

# Forecasting the impacts of future development on water quantity and quality within the Reedy River Watershed



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## ARTICLE INFO

### Article history:

Received 1 August 2014

Received in revised form

20 November 2014

Accepted 21 November 2014

### Keywords:

Low impact development

Water quality

Land use changes

Watershed modeling

TMDLs

## ABSTRACT

This study was initiated to gain a better understanding of how patterns of development within Greenville, SC and its surrounding metro area would affect the Reedy River's water quantity and quality. Greenville County is located in the Upstate of South Carolina and serves as an economic hub for this region. Greenville is located on the I-85 corridor halfway between Atlanta, GA and Charlotte, NC. A previously prepared watershed-scale model was modified to yield quantity and quality data that would result from projected growth in Greenville through year 2030 at three different growth scenarios.

The major findings of the study showed water quality was degraded with higher nutrient loads and peak and average flows were consistently higher for sprawling as compared to compact development. As more land is developed in the sprawling scenario, the amount of stormwater increases while water quality decreases. At Boyd Millpond by 2030, for instance, change in peak flow and average flow percentages more than double for the sprawling scenario. Similar effects were also seen for both total phosphorus and total nitrogen levels. Results are similar by 2030 for the flow entering Lake Greenwood from the Reedy River Arm. At that location, change in peak and average flow percentages, and changes in total nitrogen and phosphorus percentages, more than double when comparing sprawling versus compact developments.

While these results are based on the effects of predicted development along the Reedy River, in Greenville, SC, the overall implications of development on water quality applies to most any community faced with similar issues. These modeling results allow land use planners such as municipal boards to gain a better understanding of what impacts land use planning and zoning can have on a community as related to effects on water quality and quantity.

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## Introduction

Changing land use affects both hydrology and nutrient loadings. It has been recognized for quite some time that developed land has higher runoff rates and higher loading rates of phosphorus and nitrogen to receiving waters, compared to undeveloped

land (Watson et al., 1979). With ever changing water quality regulations, continuing development of Greenville County and increased demand on our water resources, modeling the pattern and impacts of future development is critical for preserving our water resources of the region. Greenville County is located in the Upstate of South Carolina and serves as an economic hub for this region. Greenville is located on the I-85 corridor halfway between Atlanta, GA and Charlotte, NC. As the Upstate continues to develop and grow, water quality and quantity effects that have been observed in the Reedy River Watershed will only increase. These effects include increased nutrient and sediment loadings within the river system and the downstream arm of Lake Greenwood. Much of this development has occurred with the conversion of agricultural and forest land being converted to residential and commercial uses. Failure to address these water resource concerns will increase

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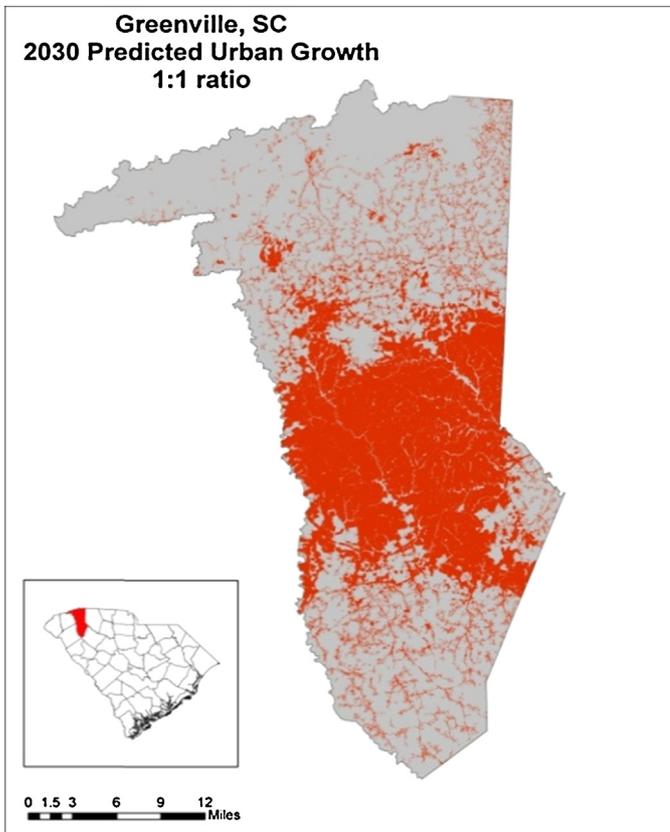


Fig. 1. Greenville County projected

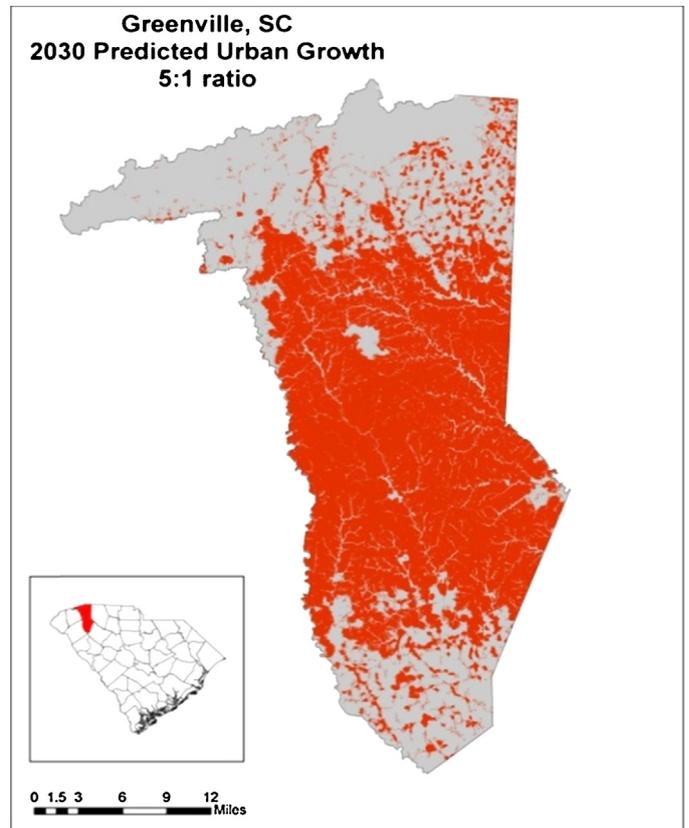


Fig. 2. Greenville County projected

ecological strain and make it harder to achieve water quality standards set forth by federal and state laws.

The amount of developed land in Greenville County grew from 52,015 acres in 1990 to 137,823 acres in 2000. It is predicted to develop to 286,441 acres by 2030, under current practices and policies. The population of Greenville County grew by 18.6% from 1990 to 2000, and is expected to grow by 37.5% by 2030 (Allen et al., 2007) as shown in Figs. 1 and 2 below.

Several segments of the Reedy River are currently in violation of the South Carolina Water Quality Standards (WQS). Particularly of interest in this report are the water bodies of Boyd Millpond and the Reedy River Arm of Lake Greenwood, the end of the Reedy. Boyd Millpond and Lake Greenwood have water quality standards of 0.06 mg/L for total phosphorus (TP) and 1.50 mg/L for total nitrogen (TN) and 8.5 for pH (Harden, 2011). As a requirement of Section 303(d) of the Clean Water Act (CWA), these waters have been placed on the 2012 303(d) List of Impaired Waters (SCDHEC, 2013). A Total Maximum Daily Load (TMDL) is currently being developed to improve the water quality to the level of the applicable nutrient standards.

The Reedy River Basin originates along the northern fringe of the Greenville Metro Area and flows southward through downtown Greenville and continues for about 40 miles through increasingly rural lands until it empties into Lake Greenwood as shown in Fig. 3. The upper watershed is moderately to heavily urbanized, and shows all the signs of an urbanized stream system: flashy hydrology, channels not connected to the flood plain, scouring and bank instability, and heavy sediment loads (UF, 2007). While the lower portion of the Reedy Watershed is largely undeveloped, research has shown (Taylor et al., 2008) that there is little attenuation of pollutant load between the Greenville Metro Area and Lake Greenwood.

### Objectives

The objective of this study was to model, compare, and analyze the water quantity and quality impacts within the Reedy River Watershed from compact and sprawling growth scenarios. The modeling results allow land use planners such as municipal boards to gain a better understanding of what impacts land use planning and zoning can have on a community as related to effects on water quality, not just where people may be working, living or commuting.

### Materials and methods

A previously-developed watershed-scale model for the Reedy River Basin in Greenville, SC was used to determine water quality and quantity impacts of various growth pattern ratios ranging from 1:1 to 5:1. Predicted patterns of future land development through the year 2030 were identified in a Strom Thurmond Institute (STI) growth study conducted and developed by Allen et al. (2007). The growth patterns utilized in the current study represented the following ratios of land development to population growth: 1:1, 3:1, and 5:1.

### Reedy River Model

The Reedy River Model was initially developed as a scientifically defensible model that South Carolina Department of Health and Environmental Control (SCDHEC) could use to prepare the nutrient TMDL for the Reedy River. The Reedy River Model is a combination of different programs, the USEPA's Loading Simulation Program in C++ (LSPC) and the Water Quality Analysis Simulation Program (WASP). LSPC and WASP are two common models used

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