Water Quality Analysis at Nahant Marsh

Carson Ford - Iowa State University, Ames

Summary

This project investigated the overall health and water quality dynamics of Nahant Marsh through comprehensive monitoring of chemical and physical parameters across various locations and weather conditions. Water samples were collected from strategic monitoring sites along the marsh's flow path, including input streams, intermediate zones, and exit streams, with measurements taken for 9 parameters. The research aimed to evaluate ecosystem stability, identify stresses, and determine the effectiveness of natural wetland processes in treating contaminated water flowing through the Nahant Marsh system

Introduction

Water quality research can give a snapshot of the overall health of a waterway and is vital in ecosystems like urban wetlands such as Nahant Marsh. Because Nahant's ecosystem exists in a delicate balance at all times, equilibrium can easily shift due to outside factors like rain or weather patterns, or the introduction of chemicals like phosphates. I tested water samples from 15 sites from around Nahant Marsh to analyze the overall health of the wetlands, which included determining how effective the marsh is at filtering out pollutants, whether rain or temperature affected the water quality, or if any of the water quality parameters affected each other directly.

Methodology

Across Nahant Marsh, 15 different locations were tested at the surface level for parameters that can indicate a snapshot of the water quality. The parameters tested include nitrates, nitrites, dissolved oxygen, temperature, turbidity, pH, chlorides, and phosphates. Weather and time were also noted for each location. These parameters were collected using a variety of scientific equipment: For nitrates, nitrites, and chlorides, Hach testing strips were used. To read temperature and pH, the Hach Pocket Pro + hand-held probe was used. Turbidity data was collected using a standard 120-centimeter tube with a black/white Secchi disk. Initially, dissolved oxygen and phosphate readings were collected using the CHEMets K-7512 and the K-8510 analytical kits. For the last two weeks of data, a DR850 colorimeter, using the ascorbic acid method, was used to collect phosphate data, and the HACG HQ40d benchtop oxygen meter was used to read dissolved oxygen levels. With these resources available, a reading was collected from each testing spot around the marsh at least once a week from June 4 -July 16, 2025. After building a thorough dataset, I analyzed and created visuals of the data using Excel and Claude. It's important to note that there are varying sample sizes per location.

Study Questions

What is the overall health of the wetlands at Nahant Marsh?
How effective is the marsh filtering out pollutants?
How do weather events affect the water quality?
Is there a relationship between parameters such as dissolved oxygen and phosphates?

Results and Figures

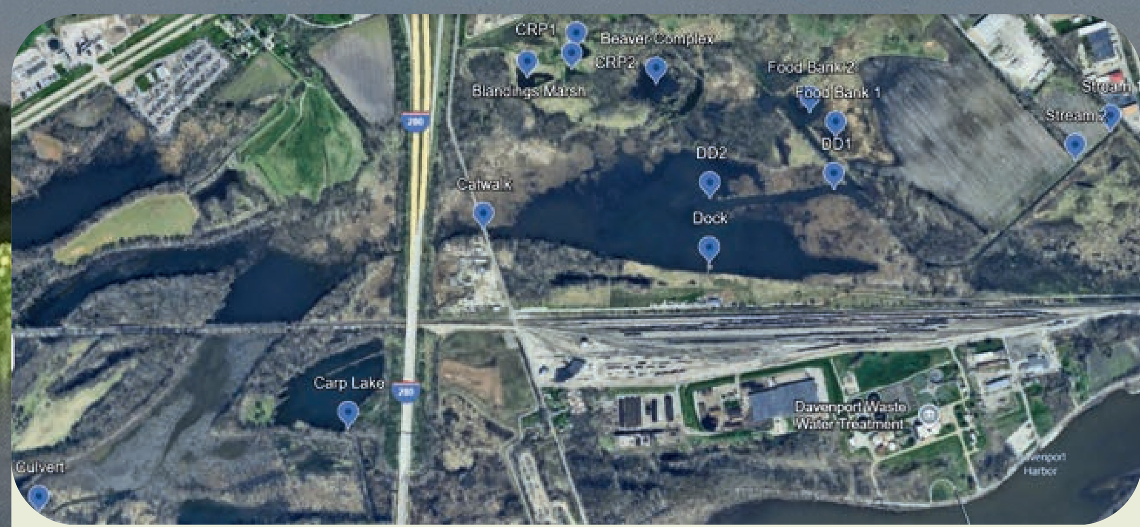

Figure 1: All water testing locations at Nahant Marsh.

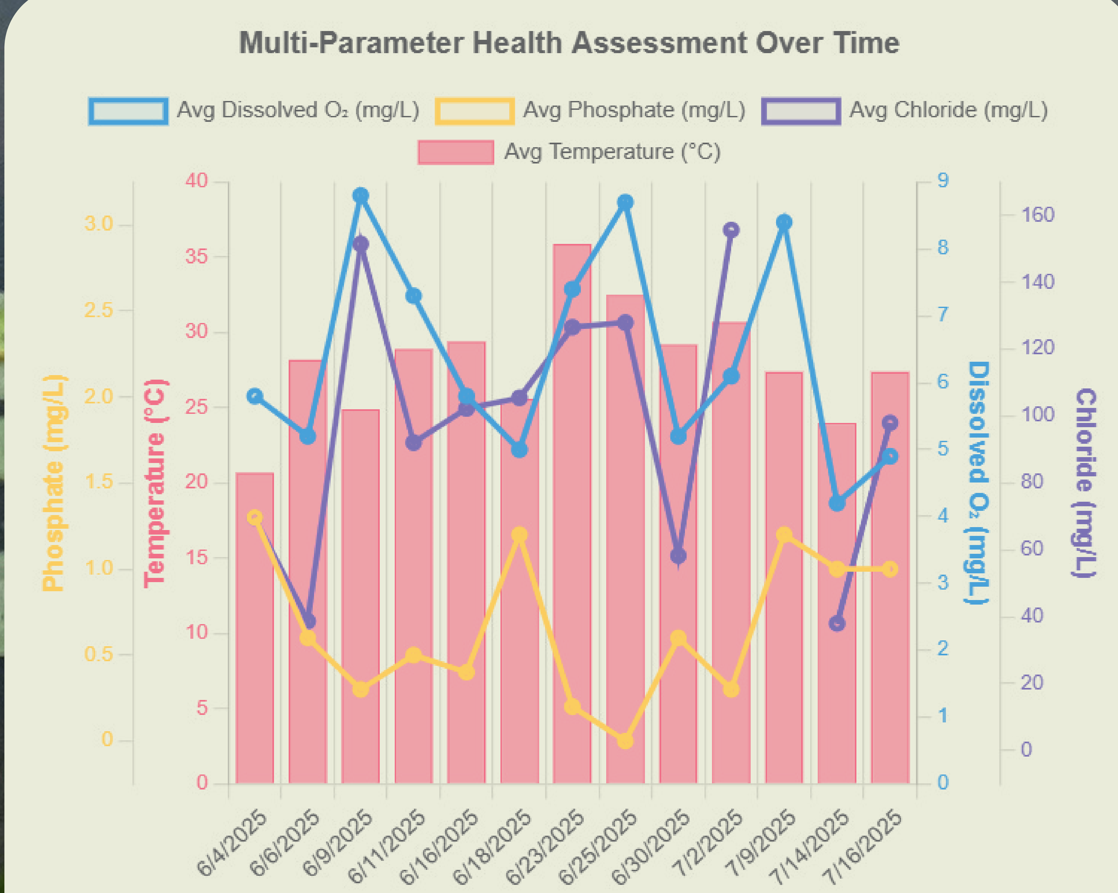

Figure 2

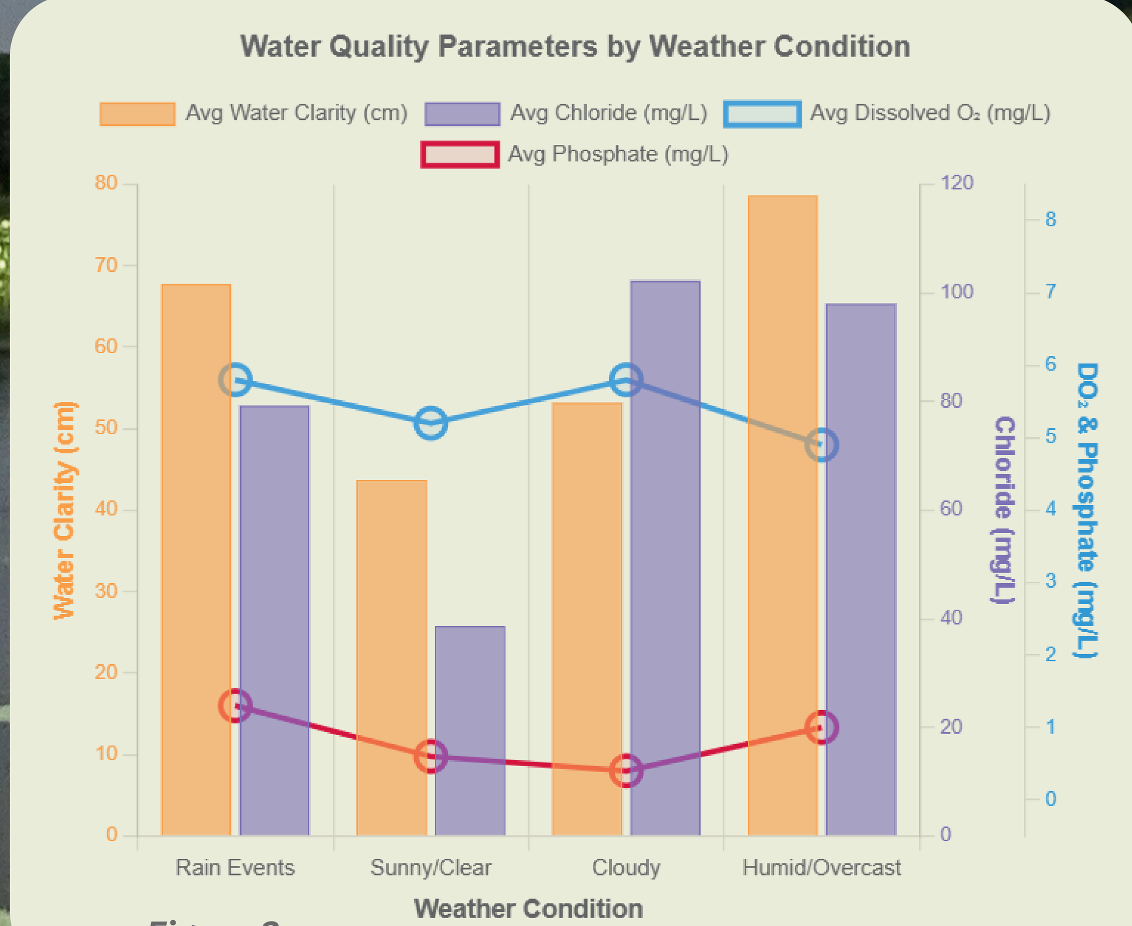

Figure 3

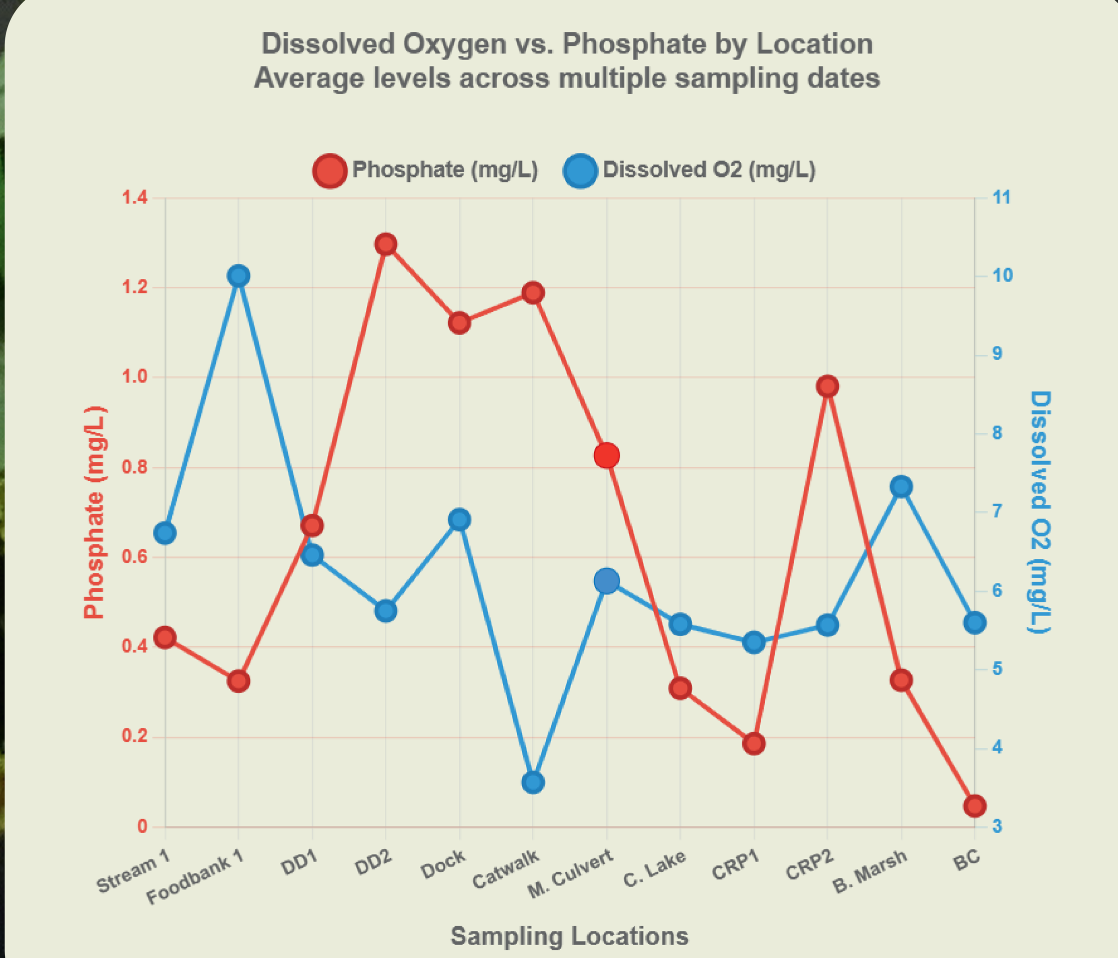

Figure 4

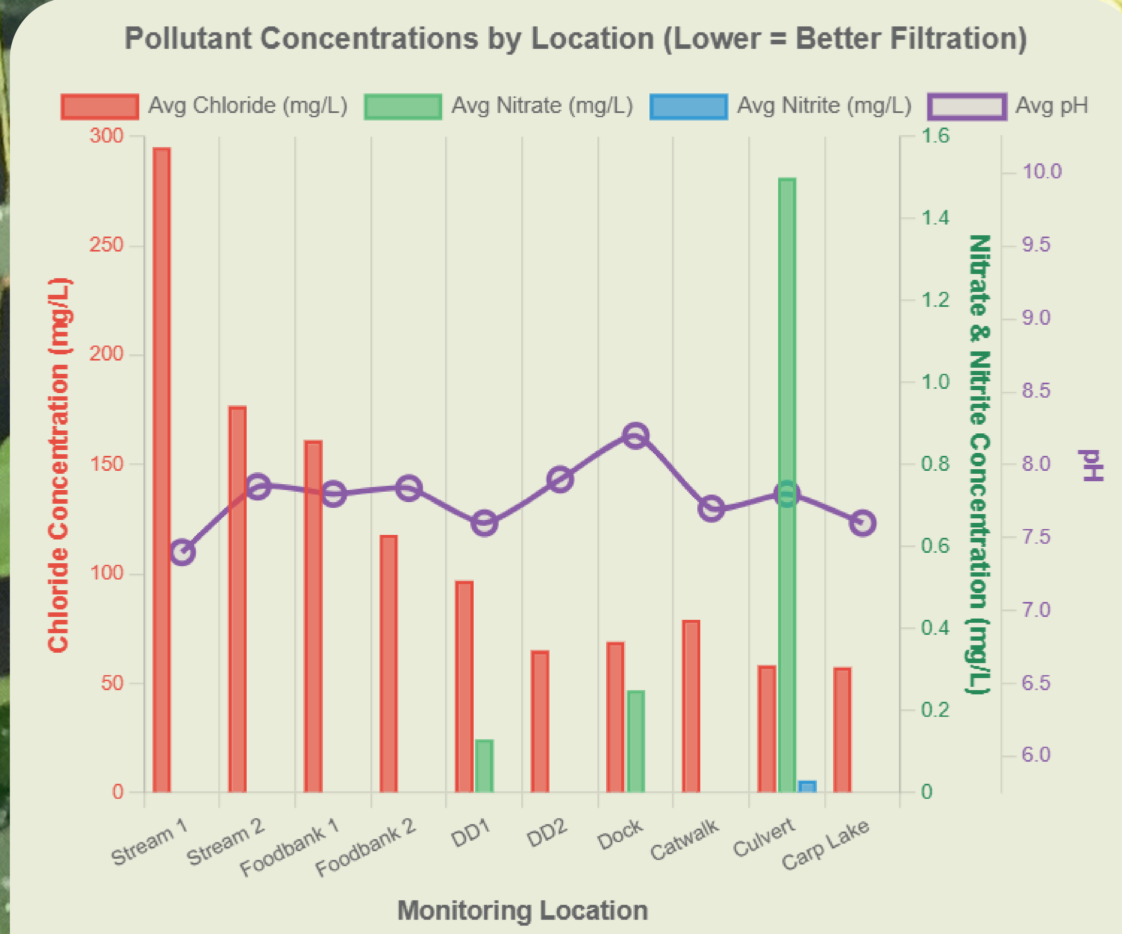

Figure 5

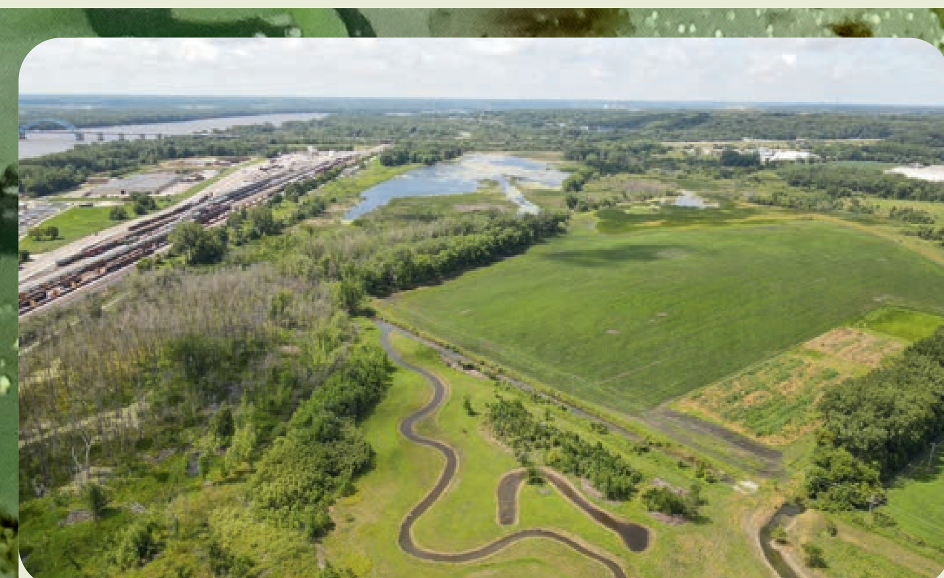

Figure 6: Aerial view of the stream site and main marsh

Discussion

The multi-parameter analysis ***(Figure 2)*** suggests visible ecosystem instability at Nahant Marsh, with dissolved oxygen fluctuations (2-16 mg/L) and temperature increases (20-39°C) indicating a system under stress requiring intervention. The parameter variability suggests the marsh may be struggling to maintain equilibrium during certain periods of the year. The weather impact analysis ***(Figure 3)*** demonstrates counterintuitive patterns where sunny conditions produced the murkiest water (44 cm Secchi depth) while rain events improved clarity to 68 cm. However, rain triggers dramatic phosphate increases from 0.6 to 1.3 mg/L, suggesting active sediment-water exchange where stored nutrients are released during disturbances. This creates a trade-off between physical clarity and chemical stress, indicating complex ecosystem dynamics beyond simple dilution effects. The phosphate cycling patterns reveal that weather events mobilize pollutants stored in runoff and bottom sediments, creating internal nutrient loading independent of external inputs. The dissolved oxygen and phosphate analysis ***(Figure 4)*** confirms a strong inverse relationship typical of eutrophication processes. Concern exists at multiple sites where dissolved oxygen dropped below 5 mg/L - the aquatic life stress threshold - while phosphate levels exceeded 1.0 mg/L. This pattern indicates the marsh exhibits natural wetland processes but operates near ecological tipping points, with several locations requiring further investigation. The spatial pollutant analysis along the flow path ***(Figure 5)*** demonstrates exceptional filtration capacity, reducing chloride concentrations from 295 mg/L at Stream 1 (beneath Highway 61) to 57.5 mg/L at Carp Lake - an 80% reduction. The Mississippi Culvert and Carp Lake locations show the cleanest conditions relative to the graph, confirming proper marsh functioning. Combined with consistent pH buffering (7.5-8.4) across all sites despite evidence of contamination, this indicates significant natural treatment capacity and ecosystem resilience. These findings suggest Nahant Marsh maintains remarkable filtration effectiveness despite operating under stress, but requires immediate upstream management and enhanced monitoring protocols to prevent system collapse during increasing weather variability.

Acknowledgements

This project was supported by the National Science Foundation, Eastern Iowa Community Colleges, the EARTh Grant, Nahant Marsh, and the city of Davenport, Iowa. A special thank you to Julie Malake for the background photo, my fellow coworkers and interns at Nahant Marsh, Elizabeth VanCamp, Dr. Kevin Geedey, P.hD and Jimmy Wiebler.
Thanks for a great summer!