Long Term Hydrologic Effects on Stream Health from Residential Development Patterns

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(Abstract)

In this study eight residential development scenarios are created for the mostly undeveloped Back Creek Watershed outside Roanoke, Virginia. The development scenarios include low, medium (cluster), medium (conventional), and high density development with and without development restrictions. These scenarios represent a large range of development as the land use imperviousness varies from 1% for the baseline condition to 34% for the most developed scenario. The hydrologic model HSPF is used to generate overland and channel flows from 43 years of rainfall.

Hydrologic output from HSPF of the various landuse patterns from the eight scenarios are evaluated using Post Processor, a Visual Basic program. The results show that increased development causes a reduction in Back Creek's baseflow and an increase in the occurrence of both high and low flow extreme events. Overall, these results indicate that increased development will increase the variability of flowrate in Back Creek.

Stream health impacts from flow variability were also analyzed with the Post Processor. First, hydrologic statistical variables with ecological relationships were used to gage the level of stream health impacts from flow variability. The averaged stream health index for the development scenarios was found to closely follow the amount of development, represented by the percent of impervious landuse. Second, the amount of velocity, depth, and both depth and velocity habitat available for three habitat guild representative species was evaluated for each scenario. The results indicated that increased development would lead to a substantial reduction in available riffle species habitat (represented by the fantail darter) and a moderate reduction in run and pool species habitat (represented by the central stoneroller and smallmouth bass, respectively).

Overall, increased development has been found to have a negative impact on stream health. This impact should be considered in any future expansion of the Roanoke suburbs into this watershed.

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