

Changing Land Use and the Environment

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Everyone has seen construction and development impacts such as mud on roadways, increased turbidity in streams, or flooding of homes. How can we prevent these impacts to our proper and ecosystem and at the same time meet the needs of an increasing population? South Carolina and the Southeastern United States are projected to have substantial population growth rates during the next thirty years. We add more than 40 people per day to the population of the Upstate of South Carolina. This population increase is accompanied by more than 200 acres per day of land conversion making South Carolina 4th in the nation in the number of acres developed per capita. If you do the math, we develop 5 acres per new person added to the population. This figure is astounding and indicates the sprawl pattern of development that typifies our state in general and the Upstate in particular. Other areas of the country that have embraced this pattern of development have done so at the expense of the environment. As a consequence, these areas are characterized by water shortages during dry periods and flooding during rainy periods. In addition, these areas experience deteriorating air and water quality. Development must occur in an environmentally sustainable manner, because preservation of natural resources is key to preservation of the services that nature provides including the natural cleansing of water, soil and air. Understanding the impacts of land use change is critical to developing strategies for environmentally sound development.

Over the last five years, researchers from Clemson University have collaborated on a multi-faceted project funded by USDA's Natural Resources Conservation Service. The goal of the Changing Land Use and the Environment (CLUE) project is to characterize on-site consequences of land use change, estimate off-site impacts of land use change, and develop strategies to facilitate land use change while preserving critical natural resources.

As principal investigators, we are pleased to provide a little background about the CLUE project. Although we have both been doing research in water quality, hydrology and sediment control, and aquatic toxicology for over thirty years, our CLUE efforts focused several years ago after John visited his brother-in-law on Thanksgiving. He had just built a new house on a three-acre lot on a site that had previously been a soybean field. Nearby, numerous houses had also been constructed on lots that had been in forests and agricultural uses for years. "What are the consequences to the environment of changing land use from soybeans to houses?" Soybean production is low input; low fertilizer rates and few pesticides are typically applied. In addition, erosion rates are usually low. The post-development condition with houses, driveways, patios, and sidewalks is expected to increase runoff volume and peak discharge. Other potential issues are increased levels of nutrients and pesticides in runoff because of fertilizers and pesticides added to lawns, gardens, and landscaped areas. After development, there is also the possibility of oils from autos. All of these changes may lead to increased runoff, as well as additional pollutants that may change characteristics in downstream waters and affect insects and fish.

To achieve the goals of this comprehensive program, we assembled an interdisciplinary team to focus research in five critical areas: water quantity, water quality, ecology, best management practice development, and socio-economics. The combined effort seeks to produce a science-based process by which many impacts of land use change can be evaluated and minimized. Specifically, our research characterizes pre-and post-development storm water responses; physical, chemical, and biological contaminant issues; changing biodiversity and population structure; practices and strategies to minimize off-site impacts of land use change; and the cost effectiveness of BMPs. Part of the challenge is to explore the behavioral issues

regarding land use change decisions and address challenges of bringing stakeholders to the decision-making process in a constructive, productive fashion.

Non-point source (NPS) pollution has been widely recognized as a source of water quality impairment since the passage of the Clean Water Act in 1972. EPA defined NPS pollution in the following statement: “NPS pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. NPS pollution is caused by rainfall moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even our underground water.” The relative significance of NPS in the overall spectrum of pollutants has also been reassessed in recent years. The United States Environmental Protection Agency has reported that more waters were found to be polluted by NPS activities than by municipal point source discharges. The primary NPS pollutants are sediment, nutrients, bacteria, metals, and pesticides.

The potential for NPS pollution to occur at any given geographic location depends upon a wide range of physical and environmental variables. All areas of a given watershed do not contribute equally to NPS pollution because of the heterogeneities in land uses, watershed slope, soils and vegetation covers. Although pollutant sources often are located over a large geographic area, numerous studies have indicated that a few critical areas are responsible for a disproportionate amount of the pollutant yield from the watershed. Efficient NPS pollution control planning requires not only the means to determine total pollutant loading, but also the means to identify the critical areas within the watershed that are responsible for the largest off-site losses. Consequently, NPS pollution control resources should be targeted on these specific areas within a watershed that have high potential for soil and nutrient losses. Available funds can be used more efficiently to alleviate potential pollution problems and protect water quality

The actions taken towards decreasing the effects of NPS pollution are called runoff quality controls or Best Management Practices (BMPs). Strategies involved in controlling pollution from urban and suburban areas seek to reduce the amounts of oils, greases, household chemicals, pesticides, fertilizers and sediments from entering waterways or ground water. An example of poor development practices; leaving steeply sloped, clear-cut and graded land uncovered and allowed to erode into the lake, is shown on the included photo.

In future articles, we will discuss how these pollutants can be controlled and the consequences if they are not. We will also describe specific BMPs related to construction and development including information on how they are installed and maintained.

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