

Phosphorus sources, bioavailability, and cycling in the Murderkill River, Delaware

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Excess phosphorus (P) is a major cause of water quality degradation and eutrophication worldwide. While the Delaware Bay overall is less prone to eutrophication, one of its sub-estuaries, the Murderkill Watershed, has experienced historically high P influx and seasonal eutrophic conditions. Here we sampled different forms of P from the Murderkill Watershed, including soil-P from agricultural, residential, and forested land, effluent-P from the wastewater treatment facility within the Murderkill River, and dissolved and particulate-P in the Murderkill River itself in mid-September. Historical data from Delaware Natural Resource and Environmental Control (DNREC) and USGS reports September averages of inorganic P (P_i) concentrations ranging 0.6–6 μM within the freshwater and tidal portions of the Murderkill River for more than a decade. P_i concentration data from this study falls within the bounds of the historical range. Despite natural P fluctuations, P_i concentration is decreasing at the confluence with the wastewater treatment facility.

Additionally, among different soil P pools, the highest concentration of P_i is found in the NaOH-P pool across soils from three different land-uses — forested, agricultural, and residential—in the Murderkill watershed. Agricultural soils have the highest P content overall. Phosphate oxygen isotope ($\delta^{18}\text{O}_p$) analysis is applied to water, soil, and particulate matter to identify potential sources of P in the Murderkill watershed. Identifying the particular sources or processes of P abatement is crucial to mitigating water quality concerns and to avoid exceeding the Murderkill River's TMDL.