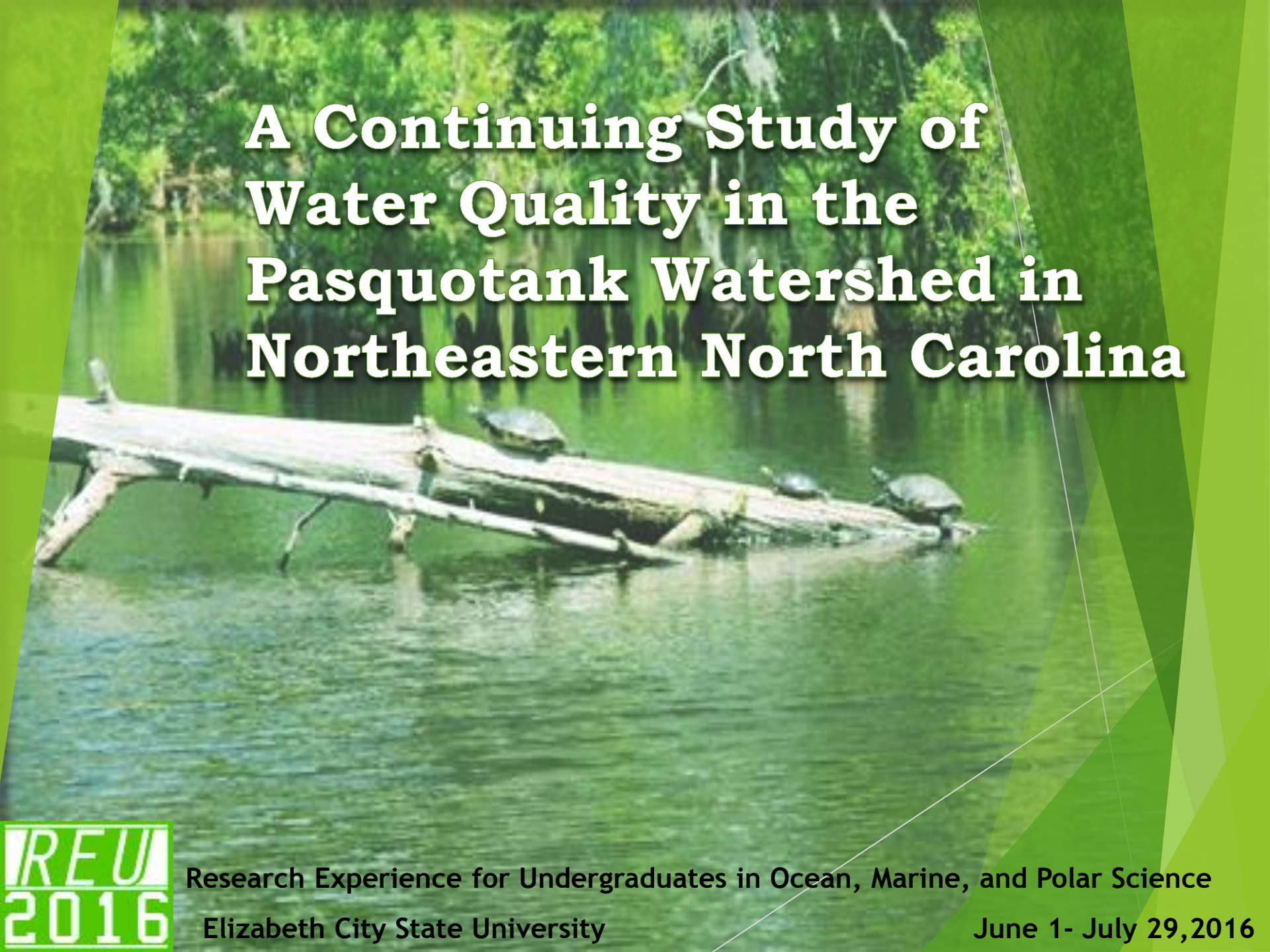


A Continuing Study of Water Quality in the Pasquotank Watershed in Northeastern North Carolina

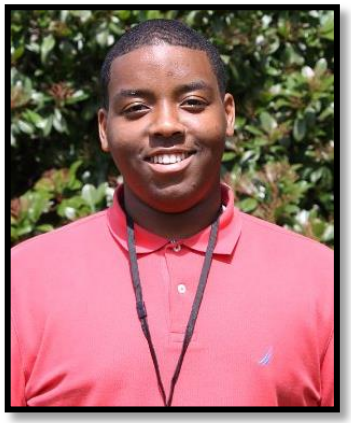
REU 2016

Research Experience for Undergraduates in Ocean, Marine, and Polar Science

Elizabeth City State University

June 1- July 29,2016

2016 Water Quality Research Team



Kamberlin King

Jeffrey Wood
Mentor

Kevin Benton

Abstract

The Pasquotank River Watershed is found in Northeast North Carolina beginning in the Great Dismal Swamp at the Virginia/North Carolina border and flows into the Albemarle Sound. The watershed provides a transition between the Great Dismal Swamp and the waters of the Albemarle Sound. The watershed is surrounded by a variety of landforms including swamps, farmland, and suburban developments. These produce a variety of runoff into the watershed affecting both the aquatic vegetation and marine life in the waters. This project built on the previous analysis of the four tributaries and the Pasquotank River completed in 2011, 2013, 2014, and 2015.

Abstract (continued)

The 2016 Research Experience for Undergraduates Pasquotank River Watershed Team completed one set of tests of the watershed. These test points originated from the 2011 and 2013 research projects with the addition of four points created in 2014 to sample further downstream in the Pasquotank River. The results were compared with previous readings utilizing a Water Quality Index (WQI), a unitless number ranging from 1 to 100 with higher numbers denoting better water quality. The waterways tested were the Pasquotank River, Newbegun Creek, Knobbs Creek, Areneuse Creek, Mill Dam Creek, and Sawyers Creek. These creeks, along with the Pasquotank River, cover a large portion of the watershed and provided a wide area of study for the watershed.

Abstract (continued)

Tests performed in the laboratory on this year's samples include pH, salinity, total dissolved solids, and conductivity. Air/water temperature, dissolved oxygen, wind speed/direction, and turbidity/clarity measurements were taken in the field. The results collected were placed online and displayed in correlation to their position utilizing Google Maps. The data was then compared to the previous projects results.

Abstract (continued)

The overall WQI for all of the tested waterways combined remained in a constant pattern. All of the waterways, except for Sawyers Creek, were at their lowest WQI when being compared to past research ranging from 2011 to 2015. The Lower Pasquotank still has the best water quality index, but the waterway had a significant decrease in its water quality score. When compared to the results of the 2014 team and the 2015 team, the Lower Pasquotank water quality went from a good Water Quality Index score to a medium Water Quality Index score, dropping 21 points. Newbegun Creek, Areneuse Creek, Mill Dam Creek, Sawyers Creek, Knobbs Creek, and the Pasquotank River all had bad Water Quality Index scores this year.

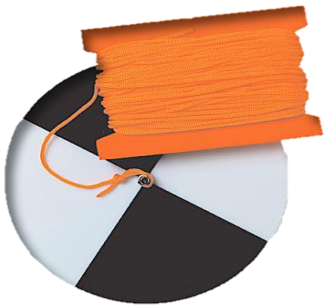
Points Tested

- Newbegun Creek
- Pasquotank River
- Knobbs Creek
- Mill Dam Creek
- Areneuse Creek
- Sawyers Creek

Tests Performed

- Dissolved Oxygen
- Total Dissolved Solids
- Salinity
- Conductivity
- pH
- Turbidity
- Clarity

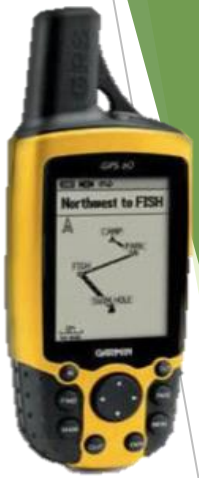
Test Equipment



Secchi Disk

Skymate Wind Meter

Tracer Pocket Tester



Garmin GPSMAP 60CSx(GPS)

Mercury Thermometer

MW600 Dissolved Oxygen Meter

pH Meter

Software Applications

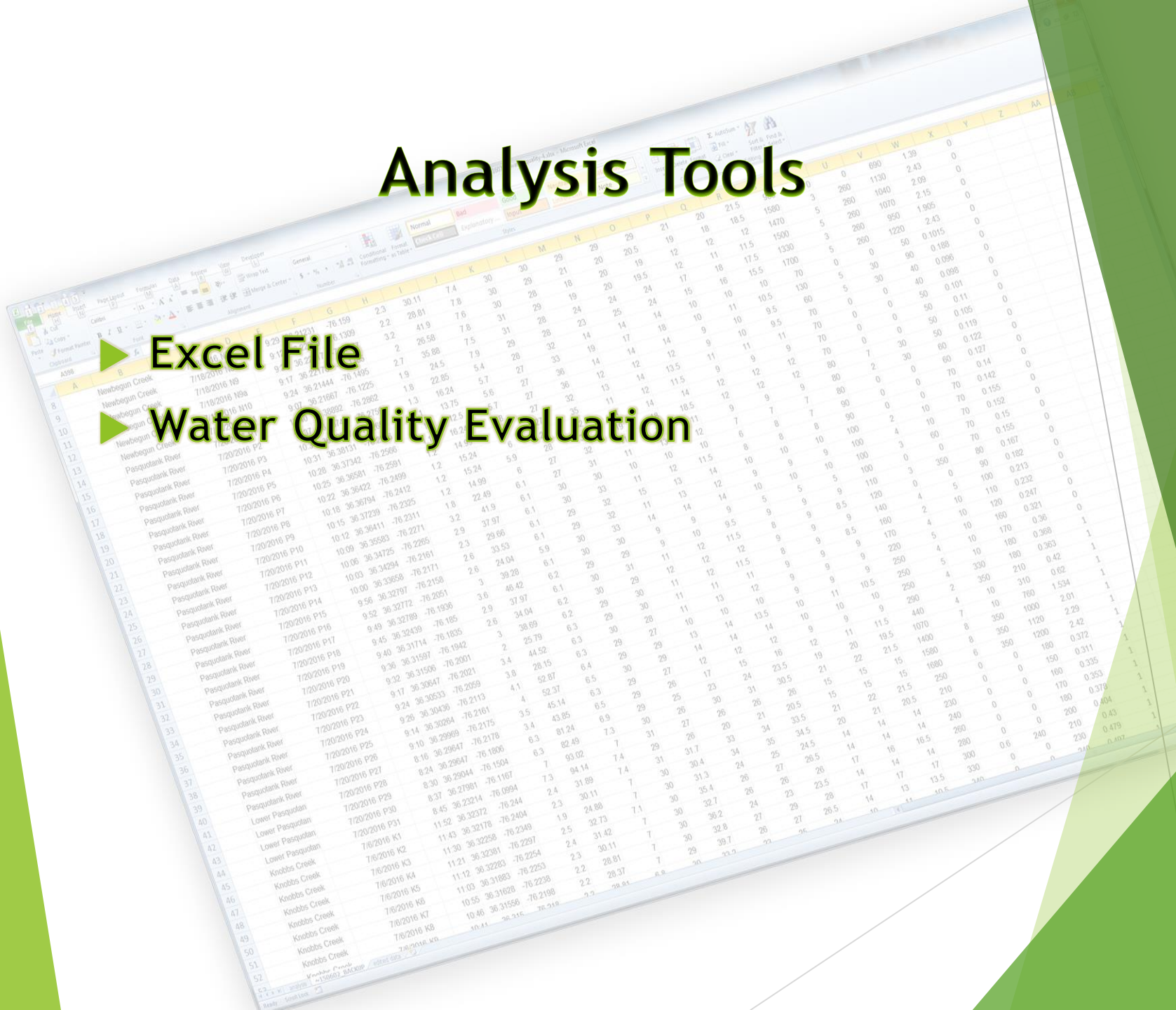
- Microsoft Excel
- Garmin Base Camp
- Google Drive
- Google Maps
- Dreamweaver

Methodology

- Field Testing
- Lab Testing
- Data Visualization
- Water Quality Index

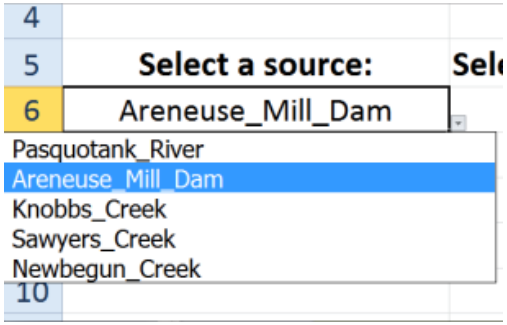
Analysis Tools

- Excel File
- Water Quality Evaluation

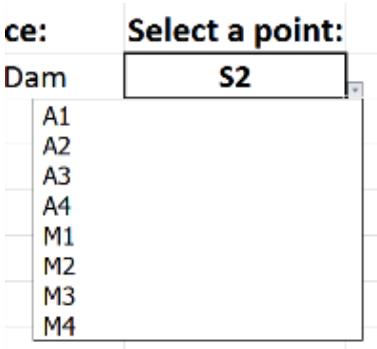


Excel

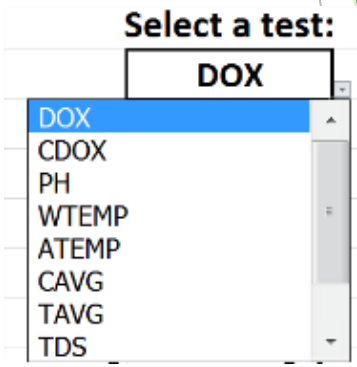
Source

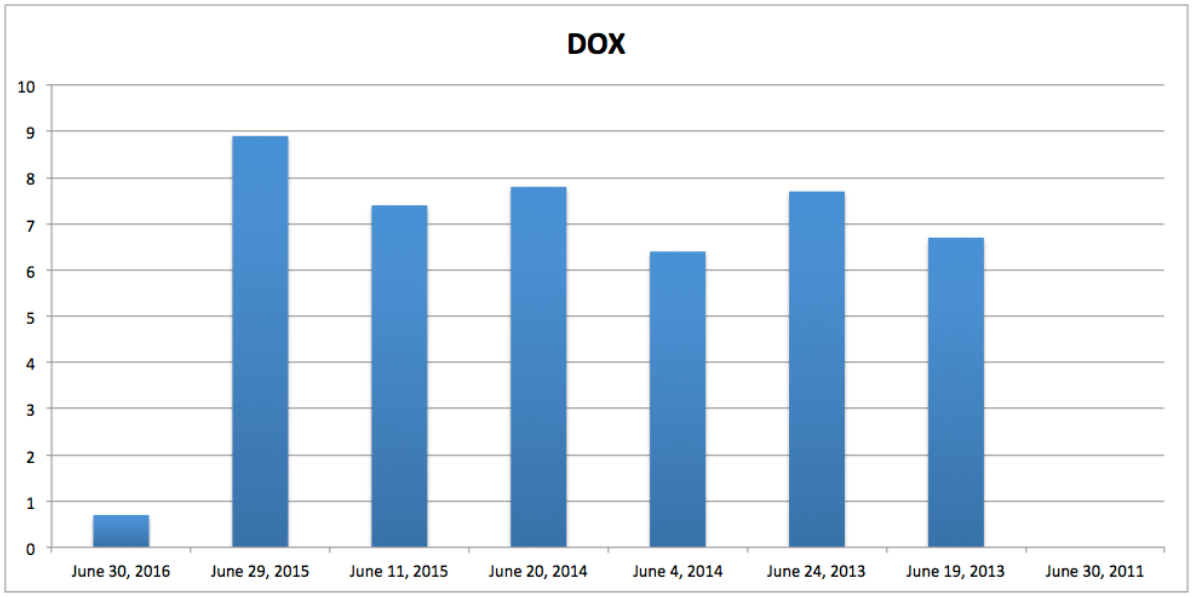


Point



Test





Water Quality Index Calculator

Dissolved Oxygen Sat(%)

20.3 | Sat(%)

12 Water Quality Index

Fecal Coliform

Fecal Coliform | colonies/100 mL

Water Quality Index

pH

7.4 | units

93 Water Quality Index

BOD

BOD | mg/L

Water Quality Index

Temperature

29.25 | C

11 Water Quality Index

Total Phosphate

Total Phosphate | mg as P/L

Water Quality Index

Nitrate

Nitrates | mg as NO3/L

Water Quality Index

Turbidity

17.7 | NTU

64 Water Quality Index

Total Solids

901.7 | mg/L

20 Water Quality Index

Water Quality Report

Factor	Weight	Quality Index
Dissolved Oxygen	0.17	12
Fecal Coliform	0.16	
pH	0.11	93
Biochemical oxygen demand	0.11	
Temperature Change	0.10	11
Total Phosphate	0.10	
Nitrates	0.10	
Turbidity	0.08	64
Total Solids	0.07	20

Calculate overall WQI

Factors entered

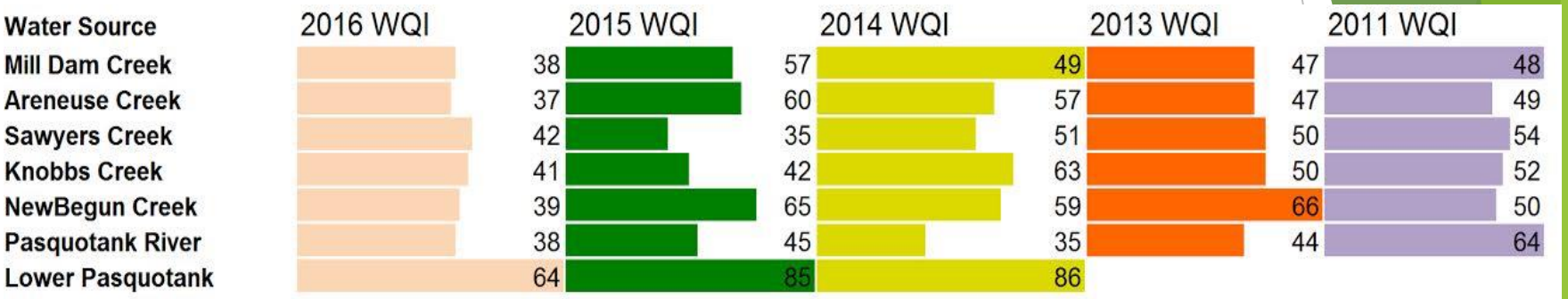
5

Overall Water Quality Index

38

Generate WQI Report

Water Quality Index Scores



Water Quality Index Score Range

0 – 25 = Very Bad

25 – 50 = Bad

50 – 70 = Medium

70 – 90 = Good

90+ = Excellent

Excel Graph Used to Compare Research

2016 Water Source	D.O.	pH	Water Temp (Celsius)	Air Temp (Celsius)	Clarity Avg (in)	Turbidity Avg (in)	Total Dissolved Solids (ppm)	Salinity (ppm)	Conductivity (milliseimens)
Mill Dam Creek	1.225	7.53	29.75	28.50	28.00	19.00	802.5	570.0	1.15
Areneuse Creek	0.9	7.48	30.00	31.65	27.13	17.13	825.0	590.0	1.89
Sawyers Creek	1.58	6.70	28.60	32.49	19.65	14.15	155.0	109.0	0.23
Knobbs Creek	1.73	6.95	29.80	32.39	23.27	14.03	320.0	226.0	0.46
NewBegun Creek	1.55	7.41	29.25	29.28	24.38	17.87	901.7	642.5	1.31
Pasquotank River	2.43	6.07	28.67	30.96	12.67	9.31	139.3	98.9	0.21
Lower Pasquotank	6.725	7.15	29.75	26.00	24.38	17.75	1432.5	1020.0	2.06

2015 Water Source	D.O.	pH	Water Temp (Celsius)	Air Temp (Celsius)	Clarity Avg (in)	Turbidity Avg (in)	Total Dissolved Solids (ppm)	Salinity (ppm)	Conductivity (milliseimens)
Mill Dam Creek	3.65	6.98	26.88	28.50	20.13	12.06	543.8	390.0	0.79
Areneuse Creek	3.8	6.95	26.00	31.63	25.06	15.50	436.3	310.0	0.63
Sawyers Creek	1.08	6.71	27.50	29.85	9.70	5.05	120.5	85.0	0.18
Knobbs Creek	1.18	6.73	27.08	30.70	15.78	9.08	180.3	127.3	0.27
NewBegun Creek	4.61	7.31	27.29	29.83	18.71	9.73	574.2	622.6	1.25
Pasquotank River	3.29	6.78	28.58	32.66	8.91	4.89	173.8	122.5	0.19
Lower Pasquotank	7.65	7.45	28.13	29.75	21.06	11.50	1106.3	720.0	1.67

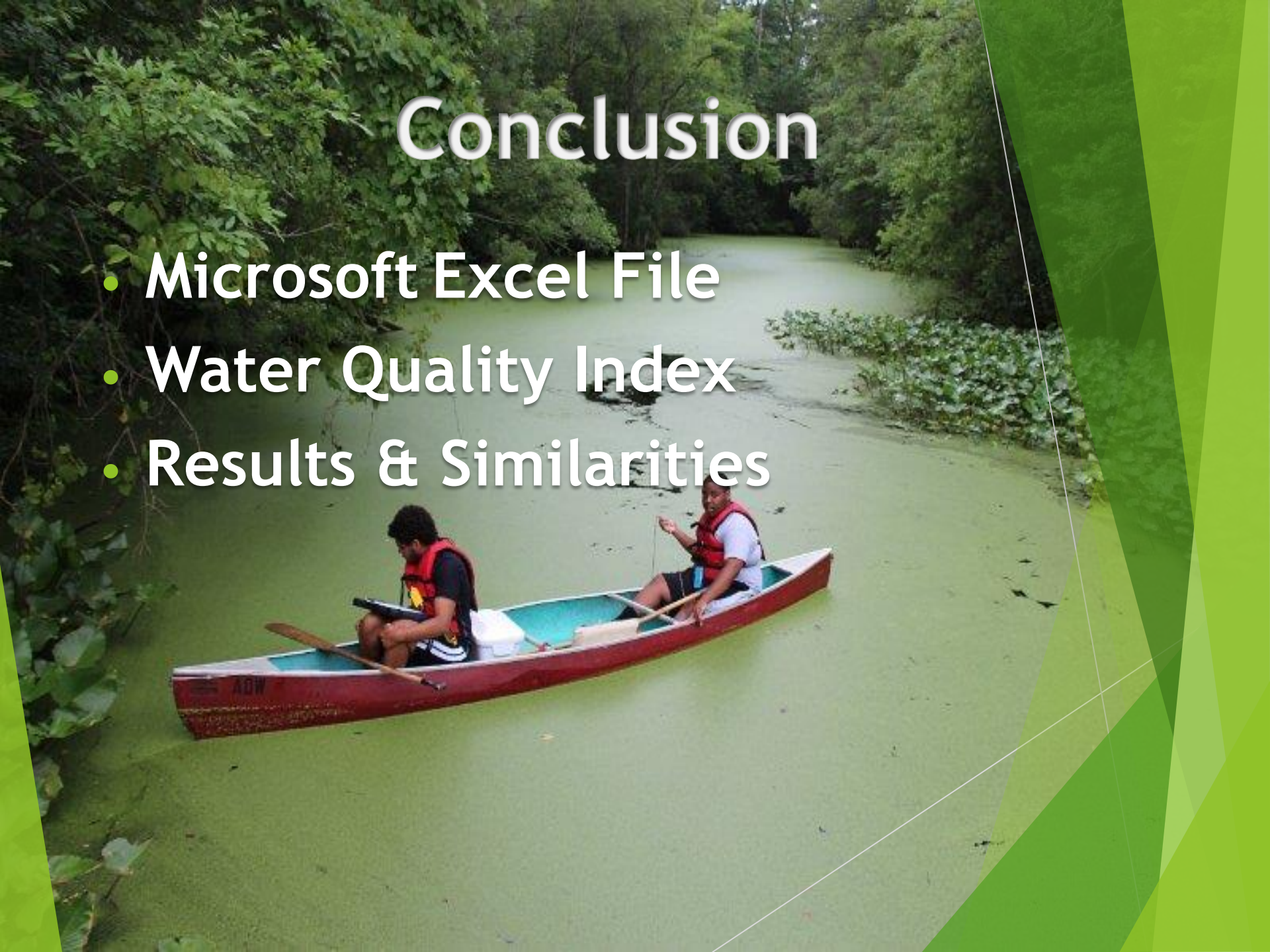
2014 Water Source	D.O.	pH	Water Temp (Celsius)	Air Temp (Celsius)	Clarity Avg (in)	Turbidity Avg (in)	Total Dissolved Solids (ppm)	Salinity (ppm)	Conductivity (milliseimens)
Mill Dam Creek	2.1	7.20	23.80	24.70	23.20	11.50	1087.5	773.8	1.56
Areneuse Creek	3.4	7.40	26.10	32.10	24.00	12.30	1057.5	755.0	1.51
Sawyers Creek	3.7	6.70	25.40	27.90	13.10	6.90	158.5	112.5	0.23
Knobbs Creek	4.7	6.90	26.00	27.80	14.60	7.90	271.7	199.4	0.41
NewBegun Creek	3.7	7.60	26.30	30.30	21.70	11.80	901.7	741.7	1.38
Pasquotank River	2.6	6.00	26.90	28.40	9.20	5.30	110.6	77.6	0.41
Lower Pasquotank	7.2	7.40	27.30	30.20	24.90	11.90	1302.5	930.0	1.87

2013 Water Source	D.O.	pH	Water Temp (Celsius)	Air Temp (Celsius)	Clarity Avg (in)	Turbidity Avg (in)	Total Dissolved Solids (ppm)	Salinity (ppm)	Conductivity (milliseimens)
Mill Dam Creek	2.5	7.00	25.50	24.50	24.00	10.50	3263.5	2331.5	4.39
Areneuse Creek	2	7.40	26.00	24.50	22.00	11.00	2455.0	1751.5	3.77
Sawyers Creek	3.5	7.50	28.50	33.00	17.50	9.50	856.0	611.0	1.09
Knobbs Creek	3	7.10	27.00	28.50	25.50	13.00	1314.5	910.0	2.03
NewBegun Creek	5	7.40	27.00	29.00	18.00	9.50	3242.0	2272.5	4.89
Pasquotank River	3	6.40	26.50	30.00	13.00	5.50	815.5	582.5	1.07

2011 Water Source	D.O.	pH	Water Temp (Celsius)	Air Temp (Celsius)	Clarity Avg (in)	Turbidity Avg (in)	Total Dissolved Solids (ppm)	Salinity (ppm)	Conductivity (milliseimens)
Mill Dam Creek	4	5.00	27.80	27.60	32.00		3203.0	2285.0	5
Areneuse Creek	4	4.00	28.30	28.20	19.00		2460.0	1758.0	4
Sawyers Creek	4	7.00	25.90	26.30	19.00		856.0	607.0	1
Knobbs Creek	5	5.00	26.60	28.50	23.00		1847.0	1325.0	3
NewBegun Creek	4	5.00	27.50	29.70	17.00		3006.0	2146.0	4
Pasquotank River	5	6.00	26.40	26.00	14.00		761.0	541.0	1

Conclusion

- Microsoft Excel File
- Water Quality Index
- Results & Similarities



Future Works

Control Company VWR
Waterproof Thermometer

Waterproof Portable Dissolved
Oxygen and BOD Meter-HI98193

Portable Turbidity and
Bentonite Check Meter - HI83749

Future Work (Continued)

- Fecal Coliform
- Total Phosphate
- Nitrate
- Biochemical Oxygen Demand (BOD)

Knobbs Creek

Acknowledgements

We would like to acknowledge Dr. Linda Hayden for her leadership of the Research Experience for Undergraduates (REU) program, the National Science Foundation (NSF) for their funding of this program, and the REU staff for their daily assistance.

Questions?