

FORESTS AND WATER PARTNERSHIP PROJECT IN THE
UPPER OCONEE WATERSHED, NORTHEAST GEORGIA, USA

by

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(Under the Direction of Todd C Rasmussen)

ABSTRACT

More than half of all drinking water in the 48 contiguous US states originates in forested watersheds. Because drinking water treatment costs increase as these forests are lost to development, innovative source-water programs are needed to protect forests to preserve the quality, quantity, and timing of water supplies they provide to downstream drinking water facilities. In 2017, the Southeastern Partnership for Forests and Water identified the Upper Oconee Watershed in Northeast Georgia as a priority watershed for forestland conservation due to rapid urban growth and the threat to local forests. This thesis summarizes efforts by the Southeastern Partnership, in collaboration with the Upper Oconee Watershed Network and Georgia Forestry Commission, toward establishing a sustainable and resilient drinking water fund by leveraging relationships, basin conditions, and funding mechanisms to secure adequate future drinking water supplies through forestland stewardship, management, and preservation.

INDEX WORDS: Drinking water, source-water protection, forests, sustainability

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CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

1.1 ALTERED LAND COVER AND THE EFFECTS OF FOREST LOSS ON AQUATIC ECOSYSTEMS AND CLEAN DRINKING WATER

Forests are an important source of drinking water, producing more than half of all drinking water in the 48 contiguous states (Brown et al., 2008), with 70-80% of this water coming from forested source-water catchments (Blinkley et al., 2004). Unfortunately, costs for treating drinking water increase when these forests are lost to urban development (Warziniak et al., 2016). According to an analysis of 37 water treatment facilities (Warziniak et al. 2016), a 1% loss of forest land cover increases turbidity by 2.6% to 5.1%, and a 1% increase in turbidity increases treatment costs by 0.08% to 0.30%. This study estimated that a 10% conversion of forestland to urban development would increase chemical treatment costs from \$2.52 to \$20.48 annually per million gallons treated. Another study of 27 water suppliers found that chemical and treatment costs decreased by 20% when forest cover increased by 10% in source watersheds (Ernst et al., 2004). This study also found that forest cover in the source watershed explains 50-55% of the variation in operating treatment costs.

Forest loss affects water quantity as well as water quality. In southwestern Wisconsin, tilled land produced a peak discharge twelve times greater than the peak discharge in a nearby forest (de la Cretaz and Barten, 2007). In watersheds near Atlanta, Georgia, flows were 25% to 35% lower in urban streams than low flows in less urbanized watersheds with higher forest cover (Rose and Peters, 2001). These results show that forest loss alters stream behavior at both ends of the hydrologic spectrum, with higher stormflows and lower baseflows.

While hydrologic changes due to forest loss depends on the characteristics of the ecoregion in which the forest is located, impervious surfaces are correlated with increased turbidity for a wide range of watersheds (Nagy et al, 2011). Adverse ecosystem effects are observed once imperviousness exceeds 10%, with severe effects once imperviousness reaches 30% (Arnold and Gibbons, 1996; Calhoun et al., 2003). Adverse ecosystem effects can include a flashier hydrograph, elevated concentration of nutrients and other contaminants, altered channel morphology, and reduced biotic richness, with increased dominance of tolerant species (Walsh et al., 2005).

Two-thirds of all overland runoff originates from forested areas. This water flows into nearby rivers and streams or infiltrates the soil to be stored as groundwater. Twenty-six thousand communities and 180 million people rely on this forest-water connection to supply adequate clean water for municipal use (USDAFS, 2000).

Foresters have been acknowledging this ecological relationship for decades. Croft and Hoover (1951) commented on research conducted within the Coweeta Experimental Watershed and stated that “water yield from forests can be materially increased or decreased as changes in forest cover alter water losses from interception and evapotranspiration” . Additionally, they acknowledged that the actions of the forester in managing soil and vegetation can alter the quantity, quality and timing of runoff.

In developed areas, this loss of ecosystem function resulting from forest removal has been referred to as urban stream syndrome. Waterways draining urban land with high levels of impervious surface receive more overland runoff faster than land with low levels of impervious surface. Increased velocity and volume of receiving waters results in impacts to both water quantity and quality (Walsh, et al; 2005). This resultant reduction in rainwater infiltration into soils can have long-term impacts to stream baseflows.

As working forests in source watersheds are converted to alternative land uses such as residential development and agriculture, organizations are joining forces to implement source water watershed protection measures through green infrastructure investment and payment

for ecosystem services funds. A statistical analysis was performed to visualize precipitation and flow relationships over 18 years for five USGS gaging stations in three adjacent watersheds within the Upper Oconee Watershed of Northeast Georgia.

This rudimentary representation of the differences in ecosystem function across USGS water monitoring gauges will be used to inform decision making regarding the development of a water fund within the basin, where 94% of municipal water is from surface sources, forest cover has decreased 20% in the past two decades, and the population is projected to increase 55% by 2050 (NEGRC, 2017).

1.2 DRINKING WATER FUNDS AS A MEANS OF ADDRESSING THE PROBLEM

Public drinking water funds are sustainably funded programs that conserve and restore lands that protect water quantity and quality. They are sometimes described as the first line of defense in an integrated approach to public health protection (Gartner et al., 2013). Such programs work to increase the resiliency of public water resources by improving water quality and quantity through source water protection. Source water protection involves the preservation of the quality, quantity and timing of surface water flow before it reaches the intake of a drinking water system (Gartner et al., 2013).

More than 93 drinking water funds are in place across the US; with thirty-five of these programs focusing on forest conservation, restoration, and sustainable management as a measure to protect local drinking water supplies (Rawlyk and Weinberg, 2017). The objective of forest-focused water funds is to sustain a supply of clean, safe water to communities by funding stewardship and preservation of forested lands that protect water quantity and quality (Krueger and Jordan, 2014).

1.3 HOW TO IMPLEMENT DRINKING WATER FUNDS

A methodology is emerging on how to successfully implement drinking water funds. The World Resources Institute, in interviews with 64 water fund professionals, derived lessons

learned from each phase of watershed investment program development (Ozment et al., 2016). These lessons, organized around the three phases of building momentum, designing the program, and implementing the action plan, have strongly guided the efforts outlined within this thesis (Table 1.1).

The need for a fund is made during the “Building Momentum” phase by identifying existing watershed risks, such as wildfire or water treatment facility upgrades. This “basin case” is shared with others to educate stakeholders in the public utilities, forestry, and conservation sectors on current basin conditions and to inform them of efforts to develop and implement a fund. Collaborative partnerships are formed and advocates are identified in this phase.

During the “Designing the Program” phase, a formal planning committee is convened to devise a strategy to achieve program goals. If lacking, the committee develops a scientifically informed watershed management plan, a business case for investment is formulated, and long-term investors and funding mechanisms are identified.

During the “Implementing the Action Plan” phase, the committee initiates conservation activities, such as conservation easement acquisition or best management practice implementation. Funding is conservatively managed to maximize project efforts. Landowners and public managers are engaged and dedicated to the sustainable management of natural infrastructure. Clear performance measures are identified and tracked. Management plans are updated on a regular basis to ensure program management is appropriate to current basin conditions.

1.4 SOUTHEASTERN DRINKING WATER FUNDS

With accelerating rates of urban growth threatening forested water-supply watersheds across the South (Wear and Greis, 2012), drinking water funds are gaining traction as a method for landscape scale watershed management. In the Upper Neuse Watershed of North Carolina, the Upper Neuse Clean Water Initiative was formed to address the threat of water treatment

facility upgrades resulting from nonpoint source pollution (Ozment et al., 2016). The City of Raleigh and six land trusts developed a collaborative partnership to target critical areas for land acquisition through conservation easements and sustainable forestry. With their mayor as champion, Raleigh contributed \$5.8 million in city funds toward conservation efforts. Additionally, a \$0.15 per thousand gallons of treated water per month fee was applied to water users. This fund generates more than \$2 million per year for fund operation and conservation efforts.

In Little Rock, Arkansas, the US Forest Service, State of Arkansas, and US Fish and Wildlife Service implemented a drinking water fund, Central Arkansas Water, motivated by land use change in their water-supply watershed. In addition to a nutrient impact fee, a \$0.45 per month per water meter fee generates over \$1 million per year towards forestland conservation on both public and private lands (Ozment et al., 2016).

In 1998, the Creek Coordination Committee was established to manage a water fund in Mecklenburg County, North Carolina (Ernst and Hart, 2005). This partnership of city and county water parks, stormwater programs, and planning departments provided \$100,000 toward land conservation. Their Surface Water Improvement and Management Plan calls for jurisdictional collaboration on water quality monitoring, stream buffers, GIS mapping and low-impact development techniques. As of 2005, 74% of the Mountain Island Lake Watershed, the City of Charlotte's drinking water source watershed, was permanently protected.

The Savannah River Clean Water Fund is a forest-stewardship fund located in the Lower Savannah Basin of Georgia and South Carolina. The fund was created through a partnership between public utilities in Savannah, Georgia, and Beaufort, South Carolina. A Conservation Prioritization Index was conducted to guide conservation implementation with the help of The Nature Conservancy. With 30% (500,000 of 1.67 million acres) of forestland already protected at fund implementation, the fund has a forest retention goal of 60% (Krueger and Jordan, 2014). Fulfillment of these forest protection measures on prioritized parcels is estimated to cost \$135 million. Half of these funds will be generated from water users, which

will cost less than a dollar per month per user when spread out over twenty years (Krueger and Jordan, 2014).

In addition to the development of water funds across the Southeast, organizations are being developed to help implement such funds. The Southeastern Partnership for Forests and Water (Southeastern Partnership) is a cooperative project funded by the US Endowment for Forestry and Communities and the USDA Forest Service to facilitate the protection and management of forest resources that positively impact drinking water sources in select watersheds of the Southeastern United States. The Southeastern Partnership has successfully facilitated the implementation of drinking water funds in Alabama, Arkansas, Florida, Georgia, North Carolina, South Carolina, and Texas.

1.5 THE GEORGIA CONTEXT

A unique feature of water fund implementation in Georgia lies in the fact that 91% of Georgia's forests are privately owned (GFC, 2018). The state has continuously acknowledged the importance of this private ownership through its many landowner assistance programs provided by the Georgia Forestry Commission. These programs provide access to a large pool of landowners who are likely interested in forestland conservation and stewardship.

In addition, nutrient limits are being developed for Georgia reservoirs, including Lakes Oconee and Sinclair in the Upper Oconee Watershed (GaDNR, 2013). Algal blooms are becoming an increasing problem as nutrients accumulate in these reservoirs (GaDNR, 2013). New effluent nutrient standards for point-source dischargers upstream of reservoirs are likely to motivate nutrient reductions from non-point sources.

Also, large tracts adjacent to waterways have recently been acquired for conservation purposes. A new national park is being considered along the Ocmulgee River to protect fifty miles of its unique biodiversity and ecosystems (Seabrook, 2019). Sixteen thousand acres of coastline along the Satilla River in southeast Georgia will soon be a wildlife management area (Rhone, 2019). In another initiative, nearly 2,000 acres have been acquired by the Georgia

Department of Natural Resources and the Open Space Institute for endangered species conservation, with 267 acres constituting the Altamaha River Forestland Protection Property in Appling County (GaDNR, 2019). These examples show that land stewardship is already happening in Georgia, making additional forest protection efforts even more attractive to existing conservation groups.

The Savannah River Clean Water Fund acquired their first conservation easement in August 2019 to support the protection of water quality and quantity in the Lower Savannah Watershed. Two conservation easements totaling 14,165 acres (the Groton Plantation and Big Snooks, both in neighboring South Carolina) are the first two properties in the Savannah River Watershed to be protected for drinking water resiliency using a water fund (Stangel, 2019). These easements highlight the protection of large tracts of land as meaningful contributions toward sustainable landscape-scale land management in the region.

The Savannah River Clean Water Fund has set a precedent for collaborative, multi-jurisdictional investments in long-term source water protection, and paves the way for the development of other water funds in Georgia. Like the Upper Oconee Watershed, the Lower Savannah Watershed has been a priority watershed of the Southeastern Partnership, which has helped facilitate fund development and hopes to use the Savannah River Watershed example as a template for future fund development.

1.6 THE LOCAL OPPORTUNITY

In 2017, the Southeastern Partnership for Forests and Water identified the Upper Oconee watershed of northeast Georgia as a priority watershed for forestland conservation due to rapid urban growth and the threat to local forests. In 2018, the Southeastern Partnership, in collaboration with the Upper Oconee Watershed Network and Georgia Forestry Commission, began building momentum for a drinking water fund in the basin. The following water fund development efforts are facilitated by the Southeastern Partnership, funded by the Georgia Forestry Commission and implemented by the Upper Oconee Watershed Network.

The Southeastern Partnership works to ensure healthy Southeastern forested watersheds that provide safe, reliable drinking water through strong partnerships, collaboration, funding and action. The Georgia Forestry Commission Water Quality Program developed the state's Forestry Best Management Practice manual and program to address forestry's impacts on water quality.

The Upper Oconee Watershed Network is an Athens-based §501(c)(3) non-profit organization whose mission is to protect the Upper Oconee watershed through monitoring, advocacy, education and recreation. The overlap of these organizations' interests facilitates the interaction of water fund development, forestry, and the water sector in the Upper Oconee basin.

The goal of this collaborative effort is to establish a sustainable drinking water fund in the Upper Oconee Watershed by leveraging relationships, basin conditions and funding mechanisms to secure adequate quantities of clean drinking water through forestland stewardship, management, and preservation. In the initial two-year period, the partnership set six objectives:

1. Review available basin information such as management documents to determine information and data gaps
2. Explore potential funding opportunities
3. Investigate long-term funding structures for a drinking water fund
4. Attend local, regional and state meetings and conferences that possible stakeholders may be attending to network and increase awareness about partnership efforts
5. Facilitate information sharing and relationship building through message development and stakeholder engagement

6. Host a watershed workshop to bring together stakeholders to discuss the forest/drinking water connection and how it can be leveraged to implement a drinking water fund in the area.

This thesis summarizes activities conducted to meet these objectives, with the goal of providing an example for future water fund development in Georgia and the Southeast. The second chapter introduces methods used to achieve the objectives, while the third chapter summarizes project successes, constraints, and provides specific recommendations for fund development. An overview of the process is provided in the final chapter.

Table 1.1: Success factors for watershed protection.

(Source: WRI, 2013)

Phase	Success Factor
Building Momentum	Drivers and opportunities for green infrastructure investment Champions and advocates Business and economic case Partnerships and collaboration Effective messages and outreach
Designing the Program	Landscape assessment and plans Agreed upon outcomes, definitions of success Sustainable funding mechanisms
Implementing the Action Plan	Partners have defined responsibilities and capacity Landowners are involved and invested
Maintaining the Program	Outcomes monitored and reported Sufficient long-term funding to achieve landscape-scale results Ability to learn from past and apply to future

CHAPTER 2

METHODOLOGY

2.1 SITE DESCRIPTION

The Upper Oconee Watershed begins in the North Georgia foothills at the headwaters of the North and Middle Oconee Rivers in Hall County. These rivers flow south before converging to form the Oconee River near Athens, Georgia. The Oconee then flows through predominantly rural land, joining with the Apalachee River before forming Lake Oconee and Lake Sinclair. The lower limit of the Upper Oconee watershed is delineated by Sinclair Dam near Milledgeville in Baldwin County (Figure 2.1).

After flowing through Sinclair Dam, the Oconee River continues flowing south before joining the Ocmulgee River to form the Altamaha River. The Altamaha, Georgia's largest river, continues southeast before reaching the Atlantic Ocean near Darien, Georgia.

2.2 BUILDING MOMENTUM FOR A DRINKING WATER FUND IN THE UPPER OCONEE WATERSHED

In January 2018, the Southeastern Partnership for Forests and Water asked for the development and implementation of a forest-focused drinking water fund in the Upper Oconee watershed. The goals of the Southeastern Partnership are to:

- Maintain or expand healthy forests in drinking water source watersheds;
- Maintain and improve water quality and quantity through healthy forest retention and stewardship;

- Initiate and develop working relationships among water utilities, the forestry sector, state and local agencies, Rural Water Associations, and conservation groups;
- Identify watersheds and initiatives that have high potential for cooperative forest conservation and long-term stewardship;
- Explore pilot projects to implement creative long-term stewardship strategies such as Payment for Watershed Services and forestry best management practices that demonstrate the interdependence of healthy forests and drinking water.
- Landowners own and manage their forests to benefit resources that we all depend on: air, water; timber; nanocellulose from trees for computer screens (comfort, survival, progress all depend on forests) (Weisman, 2017).

To implement the Southeastern Partnerships efforts in the Upper Oconee Watershed, actions were carried out in five areas between January 1, 2018, and December 31, 2019:

- Information sharing and relationship building
- Collaborative partnerships and projects
- Public outreach and communication
- Background research
- Exploring and increasing funding opportunities.

2.3 COLLABORATIVE PARTNERSHIPS AND PROJECTS

Collaborative partnerships and projects were used to further efforts in water fund development. The Southeastern Partnership has previously worked with existing organizations to launch water fund development efforts. This aligns with their efforts to establish collaborative community relationships. This tactic has proven successful with previous water fund

development efforts in Georgia. A key stratagem, therefore, was to develop relationships between the Southeastern Partnership with local organizations.

The first relationship to be established was with the Upper Oconee Watershed Network, a §501(c)(3) non-profit organization based in Athens, Georgia. UOWN was founded in 1998 by local citizens concerned with rapid urban growth in the area and subsequent declines in watershed health. UOWN has a 20-year database of water quality monitoring data and a membership of over 100 individuals and families. UOWN has also engaged with graduate students from the University of Georgia to develop an outreach campaign called “Where’s My Creek?”. This program allows residents to identify where they live on an interactive GIS map which tells them which HUC12 watershed they live in. They are then given watershed-specific information and a magnet to help remember their home watershed. These activities provide synergistic opportunities for public engagement and scientific understanding of local water-quality issues.

A collaborative partnership was also established with the Oconee River Land Trust (ORLT, another Athens-based §501(c)(3) organization) to develop an Ecological Forestry Resources Guide that is used to provide information about resources available to private woodland owners. The Guide is divided into four sections: ad valorem property tax abatement, cost-share programs and technical assistance, ecological forestry practices, and encouraging ecological forestry. Each entry includes the targeted audience, resource type, description of the document or website, and the link to access the resource. Resources were gathered from ORLT archives and internet searches.

A third collaborative partnership was initiated with the newly formed Greater Apalachee River Community (GARC, a §501(c)(3) organization formed around the Apalachee River, which is tributary to the Oconee River within the Upper Oconee Watershed). Information was provided about starting and maintaining an environmental advocacy organization, which enables the Southeastern Partnership to establish credibility within the watershed.

A fourth collaborative partnership was solicited with the Upper Oconee Water Authority, a four-county authority that provides raw water for the Athens-Clarke County drinking water facilities, as well as polished water to Oconee, Barrow, and Jackson Counties (Figure 2.2). Water is withdrawn from the Middle Oconee River upstream of Athens and used to fill Bear Creek Reservoir, which is then used as the raw water supply for Athens as well as for the drinking-water treatment plant located adjacent to the reservoir.

2.4 BACKGROUND RESEARCH

Establishing a funding mechanism for forest protection requires the development and demonstration of the benefits and costs associated with implementing watershed initiatives. This section is a first effort for conducting background research on basin conditions in the Upper Oconee Region and watershed. The focus is on regional and local source watershed management along with the linkages between forest hydrology and drinking water protection.

Making the case for fund development requires an understanding of the current situation, including the locations of drinking water sources along with where, what, who, and when water impairments affect these systems. Drinking water intakes within the Upper Oconee Basin Water Authority region were mapped, and landscape features that may affect these withdrawals were inventoried, including National Pollutant Discharge Elimination Systems, Land Application Systems, and MS4 Stormwater permits from the Georgia Environmental Protection Division's Watershed Protection Branch.

Another important requirement is determining how forest protection can improve future drinking water sources. To meet this goal, an ANCOVA analysis of a precipitation/flow model for five US Geological Survey stream gauges in the Upper Oconee watershed were examined. Precipitation (inches) and discharge (cubic feet per second, cfs) data were collected from the USGS WaterWatch website. These data originate from gauges on the North Oconee River near Commerce, North Oconee River in Athens, Middle Oconee River in Arcade, Middle Oconee River in Athens and the Oconee River near Penfield (Table 2.1). The data

was uploaded into EXCEL in a comma delineated format and separated into the proper formatting using the “Text to Columns” function. A new dataset from May 5, 2001, to November 15, 2018, was compiled to extract the time period with the greatest number of data points across all five watersheds.

Precipitation data for the Middle Oconee River was only available from March 3, 2001, to September 9, 2003. Data from the NOAA Climate Data Online Search function was used in place of USGS data for the remainder of the study period. This data was used due to the gauges proximity to the USGS gauge in the Middle Oconee watershed.

Due to variations in gauge reliability, the omit function was used in R to remove dates with missing flow or precipitation data before model selection was conducted. The data was log-transformed to reduce clustering around the graphical intercept and increase dispersion of the data. Transforming the data also substantially lowered the AIC.

Five linear models with varying combinations of factors were analyzed for goodness of fit. AIC and weight were deterministic in selecting the appropriate model for ANCOVA. A null model was included in the analysis to ensure that predictor variables increased the accuracy of the predicted flows. An Analysis of Covariance (ANCOVA) was performed using the linear model defined above. ANCOVA was chosen for its ability to explain response variable variance by covariates, categorical variables and residual variance. By centering the response variable, the intercept can be interpreted as the grand mean.

Predictions were made across all five gauges for the North Oconee River in 2003. Each gauge had a large amount of data for this specific year to compare predictions with real flows. A Tukey’s multiple comparison test was performed to determine if the covariance was statistically significant between gauges.

Table 2.1: Stream discharge gauging stations in the Upper Oconee Watershed used in this investigation.

(Watershed: NOR = North Oconee River, MOR = Middle Oconee River, OR = Oconee River)

Watershed - Location	USGS ID	Elevation (ft)	Latitude (°N)	Longitude (°W)	Area (mi ²)
NOR - Commerce	02217620	680.0	34.1692	83.4969	95
NOR - Athens	02217770	600.0	33.9697	83.3776	275
MOR - Arcade	02217475	656.4	34.0317	83.5633	332
MOR - Athens	02217500	555.5	33.9467	83.4228	398
OR - Penfield	02218300	433.0	33.7211	83.2956	940

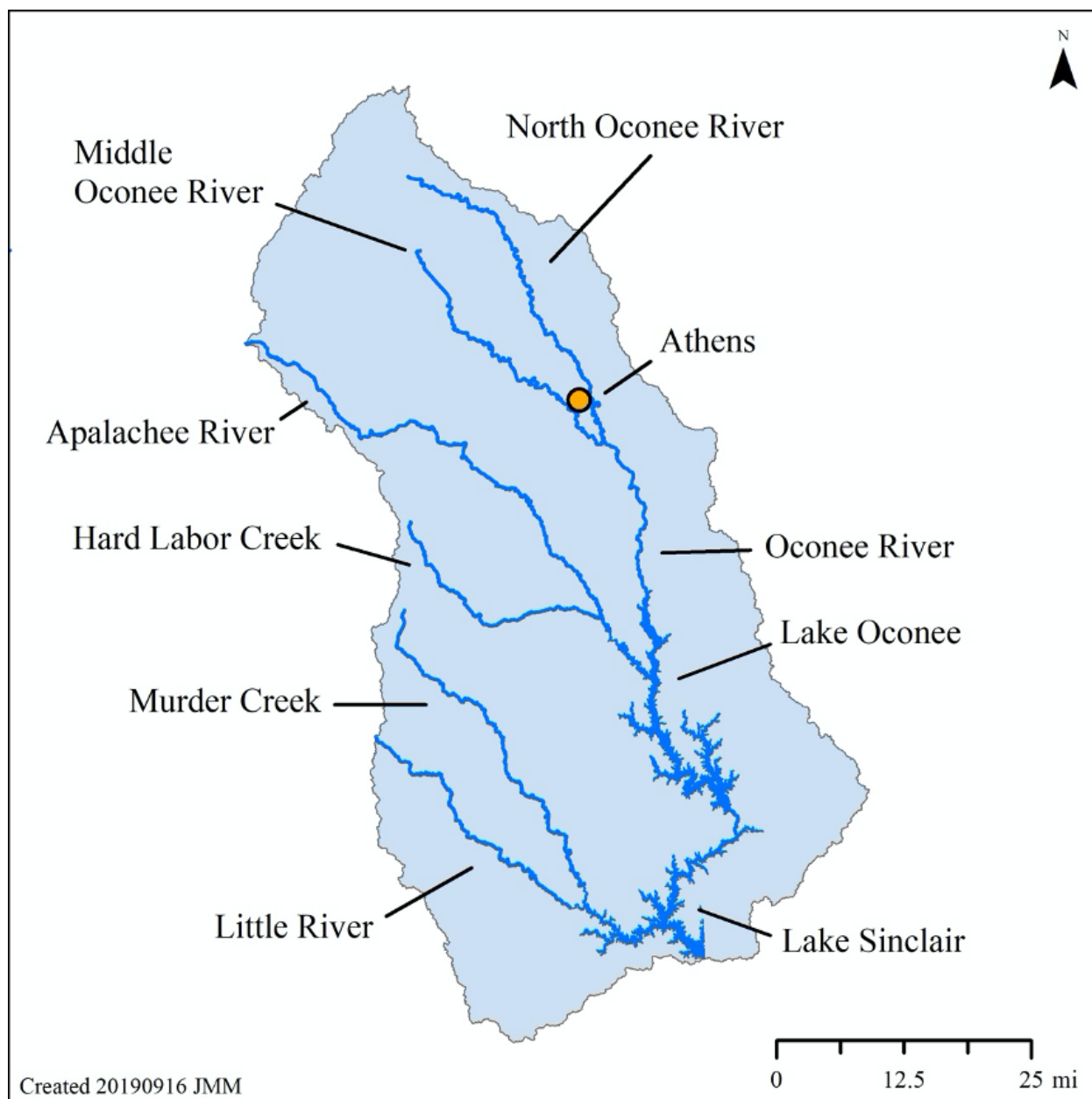


Figure 2.1: Upper Oconee Watershed, Northeast Georgia, USA.

(Source: McDonald, 2019)

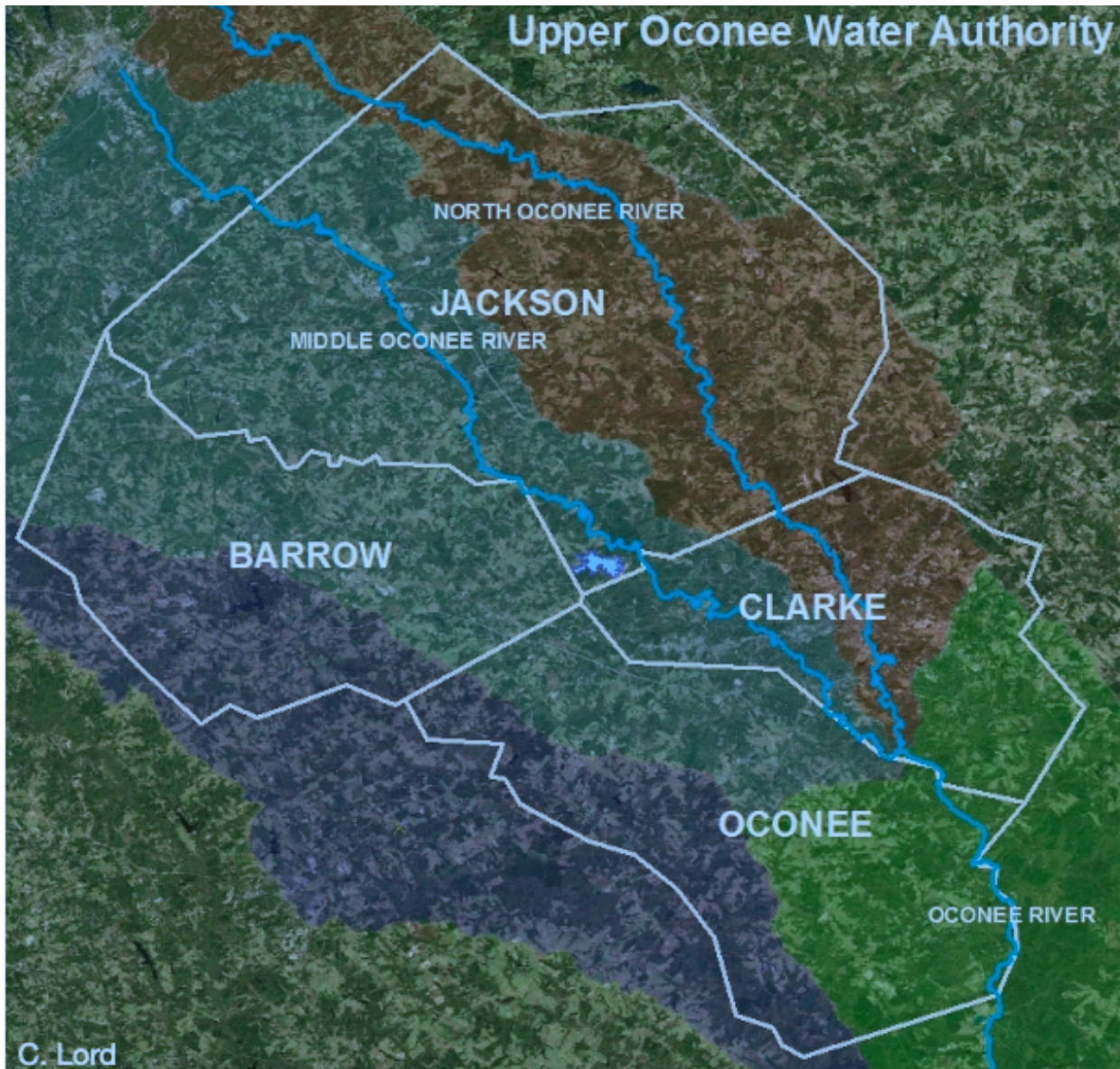


Figure 2.2: Service area for the four-county Upper Oconee Water Authority.

(Source water is diverted from the Middle Oconee River near the Jackson-Clarke county line, stored in Bear Creek Reservoir (pale blue), and then distributed to member counties.)

CHAPTER 3

RESULTS AND DISCUSSION

This chapters summarizes and discusses results related to project goals, which are to:

1. Review available basin information such as management documents to determine information and data gaps
2. Explore potential funding opportunities
3. Investigate long-term funding structures for a drinking water fund
4. Attend local, regional and state meetings and conferences that possible stakeholders may be attending to network and increase awareness about partnership efforts
5. Facilitate information sharing and relationship building through message development and stakeholder engagement
6. Host a watershed workshop to bring together stakeholders to discuss the forest/drinking water connection and how it can be leveraged to implement a drinking water fund in the area.

3.1 REVIEW BASIN INFORMATION

This study focuses on forests and drinking water systems within the Upper Oconee Watershed, which is embedded within the larger Altamaha Watershed. During our review of basin information collected and reviewed as part of this research (Table 3.1), we found that the Southern Forests Future Project (Wear and Greis, 2012) had identified the Altamaha watershed as one of three Southeastern watersheds that is expected to experience a doubling of

urban land cover between 1997 and 2060 (Figure 3.1). As noted in their study, this change is expected to occur throughout the Altamaha drainage basin, including the Upper Oconee.

The Georgia Environmental Protection Division established the Upper Oconee Regional Water Planning District, which generally conforms to the boundaries of the Upper Oconee Watershed (Figure 3.2). In this Region, 44% of water usage (including both consumptive and non-consumptive uses) is municipal, 18% is agricultural, and the remaining 38% is for industrial purposes. Municipal water usage is assumed to be 40% consumptive while agricultural is assumed to be 100% consumptive (Upper Oconee Regional Water Planning Council, 2017), for a total of 35.6% consumptive use in the basin. The Water Education Foundation defines consumptive water use as “diversions of water withdrawn upstream and not returned downstream as wastewater (Water Education Foundation, 2020).”

Many waterways in the Region are on the Clean Water Act’s §303(d) List of Impaired Waters (Figure 3.3). Both the Middle Oconee and North Oconee Rivers experience impaired macroinvertebrate communities and elevated fecal coliform levels. The North Oconee River is listed as a fishing and drinking water waterway while the Middle Oconee River is listed as fishing (EPA, 2019). Regulatory standards are determined by a waterway’s designated use with the drinking water designation being the most stringent.

In Athens-Clarke County, at the confluence of the North and Middle Oconee Rivers, nineteen out of twenty waterways listed on the 2017 List of Impaired Waters were listed due to fecal coliform contamination (Table 3.2) (ACCPUD, 2017). Due to rapid urban development in the area, changes to stream hydrology, such as elevated hydrograph flashiness, increased contaminant and nutrient loading, altered channel morphology, and changes to species richness and diversity, are pervasive throughout county watersheds (Athens-Clarke County Transportation and Public Works Department, 2018).

ACC is a member of a four-county water authority that delivers water to rural areas of the counties and the City of Athens. In the next thirty years, Athens-Clarke, Oconee, Jackson and Barrow counties are expected to grow 25%, 77%, 80%, and 148%, respectively. Across

the Region, populations are expected to increase, on average, 52% by 2050 (Upper Oconee Regional Water Planning Council, 2017). Urban encroachment puts local forests at risk of removal for development and increases the likelihood of localized water quality degradation from impervious surface runoff (Walsh et al, 2005).

Across the Region, 94% of drinking water comes from surface water sources (Upper Oconee Regional Water Planning Council, 2017). In Athens-Clarke County (ACC), that number rises to 98% (Figure 3.4; Peck-Hall, 2019). Similar to Milledgeville, which lies at the bottom of the drainage, the Athens area is a large urban center supplying drinking water to residents from surface water sources. These are critical areas in the watershed to implement upstream conservation activities for source water protection.

Table 3.2 summarizes information collected and reviewed related to the forestry-drinking water connection. Two main points were identified from these resources; a) loss of forestland cover alters streamflow, and b) the reduction of forestland cover increases drinking water treatment costs. These two points are related in that the alteration of streamflows increase rates of erosion, which increases treatment costs.

3.2 EXPLORE FUNDING OPERATIONS

Table 3.3 summarizes funding opportunities identified as part of this research. The principal finding is that the overall funding scheme for a drinking water fund needs to be a diverse collection of mechanisms to be sustainable and resilient. Short-term funding provides resources to fund the Oconee Coordinator position. A long-term, sustainable funding mechanism should be adopted by partner utilities to fund conservation easement acquisition and best management practice implementation. While these funding mechanisms mature, general fund contributions and grant opportunities for on-the-ground conservation work can be used to build capacity by funding the implementation of pilot projects.

While the initial project funding for developing a Forest Drinking Water Fund within the Upper Oconee Watershed was provided by a 2018 USDA Forest Service Landscape Scale

Restoration Grant, sustaining this initiative requires an understanding and assessment of future funding sources.

The first extension beyond the original grant focuses on obtaining funding from the Georgia Environmental Protection Division's Regional Water Planning Seed Grant Program in partnership with the Athens-Clarke County Sustainability Office. Because this grant requires matching contributions from local governmental departments, prior efforts to build partnerships have successfully resulted in commitments from Oconee County Water Resources, Athens-Clarke County Stormwater Management Program, and the Athens-Clarke County Sustainability Office.

Another opportunity for continued funding is an Environmental Water Grant provided by the Georgia Power Foundation, a branch of the Southern Company. The Oconee River Land Trust would be the primary partner and administer the grant, if awarded. Additional partners include the Athens Land Trust and Georgia River Network.

3.3 LONG-TERM FUNDING

A drinking water usage fee, or a fee per thousand gallons delivered, may be an equitable option for long-term funding. As mentioned in the Methods chapter, the Upper Neuse Clean Water Initiative has successfully generated funds using a usage fee to implement their conservation vision (Ozment et al., 2016). The Beaver Water District in Arkansas also utilizes a usage fee to fund the Beaver Watershed Alliance, donating \$0.04 per 1000 gallons to their Source Water Protection Fund (Beaver Water District, 2020).

A nominal fee built into a customer's water bill reduces the burden of having to pay larger annual or bi-annual fees. This makes both a meter fee and a usage fee preferable to a watershed fee that basin users pay less frequently than on a monthly basis. But I believe that a usage fee is preferable to a meter fee where water users pay a flat rate for their meter each month. With a usage fee, users only pay for the water they use instead of all users paying the same price regardless of usage.

Additionally, a usage fee ensures that the funds generated increase proportionally with the population. If the basin population increases by 10%, the usage fee generates 10% more. This is an important consideration as the Upper Oconee Regional Water Plan indicates that water demand increases will be driven by municipal use (see Figure 9) (GAEPD, 2017). As the population in the basin increases, there will be more people in the watershed requiring clean, adequate drinking water, increasing demand.

Using the ACC Stormwater fee as an example (ACCUG, 2004), it is important that a funding mechanism be implemented as a fee and not a tax. As a fee, all water customers have to pay, regardless of organizational status. In turn, tax-exempt organizations such as non-profits, schools and churches are exempt from paying into the program. In a town such as Athens, where the University of Georgia owns a substantial amount of property, a fee can be much more impactful in terms of generating funding.

The Natural Resources Conservation Service Regional Conservation Partnership Program (RCPP) is a 5-year grant program that offers up to \$10 million to implement natural resource conservation activities. This funding source can be used to acquire conservation easements after implementation of funding mechanisms but before substantial funding has been raised. Together, these funding mechanisms create a diverse collection of sources for fund resiliency over time.

Conservation actions should be in the form of conservation easement acquisition and forestry best management practice implementation. Land trusts in the area are already working on large scale conservation and exist to hold easements in perpetuity. Part of their conservation model is development of land management plans and annual inspections of the property which lends itself to proper management of conservation lands. Land conservation organizations are key stakeholders and working with them on easement acquisition is a strong partnership building opportunity.

Additionally, easement acquisition encourages collaboration with landowners which further strengthens the partnership. One of my objectives for this work was to encourage private

landowners to retain ownership of their property. Fee simple acquisition not only discourages long-term participation of these individuals with the partnership, it incentivizes selling the types of forestland properties this project aims to preserve.

Easement acquisition also maximizes the use of conservation funding. Fee simple acquisition costs much more than acquiring a conservation easement. It also requires an entity to retain ownership of the property and maintain it accordingly. Conservation easement acquisition strengthens the partnership, encourages participation of landowners, encourages retention of forestland by those landowners and ensures proper management of lands in conservation.

Forestry best management practices should be employed to ensure that participating forests are as healthy and well-managed as possible. Restoration projects may be beneficial for highly degraded tracts; although restoration is expensive, cost-share programs are available to support some restoration activities. UOWN can work with individual landowners and land trusts to identify the best project and funding source to be implemented on participating conservation properties.

A cost-benefit analysis has been recommended by the Georgia Forestry Commission to be used by public utilities to justify adoption of conservation finance mechanisms for source water watershed protections. A triple bottom line cost-benefit analysis was conducted for the Beaver Water District in Arkansas to determine the impacts of implementation of their Protection Strategy on the partnership, the environment and aspects of society (including other government agencies, local residents and farmers) (Sham et al., 2016). A similar analysis conducted in the Upper Oconee watershed would be a valuable decision-making tool to assist in making the economic case for long-term sustainable funding of conservation.

In addition, continued staffing is required to successfully implement a drinking water fund in the Upper Oconee watershed. The LSR funding is specifically allocated for staff time and any additional short-term funding acquired will be used for the same purpose. It is critical

to fund development to have a staff person in place to conduct outreach and research and further the implementation and development of the fund (Zyla, 2018).

It is important for long-term projects to quantify impacts and measure progress towards goals. This is especially true for landscape-scale management where impacts can be spread out both spatially and temporally.

- Funding generated
 - Grant funding
 - Funding through adopted conservation finance mechanisms
- Acres in conservation
- BMP projects implemented
- Landowners contacted
- Number of partner contributions.

These performance measures should be tracked over time, with an annual report summarizing each year's accomplishment with a comparison to previous years' performance. A set of future annual targets should be established once a baseline has been established.

3.4 ATTEND MEETINGS AND CONFERENCES

Tables 3.4-3.8 summarize participation activities related to this research project. The intent of these interactions is related to the goals of raising public awareness of these efforts, highlighting the importance of the forest/drinking water connection, and facilitating the share of basin information. Efforts were taken to communicate with stakeholders from the forestry, drinking water and conservation sectors.

3.5 INFORMATION SHARING

Stakeholder meetings and conferences were used to share Southeastern Partnership messaging and make connections with potential stakeholders (Tables 3.4-3.8). These events provided the opportunity to establish personal relationships with organizations as the Altamaha Riverkeeper, Georgia Wildlife Federation, and Georgia River Network, among others (Table 3.7). Memberships in the Georgia Aquatic Connectivity Team, Keep Athens-Clarke County Beautiful, and the Aquatic Microplastics Working Group were used to broaden outreach and communication with local and regional stakeholders.

Stakeholder access required the development and maintenance of a stakeholder contact database containing the organization name, organization contact, contact information and notes. This information was acquired through meetings, conferences, workshops, and research. Quarterly updates were made to the document to ensure its accuracy. There are 261 contacts in the database as of December 2019.

Alongside the contact list, messaging specific to the Upper Oconee Watershed was presented orally and using posters at multiple events (Tables 3.4-3.5). Informational White Sheets, a short video, informational packets and meeting handouts were presented at these events. Table 3.9 summarizes comments provided on behalf of UOWN, in person whenever possible.

3.6 WATERSHED WORKSHOP

The culminating activity for information sharing and relationship building was organizing and hosting the Upper Oconee Watershed Forests and Drinking Water Forum in September 2019. Over 42 stakeholders convened in Athens, Georgia to discuss the forest/drinking water connection and how social, hydrological and political conditions can be leveraged for development of a drinking water fund.

Forum objectives included:

- Share science-based data to highlight ecosystem connections within the watershed
- Define and rank potential hurdles in maintaining and expanding forests
- Inform decision making with case studies and identify alternative courses of action
- Identify sources of funding and share experiences in fundraising and applying for grants

Appendix A summarizes the Forests and Drinking Water Forum held on September 10, 2019, in Athens GA. The report shares information about the development and history of the drinking water partnership. It outlines key points from panel discussions and concludes with a synopsis of the facilitated discussions. Appendix A also identifies goals and next-steps identified during the event, which was then shared with attendees and other stakeholders.

3.7 HYDROLOGIC ASSESSMENT

Another research need is to establish a baseline hydrologic assessment for evaluating the benefits of source-water implementation plans. Comparing future hydrologic conditions against the baseline assessment should provide quantitative metrics for program performance.

Figure 3.8 presents a statistical summary (“Boxplot”) for the five USGS gauging stations in the Upper Oconee Watershed. Note that the summary is for the water yield, which is the average daily discharge (cfs) divided by the watershed area (mi²) to account for the natural increase of discharge with increasing watershed area. While most statistical coefficients (means, upper and lower quartiles, upper extreme values) for all five watersheds are similar, the lower 95th-percentile is lower for the two Athens sites, likely due to municipal water withdrawals immediately upstream.

A Tukey’s multiple comparison test also showed significance between gauges with all p-values well below the absolute value of the test statistic, as seen in the summary table. This means that each gauge has its own unique precipitation flow relationship. This would be expected due to complex ecosystem functions between drainages.

Table 3.10 summarizes hydrologic prediction model fits to these data. Note that Model 4 has the highest AIC value and weight, and included precipitation, site location, and year. While Models 4 and 6 have similar AIC values, Model 4 has the greater weight. Table 3.11 presents the ANCOVA summary from Model 4, given by the R-command:

```
fm4 <- lm(log(Flow) ~ Rain+Site+Year, data).
```

Figure 3.9 presents the effects of the yearly variable in Model 4. Note that some years have higher constant than others, and are consistent with mean annual precipitation for the watershed. Clearly visible are the drought years in 2002, 2007-2008, and 2011-2012, and years of above-average rainfall in 2003, 2005, and 2013.

The site coefficients are all significant, which allows us to reject our null hypothesis that the site estimates equal zero. Figure 3.10 presents observed discharges model forecasts as a function of precipitation for each of the sites.

Note that four of the model predictions in the figure are similar (except for NOR-Commerce), as well as the general lack of similarity between the observations and predictions. The first observation can be readily explained by the lag between precipitation and stormwater responses. At the watershed scale, rain that falls farther from gauge takes longer to reach the gauge. The travel time from the most distant point to the gauge is called the time of concentration. The time of concentration is much less in smaller watersheds (minutes to hours) than larger watersheds (days to months).

The drainage area above the Commerce gauge is only 99 mi², while the Penfield drainage is an order-of-magnitude greater, at 940 mi². Thus, the smallest watershed (NOR-Commerce) has a larger response to rainfall than the larger watersheds. Also note that the largest watershed (OR-Penfield) has the smallest response, while the three mid-sized watershed lie between these two extremes.

The lack of fit can also be attributed to the time of concentration, in that rainfall that falls on one day may not cause an increase in discharge on the same day. Often, peak flows reach a downstream gauge on sunny days with zero precipitation after the storm has passed,

well after the day of peak precipitation. This is further justification for altering precipitation data to capture flow lag.

Lagging the rainfall to account for the time of concentration could be tested for the different watersheds to see if this improves the accuracy of predictions. Finding lag times for each watershed that improve the models will also provide a relative estimate of the actual lag time one could expect at each respective drainage. Additionally, including the number of consecutive days of rain in the dataset could further show how the water piles up in the waterways as it moves downstream.

Also, forestland cover percentages for each gauge's drainage should be included in future analyses to determine if and how this factor influences flows. This is because forestland cover is critical for protecting source water watersheds, as well as our efforts to develop the water fund in the Upper Oconee Watershed.

Before concluding, there is an item of complexity within the dataset that should be addressed. Because all of the gauges are within the same basin, flows from one gauge are incorporated into all downstream gauges; the NOR-Commerce gauge is upstream of the NOR-Athens gauge, the MOR-Arcade gauge is upstream of the of the MOR-Athens gauge, and the OR-Penfield gauge is downstream of all four of the other gauges. There are 18 years of data from each gauge, producing replication.

Regardless of this concern, we believe that our results provide insight into how changes in ecosystem function impact a watershed, and that one must understand how watershed changes and flows are altered with movement downstream. The only way to do that is to incorporate upstream flows into downstream data.

Although the model is imperfect, it still has the ability to produce valuable information for establishing a baseline for a drinking water fund to protect drinking water quality and quantity through conservation of working forests in the Upper Oconee Watershed of Northeast Georgia. As the model is developed further, its accuracy in predicting flows and influencing decision making should only increase.

Eventually, we hope to develop the model as an easy to use, baseline indicator of ecosystem function pertaining to the land use-hydrology connection in watersheds outside of the Upper Oconee Basin. Paired with the adoption of fund related ordinances by the Association of County Commissioners of Georgia, our efforts will further develop the foundation for fund expansion.

Table 3.1: Watershed Management Review

(ACC = Athens-Clarke County; GAEPD-WPB = Georgia Environmental Protection Division, Watershed Protection Branch)

Title	Publishing Organization	Year
2016-2017 Report: ACC Watershed Protection Plan	ACC Public Utilities Department	2017
Hunnicut Creek Watershed Management Plan	ACC Stormwater Management Program	2010
Brooklyn Creek Watershed Management Plan	ACC Stormwater Management Program	2010
West Fork of Trail Creek Watershed Management Plan	ACC Stormwater Management Program	2010
Cedar Creek Watershed Management Plan	ACC Stormwater Management Program	2011
Shoal Creek Watershed Management Plan	ACC Stormwater Management Program	2014
Bear Creek Watershed Management Plan	ACC Stormwater Management Program	2018
East Fork of Trail Creek Watershed Management Plan	ACC Stormwater Management Program	2018
Malcolm Branch Watershed Management Plan	ACC Stormwater Management Program	2018
Middle Oconee River Watershed Management Plan	ACC Stormwater Management Program	2018
North Oconee River Watershed Management Plan	ACC Stormwater Management Program	2018
Sandy Creek Watershed Management Plan	ACC Stormwater Management Program	2018
Turkey Creek Watershed Management Plan	ACC Stormwater Management Program	2018
Walton Creek	ACC Stormwater Management Program	2018
McNutt Creek Watershed Management Plan	ACC Stormwater Management Program	-
Georgia 2019 Integrated 305(b)/303(d) List – Streams	US Environmental Protection Agency	2019
Georgia's Plan for the Adoption of Water Quality Standards for Nutrients	GAEPD-WPB	2013
Protecting the Future of Drinking Water Supply	Savannah River Clean Water Fund	2014
Upper Oconee Regional Water Plan	Upper Oconee Regional Water Planning Council	2017
Water Quality in ACC	ACC Public Utilities Department	2015
Oconee River Basin Plan	Upper Oconee Regional Water Planning Council	1998
Northeast Georgia Source Water Assessment Plan	ACC	2002
ACC Comprehensive Plan	ACC	2018
Land Conservation Program Acquisition Policy and Procedures	ACC	2015
Service Delivery Plan	ACC Public Utilities Department	2015
Jackson County Comprehensive Plan	Jackson County	2009
Service Delivery Strategy	Barrow County	1999
Service Delivery Strategy	Oconee County	1998
Source Water Assessment Implementation Plan	Georgia Environmental Protection Division	2000
Georgia's Statewide Nonpoint Source Management Plan	Georgia Environmental Protection Division	2019

Table 3.2: Georgia Environmental Protection Division list of impaired waters in Athens-Clarke County.

(Source: ACC PUD, 2017)

Waterway	Pollutant	Miles	Cause
Brooklyn Creek	Fecal Coliform	2	Urban Runoff
Carr Creek	Fecal Coliform	2	Industrial Facility, Urban Runoff
	Fish Biota	2	Industrial Facility, Urban Runoff
Cedar Creek	Fecal Coliform	4	Urban Runoff
Cloverhurst Branch	Fecal Coliform	2	Urban Runoff
East Fork Trail Creek	Fecal Coliform	3	Urban Runoff
Hunnicut Creek (Mitchell Brg)	Fecal Coliform	1	Urban Runoff
Kingswood Branch	Fecal Coliform	1	Urban Runoff
	pH	1	Urban Runoff
McNutt Creek	Fecal Coliform	12	Nonpoint Sources, Urban Runoff
Middle Oconee River	Fecal Coliform	11	Nonpoint Sources
	Macroinvertebrate Biota	11	Nonpoint Sources
Middle Oconee River	Fecal Coliform	12	Nonpoint Sources
Middle Oconee River	Fecal Coliform	4	Urban Runoff
Noketchee Creek	Fish Biota	5	Nonpoint Sources, Urban Runoff
North Bypass Branch	Fecal Coliform	2	Urban Runoff
North Oconee River	Fecal Coliform	2	Nonpoint Sources
North Oconee River	Fecal Coliform	8	Municipal Facility, Urban Runoff
Oconee River	Fecal Coliform	4	Urban Runoff
Tanyard Creek	Fecal Coliform	1	Urban Runoff
Trail Creek	Fecal Coliform	2	Urban Runoff
Tributary to Middle Oconee River	Fecal Coliform	1	Nonpoint Sources, Urban Runoff
West Fork Trail Creek	Fecal Coliform	3	Urban Runoff

Table 3.3: Forestry and the Forest/Hydrology Connection Review

Title & Publishing Organization	Year
2018 Annual Report	2019
Georgia Forestry Commission	
Southern Forests Futures Project	2012
USDA Forest Service	
The Urban Stream Syndrome: Current Knowledge and the Search for a Cure	2005
Journal of the North American Benthological Society	
Effect of Forest Cover on Drinking Water Treatment Costs	2016
American Water Works Association	
Water Resources and Land Use Cover in a Humid Region: The Southeastern US	2011
Journal of Environmental Quality	
Georgia's Best Management Practices for Forestry	2009
Georgia Forestry Commission, Water Quality Program	
Costs of Forestry Best Management Practices in the South: A Review	2004
Water, Air, and Soil Pollution: Focus	
Effectiveness of Forestry Best Management Practices in the US: Literature Review	2015
Forest Ecology and Management	

Table 3.4: Water Fund Development Review

Title & Publishing Organization	Year
Conserving Forests to Protect Water American Water Works Association	2004
Path to Protection: Ten Strategies for Successful Source Water Protection Trust for Public Land	2005
Natural Infrastructure: Investing in Forested Landscapes for Source Water Protection in the US World Resources Institute	2013
Protecting Drinking Water at the Source: Lessons from Watershed Investment Programs in the US World Resources Institute	2016
Delaware River Watershed Initiative: Case Study Open Space Institute	2018
Water Fund Field Guide The Nature Conservancy	2018
Beyond the Source: The Environmental, Economic and Community Benefits of Source Water Protection The Nature Conservancy	2017
Watershed and Ecosystem Services Finance Case Studies in the South Southeastern Partnership for Forests and Water	2019

Table 3.5: Conferences Attended

Event	Location	Year
Integrative Conservation Conference	University of Georgia	2019
Upper Oconee Science and Policy Summit	University of Georgia	2018
Sustainable Forestry Initiative Annual Conference	Denver, CO	2019
Georgia Conservancy Conference	Athens, GA	2019
SC/NC Forests and Drinking Water Forum	Charlotte, NC	2019
Georgia Adopt-a-Stream Conference	Unicoi State Park, GA	2019
Georgia Water Resources Conference	University of Georgia	2019

Table 3.6: Stakeholder Meetings Attended

Hosting Organization	#	Purpose of Meeting
Upper Oconee Watershed Network	20	Board Meeting
Athens-Clarke County Mayor and Commission	16	Mayor and Commission Meeting
Upper Oconee Basin Water Authority	6	Board Meeting
Athens-Clarke County Public Utilities	5	Water Data Working Group
Northeast Georgia Regional Commission	4	Board Meeting
OconeeWaters (UOWN)	3	Committee Meeting
Athens-Clarke County Sustainability Department	1	Sustainability Management Plan Stakeholder Input Meeting
Greater Apalachee River Community	1	Technical Assistance from UOWN
Georgia Environmental Protection Division	1	Nonpoint Source Management Plan Stakeholder Input
Georgia Environmental Protection Division	1	Nutrient Trading Stakeholder Input
Coastal Regional Water Planning Council	1	Ag/Forestry expert panel
Athens-Clarke County Public Utilities	1	Watershed Protection Plan Manager's Workshop
Georgia Association of Water Professionals	1	WaterWise Committee Meeting
Institute for Georgia Environmental Leadership	1	Regional Water Forum

Table 3.7: Personal Communications

Organization	Contact	Position
American Rivers	Ben Emmanuel	Director, Clean Water Supply
Arkansas Forestry and Water Collaboration	Bob Morgan	Program Manager
Athens-Clarke County	Kelly Girtz	Mayor
	Marilyn Peck Hall	Senior Water Planner
	Andrew Saunders	Sustainability Officer
	Mike Wharton	Ecological Resource Administrator
	Todd Stevenson	Stormwater Administrator
	Melissa Link	County Commissioner
	Laurie Loftin	Water Conservation Coordinator
Athens Land Trust	Krisztian Varsa	Conservation Director
Altamaha Riverkeeper	Jen Hillburn	Riverkeeper
Corblu Ecology Group	Jenny Pahl	Director of mitigation markets/policy
Elachee Nature Center	Peter Gordon	Director of Education
Georgia Assn of Water Professionals	Pam Burnett	Executive Director
Georgia Environ Protection Division	Liz Booth	Watershed Planning and Monitoring Program Manager
	Anna Trusczyynski	Assistant Branch Chief, Watershed Protection Branch
	Veronica Craw	Nonpoint Source Program Manager
Georgia Forestry Commission	Scott Thackston	Forest Water Specialist
	Seth Hawkins	Urban and Community Forestry
	Buford Sanders	Forest Legacy Program Manager
	Jess Riddle	Executive Director
	Kathy Stege	Board Member
Georgia River Network	Rena Peck Stricker	Executive Director
Georgia Water Coalition	Gina Rogers	Director of Operations
Georgia Wildlife Federation	Mike Whorley	President and CEO
Greater Apalachee River Community	Jack Rice	Board member
	Amy Lanclos	Board member
	Melba Cooper	Board member

Table 3-7: Personal Communications (continued)

Organization	Contact	Position
National Resource Conservation Service	Tina Jerome	State Resource Conservationist
Oconee County	Dave Shearon	Former Mayor
	Justin Kirouac	County Administrator
Oconee River Greenway Commission	Tim Durham	Water Resources Director
	Jake Maas	Chair
	Karen Porter	Board member
	Nat Kuykendall	Board membe
Oconee River Land Trust	Steffney Thompson	Executive Director
	Dan Crescenzo	Stewardship Coordinator
Sustainable Forestry Initiative	Chase Cook	Georgia Liason
	Pat Graham	Chair
Upper Oconee Basin Water Authority	Burke Walker	Executive Director
	Melvin Davis	Chair
	Peter Stangel	Chief Operating Officer

Table 3.8: Talks, Presentations and Posters

Event	Location	Year
Upper Oconee Science and Policy Summit	University of Georgia	2018
Introduction to Water Resources	University of Georgia	2018
Integrative Conservation Conference	University of Georgia	2019
Georgia Adopt-a-Stream Conference	Unicoi State Park, GA	2019
Georgia Water Resources Conference	University of Georgia	2019
Water Resources Seminar	Georgia Coastal College	2019

Table 3.9: Advocacy Comments on behalf of the Upper Oconee Watershed Network

Purpose	Delivered to	Year
Cedar Creek Solar Array	ACC Mayor and Commission	2018
Clean Water Rule	US Environmental Protection Agency	2018
Coal Ash Dewatering	Georgia Environmental Protection Division	2018
Hard Labor Creek/Altamaha Shiner	US Army Corps of Engineers	2018
Rayonier Discharge Permit	Georgia Environmental Protection Division	2018
Hard Labor Creek Withdrawal	Oconee County Board of Commissioners	2018
Upper Oconee Regional Water Plan	Upper Oconee Regional Water Planning Council	2018
State Nonpoint Source Management Plan	Georgia Environmental Protection Division	2019
Waters of the US	US Environmental Protection Agency	2019
Proposed Sandy Creek Sewer	ACC Mayor and Commission	2019
Hancock/Broad Roundabout	ACC Mayor and Commission	2019

Table 3.10: Hydrologic models for the Upper Oconee Watershed, listed in order of goodness-of-fit from best-to-worst.

(While AIC for Models 4 and 6 are similar, they have different weights; a weight of 0.6 is twice as likely to make accurate predictions than a model with a weight of 0.3, so that Model 4 predictions are 2.7 times better than Model 6 predictions.)

Model	Variables	logL	K	AIC	Δ AIC	Weight
4	Rain, Site, Year	-30,238	5	60,485	0	0.731
6	Rain, Site, Basin, Year	-30,238	6	60,487	2	0.269
5	Rain, Basin, Year	-31,148	5	62,305	1,820	0.000
1	Rain, Site	-33,554	4	67,115	6,630	0.000
3	Rain, Site, Basin	-33,554	5	67,117	6,632	0.000
2	Rain, Basin	-34,000	4	68,714	8,229	0.000
Null	Rain	-38.026	3	76,059	15,573	0.000

Table 3.11: Statistical summary of Hydrologic Model 4 for the Upper Oconee Watershed.

(DF = degrees of freedom, SSE = sum of squared errors, MSE = mean squared errors,
RSE = residual standard error, SE = standard error)

Variable	DF	SSE	MSE	F-stat	P(>F)
Rain	1	601	600.8	847.4	<2e-16
Site	4	10075	2518.7	3552.9	<2e-16
Year	17	5402	317.7	448.2	<2e-16
Residuals	24236	17181	0.7		

DF	RSE	R ²	Adj R ²	DF	F-stat	P(>F)
24,236	0.842	0.483	0.483	22	1,031	<2.2e-16

Variable	Value	SE	t-stat	P(>t)
Intercept	4.760612	0.032134	148.149	<2e-16
Rain	0.393298	0.015712	25.031	<2e-16
NOR-Athens	1.474654	0.013637	108.139	<2e-16
MOR-Arcade	0.008316	0.012700	0.655	0.512612
MOR-Athens	0.457405	0.013373	34.203	<2e-16
OR-Penfield	0.093647	0.011827	7.918	2.52e-15
Year 2002	0.369455	0.040867	9.040	<2e-16
Year 2003	1.345744	0.039470	34.096	<2e-16
Year 2004	0.923204	0.041231	22.391	<2e-16
Year 2005	1.244215	0.041177	30.217	<2e-16
Year 2006	0.594138	0.041232	14.409	<2e-16
Year 2007	-0.099021	0.041342	-2.395	0.016621
Year 2008	-0.214433	0.039716	-5.399	6.76e-08
Year 2009	0.742226	0.038955	19.054	<2e-16
Year 2010	0.882700	0.037876	23.305	<2e-16
Year 2011	-0.035152	0.038729	-0.908	0.364079
Year 2012	-0.140475	0.038108	-3.686	0.000228
Year 2013	1.107812	0.038280	28.940	<2e-16
Year 2014	0.693483	0.038176	18.165	<2e-16
Year 2015	0.844327	0.038318	22.035	<2e-16
Year 2016	0.396909	0.039178	10.131	<2e-16
Year 2017	0.536021	0.038637	13.873	<2e-16
Year 2018	0.936818	0.040891	22.910	<2e-16

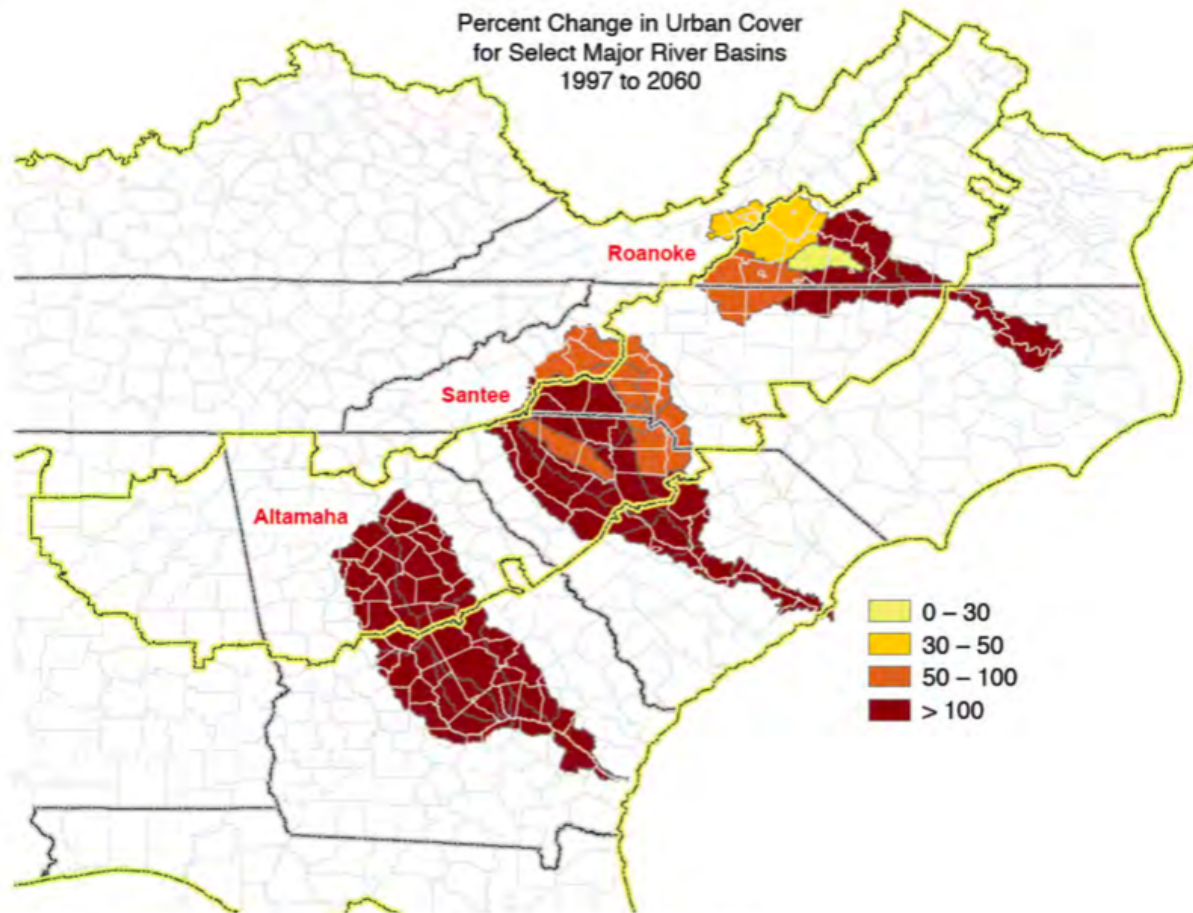


Figure 3.1: Change in urban cover for select Southeastern watersheds.

(Source: WRI, 2013)

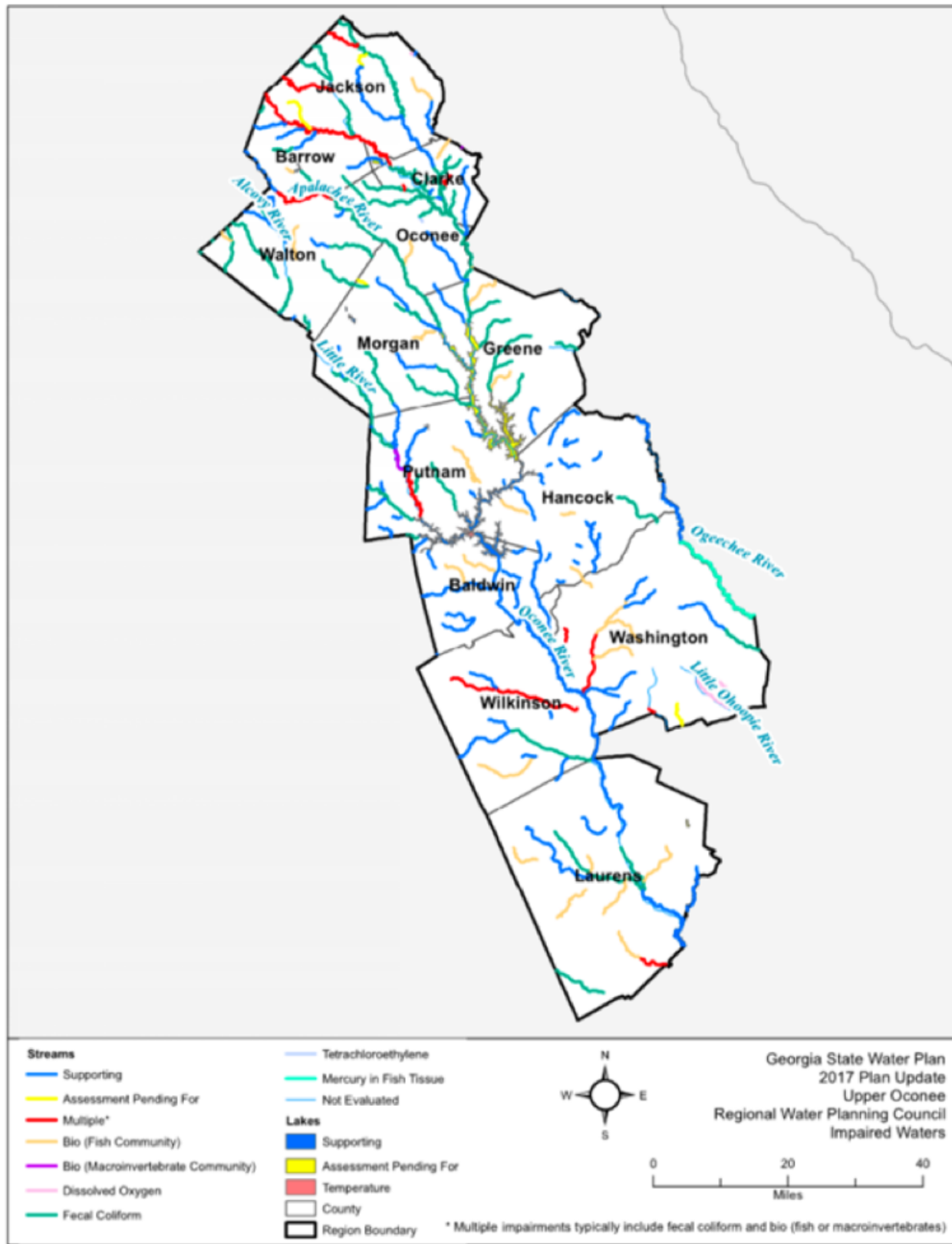


Figure 3.3: Impaired waters within the Upper Oconee Water Planning Region.

(Source: GADNR, 2015)

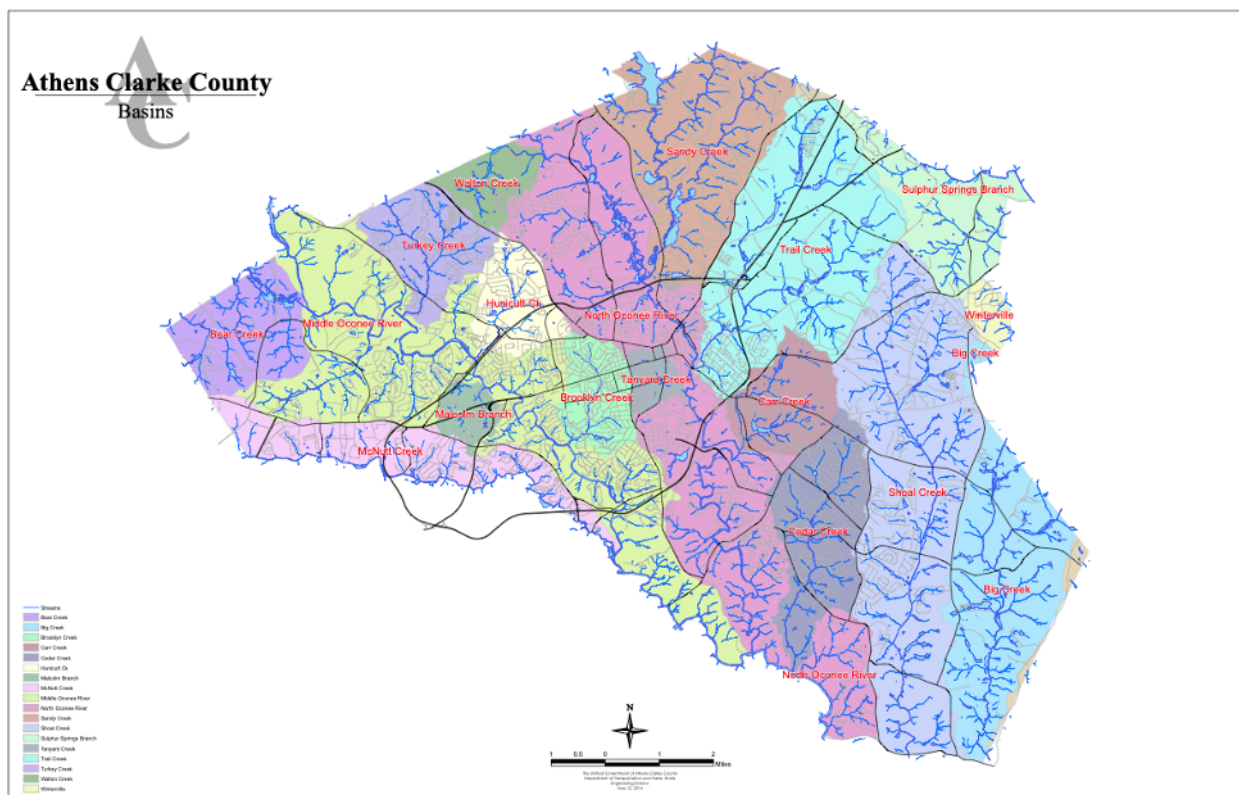


Figure 3.4: Athens-Clarke County watersheds.

(Source: ACC, 2018)

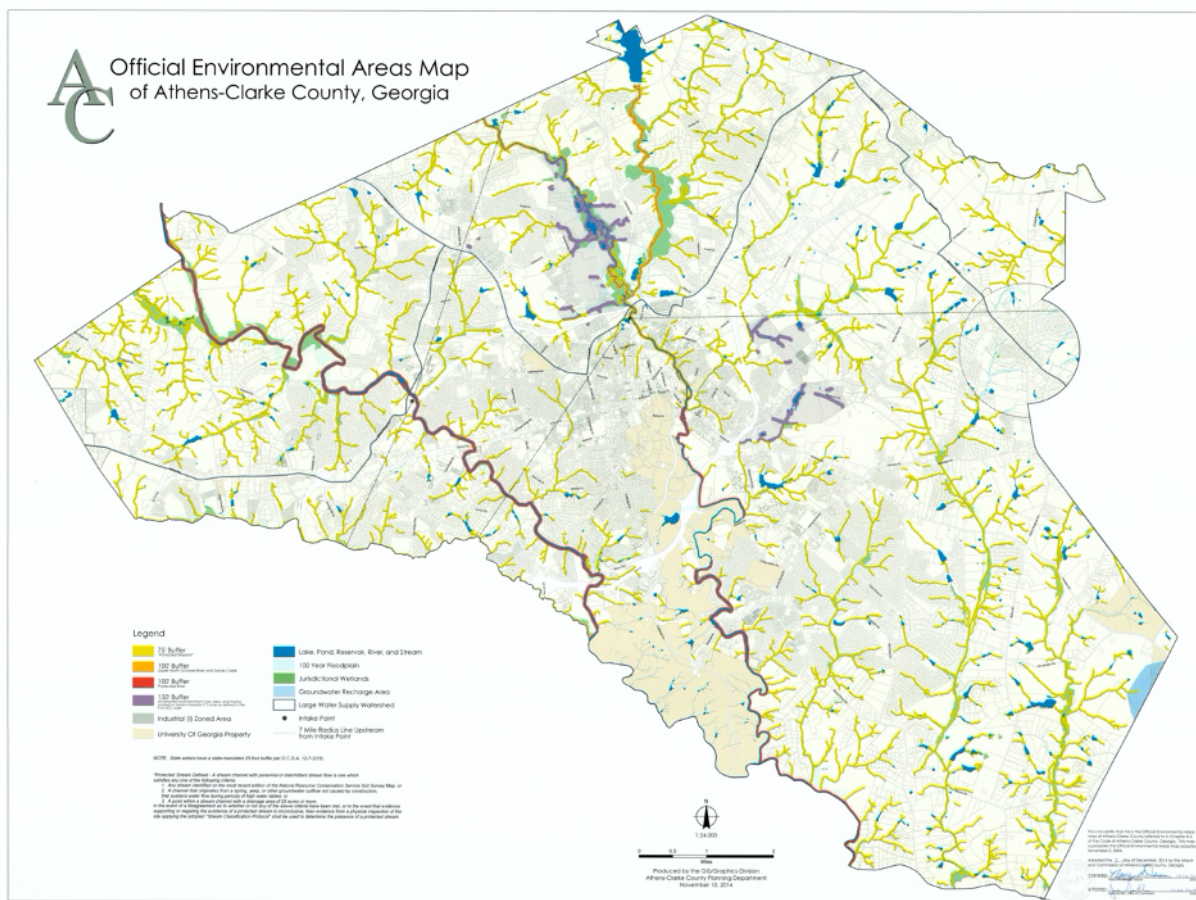


Figure 3.5: Athens-Clarke County Environmental Areas map.

(Source: ACC Planning Department, 2014)

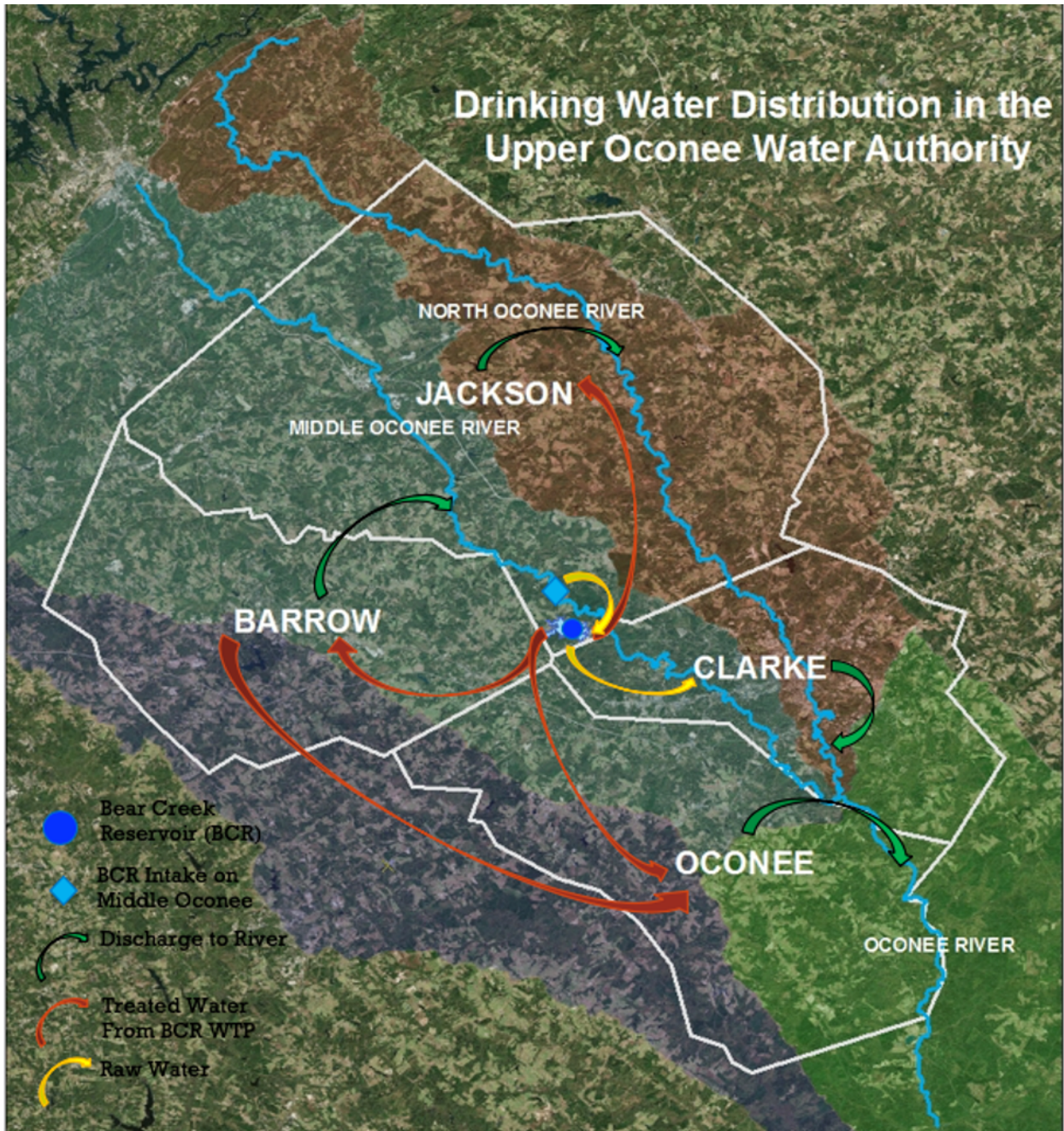


Figure 3.6: Upper Oconee Basin Water Authority drinking water distribution map.

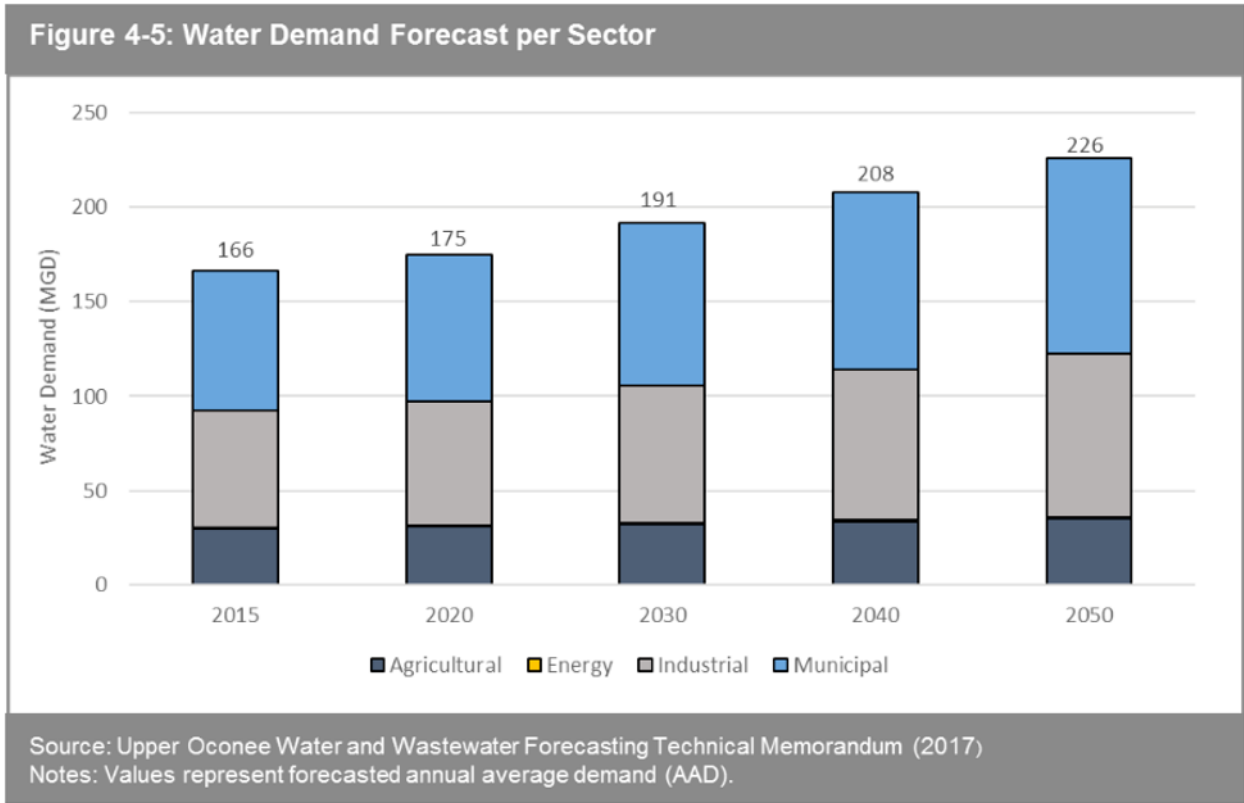


Figure 3.7: Water demand forecast for the Upper Oconee Water Planning Region.

(Source: GAEPD, 2017)

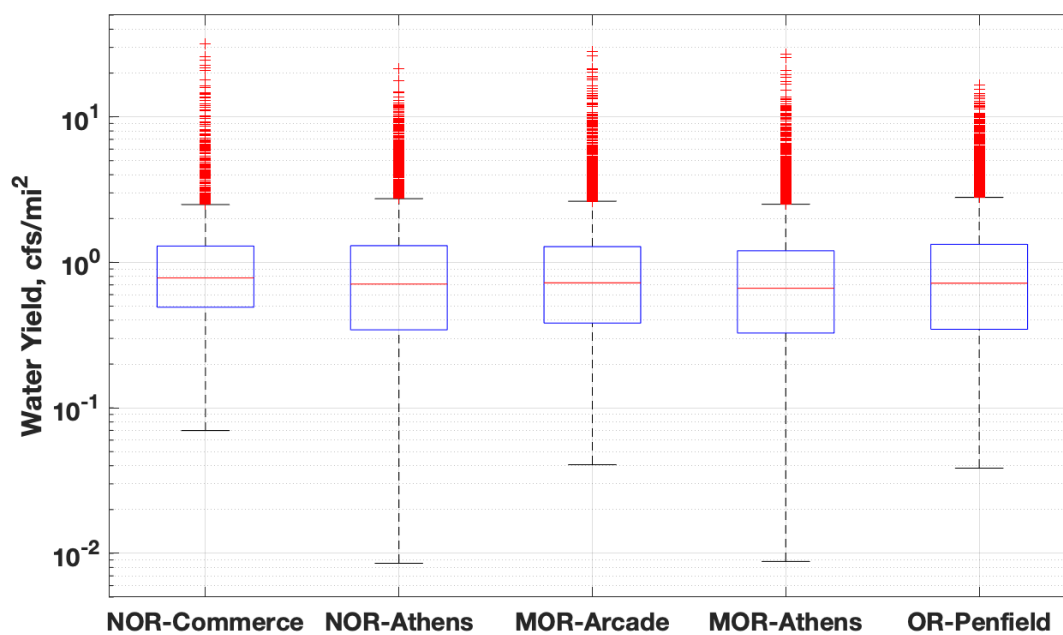


Figure 3.8: Statistical summary of observed water yields at five locations in the Upper Oconee Watershed.

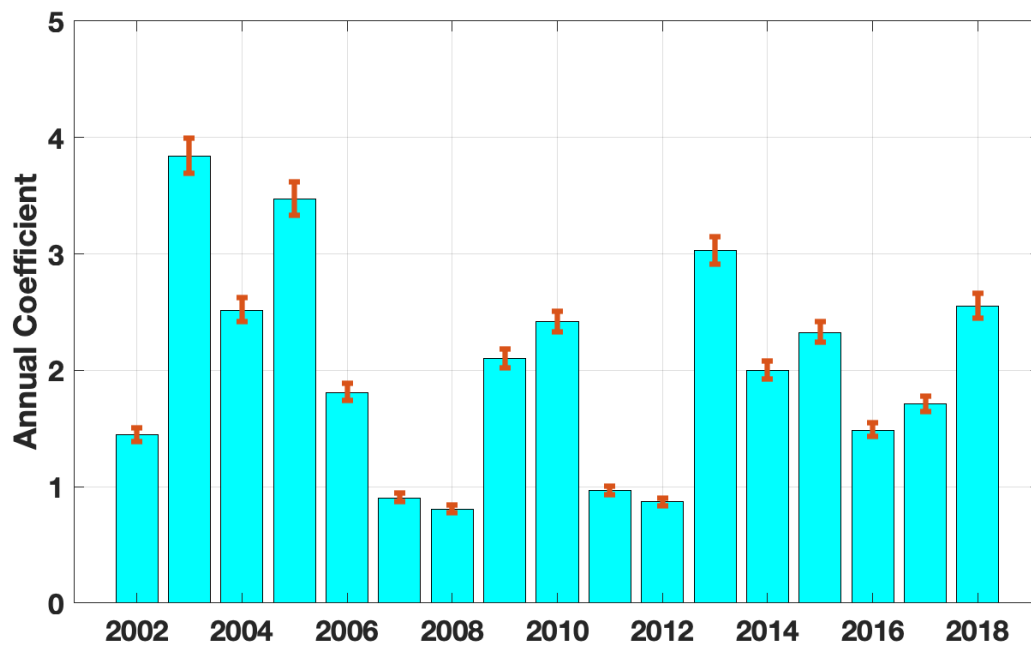


Figure 3.9: Annual discharge index (with standard errors) for flows at five location in the Upper Oconee Watershed using Model 4 coefficients.

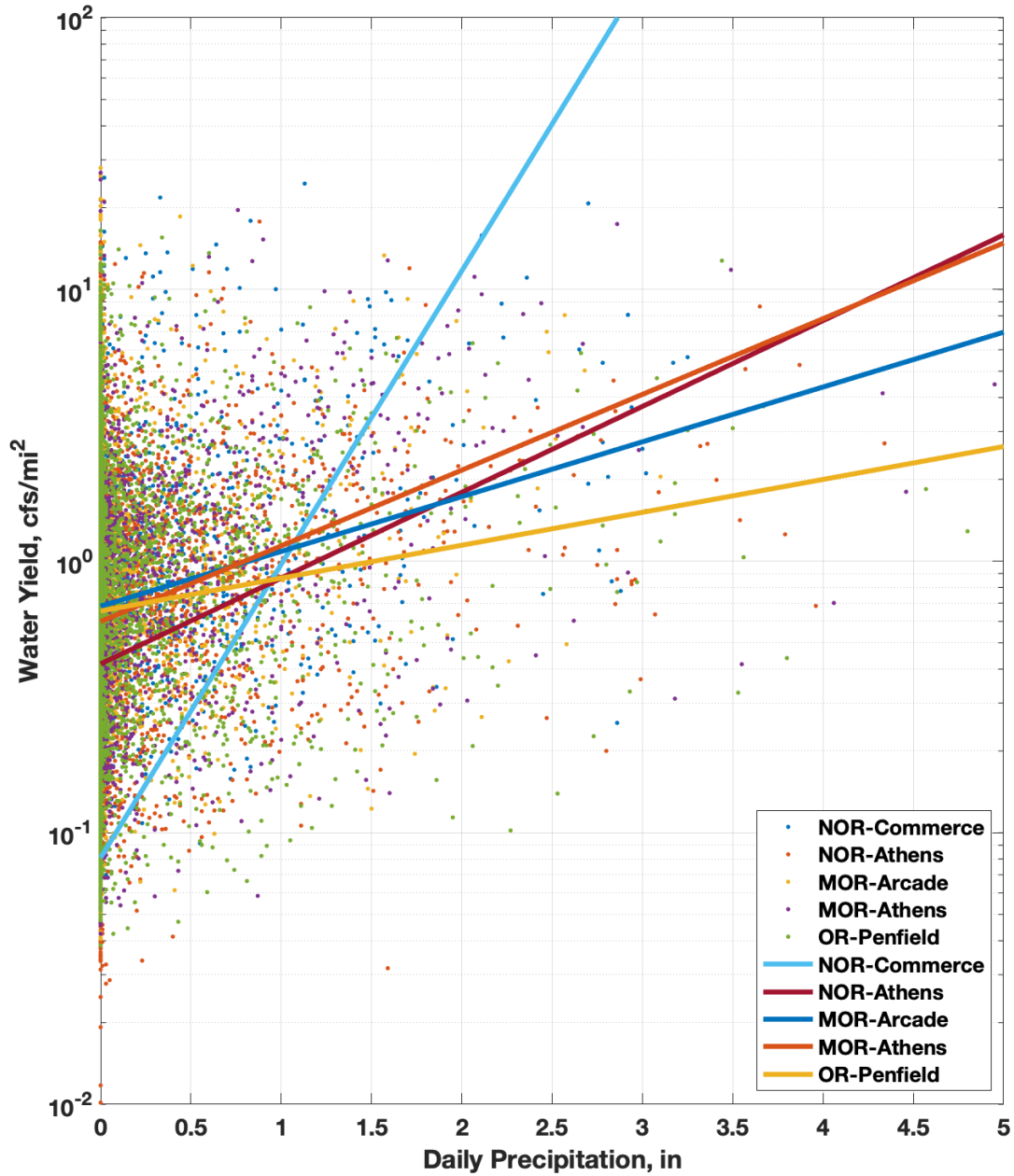


Figure 3.10: Observed and predicted water yields (dots and lines, respectively) as a function of daily precipitation at five locations in the Upper Oconee Watershed.

CHAPTER 4

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

4.1 SUMMARY

The goal of this research is to understand and develop tools for establishing a sustainable drinking water fund in the Upper Oconee Watershed. The ultimate objective is to leverage relationships, basin conditions, and funding mechanisms to secure adequate quantities of clean drinking water through forestland stewardship, management, and preservation. This thesis summarizes work related to the following six tasks:

1. Review available basin information such as management documents to determine information and data gaps

This thesis summarizes information collected and reviewed related to the forestry-drinking water connection. Two main points were identified from these resources; a) loss of forestland cover alters streamflow, and b) the reduction of forestland cover increases drinking water treatment costs. These two points are related in that the alteration of streamflows increase rates of erosion, which increases treatment costs.

2. Explore potential funding opportunities

Water utilities, therefore, have the most to gain from establishing a fund that promotes watershed-scale forest protection. The initial stages of the program focuses on building trust and acceptance that this investment yields positive benefits to the utility. As mentioned previously, other water utilities have established customer-paid water fees for watershed protection. Because building community support for instituting new fees

is often difficult to establish, a rigorous scientific baseline is needed for justifying the utility of the fee.

3. Investigate long-term funding structures for a drinking water fund

A nominal fee built into a customer's water bill reduces the burden of having to pay larger annual or bi-annual fees. This makes both a meter fee and a usage fee preferable to a watershed fee that basin users pay less frequently than on a monthly basis. But I believe that a usage fee is preferable to a meter fee where water users pay a flat rate for their meter each month. With a usage fee, users only pay for the water they use instead of all users paying the same price regardless of usage.

4. Attend local, regional and state meetings and conferences that possible stakeholders may be attending to network and increase awareness about partnership efforts

A wide range of participation activities were achieved related to this research project. The intent of these interactions is related to the goals of raising public awareness of these efforts, highlighting the importance of the forest/drinking water connection, and facilitating the share of basin information. Efforts were taken to communicate with stakeholders from the forestry, drinking water and conservation sectors.

5. Facilitate information sharing and relationship building through message development and stakeholder engagement

Stakeholder meetings and conferences were used to share Southeastern Partnership messaging and make connections with potential stakeholders. These events provided the opportunity to establish personal relationships with organizations as the Altamaha Riverkeeper, Georgia Wildlife Federation, and Georgia River Network, among others. Memberships in the Georgia Aquatic Connectivity Team, Keep Athens-Clarke County Beautiful, and the Aquatic Microplastics Working Group were used to broaden outreach and communication with local and regional stakeholders.

6. Host a watershed workshop to bring together stakeholders to discuss the forest/drinking water connection and how it can be leveraged to implement a drinking water fund in the area.

The culminating activity for information sharing and relationship building was organizing and hosting the Upper Oconee Watershed Forests and Drinking Water Forum in September 2019. Over 42 stakeholders convened in Athens, Georgia to discuss the forest/drinking water connection and how social, hydrological and political conditions can be leveraged for development of a drinking water fund.

In addition to providing a strategy for developing a forests and drinking water fund, a research effort focused on developing a quantitative understanding of rainfall-runoff process in the Upper Oconee Watershed. A statistical model was developed that predicts discharge that varies at five different locations within the watershed as a function of precipitation as well as for 17 different years. Annual discharge coefficients relate to mean climatic conditions (wet, dry), while precipitation relates to stormwater events.

4.2 CONCLUSIONS AND RECOMMENDATIONS

This research demonstrates the viability for the establishment of a Forest and Drinking Water Fund within the Upper Oconee Watershed. Additional efforts to build community support for long-term drinking water resiliency through forest preservation. Regular communication with stakeholders ensures there is a pre-existing and reciprocal relationship of trust that allows for more information sharing. Consistent messaging provides a concise vision of the project that is easy for stakeholders in all sectors to understand.

It is important to identify early opportunities for information sharing and relationship building such as conferences, board meetings and stakeholder meetings. This networking provides an opportunity to identify advocates and champions early on who can help speak out in support of water fund efforts. Establishing such relationships early also provides an opportunity to gauge stakeholder interest in participating with the program.

Additionally, it is important to identify other individuals and organizations working in water fund development who can act as mentors. With water funds being developed across the country, there is a growing field of professionals available for consultation and idea sharing. Communication with others has given me an outlet to discuss my efforts but has also provided me with examples of what has and hasn't worked for other groups. This is also a great tactic for acquiring contact information for groups and individuals outside of the watershed who are interested in forestland conservation, drinking water protection and conservation finance.

Lastly, a strong, goal-oriented action plan can be the linchpin in bringing efforts to fruition. Action plans provide the opportunity for prioritizing efforts and laying out the steps to meet those goals. They help in determining whether a certain event or meeting is worthwhile and will help the Coordinator work strategically. Action-plans also help avoid spending time and capacity on efforts that are of low priority but seem easy to accomplish.

Another need is the establishment of the financial case for the greater benefits associated with reducing or avoiding treatment costs against the costs related to forest protection. Costs of forest protection include establishing Conservation Easements, wetland and stream restoration, and monitoring. Establishing the financial model requires an understanding of the physical processes related to forest protection and watershed-scale water-quality improvements.

The hydrologic model constructed as part of this analysis shows the importance of location, precipitation, and annual climatic conditions on discharge behavior. Over time, building a robust watershed model that includes materials that increase treatment costs, e.g., sediment, nutrients, and pathogens. It is likely that non-point sources are the primary contributors of these materials, so that this model could include a broad array of watershed factors, such as land-use, topographic features, types of land-disturbing activities, unpaved roads, harvesting activities, road construction, impervious surfaces, iNational Pollutant Discharge

Elimination Systems, Land Application Systems, and MS4 Stormwater permits from the Georgia Environmental Protection Division's Watershed Protection Branch.

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APPENDIX

UPPER OCONEE WATERSHED FORESTS AND DRINKING WATER FORUM



Upper Oconee Watershed Forests and Drinking Water Forum

Final Report - September 29, 2019



A.1 INTRODUCTION

On September 10, 2019, 42 leaders and stakeholders from Georgia's forestry, drinking water, and conservation communities convened at Flinchum's Phoenix Community Center at Whitehall Forest near Athens, Georgia for the first ever Upper Oconee Forests and Drinking Water Forum. Whitehall Forest is a 740-acre research forest owned by University of Georgia's Warnell School of Forestry and Natural Resources, and was a fitting location for the Forum and the subsequent watershed tour.

The purpose of the Forum was to explore forest stewardship, management and conservation for more resilient drinking water supplies in the Upper Oconee Watershed of northeast Georgia. Forum objectives included:

- Share science-based data to highlight ecosystem connections within the watershed
- Define and rank potential hurdles in maintaining and expanding forests
- Inform current methodology with case studies and identify alternative courses of action
- Identify sources of funding and share experiences in fundraising and applying for grants

The Upper Oconee Watershed Forests and Drinking Water Forum was convened with the knowledge that forests and drinking water are strongly connected and dependent on each other. Southeastern forests that are actively managed can help protect and increase drinking water supplies while also providing economic benefits. This report, as well as other state and watershed forum and workshop materials and related documents and research are available online at: <https://sites.google.com/a/scrwa.org/south-east-water-quality-collaborative/home?pli=1> (click on Documents folder).

A.2 BACKGROUND AND HISTORY

The Upper Oconee Watershed Forests and Drinking Water Forum was initiated and supported by the Southeastern Partnership for Forests and Water, an initiative funded by the

US Forest Service and the US Endowment for Forestry and Communities to strengthen regional, state and local watershed collaboration focused on the connection between forests and drinking water. Georgia Forestry Commission and The Upper Oconee Watershed Network also helped to sponsor the event.

The Southeastern Partnership for Forests and Water initiative recognizes that healthy forests benefit drinking water quality and quantity. Stewarding, enhancing and maintaining healthy forests in key Southeastern drinking water source watersheds is necessary due to increasing population growth and urbanization in the Southeast, which is resulting in forest fragmentation, forest losses (conversion to other land uses), and a decline in forest health. The overall purpose of the Partnership is to maintain healthy watersheds that provide safe, reliable drinking water, healthy forests, and strong local and regional economies. Ultimately, the goals are for drinking water utilities/customers, the forestry sector, businesses and corporations to value forest landowners and forest lands for source water protection, and for forestry, drinking water and conservation sectors to collaborate on long-term watershed stewardship throughout the region.

The goals of the Southeastern Partnership for Forests and Water are to:

- Help maintain or expand healthy forests in drinking water source watersheds;
- Maintain and improve water quality and quantity through healthy forest retention and stewardship;
- Initiate and develop working relationships among water utilities, the forestry sector, state and local agencies, Rural Water Associations, and conservation groups;
- Identify watersheds and initiatives that have high potential for cooperative forest conservation and long-term stewardship;
- Explore pilot projects to implement creative long-term stewardship strategies such as Payment for Watershed Services and forestry best management practices that demonstrate the interdependence of healthy forests and drinking water.

- Landowners own and manage their forests to benefit resources that we all depend on: air, water; timber; nanocellulose from trees for computer screens (comfort, survival, progress all depend on forests).

A.3 FORUM FOLLOW-UP ACTIONS

Participants identified the following specific follow-up actions in two breakout groups to continue momentum towards enhanced watershed stewardship and protection in the Upper Oconee Watershed:

A.3.1 SOURCE WATER PROTECTION PLANNING & IMPLEMENTATION

- Create a plan for a smaller watershed area for Bear Creek Reservoir (four counties). Start to work on the following for this watershed:
 - Conduct research on land uses, land use and population/development trends, data/info on contamination threats and potential solutions/actions
 - Figure out primary threats in the watershed and how to mitigate the impacts of those threats
 - Determine opportunities to protect water quantity and quality
 - Start to approach county planning commissions with concept of forested watershed stewardship for drinking water and the local economy. Counties have done their own plans too - we can help them understand impacts over time if they take no action. Have some meetings with Todd Stevenson, Athens-Clarke County and his other three county counterparts to start to discuss this idea and the need for forest land stewardship
 - Identify what motivates people/what has raised a red flag - and focus on these with public education/planning (for example human health issues, fish health, HAB/dog deaths).

- Focus on gradual actions for improvement
- Select forest percentage threshold for the watershed (similar to what Savannah River Watershed did). Evaluate whether and how to set aside some forest protection between I-85 and City of Athens.
- Address how to keep sawmills in the area to keep forest landowners from leaving
- Conduct a survey to find out what motivates landowners and makes it worthwhile for them to keep their property (particularly forest lands)?
- Figure out how to involve decisionmakers in this watershed - who is missing and how do we draw them in?

A.3.2 FUNDING AND FINANCING

- Work with municipalities, UGA, and others to form a group to determine how to develop a watershed fund and what it would do (using guidance found on pages 8-9 of this report).
- Investigate what it would take to create a local watershed fund - consider mechanisms such as Special Purpose Local Option Sales Tax (SPLOST), watershed tax, or drinking water rate/fee. Perhaps create a ballot initiative to gauge interest from taxpayers (a non-binding referendum). Use City of Austin's bond efforts and other southeastern examples as a guide.
- Consider having each county come up with their own funding mechanism, and it could be dual purpose (drinking water and recreation benefits).
- Consider credits for investing in forest land/green infrastructure as part of NPDES permit
- Contact county offices that attended the Forum to find out more about the Regional Water Plan Seed Grant (Barrow County, Oconee County, Athens-Clarke County).

- Call EPD about Seed Grant application assistance once partners have been identified.
- Identify grant writing assistance resources and contact them:
 - UGA Agricultural and Environmental Sciences Lab
 - UGA Grant Writing Division
 - Identify other sources of funding and begin to apply:
 - GEFA and EPD funding sources
 - NRCS RCPP & NWQI grant programs
 - CWA 319 grants
 - Sustainable Forestry Initiative

A.3.3 OTHER FOLLOW-UP IDEAS

- Ask fertilization companies how they determine treatments - maybe educate these companies and landowners.
- More research is needed on sources of contamination (fertilization vs. urban/suburban runoff vs. pets)
- Low Impact Development is a great tool to address water quality issues
- Use Chesapeake Bay Area as example for how to track fertilizing through surveying landowners.
- Consider a state initiative to compensate forest landowners
- Need to build green infrastructure into local plans and watershed plans and any other relevant plans

A.4 FORUM PRESENTATIONS, DISCUSSION, IDEAS AND MESSAGES

The Forum Program began with welcoming remarks from Cassidy Lord, President of the Upper Oconee Watershed Network. Next followed three speaker panels on Water Quality and Quantity in the Upper Oconee Watershed; Sustainable Forestry; and Forestland Conservation and Drinking Water Funds. Key messages from these panels are below.

Dale Greene, Dean of University of Georgia's Warnell School of Forestry and Natural Resources provided some lunchtime remarks:

- Warnell School goes back to 1906
- The Warnell School helps GFC to conduct Best Management Practices (BM) assessments
- One of the goals of the Warnell School is to provide an example to students demonstrating how to properly manage forest lands using Demonstration/Experimental Forests
- Demonstration/Experimental forests include Whitehall Forest (800 acres), Blossom Springs Forest (600 acres), and one other forest (150 acres) - these lands are managed primarily to teach students, and conduct experiments and research to better understand forest management.
- One of Warnell School's experimental projects was dam removal of the White Dam on the Middle Oconee River which changed the dynamic of the river and temperature
- American Tree Farm System - UGA put most of their property in Tree Farm System in 2018 which ensures that the forests are managed sustainably and according to Best Management Practices.
- Another Warnell School project at Lake Herrick and Oconee Forest Park - a catchment pond that had filled with sediment was cleaned out and improved. They partnered with GA Power and the Center for Sustainability.

- Warnell School is very interested in income production on their lands, and does lease some lands for hunting. They will be exploring income-producing mechanisms like carbon sequestration for the carbon market.

A.5 KEY FORUM MESSAGES

After lunch, participants broke out into two groups to discuss Watershed and Source Water Protection and Watershed Funding and Financing. Breakout session concepts and ideas are below.

- The Upper Oconee Watershed is 55 percent forest cover, but this number is declining
- Two out of every three raindrops in GA falls on forest land - 2/3 of all precipitation falling in Georgia falls on forested land
- Only 25 percent of today's population lives in rural areas (vs. 75 percent in 1907) - resulting in expansion of urban areas into rural, forested areas and loss of forests over time. This trend is continuing.
- Georgia has more private forests than any other state, more forest exports, highest harvest levels, and is a very sustainable forestry state, growing more timber than is harvested.
- 22 million acres of private working forests are owned by 450,000 landowners (only about a third is owned by corporations).
- According to the 2014 US Forest Service Southern Forest Futures Report, the primary threats to Southern Forests are urban development, conversion to other uses, climate changes, contaminants, invasive species, and fire.
- Drinking water in the Upper Oconee Watershed is dependent on healthy, managed forests for both quality and quantity.

A.5.1 WATER QUALITY AND QUANTITY PANEL & KEY MESSAGES

The panel included:

- Tina Jerome, State Resource Conservationist, Natural Resources Conservation Service (NRCS) Georgia
- Liz Booth, Program Manager, Watershed Planning & Monitoring, GA Environmental Protection Division
- Mike Wharton, Ecological Resources Administrator, Athens-Clarke County

Key Panel Messages:

Tina Jerome NRCS provides financial and technical assistance to landowners to implement management practices on their lands, focusing on a broad reach of natural resource concerns. Financial assistance comes from the US Farm Bill, and there are lots of funding opportunities. There is a new National Water Quality Initiative (NWQI) funding program that includes 10 percent of funding specifically for drinking water source protection (about \$4 million). Watersheds are assigned priority for water quality practices.

Liz Booth Georgia EPD's Water Quality Monitoring Program creates state water quality standards (big one is nutrient criteria - including Lake Oconee and Lake Sinclair). These criteria are now waiting for final approval. The program monitors lakes, rivers, streams and estuaries, and creates a report every two years - the Water Quality Report (this year the report will be prepared as a Story Map - more visual and easy to understand). Total Maximum Daily Loads (TMDL's) are standards created under the authority of the federal Clean Water Act, and determine what can go into state waters in order to meet water quality standards - these are essentially the permit limits for pollutant dischargers. TMDL setting is based on water quality data. GA EPD water quality data collected includes pollutants, including nutrients, temperature, dissolved oxygen,

turbidity, etc. Current water quality modeling for the region includes temperature and flows.

Mike Wharton The Athens-Clarke County Sustainability Program manages the frontline of local natural resources management - the local Parks and Recreation Department, which often gets left out of these types of watershed discussions. They manage through a combination of regulations, resource stewardship, and public education/use. The program is beginning to look at ecosystem services to have a full understanding of what benefits the watershed provides. There is about a mile of the Oconee River inside Athens City limits. The Middle and North Oconee Rivers also flow through Clarke County. Their program is looking at riparian buffers, wildlife corridors; pollution controls, research out of SE Forest Research Station; how to promote forestry and land management.

A.5.2 PANEL DISCUSSION IDEAS AND CONCEPTS

- The majority of the region's drinking water north of the Fall Line comes from surface water, then south of that comes from groundwater. So Upper Oconee Watershed region's drinking water supply is 94 percent from surface water. (Note: Georgia's Fall Line is a geological boundary, about twenty miles wide, running northeast across Georgia from Columbus to Augusta. It is a gently sloping region that rapidly loses elevation from the north to the south, thereby creating a series of waterfalls. The Fall Line geology is notable for its impact on water resources, wildlife, and the region's settlement patterns and economy).
- Maintaining the amount of river flow for this region is very important; the region needs a certain amount of water quantity for drinking water and other uses.
- Shading (from forests) is also important for temperature regulation for drinking water and habitat.

- Healthy forests provide critical surface water recharge; baseflow is critical; small streams running off from an urban environment can raise temperatures of larger rivers/streams - can wipe a stream out (especially for fish).
- The recent Lake Allatoona example of toxic/deadly blue green algae blooms is related to nutrient loads combined with high water temperatures.
- Harmful Algal Blooms (HAB's) are proving very difficult to detect and treat for drinking water utilities.
- Lake Oconee - Sugar Creek watershed had a really long blue green algae bloom
- Mike shared an example provided of large reservoir treatment to restore native plants to filter water; also looking at small scale urban areas to catch contamination and filter it earlier; also looking at trash traps to catch trash upstream.
- Upper Oconee Watershed Network water quality data shows a clear difference between forests and non-forested environments - forested environments produce much cleaner water.
- Lack of public knowledge is a barrier that needs to be addressed
- Native plants information for specific areas is very helpful for landowners to protect water quality and quantity. Athens-Clarke County has a recipe list for native plants (plants, shrubs, trees) for six habitats, which will be available to landowners and companies in the next three months.
- Tina provided an example of the eastern shore of Virginia, where watershed partners are working with nurseries to label beneficial native plants to encourage landowners to purchase them.
- Pet waste can be a water quality concern too - recent study done (see 2019 GA Environmental Conference proceedings)

- NRCS RCPP funding is available to partnerships for regional watershed projects - deadline coming up in December.
- You can't always tell where the pollutant sources are unless you have DNA data; what we do know is that certain practices have a positive impact on water quality including maintaining forests in priority areas.
- IDEA - ask fertilization companies how they determine treatments - maybe educate these companies and landowners.
- IDEA - more research is needed on sources of contamination (fertilization vs. urban/suburban runoff vs. pets)
- IDEA - Low Impact Development is a great tool to address water quality issues
- IDEA - Use Chesapeake Bay Area as example for how to track fertilizing through surveying landowners.

A.5.3 SUSTAINABLE FORESTRY PANEL & KEY MESSAGES

The panel included:

- Chuck Williams, Director & State Forester - Georgia Forestry Commission
- Andrés Villegas, President, Georgia Forestry Association
- Ritchie Mullen, Georgia Forestry Commission - Water Quality Protection
- Chase Cook, Georgia Sustainable Forestry Initiative

A.6 KEY PANEL MESSAGES

Chuck Williams Georgia Forestry Commission is charged by the State of Georgia to help landowners manage and protect Georgia's forests. Georgia is somewhat unique with

a high percentage of forests owned and managed by private landowners. Tree Farm Program goals are: wood, water, wildlife, and recreation. For landowners, they are not just focused on one benefit from their land - they are managing their lands for many benefits and reasons. In Georgia, the state is overall growing more wood than is being harvested. Focus is on trying to be sustainable. GFC is taking a closer look at economic sustainability. Private landowners aren't independently wealthy - they have to have some economic benefit. We have to understand that landowners need to harvest their timber. We must ensure landowners have the opportunity to reasonably harvest that resource, including having tax policy that supports forest landowners. Almost all private landowners are focused on doing the right thing and Best Management Practices monitoring data shows this. Georgia's growing population is a direct challenge to forest land. We need to continue to educate the public and elected officials to tell the story of forestry. Two thirds of precipitation in Georgia falls on forested land.

Andrés Villegas Georgia Forestry Association is membership-based, landowners are their members. GFA started in 1907. They work with policy makers on forest policy. We are all connected to forests and depend on forests for various benefits including air, water, wildlife, and wood products. Parcelization due to urbanization and population growth is reducing the state's forest footprint. Impact of parcelization = one out of every six acres of forest lands in north America has traded hands. New land ownership results in new interests - the new owners may see opportunity to sell off forest lands. Keep forests as forests by having healthy forest markets - landowners have to generate income. 2011 report by UGA demonstrated the non-market services from forests (value of air, water, wildlife, etc.). Some communities are paying landowners for the value of their forests. "Keeping Forests as Forests" is a US Forest Service initiative that GFA is part of that is looking at how to retain the southeast's 280 million acres of healthy forests. Research shows that forests are absolute best land use for water (particularly well managed forests); It's very important in drinking water source watersheds to perform

some economic modeling to determine benefits of forest land. It's equally important to get landowners on board! Scale is absolutely critical - scale of forest is what we need to focus in on. GA Forestry Foundation is researching knowledge gaps about role of forests for ecosystem services. GFA wants to work on developing a market approach to maintain/sustain forests in certain priority communities.

Ritchie Mullen Worked for GA Kraft Timber Company which owned 1.5 million acres of timber; a lot of timber companies have been sold off and owned now by lots of smaller private landowners. In 1978 EPD contracted with GFC to monitor for water quality in the woods. GFC provides training to loggers on best management practices (BMP's). GFC also conducts BMP assurance exams/inspections, a bi-annual BMP survey (statewide, random survey), and a survey to determine how much timber comes off forest lands. GFC also addresses logging complaints (more in north GA because that's where most population growth and development is happening). Forestry BMP compliance rate in Georgia is very high = 96 percent.

Chase Cook The Sustainable Forestry Initiative (SFI) ensures that the forest products supply chain matches environmental/natural resource/ecosystem services values of customers and forest landowners. Less than 14 percent of GA Forests lands are certified under SFI, so there is an opportunity to increase SFI certification statewide. SFI includes fiber sourcing certification for mills. The SFI compliance rate is about 92.6 percent. SFI certification requirements include education and accountability. Education = master timber harvester training, including BMP's, State Logger Education Program (vast majority of loggers in GA). SFI is trying to also contact new forest landowners. Accountability is built into SFI's program - ensures landowners are following BMP's. SFI market drives compliance because landowners want to be able to sell their timber as SFI certified.

A.7 PANEL DISCUSSION IDEAS AND CONCEPTS

- Question about how to increase BMP compliance even higher than current compliance rate? Panel experts agreed that there are marginal returns when going after the remaining few landowners who are out of compliance. The challenge is that weather, natural conditions, and human error/accidents make up the small remainder of non-compliance percentage points.
- Ritchie said that GFC's BMP survey in 2017 surveyed 232 sites. The survey showed that the biggest challenge was stream crossings (culverts being too small or blocking flow of water), stream approaches, improper culvert installation, and retiring skid crossings. So to focus on remaining non-compliers, we can focus on these challenges.
- Easements may be a good tool to accomplish water quality protection in areas with parcelization and growth, but this depends on the landowner's willingness, and it is only one tool in the toolbox.
- Andrés mentioned that American Forestry Association and The Nature Conservancy have developed a mechanism to pay landowners for management of forest lands to value forest carbon, but it's not a true easement. Timed easements (rather than permanent easements) can be helpful for landowners because they are flexible.
- In the 2018 election, GA Amendment 3 passed, which helps small, private forest landowners with tax incentives. The Georgia Conservation Use Valuation Assessment (CUVA) is another tax incentive program that helps forest landowners.
- In the Savannah River Watershed, several partners worked with a private forest landowner, Billy Exley, to protect riparian forests along the Savannah River just below the drinking water intake. This example shows that forest landowners can be very willing to adopt flexible easements that are only on the part of their property that is most critical for the drinking water supply.

- Question about recreation/wildlife benefits of forests - Chuck said some landowners are in it for recreation benefits (hunting, fishing, camping).
- Andrés said prescribed fire really helps with forest stand management by decreasing the fuel load; benefits of prescribed fire also include water quality benefits and other benefits.
- One beneficial timber management approach is “age stand harvesting” - timing timber cutting by age of trees.

A.8 FUNDING AND FINANCING PANEL & KEY MESSAGES

The panel included Kitty Weisman, Southeastern Partnership for Forests and Water - Coordinator

Key Panel Messages:

- The Southeastern Partnership for Forests and Water was created in 2014, is funded by the US Forest Service and the US Endowment for Forestry and Communities, and includes eight states: Alabama, Arkansas, Florida, Georgia, North Carolina, South Carolina, Texas, and Virginia. The SE Partnership’s mission is to ensure healthy SE forested watersheds that provide safe, reliable drinking water through strong partnerships, collaboration, funding, & action. We do this by helping to retain, expand and steward healthy forests; fostering relationships & partnerships; identifying watersheds for cooperative stewardship, developing sustainable funding, and implementing pilot projects. Funding is a big need, especially because grant and loan funding is declining and there is a lot of competition for these funds. It’s important to seek grants and loans, but you need to have some of your own watershed funds to leverage grants and loans (such as NRCS’s Resource Conservation Partnership Program and National Water Quality Initiative, Drinking Water and Clean Water State Revolving Funds, Clean Water Act Section 319 funding, etc.). It’s also really important to funders that you

have a watershed plan/source water protection plan that details your priorities. A 2016 study by World Resources Institute, *Protecting Drinking Water at the Source*, shows that communities with successful watershed protection programs have several success factors in common (strong leadership, an economic/business case, dedicated funding, watershed plans, strong partnerships/collaboration, effective messaging/outreach). To create a local, dedicated watershed fund requires that most of these success factors be in place. Examples of watersheds in the southeast that have developed a local watershed fund include San Antonio, TX (sales tax); Little Rock, AR (drinking water use fee); Beaver Water District, AR (drinking water rates), City of Raleigh, NC (drinking water use fee), and Savannah River Watershed (GA & SC - five water utilities; utilities contribute out of their general fund). Help exists to create a local water fund and to apply for grants and loans - contact Kitty for more information. The Nature Conservancy has a *Water Funds Field Guide* with information on how to create a water fund.

- Funding exists for stewarding and protecting forested watersheds, including USFS Forest Legacy Program and Landscape Scale Conservation Program; Healthy Watersheds Consortium Grant Program, NRCS Resource Conservation Partnership Program (RCPP) and National Water Quality Initiative (NWQI) Program, US Forest Service Forest Resilience Bonds and other local green bond options, carbon sequestration/forest carbon revenues, Clean Water Act Section 319 funds, Clean Water and Drinking Water State Revolving Funds (SRF's), National Audubon Society Forest Land Bird Legacy Program, National Fish and Wildlife Foundation Five Star and Urban Waters Restoration Grants, The Conservation Fund, Sustainable Forestry Initiative (SFI), to name a few.
- Making an economic case for investing in forested watershed stewardship and protection can help the public and other stakeholders understand the value of creating a local funding source:

- This can be done using Triple Bottom Line Analysis factors in economic, social, and environmental benefits and costs of certain activities
- Some analyses show avoided costs are a big element of watershed stewardship and protection
- In Beaver Watershed, AR - for every \$1 spent on watershed stewardship and protection, the analysis showed there are \$7 achieved in benefits (including reduced treatment costs).

A.9 BREAKOUT SESSIONS - DISCUSSION & IDEAS

A.9.1 WATERSHED AND SOURCE WATER PROTECTION

- Todd Rasmussen talked about Lake Herrick example - was off-leash dog park, residential areas - most of contamination was coming off intramural ballfields (from RV's flushing their tanks) - so not typical pollution source and it was discovered accidentally.
- Does City of Athens have a source water protection plan? Yes but it may be out of date. Athens-Clarke County also has watershed protection plan related to their service area (for all discharges - but not related to NPDES, it's related to their growth). We also know that there is a State Comprehensive Water Basin Plan for the Oconee Basin - focused on water sustainability and capacity. EPD will be developing nutrient management plan for Lake Oconee and Lake Sinclair - will identify loads and sources, to set water quality standards. Also, Jackson County - also may have a plan (may not be a SWP plan). Clarke County may also have a plan for greenspace (want to maintain greenspace at 55 percent), find out if they have an impervious surface goal. Three councils involved - Upper, Lower (Altamaha), North Metro.
- It may be important for these plans to be connected somehow and not be independent of each other

- Bear Creek Water Authority - four county effort - they must have a source water protection plan. Idea to maybe grow the Upper Oconee watershed planning effort using this effort as a starting point? How many counties are involved? Maybe 13 counties which have county master plans (including Baldwin, Barrow, Clarke, Greene, Hancock, Jackson, Laurens, Morgan, Oconee, Putnam, Walton, Washington, Wilkinson). Idea is to not create a new bureaucratic monster but rather start from a smaller area and grow it as a pilot project.
- John Daniell - Upper Oconee Water Basin Authority driver is water supply for Bear Creek Reservoir. Hard Labor Creek Reservoir - new drinking water source just created.
- What is a source water protection plan? Kitty described source water protection plan process (fed, state, utility): assessment of protection area (including contribution zone and potential sources of contamination); development of priority actions including schedule and funding. There is funding available through various federal and state grant programs to develop or update source water protection plans.
- Ocmulgee Watershed is 96 percent forested, with higher peak flows than anywhere else in GA. It's a pristine forest but has the worst hydrologic behavior in the state. This is because of historic land use of those forests. Poor past management practices (or lack thereof). Protecting forests is not enough - have to manage forests for specific benefits. Partnership with NRCS and GFC and other land management agencies is really important.
- Land trusts typically don't have a lot of resources to do land management. Funding and resources aren't there, but they are an excellent partner to help raise funds and steward lands.
- In some watersheds, beavers have been a great solution to restore beneficial watershed conditions but property owners may worry about their land value.

- Water in Bear Creek Reservoir - is there a situation with water quantity or water quality? Severe drought might be a concern. 505 acres, 5 billion gallons of water stored, intake is drawing out 11 million gallons a day in August for four counties: Oconee, Barrow, Jackson, and Clarke counties. Who owns the land, how are they managing their land, what is the future of this watershed? Lower watershed is mostly forested, upper watershed is becoming urbanized. There will be a new transportation corridor through this watershed, likely will be increased growth and development. Figure out what primary threats are in this watershed and how to mitigate the impacts of those threats. Idea to set aside some forest protection between I-85 and City of Athens. Maybe approach county planning commissions? Counties have done their own plans too - we can help them understand impacts over time if they take no action.
- South Carolina Source Water Protection Plan - Todd R. helped with this. Different protection criteria for different zones. Priorities for land uses in each of those zones. Steep slopes near rivers had big impact on the rivers.
- North Carolina has statutes that relate to water supply watersheds/reservoirs - especially related to buffer zones and nutrient loading. Have specific nutrient standards for specific watersheds. Cities and towns are starting to take on responsibility for regulating these inputs now.
- Georgia - County planning isn't necessarily looking at the future of water, they are more interested in economic development and population growth. Local areas can take some actions to protect water but it's not necessarily a priority for them. Hard to get them to pay attention. What would it take for county to be more involved in this? Maybe they need more data.
- Lot of homeless people who live right along the North Oconee River - human waste issue. How to address this - encampments up and down the river. Maybe install com-

posting toilets? Seriously contaminated area on river along greenway. Garbage and human waste. Greenway isn't accessible to the public now.

- Todd - routine biological monitoring - looking for antibiotic and microbial resistant bacteria. Below hospitals and poultry plant. Sewers are leaking into local streams. What is solution? Sanitary sewer systems - need to figure out funding for improving sanitary sewer system.
- Is there one place that captures all the threats and issues and priorities for the Upper Oconee Watershed? Doesn't sound like it. Idea - to create a plan with all the data/info on threats and listing potential solutions/actions. Identify things that motivate people - and focus on these with public education/planning - what has raised red flag for people? Human health issues, fish health, HAB/dog deaths. Plan should focus on gradual actions for improvement
- Bear Creek Reservoir - has no significant water quality or water quantity concerns right now but what's the threshold of forest land conversion/loss before we start to get concerned? Idea to proceed like Savannah River Watershed did, and select a forest land percentage threshold.
- As development increases you will need to increase your buffers.
- Chase - sawmills moving out can have huge impacts on watershed. Figure out how to keep sawmills in your area to keep forest landowners there.
- Follow Up Action - look into Bear Creek Watershed area - conduct research on land uses, land use and population/development trends, opportunities to protect water quantity and quality? Maybe start with getting Todd Stevenson, Clarke County and his other three county counterparts in a follow-up meeting?
- Find out what makes it worthwhile for property owners to keep their property (particularly forest lands)? Survey landowners to find out what motivates them?

- Idea - state initiative to compensate forest landowners
- Figure out how to involve decisionmakers in this watershed - who is missing and how do we draw them in?

A.9.2 FUNDING AND FINANCING

- Central Arkansas Water implemented a \$.45 fee per drinking water meter per month to create the City of Little Rock's source watershed protection fund. Their water quality was declining. Funds are used to purchase land and conservation easements, primarily forested lands.
- City of Raleigh's drinking water fund protects the Upper Neuse River forested watershed for the city's drinking water supply. They charge \$.15 per 1,000 gallons of water used. They also partner with USDS, North Carolina Clean Water Management Trust Fund and local land trusts.
- City of Athens and other Upper Oconee Watershed drinking water customers might want to consider a source water protection fund. In one example, a fee of \$0.15/1000 gal/month would generate about \$400,000 annually for Athens-Clarke County. This number gets larger when applied to the four-county Upper Oconee Basin Water Authority.
- What about considering a Special Purpose Local Option Sales Tax (SPLOST)? The general consensus of this group is that the SPLOST is already too high in Athens at 8 percent. SPLOST comes up on the ballot for Oconee County in 2020.
- Idea to give voters the opportunity to vote on a watershed tax of some kind? Perhaps a ballot initiative to gauge interest from taxpayers (a non-binding referendum)?
- Group discussed whether the fund should be a water use fee or a tax - pros and cons to both

- Idea to let each county come up with their own funding mechanism, and it could be dual purpose (drinking water and recreation benefits)
- Idea to work with municipalities, UGA, and others to form a group to determine how to develop a watershed fund and what it would do
- GA EPD - has state funding each year for regional water plan implementation. Requires 40 percent match (10 percent cash match). Deadline is October 31st. Maximum funding allowed is \$75,000.
- 319 Nonpoint Source Funding - from GA EPD. Requires 40 percent match (doesn't have to be cash - can be in-kind). To be eligible, must be implementing a watershed plan.
- NRCS RCPP funding - the more partners involved, the more competitive the application will be. Can request financial assistance for conservation easements, developing plans, land conservation investments, landowner agreements. No match is required. Grant maximum is about \$1.5 million per application. Tina Jerome can help understand program and how to apply.
 - Consider credits for investing in forest land/green infrastructure as part of NPDES permit
 - NRCS also has land BMP funds available - they get more money each year and some of it goes unused.
 - Contact county offices that attended the Forum to discuss the Regional Water Plan Seed Grant
 - Barrow County
 - Oconee County
 - Athens-Clarke County

- Identify grant writing assistance and resources and contact them
- UGA Agricultural and Environmental Sciences Lab
- UGA Grant Writing Division
- Call EPD about Seed Grant application assistance once partners have been identified
- Identify other sources of funding and identify contacts at agencies
- NRCS
- RCPP
- 319
- Sustainable Forestry Initiative