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MODELED STREAMFLOW: ASSESSMENT AND IMPLICATIONS OF SCALE, HISTORICAL CLIMATE INPUTS, AND CLIMATE FORECASTS

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ABSTRACT: RTI's Watershed Flow and ALLocation Model (WaterFALL™) is a combination of two highly utilized and highly valuable hydrologic tools: the enhanced National Hydrography Dataset (NHDPlus) and the Generalized Watershed Loading Function (GWLF). Parameterized using national datasets, WaterFALL™ has been designed to enable multi-scale quantitative investigation of the sensitivity of watershed yields to a variety of factors across the continental U.S. The system incorporates a web-based user interface that allows users to quickly and efficiently examine a variety of user-defined "What if?" scenarios regarding possible changes in local climatic conditions, changes in water demand patterns, changes in land use, and/or changes in applicable regulatory frameworks such as environmental flow restrictions.

Using WaterFALL™, we examined streamflow sensitivities to climate inputs (temperature and precipitation) across several subbasins within the Upper Neuse Watershed in North Carolina. We first used historical climate data from monitoring stations (points), subbasin averages (spatially aggregated), and gridded values (spatially disaggregated) to quantify the performance of the model for monthly and annual streamflow metrics during a period before regulation of the main stem river due to damming. We repeated this analysis focusing on the reach gains between regulation points for the current period of record (last 20 years) to provide context for current reservoir operating rules. Finally, we provided potential future scenarios of streamflow for which operating rules may need to be modified by applying two different sets of forecasted climate data as input to the model. We assessed the regulatory and water resources impacts of these potential changes in streamflow for Falls Lake water supply reservoir.

To provide additional context to the WaterFALL™ system, we also compared and contrasted its results to streamflow estimates obtained using the U.S. EPA's BASINS (Better Assessment Science Integrating point & Non-point Sources) modeling tools (specifically, the Hydrologic Simulation Program - FORTRAN [HSPF] model) to validate model performance and determine any perceived trade-offs between level of effort in model setup, parameterization, spatial resolution of outputs, or performance for the current period of record and future scenarios.

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