Name: Sameer Bhattarai

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Title: The Response of Streams to Land Use and Urban Best Management Practices in the Piedmont Region of Virginia, USA

Dissertation Advisor: Dr. R. Chris Jones
Committee members: Dr. Ryan J. Albert, Dr. Richard Diecchio, Dr. Dann Sklarew

Abstract:

Streams are vital natural resources necessary for the survival of a plethora of plants and animals, including humans. Yet, rising demand for urban land development due to rapid human population growth has led to large and increasingly adverse effects on these resources worldwide. Understanding the relationship among watershed characteristics and stream physicochemical and biological qualities is important in addressing this challenge. The objectives of this study were to 1) evaluate the influence of best management practices (BMPs) on physicochemical properties and macroinvertebrates of urban streams, 2) explore the relationships among watershed characteristics, stream physicochemistry, and macroinvertebrates, and 3) compare the response patterns of physicochemical quality and macroinvertebrates to two commonly used measures of urbanization – urban intensity index and percent impervious cover. Streams with higher watershed BMP coverage exhibited numerous indicators of good physicochemical properties and macroinvertebrate communities as compared to streams with lower watershed BMP coverage, although BMPs were not able to recover the full extent of physicochemical properties and macroinvertebrate communities found in least impacted, forested streams. Physicochemical and habitat quality as well as macroinvertebrate communities degraded with increasing levels of urbanization and decreasing forest cover in the watershed. Physicochemical variables that were most important in explaining the variation in macroinvertebrate variables were specific conductance (-) and flow velocity (+). Results indicated that impacts on macroinvertebrates occurred at about 10% impervious cover, which corresponded to urban intensity index of about 35. The relationships of macroinvertebrate variables with urban intensity index and percent impervious cover were similar, and so were the relationships of physicochemical variables with urban intensity index and percent impervious cover. This indicates that urban intensity index may be used as an alternative to impervious cover for assessing the effects of urbanization on stream ecological condition. There was a significant correlation between percent impervious covers estimated from land cover data and from planimetric data that gives detailed depiction of actual roads, rooftops, and parking lots in the watershed. This suggests that watershed imperviousness estimated using land cover data that are readily available in online databases of government and local agencies may be useful to predict stream response to urbanization for management purposes.