Watershed Insights Report No. 12

Land Use Change and Flooding

North Wind, Inc. (NWI), under direction of the Saluda-Reedy Watershed Consortium (SRWC), has evaluated development patterns and flood dynamics in the Saluda-Reedy Watershed (SRW). Results of land cover change, climatic and streamflow analyses suggest a relationship between land use and streamflow patterns. Forest cover loss and urbanization has led to increased peak flows and decreased baseflows. Such changes cause significant impacts to personal property and stream integrity.

Geography and Population: The SRW is located in the upper South Carolina Piedmont and contains all land that drains to Lake Greenwood. It includes portions of seven counties and covers 1,167 square miles (~ 746,857 acres). The SRW contains a wide variety of land cover types from urban to rural areas. In 2005, approximately 338,000 persons lived within the SRW. The population density in this area is about 290 persons per square mile, over two times the statewide average, and is projected to grow by greater than 33% by 2030.

Land Cover Change: Land cover change in the SRW has been evaluated through several SRWC studies. Results of land cover analyses from 1990 to 2000 and for a projected 2030 scenario indicate that the largest losses have and will continue to occur in forest land cover, with corresponding increases in residential, commercial, and developing land.

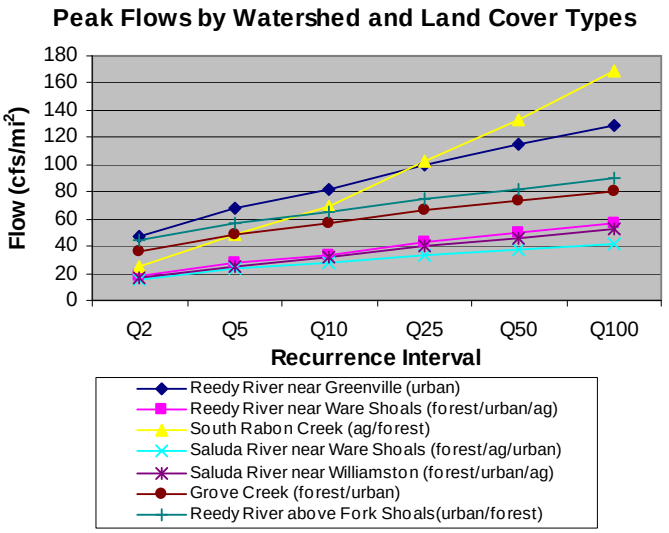
A separate report documented a decrease in forest cover from 75 to 67 percent from 1985 to 2000. The largest loss was detected in the Upper Reedy River Watershed (URRW) that contains the rapidly growing Greenville area. During this same time 34 percent of land in the URRW transitioned from undeveloped to developed land.

Impacts on Peak Flows: Loss of forest cover has affected streamflow and flooding patterns across the SRW with more noticeable impacts in more developed areas of the SRW. Figure 1 shows a comparison of flood frequency flows in seven smaller gauged watersheds within the SRW that represent different land cover types. Flood frequency analyses are used to estimate the probability of the occurrence of a given hydrologic event. Using historic annual peak flow data, the 2, 5, 10, 25, 50 and 100-year recurrence interval peak flows were determined for the seven SRW gauges. The recurrence interval (also called the return period) is based on the probability that a given event will be equaled or exceeded in any given year. For example, a 2-year frequency flood has a one in 2 chance (0.5 probability, or 50% chance) of occurring and a 100-year flood has a 1 in 100 chance (0.01 probability, or 1% chance) of occurring in any given year. Note that peak flows by watershed graphed in Figure 1 are in cubic feet per second per square mile and therefore are normalized relative to watershed size.

Excluding South Rabon Creek, the stream gauge draining the most urbanized area (Reedy River near Greenville) had the highest per area peak flows; the second highest set of flows was observed for the second most urbanized watershed (Reedy River above Fork Shoals), which includes the drainage area above the Reedy River Greenville gauge; and the third highest set of flows corresponded with the third most urbanized watershed (Grove Creek near Piedmont). For South Rabon Creek, the shape of the drainage area (long and narrow, thus causing rapid streamflow response) rather than land use is most likely the primary driver causing larger per area peak flows. The remaining watersheds all had lower per area peak flows and were predominantly forested. From this analysis it appears that differing land cover types have the largest impact on peak flow occurrence intervals. Loss of forest cover and the conversion of areas previously forested to higher intensity uses such as urban and suburban areas leads to a flashier hydrograph with higher peak flows and lower baseflows due to precipitation running off from the landscape much faster than under forested conditions.

Figure 1*

**Note*: Land cover types in order of dominance are listed in the legend beside their respective watersheds.



Additional Analysis: In a separate study, analysis of historic hydrologic data provides evidence that urbanization and loss of forest cover has altered natural stream flows within the URRW to produce higher peak flows and lower base flows. Statistical analyses showed a significant increasing trend in monthly peak flows and a corresponding decreasing trend in annual baseflows for the Reedy River from 1942 to 2005 with no significant trend in precipitation patterns over the same period of time. In the absence of a climatic trend, streamflow changes are therefore most likely attributable to land use changes in the watershed.

Synopsis: The conversion of forested and other undeveloped land to developed, urban areas has caused changes in streamflow response and increases in peak flows in the SRW. The use of low impact development techniques can help to offset adverse impacts of land cover change on flooding in the SRW.

- This project was sponsored by the Saluda-Reedy Watershed Consortium and has involved technical work by North Wind Inc.
- Watershed Insights Report No. 12, authorized for release by SRWC on 08/17/2007.

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