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Assessing The Presence and Concentrations of Nutrient Pollution In Freshwater Environments In Fredericksburg, Virginia

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Introduction

This study examined concentrations of phosphate, nitrate, nitrite, copper, and chlorine in freshwater environments in the Fredericksburg area. While aquatic ecosystems require nutrients such as phosphorus and nitrogen to function properly, excess concentrations of these two elements can cause a range of adverse effects including algal blooms, hypoxia, and dead zones. Sources of excess nutrients include agricultural runoff, leaking septic systems, sewage treatment plant discharge, and erosion of natural deposits. Heavy rainfall induces runoff into these bodies of water. Phosphorus is the limiting nutrient for aquatic ecosystems and therefore small changes can negatively affect the water quality. Excess nitrate causes unstable levels of dissolved oxygen with high levels during the day and decreased levels at night. This study is designed to address possible sources of changes in nutrient concentrations in local freshwater environments.

Objectives

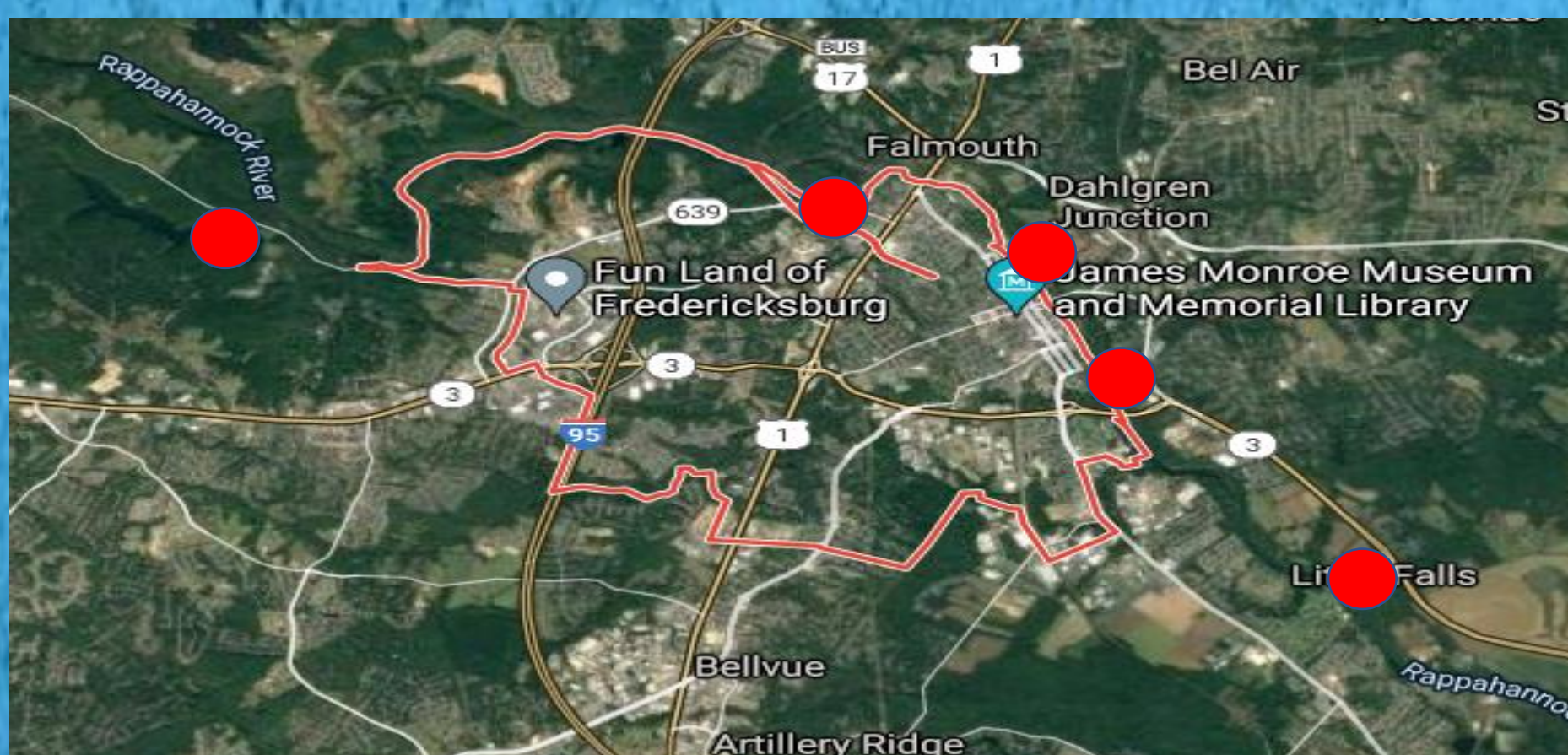
- To assess whether changes in rainfall or temperature affect nitrate and phosphorus levels in freshwater environments near the Rappahannock River
- To assess the presence and concentrations of nitrate and total phosphorus at five locations (City Dock, Old Mill Park, Ficklen Island, Motts Run Reservoir, and Little Falls) near the UMW campus

Hypotheses

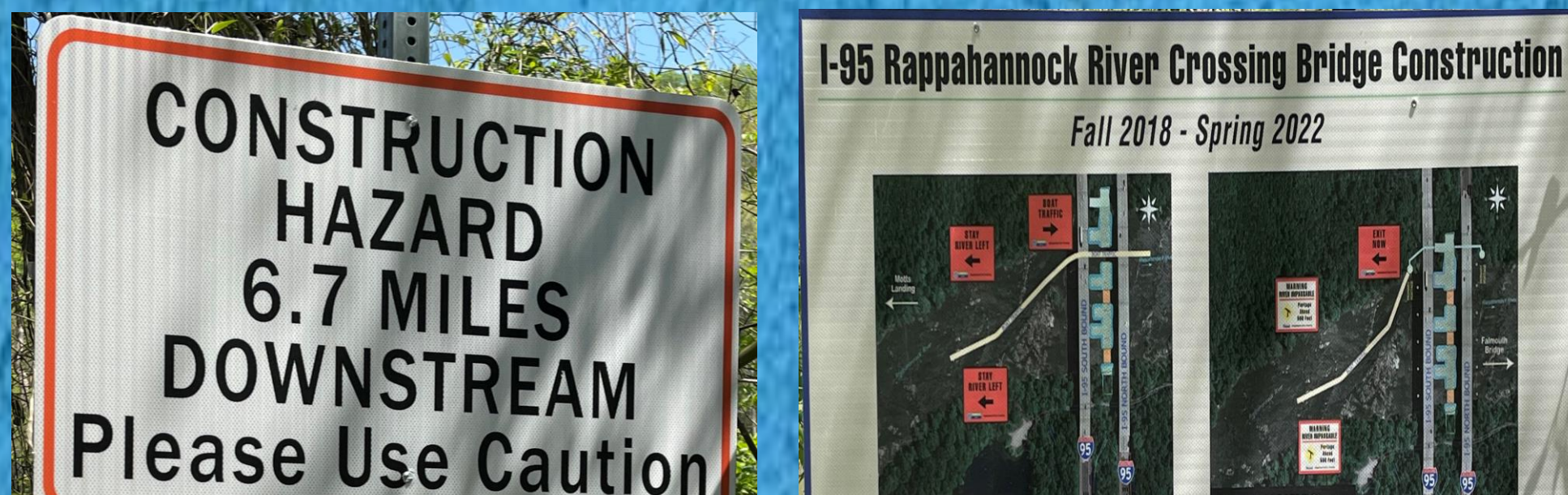
- Natural nutrient levels will increase with heavier precipitation due to runoff events and the expulsion of water from treatment plants.
- Only natural nutrients such as nitrite, nitrate, and phosphate should see levels in the water. Copper and chlorine will be present if there is a contamination site nearby.

Methods

- Daily temperature and precipitation data was obtained from USGS data and the Fredericksburg weather history from the Shannon Station of *Weather Underground*.
- Water samples collected weekly from February 17-March 24 from each location. Analysis of each sample was done within an hour of collection.
- Samples were filtered with a Corning 28mm syringe filter and tested for nitrate, phosphate, nitrite, copper, and chlorine using the following kits:
 - HACH Nitrate Test Kit, Model NI-11
 - Lovibond Nitrite LR Test Kit, 147300
 - Lovibond Copper LR Test Kit, 147440
 - Lovibond Chlorine (Free) 147050
 - Lovibond Phosphate LR 14724



Fredericksburg Map With Marked Testing Locations



Construction Warning at Motts Run Reservoir

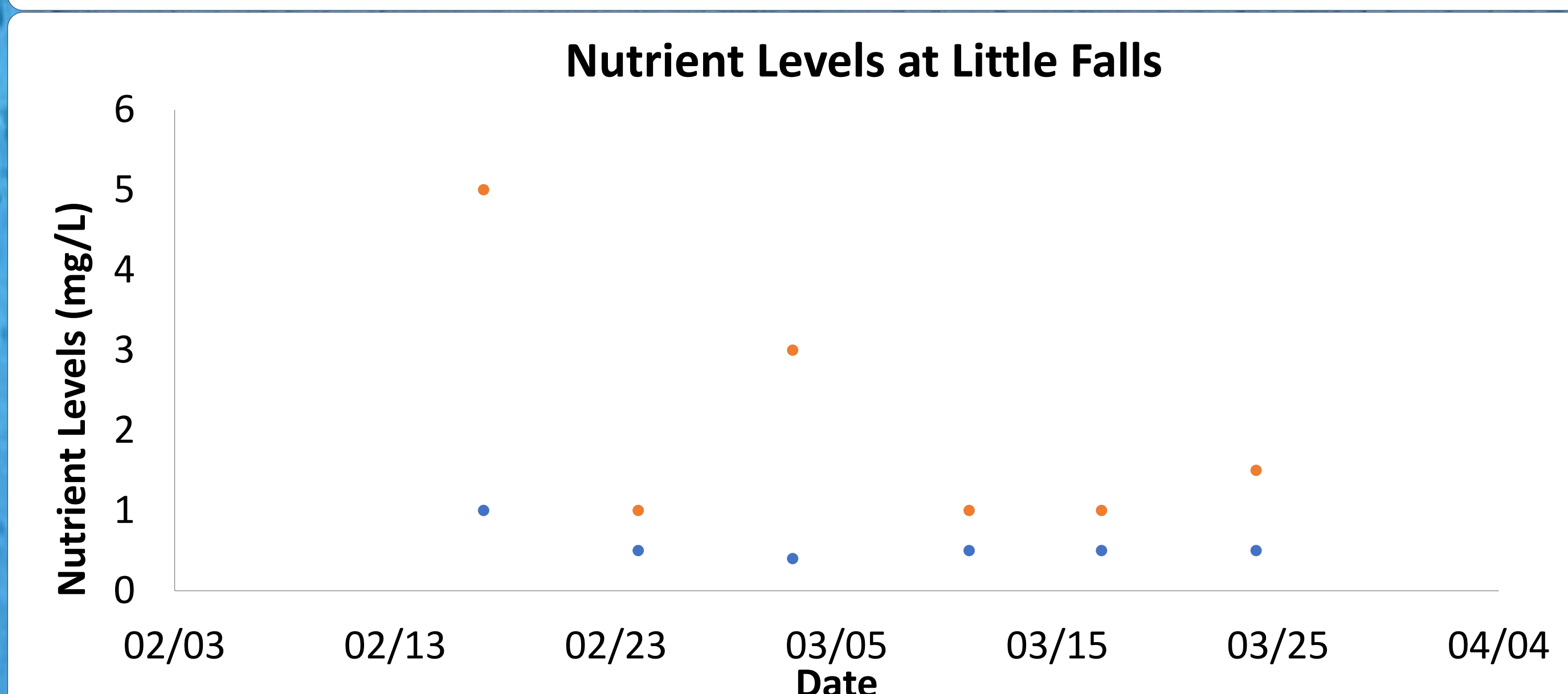
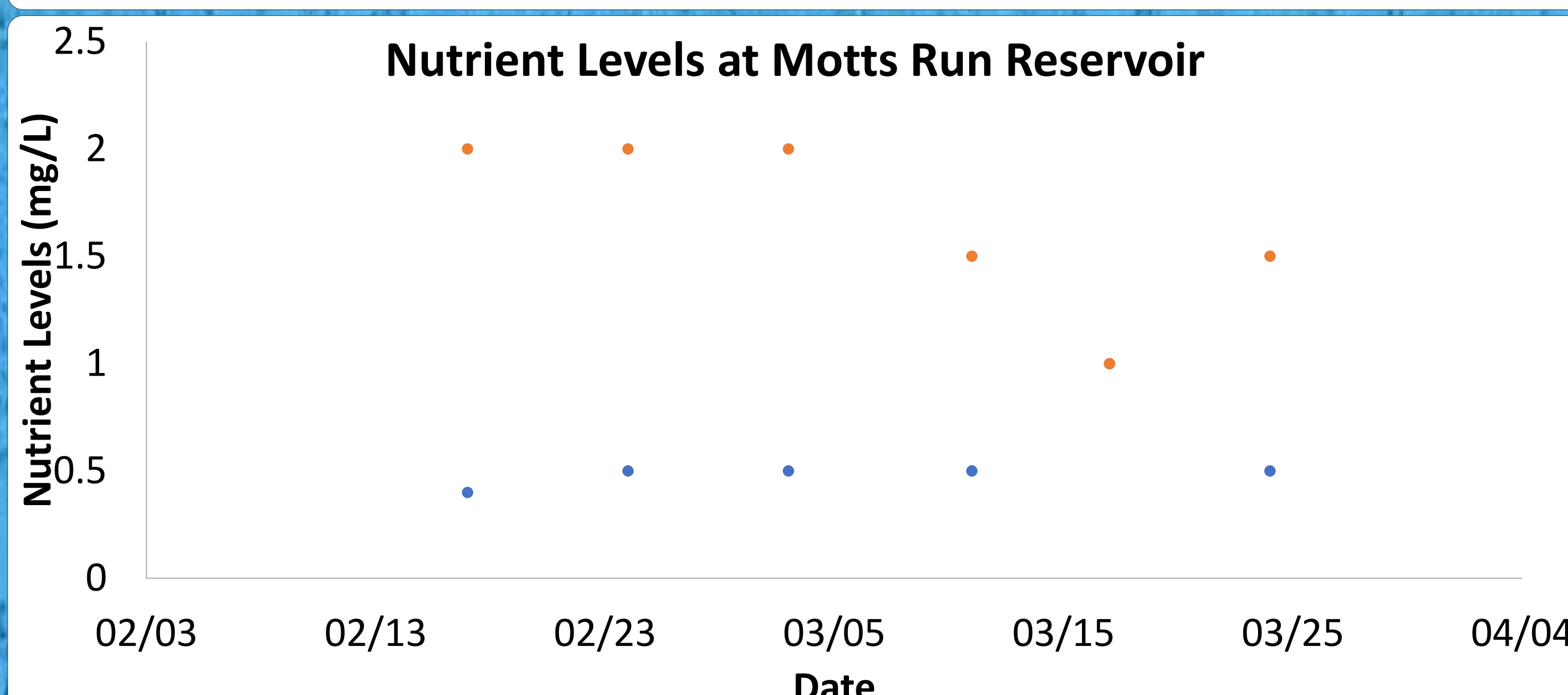
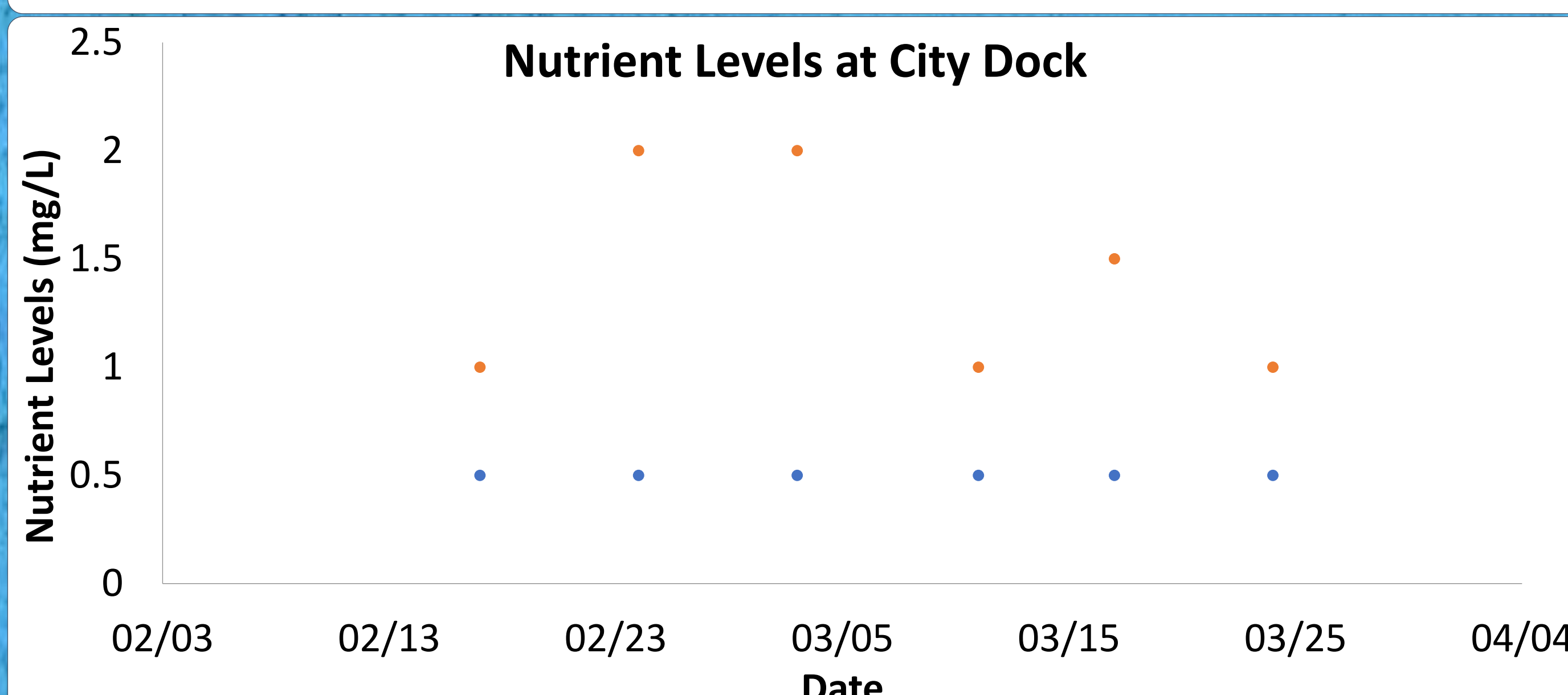
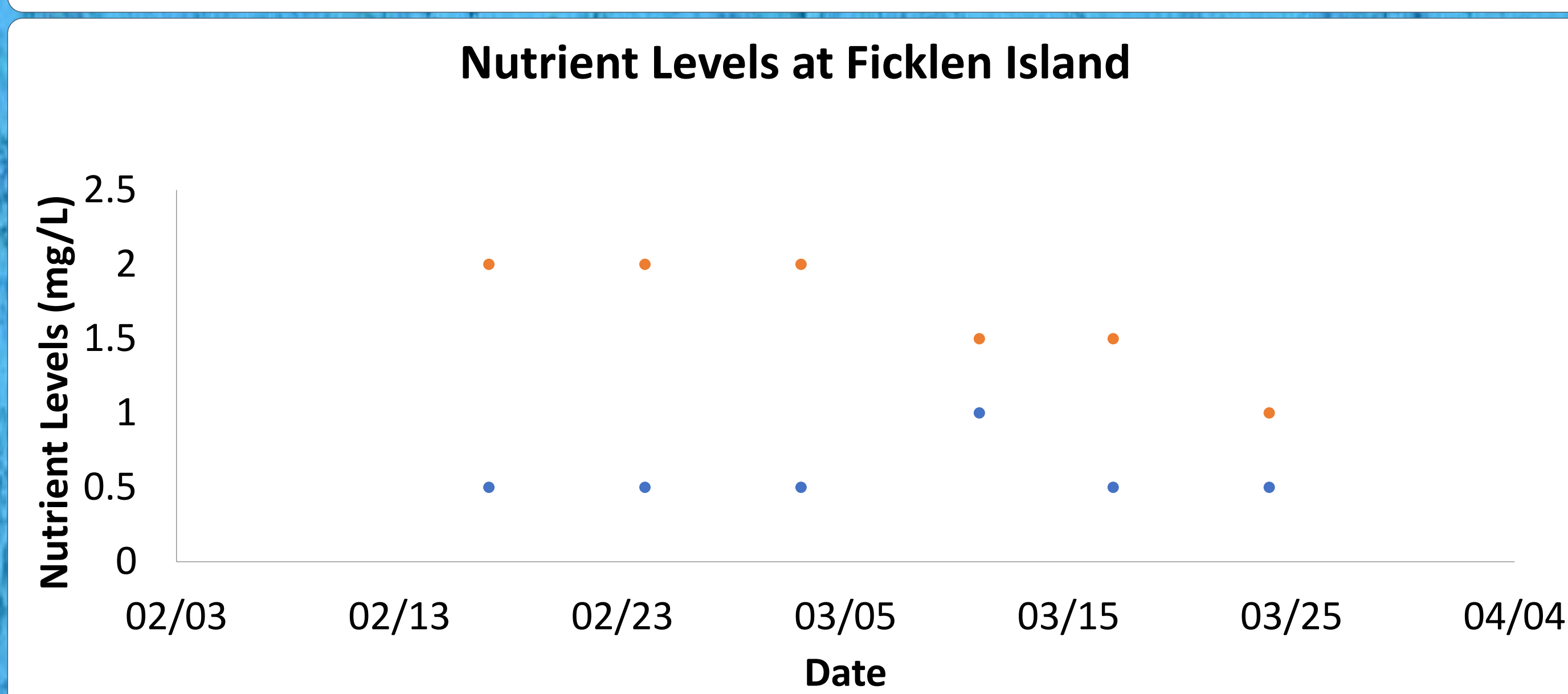
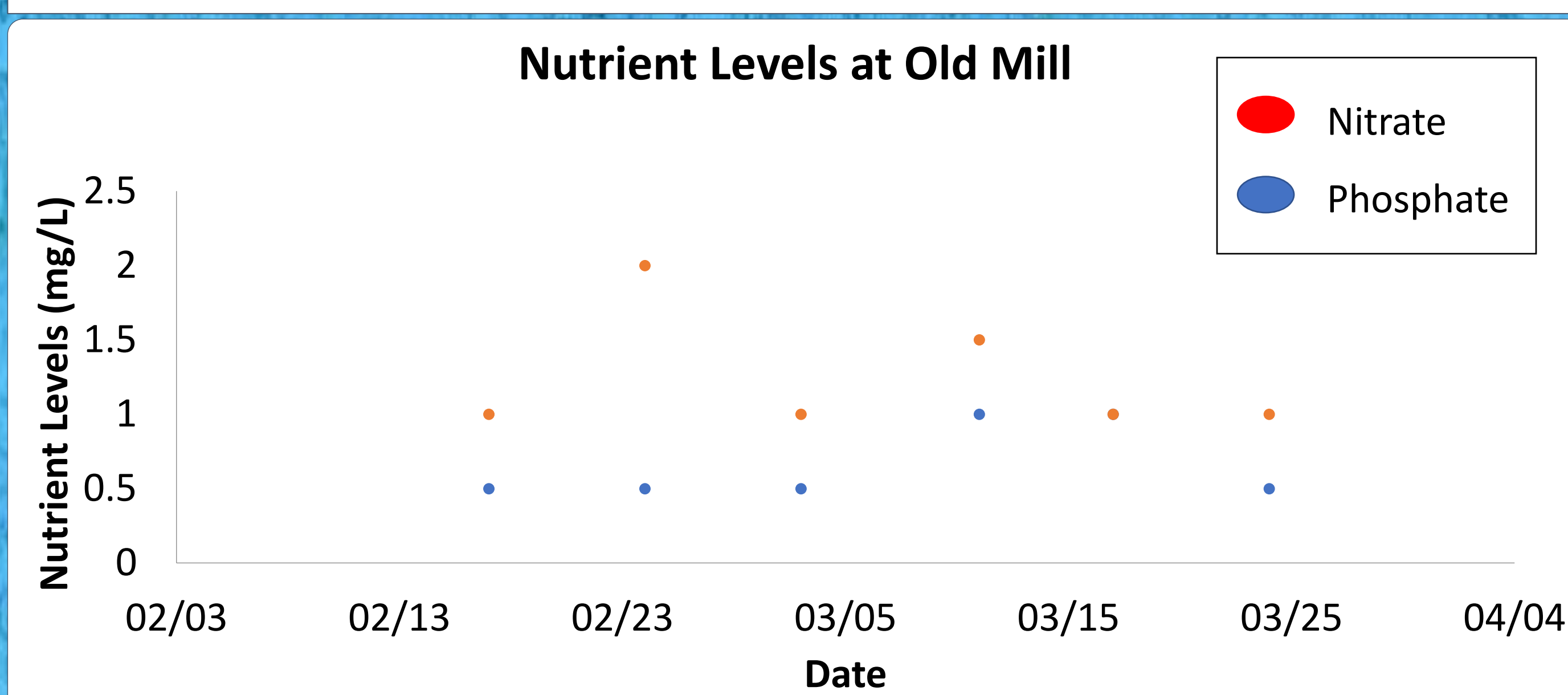
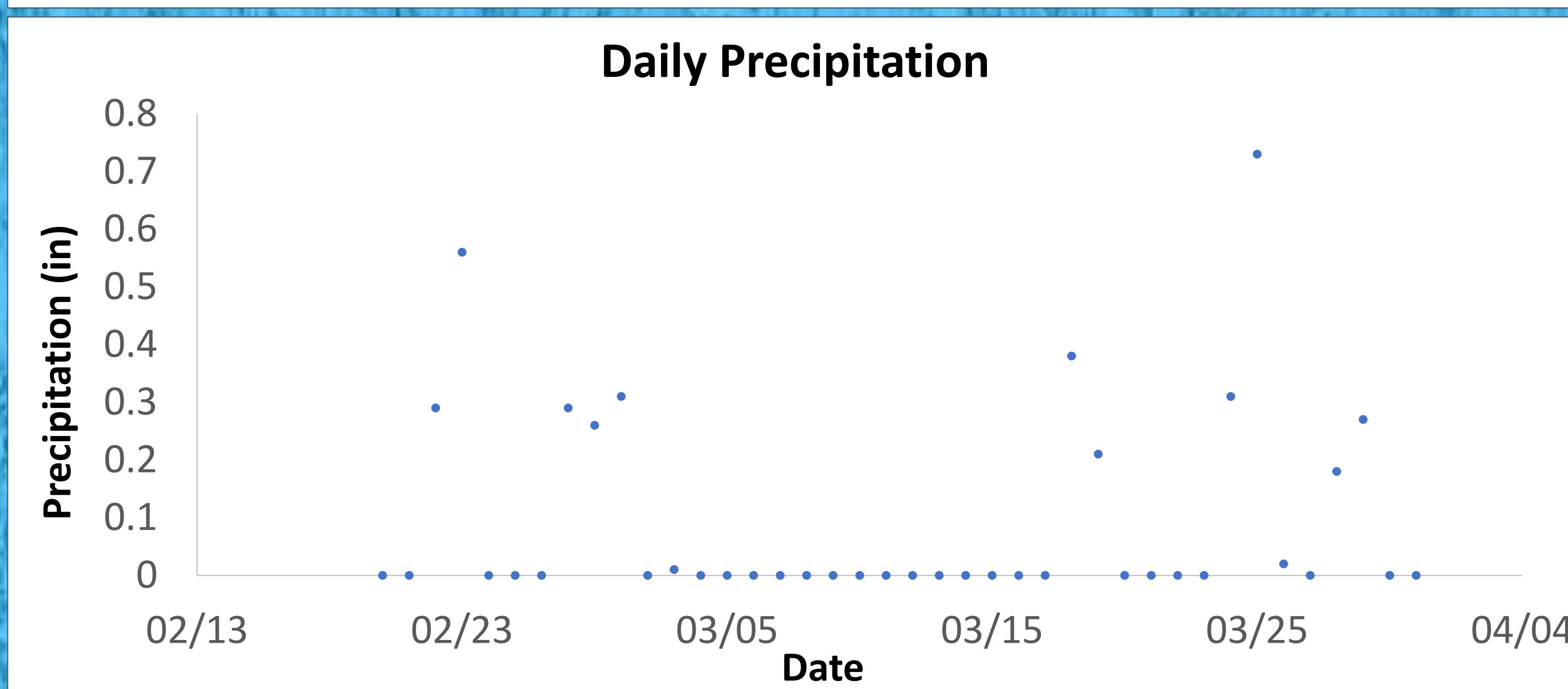
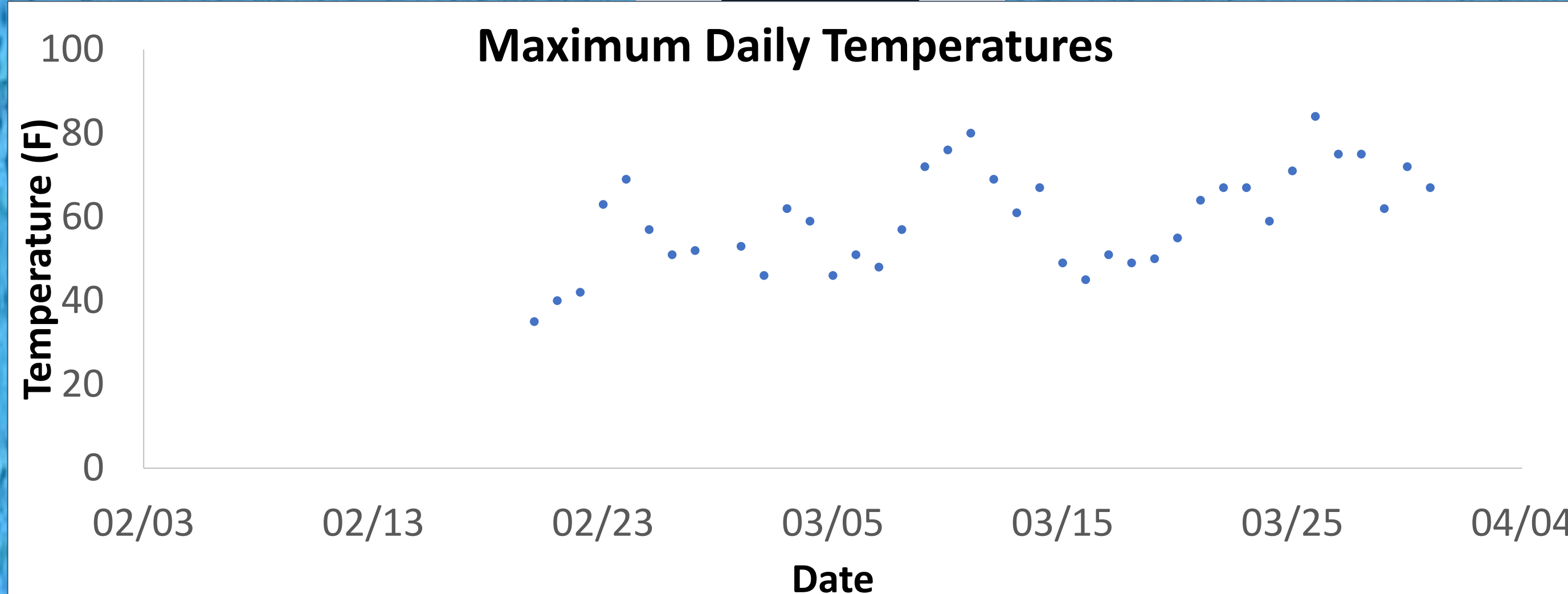


Construction upstream from City Dock



Little Falls Water Treatment Facility

Results



Results (Cont.)

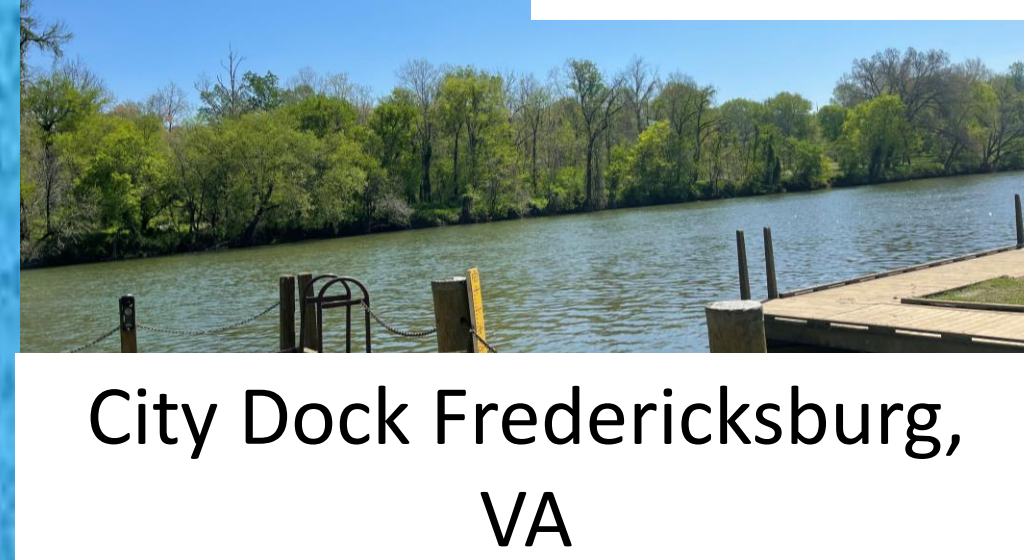
- Copper, nitrite, and chlorine were measured and found to have no detectable concentrations.
- Data suggests no correlation between increasing temperatures with increasing nutrient concentrations. Concentrations at Old Mill and Little Falls decreases with rising temperatures.
- Concentrations fluctuated with precipitation, but results were not consistent; implying a separate source of increasing nutrients.
- Phosphates remained constant at 0.5-1.0mg/L at all sites.
- Observed decreasing trend of nitrates at Ficklen Island but fluctuated at all other sites. The highest levels of nitrates were seen in February, possibly due to areas of snowpack.

Discussion

- The EPA's maximum nutrient level for these streams for phosphate is 0.1mg/L and the lowest observed concentration here was 0.5mg/L. Phosphate is the nutrient of concern for monitoring levels and doing further research of how levels are getting that high and what sources are causing it. The EPA maximum total nitrate level is 10mg/L which is more than double the concentrations observed here, showing nitrate is not a cause for concern. Nitrite levels remained below detection as it gets converted to nitrate through the nitrogen cycle.
- As precipitation washes the loose sediment created from construction, nutrients are flushed into the waterway. Construction was seen upstream from City Dock and downstream from Motts Run Reservoir.
- At Little Falls, nutrient levels were the highest in February after snowfall which suggests the release of excess wastewater from the facility back into the surrounding water.
- Observed trends in increasing nutrient levels with increasing daily temperatures suggests the need to be more aware during warmer months as warm temperatures prevent water from mixing, allowing algal blooms to grow faster. Warmer months have longer hours of sunlight which also encourages algal blooms.



Old Mill Park Fredericksburg, VA



City Dock Fredericksburg, VA



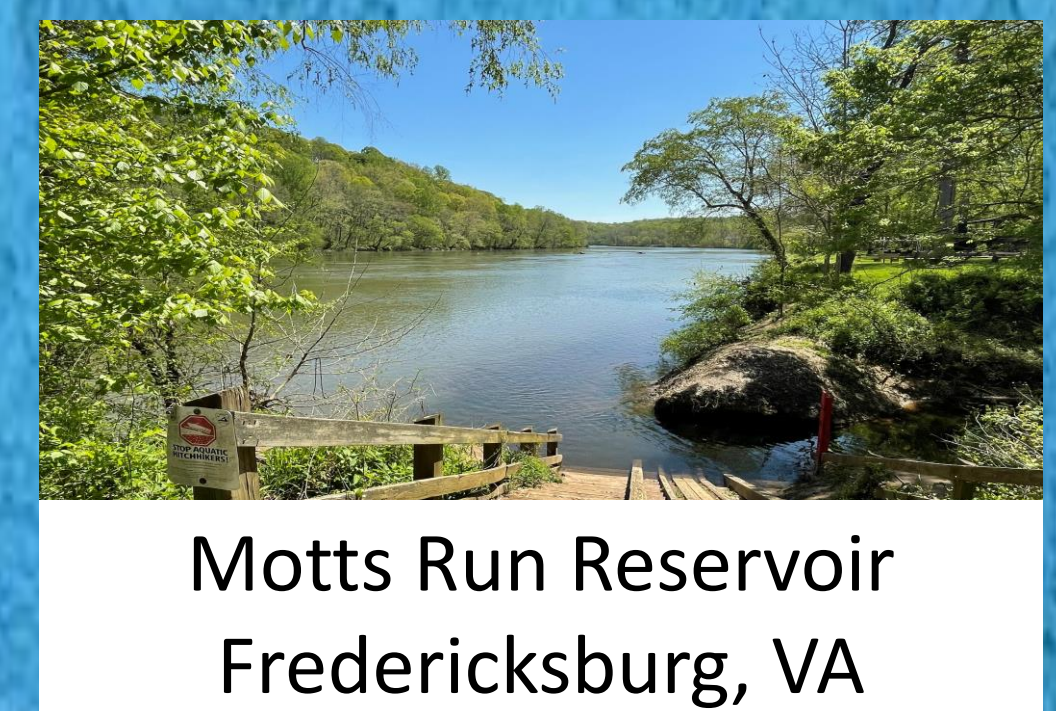
Ficklen Island Fredericksburg, VA

Future Directions

- Conduct a long-term study that assesses how changes in temperature and rainfall affect nutrient concentrations. Changes in water temperature will allow us to examine concentrations in cold water and warm water with possible algal blooms.
- Increase the number of testing sites to include potential areas of concern (e.g. public pools, agricultural sites, etc.)
- Incorporating studies that examine the impacts of fluctuating nutrient concentrations on organisms in different trophic levels to better understand the optimum range in concentrations in freshwater ecosystems.



Little Falls Fredericksburg, VA



Motts Run Reservoir Fredericksburg, VA

Acknowledgements

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