Development of Basinwide Surface-Water Quantity Models in South Carolina

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Fifth Interagency Conference on Research in the Watersheds
Charleston, S.C.
March 5, 2015

One recommendation is for the development of regional water plans for each major river basin in the State.
Regional water plans will be developed for each of these basins, the same basins used by DHEC for water-quality assessments and for managing interbasin transfers of water.
Before planning begins, surface-water quantity models will be developed for each basin.

Models will be used to...

• Determine surface-water availability
• Predict where and when water shortages might occur
• Test alternative water-management strategies
• Help resolve water disputes
• Evaluate interbasin transfers and withdrawal permits
• Support development of drought management plans
Surface-water quantity models

• CDM Smith, Inc. was awarded a contract to develop these models using its *Simplified Water Allocation Model* (SWAM) modeling tool.

• A stakeholder process will be facilitated by Clemson University with support from DNR, DHEC, and CDM Smith.
Simplified Water Allocation Model (SWAM)

• The model tracks streamflow and reservoir storage at points of interest (nodes) in the basin on a daily or monthly time-step

• At withdrawal nodes, water is removed from the river or reservoir; at discharge nodes, water is added to the river or reservoir
All USGS streamflow records are compiled, along with historic water-use data, reservoir operations and levels, and meteorological data in the basin. All of these data will be part of the model.
UIFs (unimpaired flows) represent the natural flows in a river after removing human alterations. Withdrawals are added back into the flow record and discharges are subtracted out of the flow record. Evaporation is added back into a reservoir and precipitation is removed.

UIFs provide a baseline for evaluating impacts of human use.
Major Steps in Model Development

Step 1
Data Collection
Compile all hydrologic and water-use data for each basin

Step 2
Unimpaired Flow Development (UIF)
Remove all human alterations to flow

Step 3
Data Analysis
Gap fill and extend all USGS streamgages

All USGS gages will be gap-filled and extended. This chart shows the period of record for 34 streamgages in the Saluda River basin. The longest dates back to 1925.
**Major Steps in Model Development**

**Step 4**

**Basin Schematic**

Develop model framework

An example of a basin schematic. Symbols represent withdrawals, discharges, tributaries, gages, and reservoirs in the Saluda River basin.
Major Steps in Model Development

Step 4: Basin Schematic
- Develop model framework

Step 5: Model Calibration
- Reproduce actual conditions

Models are calibrated by comparing simulated streamflows and reservoir levels to actual flows and levels.
A model run is made using current management conditions (withdrawals, discharges, and reservoir rules) and the historic unimpaired flows as input.
Major Steps in Model Development

A model run will be made using current management conditions and the historic natural flows as input.

A. Current withdrawal and return amounts and locations
B. Current reservoir operating rules
C. Drought management plans and requirements
D. Instream flow requirements

An example of a basin schematic.

Symbols represent withdrawals, discharges, tributaries, gages, and reservoirs in the Saluda River basin.

Models will be calibrated by comparing simulated streamflows and reservoir levels to actual flows and levels.

Saluda River basin
5. All Discharge Points

Legend

- High Order Tribs.
- Secondary Tribs.
- Primary Tribs.
- Major Branches
- Saluda and Congaree
- Waterbodies_Saluda
- SCBasins

Dischargers with a Water Permit
- Saluda In and Out (See Map 6 for Labels)
- Saluda Out
- Broad to Saluda
- Savannah to Saluda

Other Framework Dischargers
- Include, but no Water Permit

Model Tributary Objects

Saluda River basin
An example of a basin schematic. Symbols represent withdrawals, discharges, tributaries, gages, and reservoirs in the Saluda River basin.
“Do we have enough water in our basins to meet both instream and offstream demands 50 years into the future?”

The model works by evaluating future demands in relation to hydrologic conditions (flows) that occurred in the Saluda basin from 1925-2013.

If demands cannot be met, the model can be used to test alternative management strategies, such as changing reservoir operating rules or introducing conservation plans.
Schedule for Developing the Models

- **Pilot Model** of the Saluda River Basin
- Other models to follow, with order based on data availability
- 2-year schedule requires that groups of models be constructed in parallel

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Step 1...

Surface water quantity models

Development of the surface water models is just the first step in the development of regional and statewide water plans.
Groundwater models will be used to predict water-level declines, recharge rates, and impacts of groundwater withdrawals on aquifers, streamflows, and on other users in the basin.
Water-demand forecasts will be made for agriculture, energy, industry, and public-supply at 5-10 year intervals over a 50-year planning period.

Step 3...

Water-demand forecasts

Water-demand forecasts will be made for agriculture, energy, industry, and public-supply at 5-10 year intervals over a 50-year planning period.
Step 4...

Regional (basinwide) water plans

Using the models and forecasts, and with oversight from State agencies, stakeholders will begin the process of developing regional water plans for each basin.

- An analysis to determine if any water deficits will occur
- Management strategies to meet the future demands
- Water conservation and drought management recommendations
Step 5...

State water plan

Upon completion of the regional water plans, the State water plan will be updated by DNR.

- Assess the overall condition of water resources in the State
- Evaluate statewide trends in water use and availability
- Offer water-resource policy and program recommendations
- Introduce innovative practices
Water Planning in South Carolina

The South Carolina Water Resources Planning and Coordination Act of 1967 assigned the overall responsibility for developing a comprehensive water resources policy for the State, including coordination of policies and activities among State departments and agencies, to the South Carolina Water Resources Commission. As part of government restructuring, this act was amended in 1993, and these responsibilities were placed with the South Carolina Department of Natural Resources (DNR).

The water resources policy plan consists of two parts. Phase I—an overall assessment of the water resources of the State—was published as Water Resources Commission Report No. 140, South Carolina State Water Assessment. The Assessment describes the State’s stream, lake, and aquifer systems and provides information relating to the occurrence and availability of water in South Carolina. Phase II outlines guidelines and procedures for managing the State’s water resources, and was first published in 1998 by the Department of Natural Resources as the South Carolina Water Plan.

Questions, comments, advice

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Paddling on the Catawba River