

# A Corresponding Study of Water Quality Evaluation of the Pasquotank Watershed in Northeastern North Carolina with a sea level rise component

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**Abstract-** The Pasquotank River Watershed covers over 450 square miles and is located in the Coastal Plain of northeastern North Carolina. It flows from the Great Dismal Swamp at the Virginia/North Carolina border into the Albemarle Sound. The watershed is part of the Albemarle-Pamlico Estuarine System, the second largest system in the United States after the Chesapeake Bay Estuary and provides a transition between spawning grounds and the waters of the Albemarle Sound. Forested swamp wetlands border much of the waterways. Increased agricultural and urban development has greatly affected water quality during recent years.

The 2015 Research Experience for Undergraduates Pasquotank River Watershed Team completed various tests along the tributaries and the river itself, adding to the previously gathered data from 2011, 2013, and 2014. The test points were derived during the 2011 Summer Watershed Team research project with four points added during the 2014 summer project. Results were compared with previous readings for analysis. Streams tested were the Newbegun Creek, Knobbs Creek, Areneuse Creek, Mill Dam Creek, and Sawyers Creek. These streams, along with the river, cover a large area of the watershed and provide a wide variety of shore development from swampland and farmland to industrial development.

In-house tests on this year's samples continued to 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 from these readings were placed into an online database where they are correlated to the location of the sample using Google Maps®.

Analysis tools were developed in order to compare the data from all years for any variations or similarities. Excel spreadsheets were developed to look more closely at individual points and tests for each point. Past projects have used a general analysis of the entire stream to determine water quality. Steps were also made to research the development of an online graphing tool for analyzing the data at individual points over several years. Test results collected were added to a database developed during the 2014-2015 academic year at

Elizabeth City State University. This database was connected to a data visualization page utilizing Google Maps®.

The results show that there were variations for the individual water quality scores, but the overall water quality score for all the tested water sources remained at a comparable level from previous years. Mill Dam Creek rose above the previous three scores of 48 (2011), 47 (2013), and 49 (2014) and achieved a medium water quality score of 57. Areneuse Creek improved in water quality with a medium water quality score of 60. Sawyers Creek became the lowest scoring waterway tested at 35. Knobbs Creek decreased from previous years with a water quality score of 42. For a fourth consecutive testing year, Newbegun Creek fell within the medium water quality range with a score of 65. Pasquotank River rose from the previous testing year's score of 35 but still remained within the bad water quality range with a score of 45. The Lower Pasquotank remained the highest scoring tributary for a second consecutive year with a score of 85.

## I. INTRODUCTION

### A. Overview

The Pasquotank Watershed was used for testing the water quality in the Northeastern North Carolina area. This was the fourth year for testing water quality in this watershed. The water sources within the watershed are Mill Dam Creek, Areneuse Creek, Sawyers Creek, Knobbs Creek, and Newbegun Creek.

Watershed boundaries can easily be delineated using a topographical map that shows the ridges related with the various drainages and the mouth of the stream or river where water flows out of the watershed. Because the water naturally moves downstream in a watershed, any activity affecting the water quality, quantity, infiltration, or rate of drainage at one location in the watershed can change the physical, chemical, and biological characteristics at downstream locations [2].

The previous periods of testing the Pasquotank Watershed were 2011, 2013, and 2014. Testing done within the waterways was for clarity, turbidity, dissolved oxygen,

air temperature, water temperature, wind speed, and wind direction. Other variables recorded in field-testing were time, date, longitude, and latitude. Laboratory tests were done for the following variables: pH, salinity, conductivity, and total dissolved solids. The Lower Pasquotank became an addition to the Pasquotank Watershed in the year of 2014. The reason was to continue monitoring the salinity levels, which is an indicator of sea level rise in coastal waterways.

## II. METHODOLOGY

### A. Field Work

At each test point, there were several tests performed and recorded and water samples were obtained. The time was documented as a reference for water samples being taken as test results may vary throughout the day.

### B. Post-Field Work

After collecting data from each waterway, in-house tests were done to obtain the pH, conductivity, salinity, and total dissolved solids readings. Each meter was placed in the water sample to obtain readings.

### C. Offline Data Visualization

Data was entered into Google Drive Excel sheets. These spreadsheets were used for recording the data in field and laboratory testing. The data was also used in Microsoft Excel spreadsheets to compare using visual graphs. The data in the spreadsheet is merged with HTML and JavaScript to be used in Google Maps to display the data in the web browser.

### D. Online Data Visualization

The feasibility of online data visualization was also researched. This online data visualization would be utilized for comparisons of a specific test factor of a specific waterway for the four years of water testing. This visualization would be placed on the team's webpage as a reference for analyzing the data.

## III. ANALYSIS

### A. Water Quality Index

The overall water quality for all the waterways combined remained at a consistent level. Mill Dam Creek increased in its water quality score and went from a bad water quality score in the high 40's for the testing years of 2011, 2013, and 2014 to a medium water quality. Areneuse Creek, along with Mill Dam Creek, has reached its highest point of the four testing years. Areneuse Creek reached the medium water quality score range. Sawyers Creek was the lowest scoring waterway tested during this research. Sawyers Creek fell from a medium water quality score range for the years of 2011, 2013, and 2014 to a bad water quality score in 2015. Knobbs Creek also obtained its lowest water quality index score of the four testing years. Newbegun Creek fell between the two previous testing years of 2014 and 2013 with a medium water quality score. The Pasquotank River increased from the 2014 testing year but remained at a bad water quality score. This is the second consecutive year that the

Lower Pasquotank has been tested. It remained constant in the good water quality range and remained the highest scoring waterway tested.

## IV. CONCLUSION

### A. Overall

The overall Water Quality Index (WQI) score of the Pasquotank Watershed was calculated by using the Water Quality Index Calculator. Percent saturation of dissolved oxygen; NTU measurements of turbidity, and pH measurements were used to determine the individual scores for each waterway. Mainly due to their dissolved oxygen readings, the lowest score came from Sawyers Creek and the highest score came from the Lower Pasquotank.

### B. Variations and Correlations

The pH readings for Mill Dam Creek, Areneuse Creek, and Newbegun Creek correlate with one another as basic waterways, and the same applies for Sawyers Creek and Knobbs Creek as they were proven to be acidic waterways.

## V. FUTURE WORKS

### A. Adding Test

There are many tests that can be added. The most preferred test is the nitrate test. This test can increase the accuracy of the Water Quality Index score of each waterway that would be used for testing. The HI764 Marine Nitrite Ultra Low Range Checker HC, which is manufactured by Hanna Instruments, is a capable of measuring Nitrate.

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