WATER AVAILABILITY FOR ECOLOGICAL NEEDS IN THE UPPER FLINT RIVER BASIN, GEORGIA— A USGS SCIENCE THRUST PROJECT

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Abstract. The Flint River Science Thrust project of the U.S. Geological Survey is part of a federally funded program to address key National science priorities including landslides/debris flows, fire science, integrated landscape monitoring, and water availability. The purpose of the project is to advance the science needed to specify the hydrologic conditions necessary to support flowing-water ecosystems. This information is critical for management of water supplies. Specific project goals include:

- Develop conceptual models that relate hydrology, geomorphology, and water quality to biological management objectives.
- Evaluate and determine the major factors driving the conceptual models and determine additional data needs.
- Use the upper Flint River Basin to demonstrate a spatially explicit predictive model for evaluating water-supply development options that links watershed conditions to biological management objectives.
- Identify research and monitoring needed to address critical uncertainties and data gaps determined during model development.

BACKGROUND

Sustaining the ecological integrity of aquatic ecosystems while meeting human needs for water resources is a major challenge facing society. In many regions, including the Eastern United States, the growing demand for water supply and changing land use, such as urbanization, are altering hydrologic regimes in streams and rivers that society depends on for ecological services. These services include drinking, irrigation, and industrial water supplies; assimilation and removal of waste; mitigation of droughts and floods; control of river channel erosion; recreation; fisheries; and maintenance of biological diversity. Meeting the challenge of balancing human needs for water resources with protecting aquatic ecosystems requires science-based information on what aspects of natural, or unaltered, hydrologic conditions are essential for the long-term maintenance of healthy aquatic ecosystems.

The U.S. Geological Survey (USGS) has the extensive research background and interdisciplinary capabilities that position the agency to take a lead role in developing the science needed to improve management of water supply and aquatic ecosystems, especially in urbanizing landscapes. To accomplish this goal, the USGS Director selected "Water availability for ecological needs" as a national priority science thrust program for 2006–2008.

PROJECT GOALS

More than 200 methods for deriving "environmental" flow requirements have been developed to meet the needs of water managers (Tharme, 2003). Many of these methods focus on the minimum flows needed to support survival of aquatic organisms. Because flow conditions that drive ecosystem functions are complex, current emphasis in flow management is to identify *hydrologic regimes* necessary to protect and maintain differing levels of ecological integrity (Arthington and Pusey, 2003; King and others, 2003; Postel and Richter, 2003; Annear and others, 2004). Current limitations on quantifying the linkages between flow regimes and ecosystem processes underlie much of the uncertainty in predicting ecological effects of flow-regime alteration (Castleberry and others, 1996; Irwin and Freeman, 2002; Tharme, 2003). The USGS and its partners can advance the science underlying environmental flow specifications by applying multidisciplinary expertise and data from other studies of riverine processes to *build and evaluate alternative hypotheses regarding flow-regime effects on geomorphic and ecological processes*—in this case, for a Piedmont river system. Through this process, the USGS anticipates addressing questions such as:

- What are the appropriate spatial scales for identifying geomorphic variation in hydrologic-ecologic linkages?
- What are the relative roles of changes in sediment transport, water quality, and habitat conditions in altering ecological communities?
- How does altering the flow regime (magnitude, duration, frequency of occurrence, seasonality, rate of change) influence persistence of native aquatic species and communities?
- How are direct effects of flow regulation and water diversion on physical and biological processes altered by different land uses within the watershed?

Results of this project will contribute to the global effort to improve the understanding of the effects of hydrologic alteration on the ecological integrity of flowing-water ecosystems, as well as supporting the development of a model-based framework for adaptively applying current scientific understanding to address stream-management issues.

STUDY AREA

A number of factors make the upper Flint River Basin (Fig. 1) an appropriate setting for developing science to address water and ecosystem management issues. The upper Flint River flows unimpeded by major impoundments for about 195 river miles from its Piedmont headwaters onto the Coastal Plain Province and harbors habitats and biologically diverse communities that have been lost from impounded reaches of many other Eastern rivers. The upper Flint River Basin also supplies water to a growing population in the Atlanta metropolitan area and is a major recreational resource for the region, providing canoeing, white-water rafting, and sportfishing opportunities.

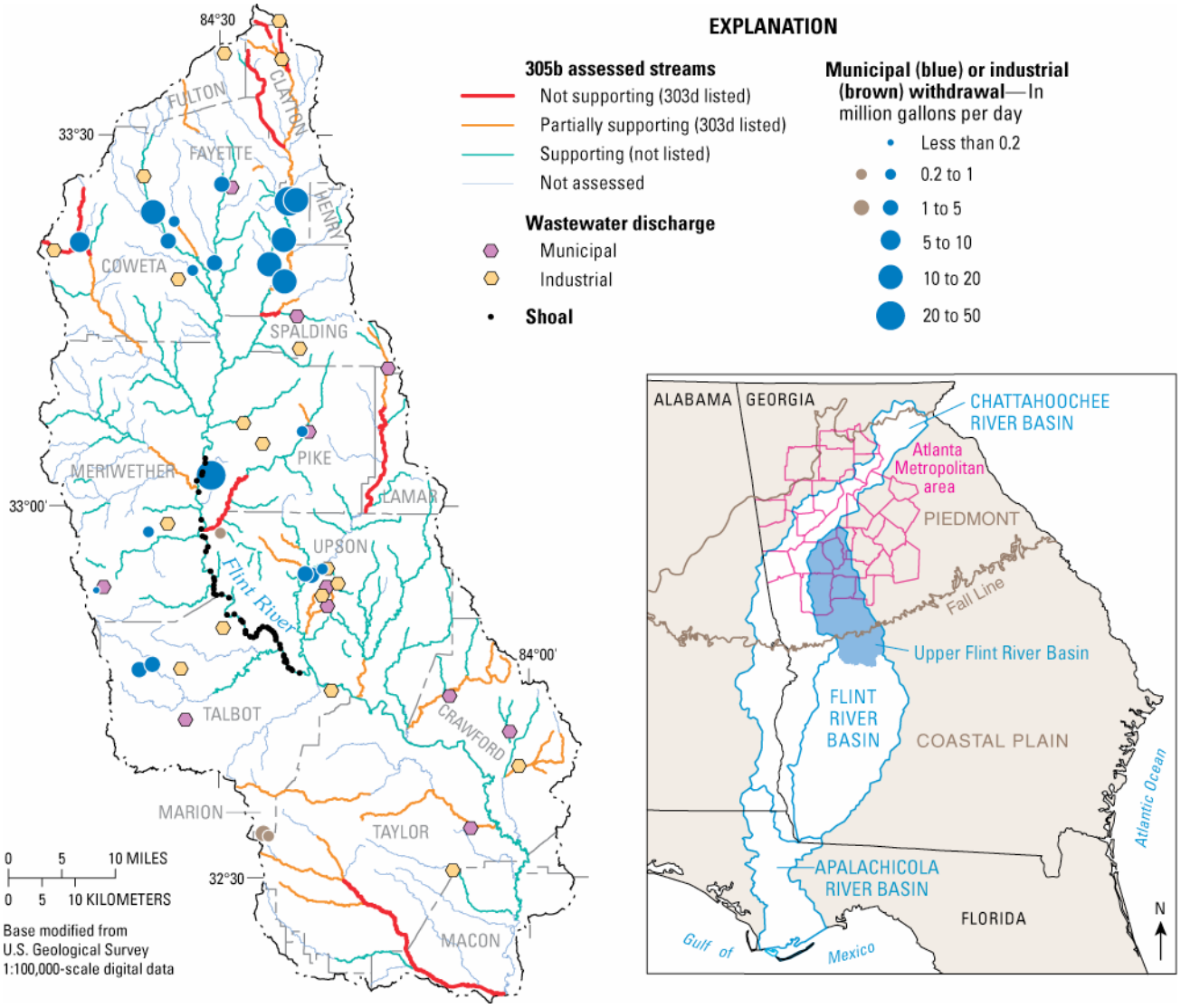

Figure 1. The upper Flint River Basin.

Long-term streamflow gaging stations have provided flow data for more than 90 years in the upper Flint River Basin. Recently completed investigations of freshwater mussel distributions and fish-habitat relations in the upper mainstem and an aquatic Gap Analysis Program (Irwin and others, 2002) provide baseline data for the system. Continued growth in the Atlanta area will increase pressure on the ecological systems of the Flint River Basin because of the potential for increased water withdrawals, reservoir construction for water storage, urban runoff, and additional wastewater loadings. Thus, this setting incorporates problems common to many regions and rivers in the Eastern United States—how to balance water-supply development with protection of diverse aquatic ecosystem—and provides an opportunity for interdisciplinary innovation in providing science-based solutions.

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