

Long-Term Effectiveness of Multiple Restoration Projects in Streams of the Lititz Run Watershed

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Introduction

Stream restoration is used as a practice to offset the degradation of stream function due to agricultural and urban influences.

This research evaluates water quality above and below older (> 10 years) restorations along Lititz Run and its major tributary Santo Domingo Creek, which pass through both urban and rural areas. Based on available land area, these restoration sites can be classified as primarily bank stabilization (Lower portion of New Street Park and Riparian Park) or floodplain restoration (Rock Lititz and Upper portion of New Street Park). (Figures 1 and 2)



Figure 2. From left to right. Rock Lititz (RL) floodplain restoration (photo from Land Studies, Inc.), New Street (NS) Upstream, NS Wetland, NS Transition, NS Downstream, Riparian Park (RP) Upstream at Trout Hatchery, RP Midpoint, and RP Downstream.

Results

Composite Analysis

- Nitrate concentrations (Figure 3) along Santo Domingo Creek are highly variable and when aggregated, impacts of floodplain restoration are not visible.
- For phosphate (Figure 4), floodplain restoration with the interaction with vegetation is highly effective at reducing and stabilizing phosphate concentrations.

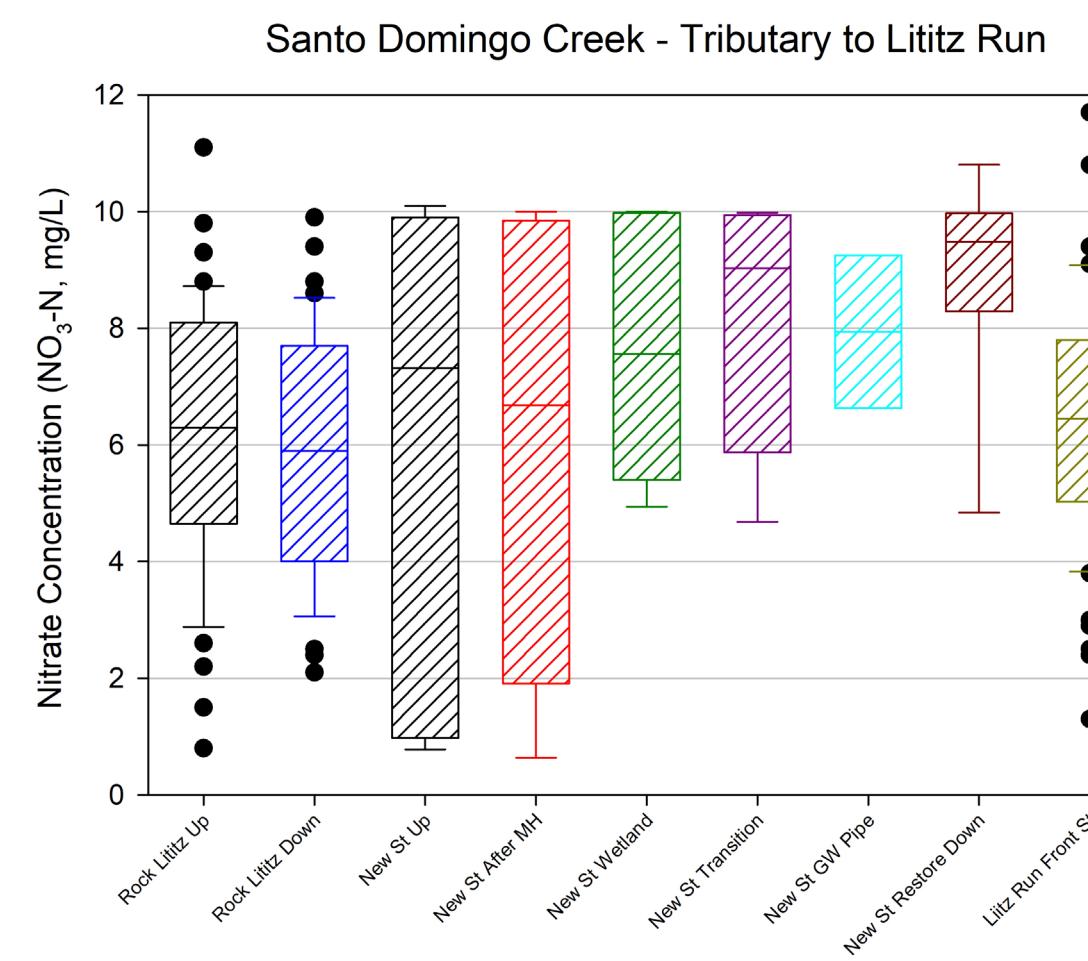


Figure 3. Nitrate, Santo Domingo Creek.

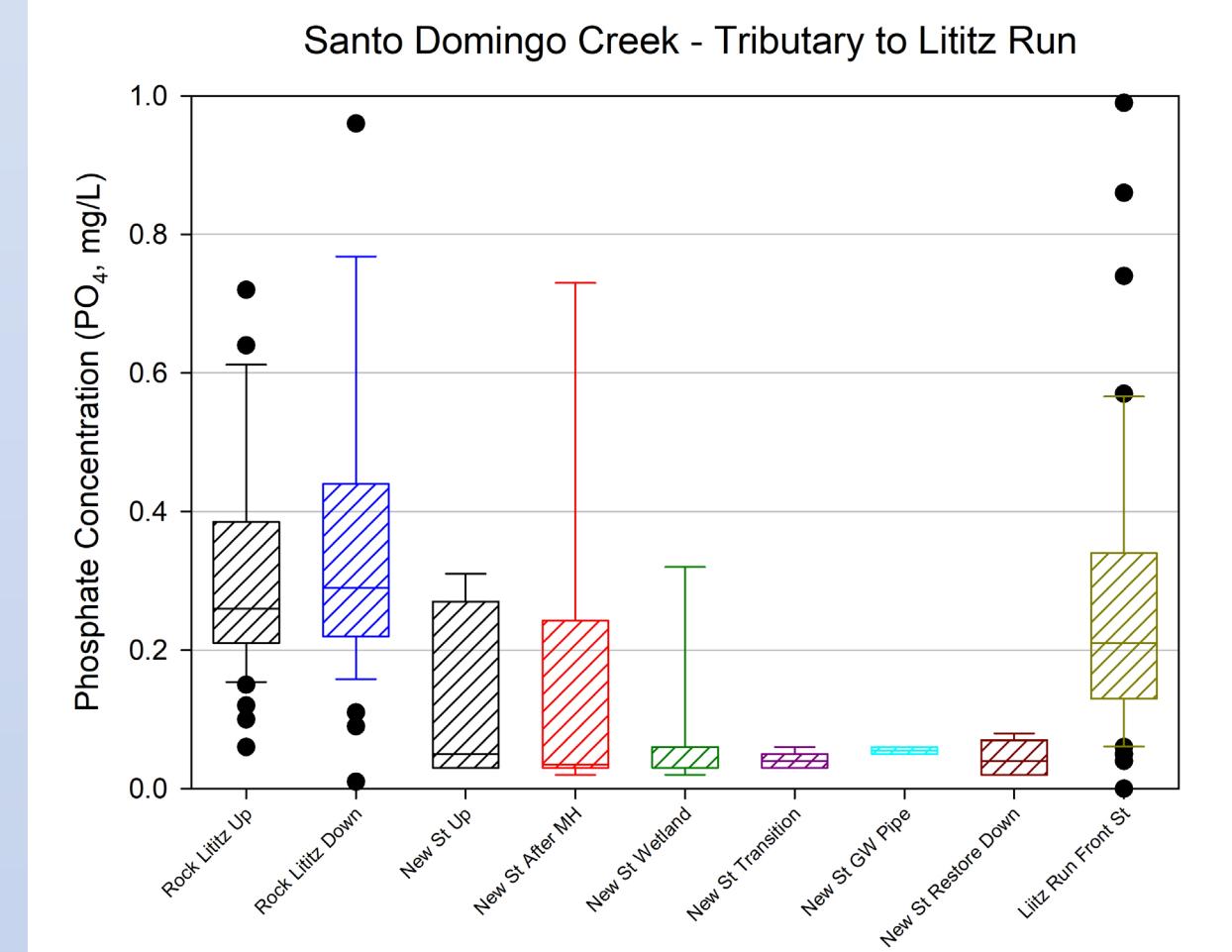


Figure 4. Phosphate, Santo Domingo Creek.

Seasonal and Flow Analysis in New Street Park and Riparian Park

- Both Santo Domingo Creek and Lititz Run interact with the groundwater along their length. Groundwater in this area is contaminated with nitrate from historic agricultural operations.
- At the start of the New Street Park restoration, two sanitary sewer manholes bracket the creek banks and sediment just below the manhole has a sewage smell.
- The Riparian Park restoration site is below the discharges from a trout hatchery and the Warwick Township Wastewater Treatment Plant.
- Nitrate (Figure 5):** Vegetation matters (summer vs winter concentrations with summer being lower). Vegetation interaction matters (fall low flow versus summer/winter in Santo Domingo Creek). Stabilization in Riparian Park limited impact (historical and 2019-2021 field data).
- Phosphate (Figure 6):** Groundwater dilutes phosphate concentrations (summer and winter) vs fall where the flows were very low or none in the wetland creek channel. Might be sewage leaking from manholes or buried pipes. Treated wastewater also higher percentage of flow in fall at Riparian Park, resulting in increased concentrations.

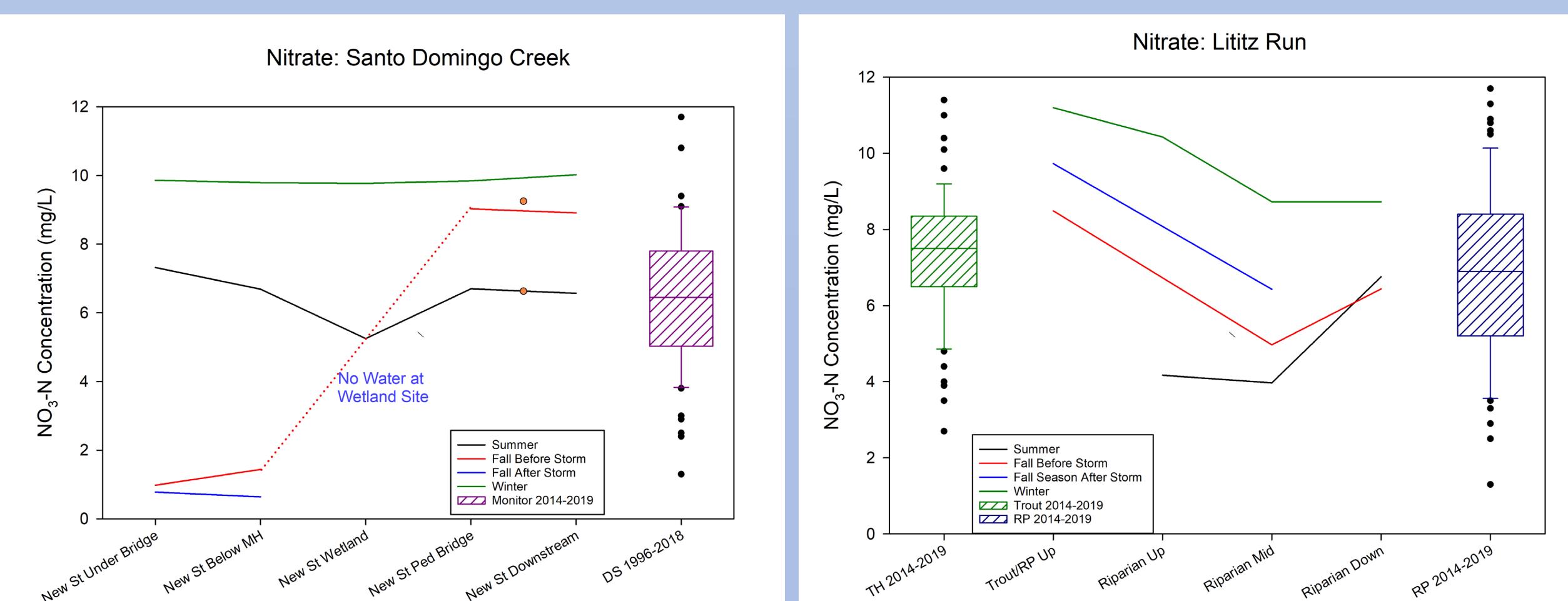


Figure 5. Nitrate concentrations. Left: New Street Park, Santo Domingo Creek. Right: Riparian Park on Lititz Run.

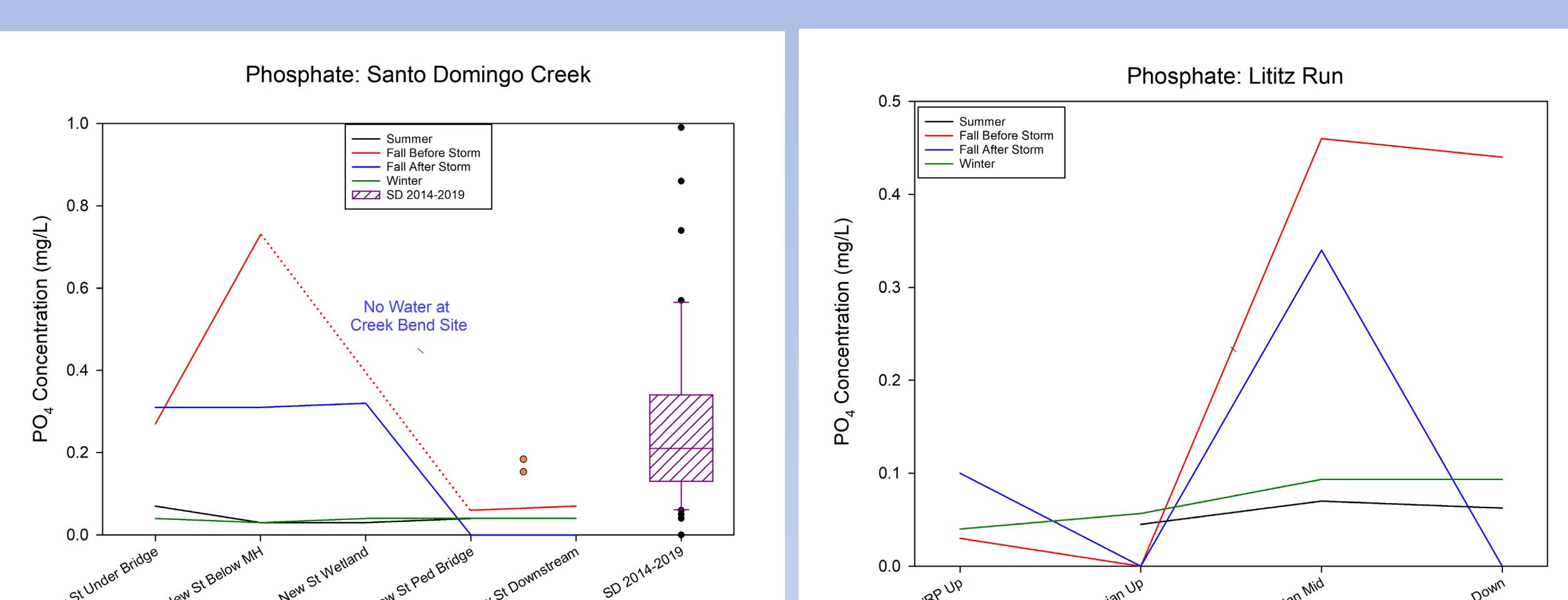


Figure 6. Phosphate concentrations. Left: New Street Park on Santo Domingo Creek. Right: Riparian Park on Lititz Run.

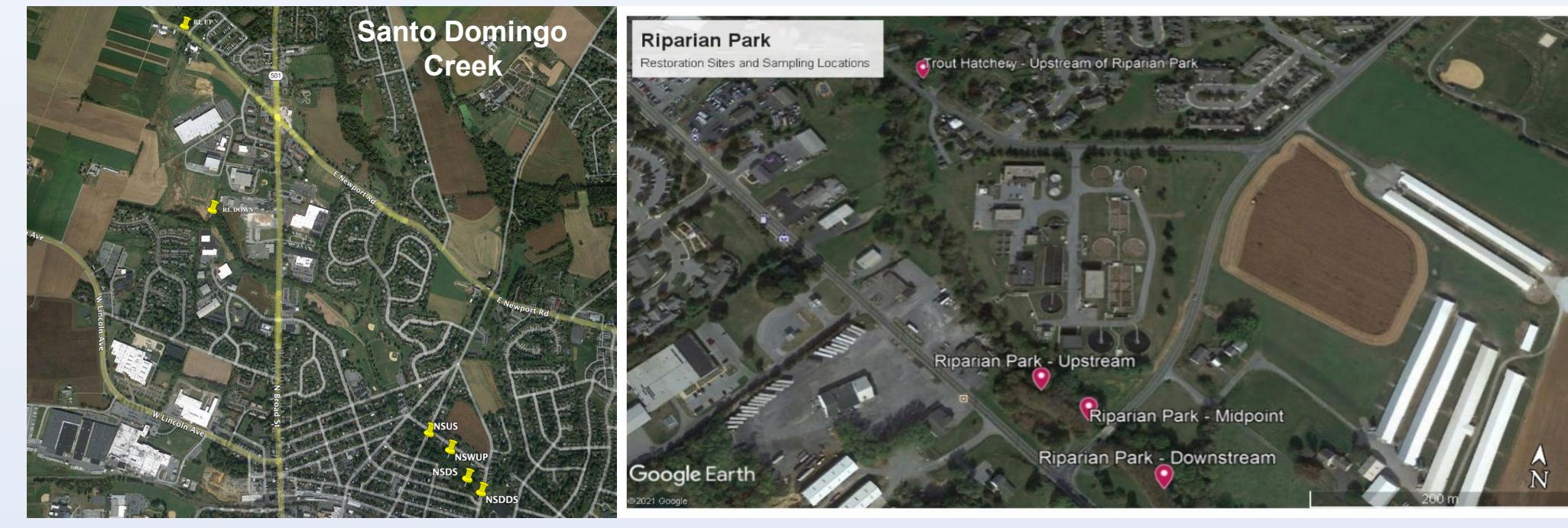


Figure 1. Google Earth Maps of Restoration Locations (left: Santo Domingo Creek with Rock Lititz (RL) and New Street Park (NS) sites; right: Riparian Park sites).

Methods

- Restoration sites (Figure 1) selected based on the age and type of restoration: streambank stabilization vs. floodplain restoration.
- Historic data collected from Warwick Township from 2014 – 2019. Field data collection occurred during 2019- 2021.
- Water testing was conducted upstream and downstream of the restoration, as well as at specifically identified inputs.
- Total N, Total P, Nitrate ($\text{NO}_3\text{-N}$) and Ammonia ($\text{NH}_3\text{-N}$) were analyzed.

Discussion and Conclusions

- Chesapeake Bay TMDL:** Historical analyses did not test for total nitrogen (TN) and total phosphorus (TP). Figure 7 highlights the behavior of TN and TP throughout the urban restoration sites in Santo Domingo Creek and Lititz Run.

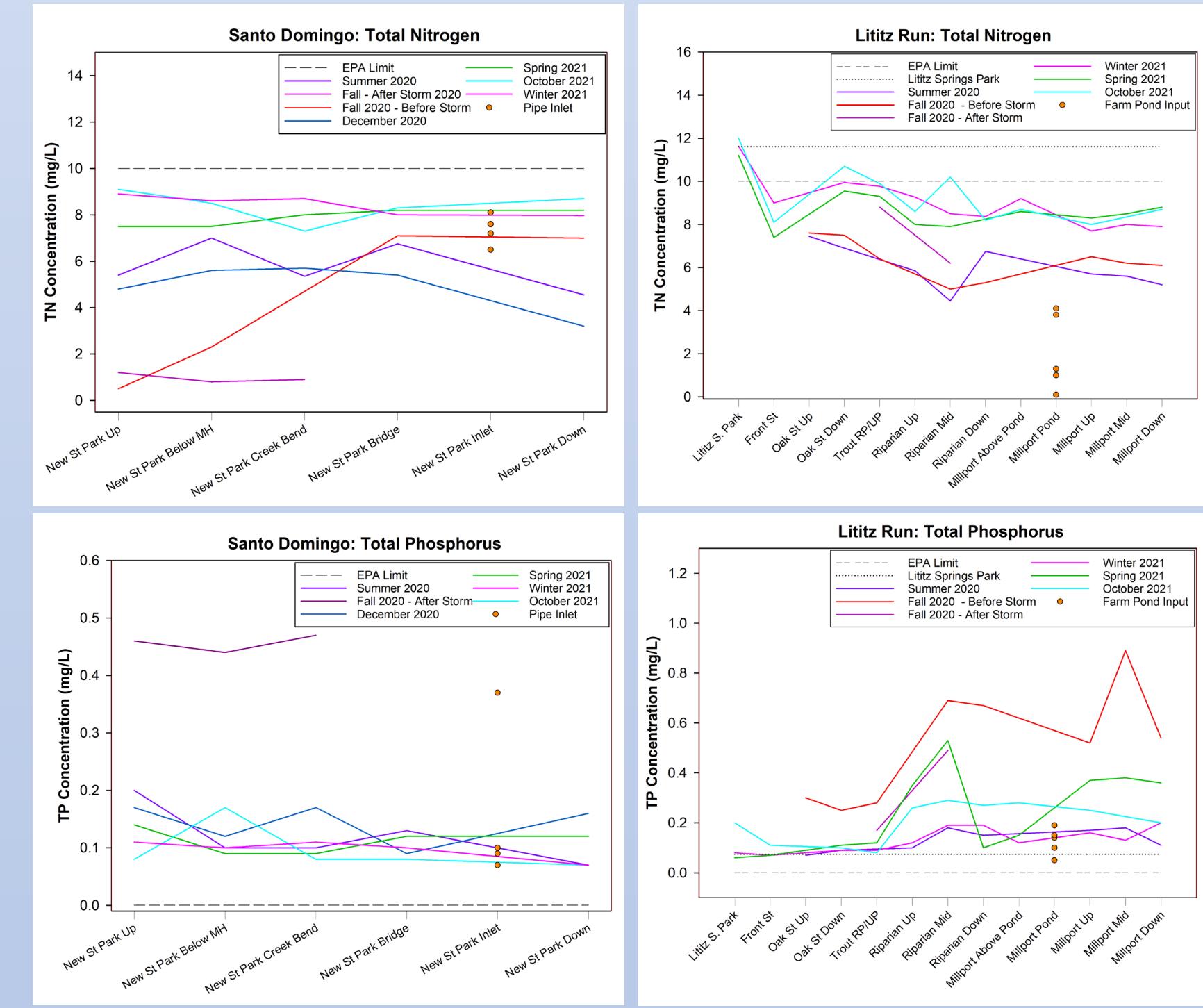


Figure 7. Total Nitrogen (top) and Total Phosphorus (bottom) for Santo Domingo Creek and Lititz Run, including all sampling sites.

- Floodplain restoration sites were effective at removing nutrients, especially when water had time to interact with the vegetation. In comparison, in streams where the channel width and/or flow rates do not allow that interaction, nutrient reductions are smaller.
- These creeks have additional inputs of nutrients inside restoration areas as well as between restoration areas. Therefore, land management must be considered in addition to stream restoration to achieve the nutrient reduction goals of the Bay TMDL.
 - Stream pools, groundwater and other outside influences like the wastewater treatment facility, fish hatchery and car wash could be the reason for the inconsistent TN reduction.
- Overall, the streambank armoring site at the Riparian Park was less effective at removing nutrients (also based on prior work in other streams in this area).
- In areas of limited land to restore the floodplain, stabilization (armoring with riprap and trees) is vital to prevent nutrients from entering the stream from eroding soils.

Acknowledgments

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Master's Research Papers

- Rachel Smolinski, M. Eng. ENVE (2019). *Effect of Floodplain Restoration on Water Quality in Streams of Lancaster County, PA*.
- Aleksandra Dimova, M. Eng. ENVE (2021). *Long-term effectiveness of restoration activities on streams in the Lititz Run Watershed*.