ABSTRACT

EVALUATING THE IMPACT OF LAND USE CHANGES, DRIVERS OF TMDL DEVELOPMENT, AND GREEN INFRASTRUCTURE ON STREAM IMPAIRMENTS

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Despite the water quality improvements and regulatory advancements over the last 50 years since the enactment of the Clean Water Act, water bodies within the United States are still impaired for a broad range of contaminants from non-point source pollution. Improving watershed management approaches to meet this challenge will require a greater understanding of (1) how changes within a watershed, such as changing land use, impact stream water quality, (2) what influence socioeconomic, spatial and political factors may have on the progress towards meeting water quality goals, such as Total Maximum Daily Loads (TMDLs), and (3) how specific best management practices can be designed to address water body impairments. First, land use within a watershed is known to have a direct impact on downstream water quality; however, temporal dynamics of these relationships are ill-defined. This is an important gap as management approaches are largely compartmentalized among land use types. Additionally, while management plans can span several decades, the impact of land use changes on water quality is often overlooked. Therefore, this dissertation evaluates land-use changes and their relationship to discharge and water quality trends at stream gages across the U.S. Second, the TMDL program is the primary regulatory lever in the U.S. for addressing non-point source pollution, but its implementation has been uneven across states. This could be due to the diverse socioeconomic, spatial, and political factors of each state. This dissertation therefore seeks to define the influence of these factors on indicators of TMDL progress. Finally, at the site level, management actions to meet regulatory permits include the use of green stormwater infrastructure to capture, treat, and infiltrate runoff at the source. One of the largest sources of impairments in the TMDL program is temperature; however, no studies have evaluated how green stormwater infrastructure in series mitigates runoff temperatures during summer storms. To address this gap, this dissertation analyzes the temperature mitigation potential of interconnected green infrastructure practices through field observations. As a whole, the outcomes of this dissertation help to advance our understanding of how watershed planning, regulatory, and engineering actions affect downstream water quality.