

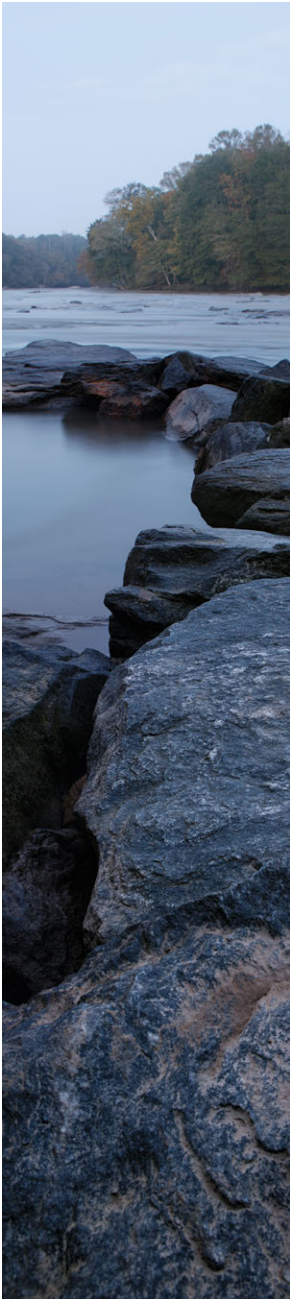


Filling the Water Gap:

**Conservation Successes
and Opportunities for
Communities that
Depend on the
Chattahoochee River**

CHATTAHOOCHEE
RIVERKEEPER®

Keeping Watch Over Our Waters



About Chattahoochee Riverkeeper, Inc.

Chattahoochee Riverkeeper's (CRK) mission is to advocate and secure the protection and stewardship of the Chattahoochee River, including its lakes, tributaries and watershed, in order to restore and conserve their ecological health for the people and wildlife that depend on the river system.

Established in 1993, CRK is an environmental advocacy and education organization with more than 9,300 members dedicated solely to protecting and restoring the Chattahoochee River Basin. CRK was the 11th licensed program in the international WATERKEEPER Alliance, now more than 340 organizations and affiliates strong. CRK was also a founding member of the Georgia Water Coalition.



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- Chapter 1 -

Introduction

Georgia just experienced one of the wettest years in history. Atlanta racked up 70 inches of rain in 2018 making it the second wettest year in the city's history.¹

The New Year brought rain all across the Southeast, filling reservoirs and rivers beyond their banks. With Lake Lanier and the Chattahoochee River running full, it is the perfect time to talk about water scarcity, how to plan for the next dry period, and how the metro Atlanta region can save between 14 and 22 million gallons of water per day. Excess rainfall and floods, ignoring climate change, and continued celebration of previous achievements can lead to complacency and a lack of action. If you need a recent example, think about South Africa.

Excess rainfall and floods, ignoring climate change, and continued celebration of previous achievements can lead to complacency and a lack of action.

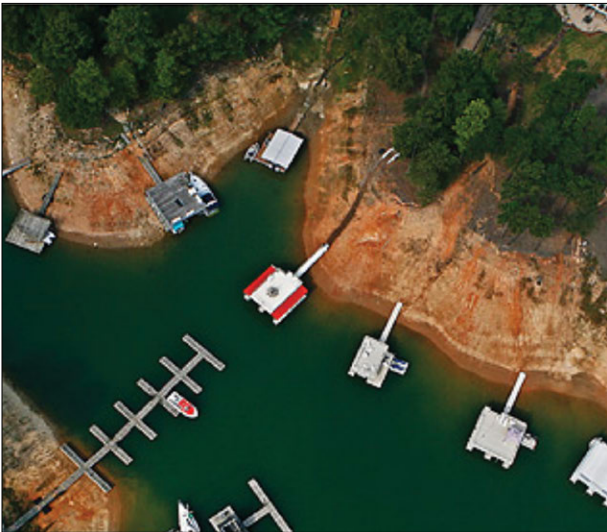
After three years of drought, Cape Town was running out of water in 2017. In response to dwindling surface water supplies in reservoirs, local officials implored residents to adopt a culture of conservation and announced that “Day Zero”—the day when the city would turn off the taps and 4 million residents would have to stand in line for a daily ration of 7 gallons of water—should be expected in April 2018.² The message was clear. If people changed the way they thought about water and their personal water behavior, then they could avoid a loss of control over their water use, and, as one top elected official explained, “anarchy.”³

The dire Day Zero threat and an aggressive public relations campaign convinced many residents to reduce their water consumption. Beginning in January 2018, individual residents were told to reduce household water use—eventually to 13 gallons per day (for reference, an average home in the southeastern United States uses between 130-165 gallons per day⁴). Agricultural water use was reduced by 60 percent, and in one case an agricultural association released storage from their own reservoirs to benefit municipal supply.⁵ The water utility immediately implemented aggressive water conservation and efficiency measures. They reduced the water system’s pressure, fixed leaks, and installed tens-of thousands of water management devices dubbed “aqua-locs” on individual water meters to restrict flow if consumption exceeded 2,700 gallons per

month (or half of what a home in the southeastern U.S. uses per month).⁶ After residents used body wipes or took lightning-fast showers, reused shower water to flush toilets, eliminated all outdoor water use in swimming pools and personal landscapes, and hauled water from natural springs, daily water consumption in the city and its suburbs dropped by 40 percent.⁷ As a result of the reduced water use, Day Zero did not arrive.⁸ Cape Town’s 2018 rainy season replenished the region’s six reservoirs—which as of publication of this report hold about 50 percent of total capacity—and personal water use remained limited to 28 gallons (105 liters) per person per day.⁹

There are many important caveats to this narrative, including how the legacy of racial

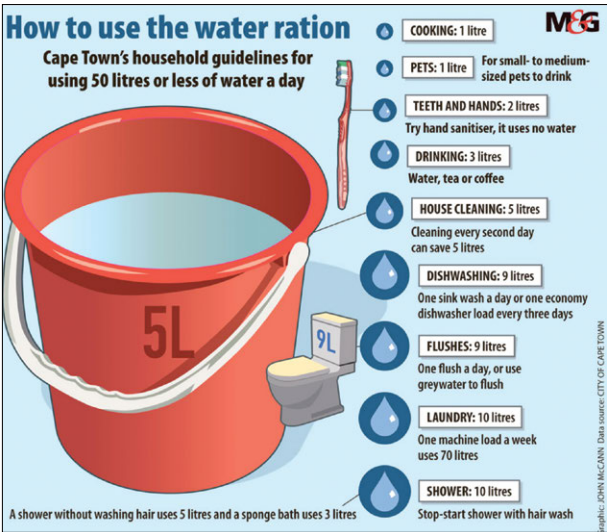
violence, inequity, and political infighting stoked fear and influenced the Day Zero communication campaign that produced results. The city—or more accurately, white and affluent South Africans—ultimately escaped Day Zero. While many individual residents implemented aggressive personal conservation measures, others—called the “borehole bourgeoisie” by one critic—drilled personal water supply wells and did not change their attitude or water behavior.¹⁰ And for the South Africans living in the majority black townships, many already lived on a daily basis what Day Zero threatened to bring to the rest of Cape Town. They were already accustomed to lines at central water-wells or living without indoor plumbing. For these South Africans, water conservation was a daily ritual and not a special requirement.



Lake Lanier, metropolitan Atlanta’s primary source of drinking water approaching a historic low point during the 2007 and 2009 drought. ([New York Times](#))



Theewaterskloof, Cape Town’s primary source of drinking water in 2016 (top) and 2018 (bottom) after losing 90 percent of its water supply. ([GeoVille](#))



The City of Cape Town developed these metrics when residents were asked to subsist on 50 liters (or 13 gallons) per day during drought in 2018. ([Mail & Guardian](#))

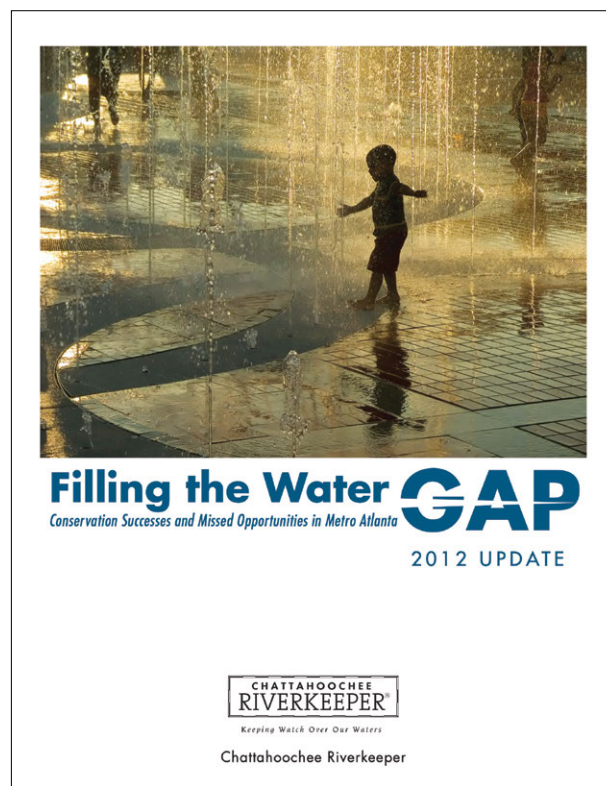
Finding more water for more people is like putting a puzzle together. Comprehensive water conservation programming and efficient water supply systems are major pieces of the puzzle. But at the end of the day, it will take leadership to change the way people think about water and their personal water behavior.

During the drought crisis and afterward, critics took the region's leaders to task for ignoring previous calls to plan for population growth, increased water demand, and the looming threat of climate change. As recently as 2007, a regional water study concluded that Cape Town and neighboring municipalities would need to find additional water supply by 2011 or 2015. At that time, water planners focused on reducing demand—like fixing pipes, water meters, pressure management, and other conservation and efficiency measures. According to one local expert, water demand was nearly flat for 18 years, and in 2013, above average rainfall contributed to a reduction in demand and outdoor water use. As a result Cape Town got an international award for water conservation efforts and addressing climate change in 2015. Then the drought began because it “forgot to rain,” which was followed by “Day Zero” and its consequences.¹¹

So what is next for Cape Town, dozens of other similar cities scattered all over the globe and their water supplies? Smart and forward thinking water planning matters. But Cape Town may have celebrated success too early and grew complacent. Aside from current plans to develop new groundwater sources and exploration of other supply-side options, Cape Town still has low hanging fruit to pick.¹² For example, the University of Cape Town has replaced sink faucet aerators and 238 clothes washers that will each save 26 gallons (100 liters) of water per wash.¹³ And even

regions that have managed water for over a century have come up short and learned lessons the hard way.

Back in the United States, California's elaborate and complicated water supply system—its diversity of water supply sources, dams, aquifers, reservoirs, and aqueducts—has been pushed to the brink on multiple occasions, most recently in a



seven-year event that ended in 2017. As one California planner reflected, “In the late ‘80s drought, we learned how much [water] we can save indoors. In this drought we learned how much [water] we can save outdoors.”¹⁴ Not unlike Cape Town, some of California's vulnerable rural residents were among those affected when their groundwater wells dried up as agricultural pumping sucked aquifers dry. In both cases global climate change is thought to be a contributing factor. A lack of rainfall in South Africa and reduced mountain snowpack in the western U.S. were critical factors to the droughts in both regions.

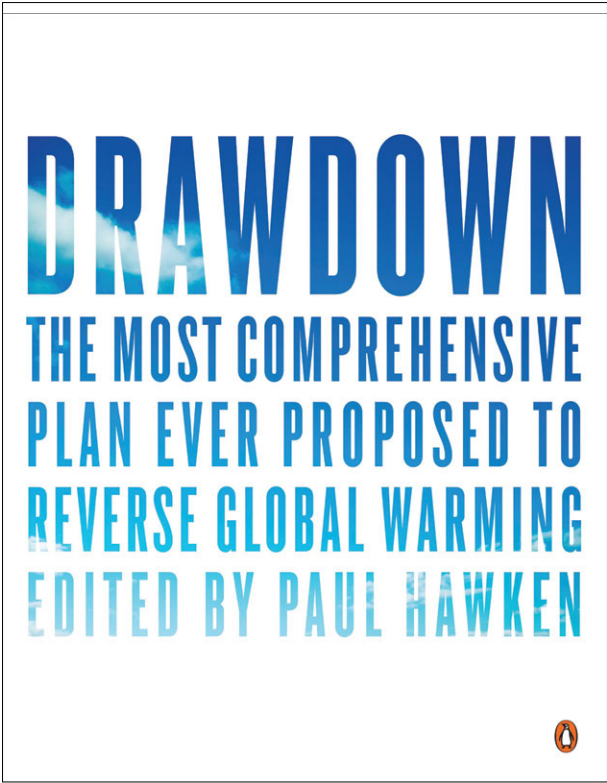
Finding more water for more people is like putting a puzzle together. Comprehensive water conservation programming and efficient water supply systems are major pieces of the puzzle. But at the end of the day, it will take leadership to change the way people think about water and their personal water behavior.

For Georgians who lived through the drought of 2007 and 2008, perhaps images of South Africa's dry reservoirs and stories of creative water conservation from Cape Town are familiar. After Georgia's record-breaking drought event, Chattahoochee Riverkeeper produced *Filling the Water Gap: Conservation Successes and Missed Opportunities in Metro Atlanta* in 2011 and 2012 to outline local water conservation efforts within the 15-county metro Atlanta region. This report highlights eleven jurisdictions—cities, counties, and water utilities—that rely on water sourced from the Chattahoochee River basin. Nine of the eleven jurisdictions—which have been showcased in previous editions of this report—are located in

the Atlanta region and are part of what is called the Metropolitan North Georgia Water Planning District. These entities source their water from Lake Lanier—a federal reservoir backed-up behind Buford Dam—and the Chattahoochee River or its tributaries. The remaining two communities—LaGrange and Columbus—source their water from two downstream Chattahoochee River reservoirs: West Point Lake and Lake Oliver, respectively.

The goal of this report is to highlight successes and opportunities to advance water conservation and efficiency in the Chattahoochee River basin and beyond. And the timing is perfect: the entire state is preparing to update all regional water plans, which were last revised in 2017. Furthermore, though the effects of climate change often seem distant, the Chattahoochee River is already feeling the heat. The changes being observed on the River are no surprise given that the Fourth National Climate Assessment identified increasing temperature and increases in extreme rainfall as critical areas of concern for our region. And, the most recent National Oceanic and Atmospheric Administration’s State Climate Summary asserted that “higher temperatures will increase the rate of loss of soil moisture during dry spells, which could lead to more intense droughts and increased competition for the state’s water resources.”¹⁵ Aggressive water conservation and efficiency at the local and regional level among municipal users that CRK has worked to promote is becoming increasingly important to address the impacts of climate change and adapt to prolonged drought conditions.

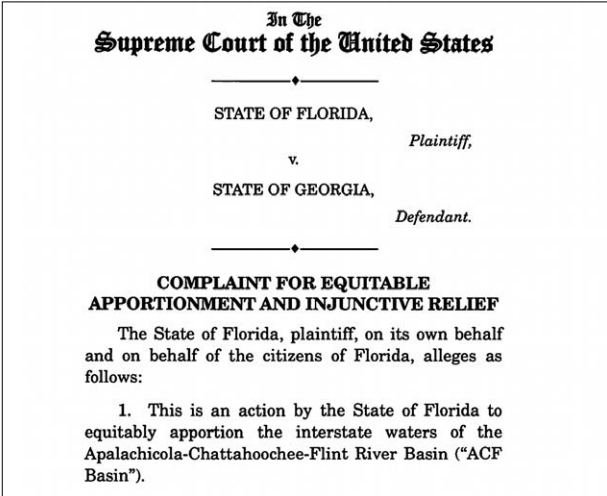
Water conservation and efficiency are essential tools that protect the natural and human



environment, and lead to a sustainable future. In a municipal context, water conservation and efficiency programs do more than encourage individuals to “think at the sink” when washing the dishes or brushing their teeth. As climate change expert Paul Hawken and his collaborators state in *Drawdown*, “water distribution efficiency can be put to work to address climate change and to cope with its effects.” Successful water conservation and efficiency programs reduce the demand for the withdrawal, pumping, transmission and treatment of drinking water and wastewater. Each of those steps requires energy and has a carbon footprint. By reducing water use and demand

among all users, and increasing efficiencies in the system, we use less energy and generate less carbon.¹⁶ This can all have a positive effect on the Chattahoochee River’s communities and environments.

After a review of utility water loss audits, current policy, and best practices in communities across the country, this report offers 11 recommendations to help put the water supply puzzle together as the state prepares to enter another round of regional water planning. These recommendations will succeed with a combination of individual action and leadership at the local, regional, and state levels. The outcome—reduced water use—will benefit our communities, economies, and hardworking Chattahoochee River. Above all, better water management will leave more water in the river for downstream users, support fish and wildlife, and reduce the chance for thirty more years of “water wars” conflict between Alabama, Florida, and Georgia.¹⁷





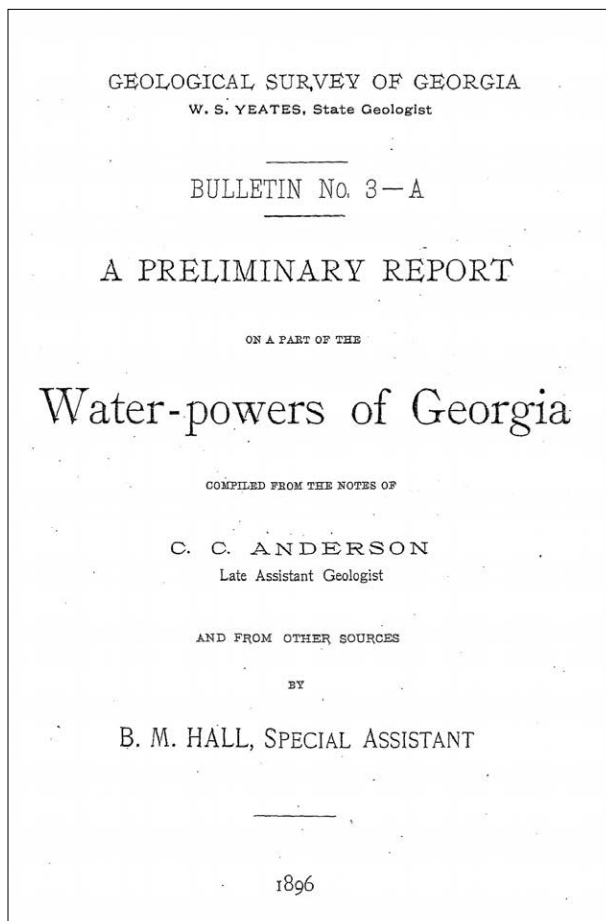
- Chapter 2 -

Water Planning in Georgia

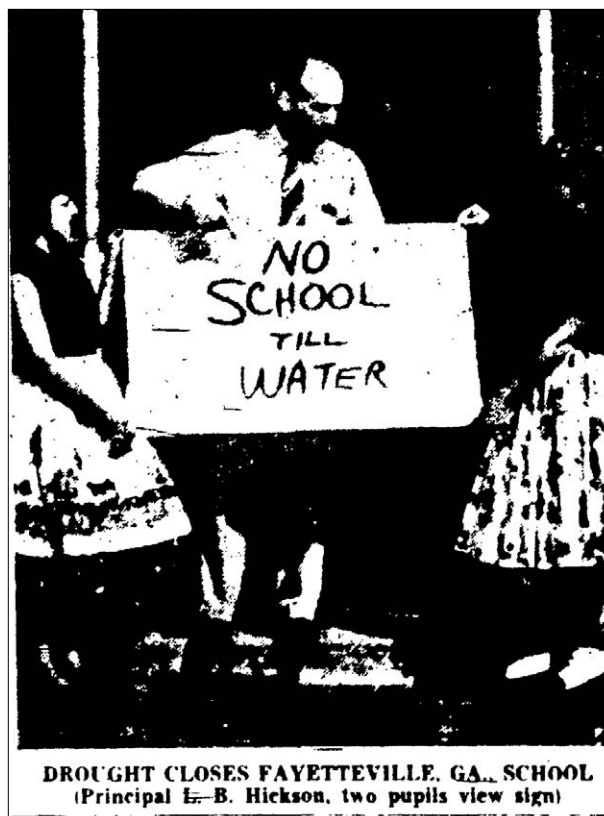
Georgians have spent a lot of time and energy assessing, evaluating, and measuring water resources. In short, there is a long history of water planning in the Peach State. Yet, for all this planning, we continue to remain captive to the politics of water scarcity.

The planning began when state and federal government experts completed three Georgia “water power” surveys between 1896 and 1921. They inventoried potential sites for dams to generate waterpower and hydropower, and began collecting flow data. Georgia Power and other energy producing entities eventually developed the most significant dam sites to electrify cities, streetcars, and factories. These reports were equally quantitative reports as much as they were marketing material that shared a dominant promotional narrative: Georgia had plenty of water to support economic development.¹⁸

The next major phase of regional water planning took place in the 1930s. The U.S. Army Corps of Engineers surveyed rivers all over the country, including the Chattahoochee and other southern rivers. At the time, the Corps expressed limited interest in building large dams, and remained focused on managing floods and navigation projects. Their mission soon evolved to include building big dams and reservoirs—like Buford Dam and Lake Lanier—after severe droughts in the following decades.¹⁹



The 1954 drought is one example that fundamentally changed Georgia's approach to state and federal water planning. Fayetteville city schools closed because of a lack of water. The City of Atlanta planned to implement draconian water conservation measures as the Chattahoochee River's level at the city's drinking water intake dropped. Crops withered statewide.²⁰ In response, Georgia's Governor assembled a committee of stakeholders represented by often competing



Source: "Emergency water shortages hit six Georgia Communities; Bremen situation is critical," *Augusta (Ga.) Chronicle*, October 6, 1954.

water users from the agricultural, municipal, industrial, and recreational sectors to figure out what happened and what to do for the future. The ensuing *Water in Georgia* report recommended a state-wide water plan and was cognizant of the state's diverse geography and varying local conditions. While they concluded that no one plan would solve all problems, they agreed planning was necessary to ensure upstream and downstream communities had equitable access to

clean water. To solve the state's water woes, the members recommended additional storage capacity, waste water treatment that would benefit downstream communities, and possible changes to state water law.²¹

The federal response to the 1950s drought included a multi-year investigation led by Columbus, Georgia's James W. Woodruff, Jr. In 1963, the U.S. Study Commission for Southeast River Basins completed a report with recommendations for comprehensive development—including plans for flood control, navigation, power generation, recreation, etc.—in eight river basins located primarily in Georgia but also shared by Alabama, Florida, North Carolina, and South Carolina.²² However, upon completion the commission was dissolved and the report was shelved. The report failed for multiple reasons. The Georgia Power Company—an influential actor in state affairs—wrote an extensive comment letter expressing displeasure with any increased federal river management and competition from federal hydroelectric power generation. Others expressed concern that the commission was another unwelcome interloper at a time when southerners actively resisted integration and the civil rights movement. Wrapped together, these reasons presented the commission as example of federal over-reach into southern affairs. At the core, states' rights trumped a chance for transboundary water planning in the New South.²³

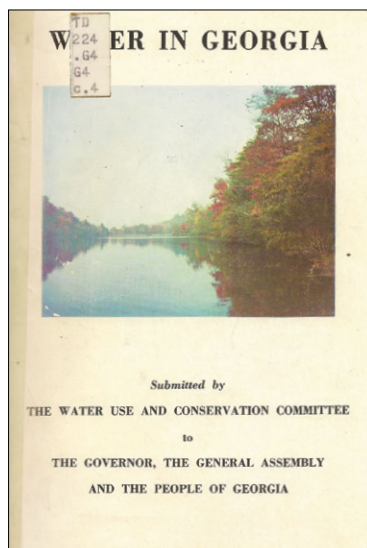
Decades and more droughts would pass before Georgia embarked on state-scale water planning. In 2004, the General Assembly created a Water Council to produce a Comprehensive Statewide Water Management Plan. This plan required

development of water use assessments and forecasts, and the creation of policy statements about water supply options. The process represented a step in the right direction, and in 2011 the state's ten Water Councils produced

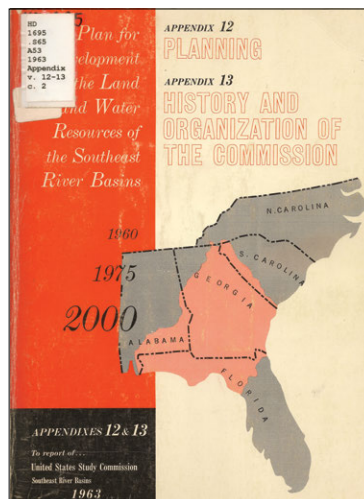
Georgia's first [Regional Water Plans](#) (which were revised in 2017). While the plans included regionally specific recommendations to improve water supply and quality, they remain hobbled by a lack of legal requirements or long-term funding

mechanisms to ensure implementation.²⁴ These are major weak points in the regional water planning process all across the state. Except in the metro Atlanta region.

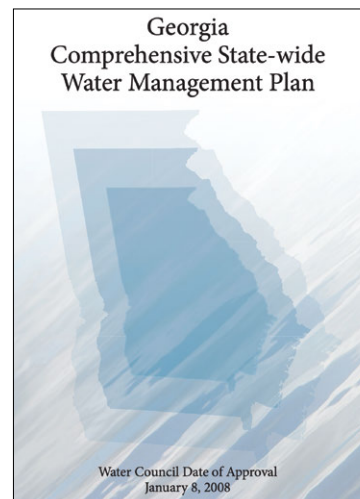
A brief timeline of Georgia water planning publications discussed in this report.



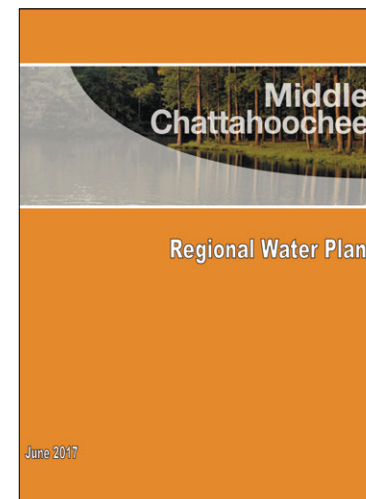
1955



1963



2008



2017

Recommendation 1:

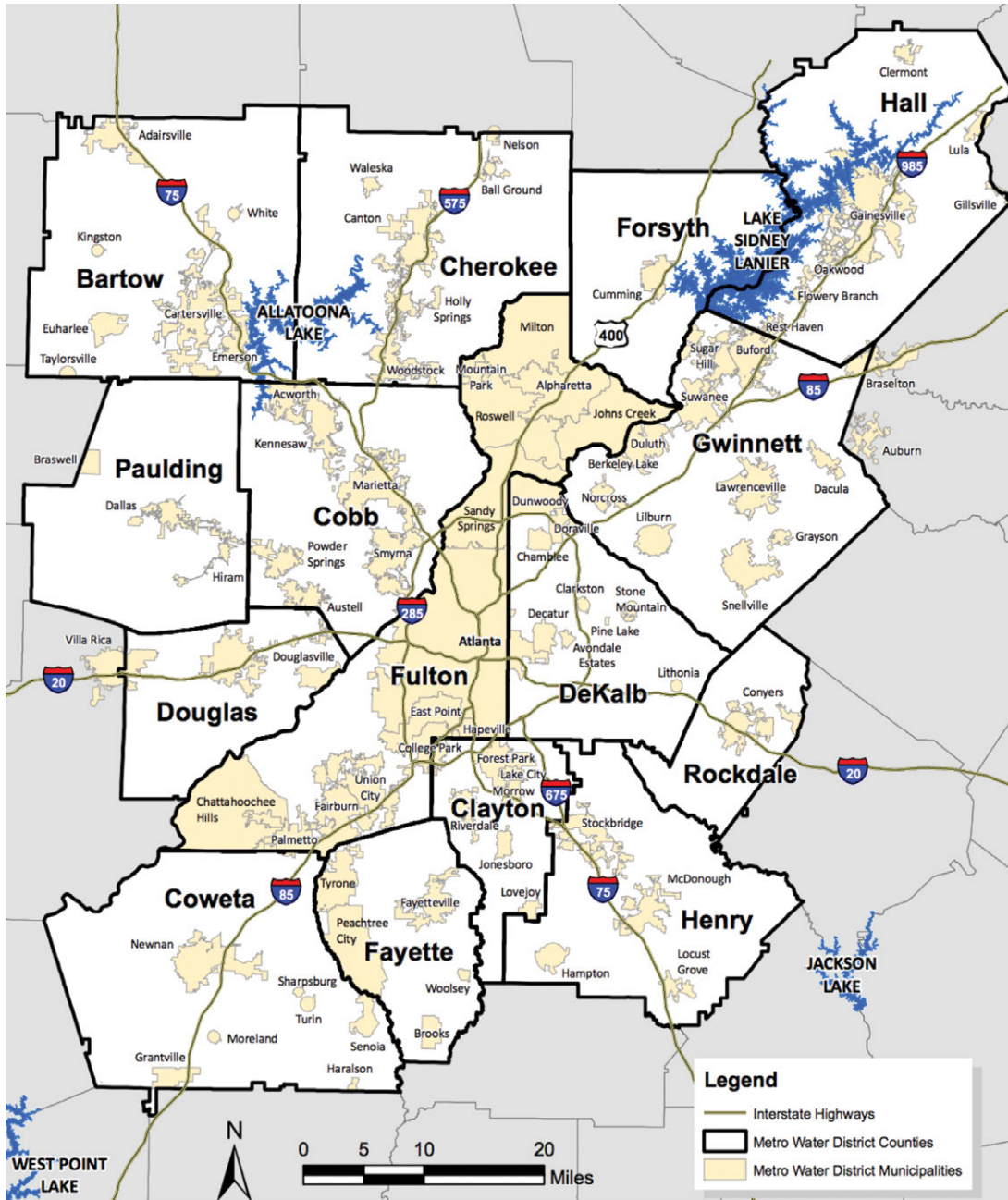
The Georgia General Assembly should empower Georgia's Regional Water Councils with statutory implementation authority and robust financial support.

The Metropolitan North Georgia Water Planning District

The metro Atlanta region actually preceded the rest of the state in comprehensive water planning in response to the “water wars” and the need to improve the Chattahoochee River’s water quality.²⁵

In 2001, the Georgia General Assembly created the [Metropolitan North Georgia Water Planning District](#). “The District” includes 15 metropolitan Atlanta counties and 93 municipalities serving a population of 5 million people. The District is run day-to-day by full time staff from the Atlanta Regional Commission and is guided by a Governing Board. Funding comes from the state legislature and from member municipalities and utilities.²⁶

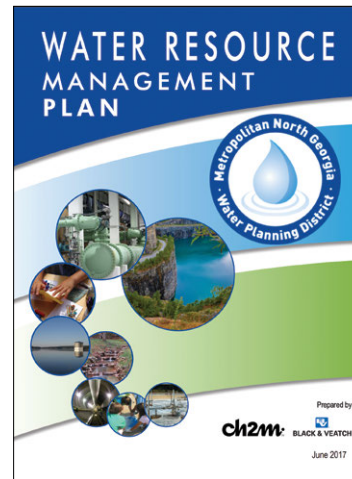
Since 2001, the District has published three water management plans. The first two, completed in 2003 and 2009—consisted of three-volume sets including plans for water supply and conservation, wastewater, and watershed management. In 2015, the District launched a revision process to coincide with the *State Water Plan* and regional water planning process underway all over Georgia. This culminated in release of the District’s new integrated [Water Resource Management Plan](#) in 2017.²⁷



How is the District's water plan implemented?

Ultimately, implementation takes place at the local and utility level. With stakeholder input, the District develops the plan's required action items for implementation by local governments, and water and wastewater providers. Additionally, the Georgia Environmental Protection Division (EPD) audits the local governments and water and wastewater providers to determine compliance. Demonstrated non-compliance may result in EPD delaying issuance of water withdrawal and wastewater discharge permits, or restricted access to state financing (for example, Georgia Environmental Finance Authority loans).

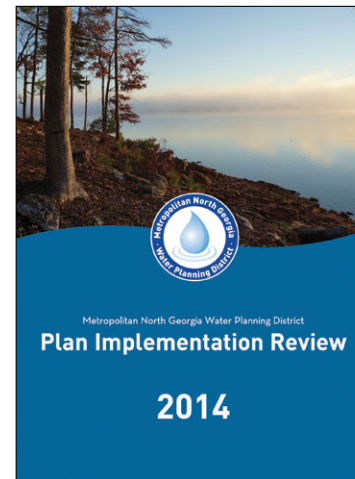
The District also conducts semi-regular surveys and compiles results in *Plan Implementation Reviews* to determine levels of compliance with action items.²⁸ The review and survey process has been underway since 2004 but does not take place every year. Reviews took place nine times between 2004 and 2014. When the District launched the drafting process for the *Water Resource Management Plan* in 2015, the District stopped conducting surveys. After revision was completed in 2017, the District sent out surveys in mid-2018.



Responding to and submitting the survey is voluntary. In 2014, the vast majority of 105 jurisdictions returned complete surveys. Only 9 returned partially complete surveys, and 24 did not return surveys.²⁹ Analysis of the 2014 survey yields many questions and areas for improvement.

Should the District's surveys be mandatory?

If the surveys were required, the District might discover problems earlier. For example, Grantville, a small city widely known as the set for *The Walking Dead*, is home to about 3,000 residents. The city purchases water from the Coweta County Water Authority. While the city is located within



the District, Grantville did not complete Plan Implementation surveys in 2013 or [2014](#), so it was not clear if the community implemented water loss reduction measures as required by the District. In 2016 and 2017, the community conducted a water loss audit and discovered significant loss of water: 39% of the drinking water the city purchased from Coweta County was lost to leaks in the city's water distribution system.³⁰ This was four times one industry benchmark for water loss.

The survey results prompt another question: are District communities fully complying with the Georgia Water Stewardship Act of 2010? The Water Stewardship Act requires all new multiunit residential buildings constructed after 2012 to include sub-meters for each unit. Unfortunately, the survey responses include incomplete information regarding local level implementation of this state requirement. This and other examples, cast doubt that the Water Stewardship Act is being fully implemented in the fast-growing metro Atlanta region as well as the rest of the state almost ten years after it was signed by the Governor.

Recommendation 2:

The District should require completion of Implementation Surveys that focus on implementation of the Water Stewardship Act.



- Chapter 4 -

Water Use, Costs and Efficiency

According to a report produced by the Georgia Environmental Finance Authority and the University of North Carolina Environmental Finance Center, a residential home in the Southeast consumes an average of 4,000 to 5,000 gallons of water every month (or 130 to 165 gallons per day). When all the human resource, maintenance, and energy costs that go into making drinking water are considered, it is affordable. For example, a gallon of water costs about \$1.00 in the local grocery store. From your tap, it costs about \$0.0054 per gallon on average to pay the costs necessary to withdraw raw water from a source like the Chattahoochee River, transform river water into drinking water, and pump it to a residential kitchen sink, toilet, shower, clothes washing machine, and outdoor garden or lawn.³¹

Access to clean water is necessary for individual and community health, and running a water system costs money. Low-cost water can have negative consequences for a utility and its community. According to one study, 45 percent of Georgia water and sewer utilities “did not generate enough revenue during the year to pay for their day-to-day operations and maintenance expenses and account for future” investment in new infrastructure like water pipes and treatment facilities.³² This indicates that some utilities are only focusing on operations and maintenance, or on future planning, but not necessarily both.

Water supply, quality, and the costs involved are all connected to water efficiency and conservation. Utilities can structure consumers' bills to encourage wise use of water. Water providers in the District are required to use what is called an "increasing block" rate structure to send an economic signal to customers and encourage a reduction in water use.³³ Put simply, above a minimum threshold a customer who uses more water pays more money.

But not all increasing block rate structures are the same and may not send a conservation signal to customers. Water providers and utilities discussed in this report have rate structures based on consumption levels between two and five blocks, and customers can use between 2,000 and 10,000 gallons of water before beginning to pay a higher rate. Information about each water provider's and utility's "Conservation Pricing" can be found in the Performance Dashboard section of this report, beginning on [page 34](#).

For example, the City of Atlanta's customers can use up to 2,244 gallons of water a month in the first of three blocks before paying more. In Cobb County, a customer can use 3,000 gallons in the first of five blocks. Gwinnett County's block rate structure is similar to Atlanta's but has a much

Water conservation and efficiency can have positive effects on the budget and the bottom line. These initiatives can also save rate payers money in the long run and eliminate the need to develop new supply sources.

higher threshold: a customer can use up to 8,000 gallons before moving into the second block and paying significantly more for additional water. Furthermore, rate structures in Atlanta, and Douglas and Gwinnett counties indicate that customers are more likely to spend far more money for the water they use than those in other counties in the basin.

Two jurisdictions located outside of the District have different rate structures. For example, Columbus Water Works has a two-block rate structure; after a consumer uses 11,220 gallons in the first block, a higher rate kicks-in in the second block. According to one report, LaGrange relied on a declining block rate until recently. According to a 2017 survey, LaGrange has operated with a uniform rate, which means customers pay a flat rate for water regardless of how much water they use or conserve. This type of rate structure is not designed to encourage water conservation and is an example of a rate structure that may not be implemented in the District.³⁴

Historically, utilities were in the business to sell as much water as possible. The old business model

did not want to encourage customers to conserve because such action resulted in lower water use and thus reduced utility revenue. Today, a number of factors have changed the old business plan. A growing customer base that uses less water due to more efficient plumbing fixtures and appliances, more frequent droughts, and the high-cost of developing brand new water supplies has begun to bake water conservation and efficiency into a new business model. These trends are evident in many metro Atlanta communities.

Water conservation and efficiency can have positive effects on the budget and the bottom line. These initiatives can also save rate payers money in the long run and eliminate the need to develop new supply sources. For example, between 1996 and 2016, the City of Los Angeles's water conservation programming and innovative rate structures avoided \$11 billion in costs necessary to secure additional water supply as the city grew. Additionally, water bills were reduced by over 25 percent and the city's "long-term water sustainability" improved.³⁵

Recommendation 3:

The District and the State should investigate the effectiveness of conservation rate structures to determine if they are sending the appropriate "conservation signal."



- Chapter 5 -

Georgia Water Loss and Control Audits

One of the best ways to address how a system operates is to conduct an audit to assess how much water customers are using, evaluate a utility's billing process, and determine how much water is leaking out of the system.

Beginning in 2011, large Georgia utilities were required by state law to conduct annual water loss and control audits. The Performance Dashboards, beginning on [page 34](#), provide a snap-shot of the water provider's "Water Loss and Control Audit Results" discussed in this report.

Many water providers in Georgia have been conducting water loss audits for more than a decade. But after the General Assembly enacted the 2010 Water Stewardship Act, every water utility in Georgia serving 3,300 or more individuals was required by law to conduct and submit a water loss and control audit to the Georgia Environmental Protection Division. Under this legislation, utilities have been conducting water loss audits statewide since 2011 and seven years of data are publically available.

In general, the more data a utility collects, the better a road map they are creating for improving water conservation programing and operational efficiency.³⁶

What do audits tell us?

It's important to understand that comparing audit results among providers and utilities is fraught with problems. Every utility is different: the age and size of the system; the number and type of customers (for example, residential v. commercial customers); the quality of a water source will affect treatment costs; terrain affects pumping costs, etc. In other words, comparing one utility to another is not necessarily a useful exercise. The value lies in establishing a good baseline and then comparing the utility to itself over multiple years to begin spotlighting the good practices and results, and the areas in need of improvement.³⁷

An audit's "validity score" is a good overall assessment of an individual utility's operations. The score is "a rating of a utility's confidence and accuracy of data" in the audit "on a scale from zero to 100." While the score is out of 100, it is important not to think about the value as an "A" or "D." A score of 50 and below indicates a utility has a fair amount of work to do including assess water loss control procedures, data collection, and system operations. A score of 50 to 70 indicates a utility has enough data and information to begin long-term goal and target setting. A score of 70 and above indicates a utility can begin refining water loss data collection procedures, conduct detailed budget and project planning, and establish five-year goals.³⁸

Water Loss

There are two kinds of "water loss" that matter. The first is "apparent water loss," which is defined as unauthorized or unbilled consumption, customer metering inaccuracies, and systematic data handling errors. For example, fire hydrant flushing, water use on construction sites, or in parks without metering devices, and possible water theft all represent apparent loss. In these situations fixing leaking physical infrastructure is not the first place to begin fixing the system. Many of these losses are paper losses that can be reconciled and, with proper categorization, recovered. These desktop and back office errors

would necessarily be the first line of fixes before undertaking expensive infrastructure projects in the field.

The second kind of water loss is "real loss." These losses are real: physical leakage from water pipes and mains, service lines, and loss of storage. This type of loss would indicate a need to fix physical infrastructure. These fixes would undoubtedly cost a lot but ultimately improve revenue collection.

In short, these two types of water loss data can help pinpoint where a utility should focus resources to fix water loss. In the past, real loss in excess of 10 percent was considered above the industry norm. Today additional benchmarks are used to assess a utility's water loss. For example the District's "Water Loss Control and Reduction" action item asks water providers to assess the relationship between the density of connections per mile of water mains and real losses. The water provider is then expected to use their 2013 Water Loss and Control Audit as a baseline to establish a 2050 water loss reduction goal.³⁹

General Observations

Water loss is an issue everywhere. And water loss audit data for each individual water provider and utility discussed in this report between the years 2011 to 2017 indicates some clear trend lines. Newer systems like Gwinnett County lose less water than older systems like the cities of Atlanta and Columbus. But smaller systems—like Gainesville and LaGrange—also have water loss issues.

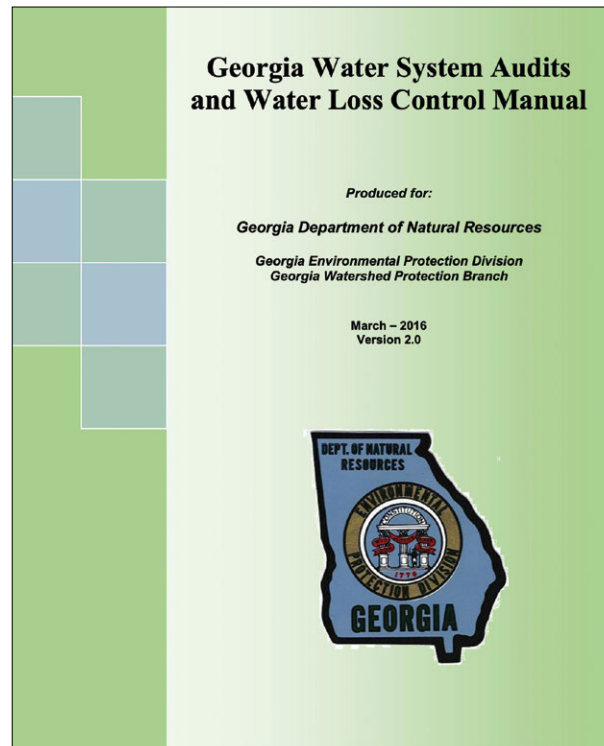
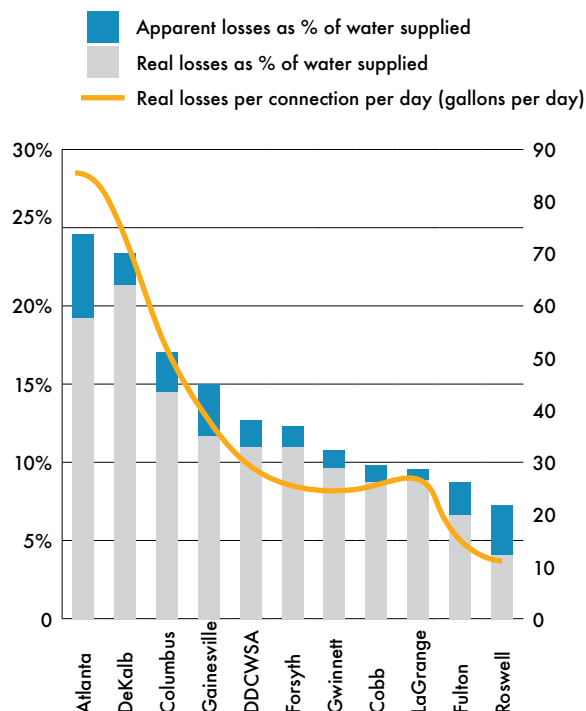


Figure 1. Water Loss in 2017



This graph illustrates two water loss metrics for eleven Chattahoochee River basin water suppliers in 2017. The bar graph demonstrates water loss as a percent of water supplied. The line graph indicates real water loss per connection per day.

For the year 2017 and among the utilities investigated, the City of Atlanta's and DeKalb County's water systems, which are among the largest and oldest in the Chattahoochee River basin, have real losses of about 20 percent. [See Figure 1] That means about one-fifth of the water that is withdrawn from the Chattahoochee River and treated to drinking water quality standards is lost to leaky pipes before reaching customers. Douglas and Forsyth Counties, and the cities

The District has made strides in water conservation while Atlanta's population has grown. However, a reduction in per capita water consumption alone is not the same as a reduction in overall water use or withdrawals from the river. Other factors are at play.

of Gainesville and Columbus experienced real losses of between 10 and 15 percent. And the remaining five jurisdictions—Gwinnett, Cobb, and Fulton counties plus the cities LaGrange and Roswell—had real losses of less than 10 percent. It is important for a system to determine where it is losing water. That is the strength and benefit of Georgia's required water loss auditing. As discussed in the previous section, public water systems can struggle financially, so knowing if, where, and when to invest limited resources is critical.

Since the City of Atlanta began conducting water loss audits as required by the Georgia Water Stewardship Act, real losses increased while apparent losses decreased between 2013 and 2015. On the one hand, the reduction in apparent loss indicates the city has improved account management and tracking down unaccounted for water loss (i.e. fire hydrant flushing). On the other hand, the over 100-year old system continues to leak. As noted in the city Auditor's 2017 report titled *Performance Audit: Department of Watershed Management Efforts to Reduce Water Loss*, the city lacks a finalized water loss control plan.⁴¹

A water loss control program would indicate how a utility manages leak detection, verifies meter operations (flow verification, testing, and calibration), and recovers associated lost revenue. The city anticipates finalizing a water loss control program before the end of the 2019 calendar



year. However, the Georgia Water Stewardship Act required utilities to implement water loss programs and expected implementation before July 1, 2016. This is another example of the Water Stewardship Act's broad scope and promise, but also a potential lack of full implementation by a District utility nearly a decade after the act was signed by the Governor. It is unknown how many other utilities in the District or the state also lack a formalized water loss control program as required by state law.

The District has also made strides in water conservation while the Atlanta region's population has grown. However, a reduction in per capita water consumption alone is not the same as a reduction in overall water use or withdrawals from the river. Other factors are at play.

For example, per capita water use in the District dropped below 100 gallons of water use per capita in wet years like 2013 and 2015. In drought years, the per capita water use climbed above 100, as it did in 2012 and 2016. [See Figure 2]

The District’s average low of 97 gallons per capita day (gpcd) in 2013 coincided with a year that received significantly more rainfall than normal—66.02 inches according to the National Weather Service’s Atlanta station. What does this mean? In 2013, the metro Atlanta region received nearly 20 inches more rainfall than the thirty-year average. In 2013, with more rain falling from the

sky, fewer customers were watering outdoors—which is among a typical household’s highest water use activities. Conversely, in 2016 per capita water use climbed when annual rainfall in Atlanta dropped to 38.7 inches, utilities reported high volume outdoor water use by end users, and Georgia’s Environmental Protection Division was slow to initiate a drought mitigation response by implementing more restrictive outdoor water use requirements.

Average water withdrawals by the nine District water providers discussed in this report have decreased between 1996 and 2016, as indicated

by the trend line in Figure 3. However, there appears to be a slight increase in the volume of average withdrawals for the same nine utilities between 2010 and 2016 as indicated by the trend line in Figure 4.⁴² The Performance Dashboards, beginning on page 34, provide a snap-shot of the annual rainfall in a water provider’s region and their withdrawals (“Water Use”).

The water loss audits do reveal a similar trend. To determine how much water a system is losing, a utility begins the calculation with the quantity of drinking water that enters their system and is delivered to customers. The audits considered

Figure 2. District Annual Per Capita Water Usage and Total Rainfall in Atlanta

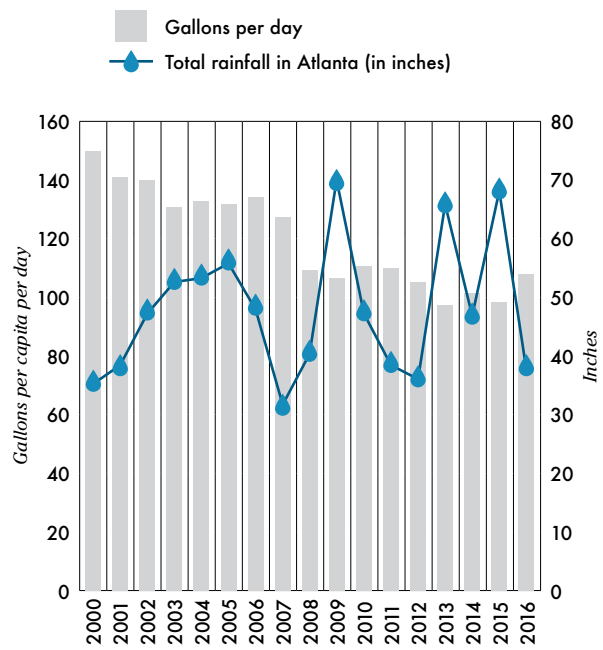


Figure 3. Average Water Withdrawals for Nine District Utilities, 1996-2016

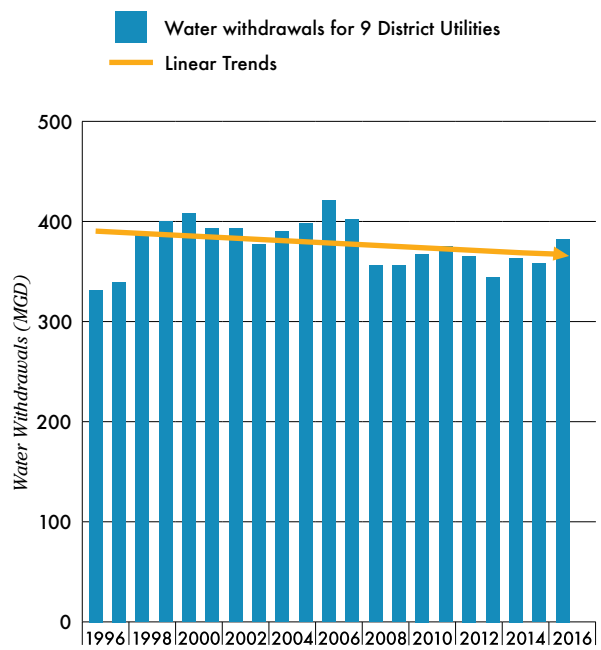
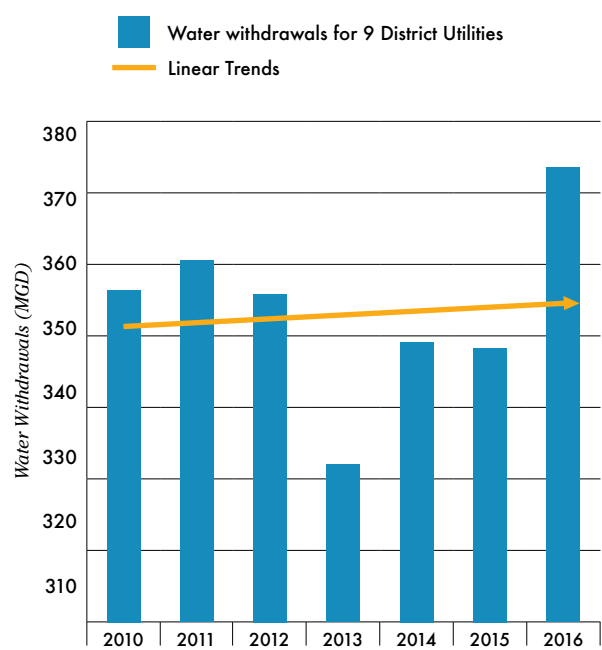


Figure 4: Average Water Withdrawals for Nine District Utilities, 2010-2016



for this report indicate a trend of increased “water supplied” between 2011 and 2017 in Cobb, Douglas, and Forsyth counties plus the City of Gainesville. [Figure 5 and 6]

The state has more tools to help water providers control water loss. The Georgia Environmental

Protection Division (EPD) analyzes water withdrawal data and water loss audits when a community requests new or modified permits to withdraw water from the state’s reservoirs and rivers, including Lake Lanier and the Chattahoochee River. In 2018, EPD determined that Forsyth County’s summer withdrawals

were very high. EPD issued a new permit that includes specific and enforceable requirements for water loss reporting and planning including a timeline for implementation. These conditions will insure a permittee complies with the Georgia Water Stewardship Act, demonstrates measurable progress, and continues to make reasonable use of the state’s water resources. Tools that specifically define progress will clarify expectations and timelines to benefit the state’s valuable water resources.

Figure 5: Forsyth County Water Supplied (Million Gallons/Year)

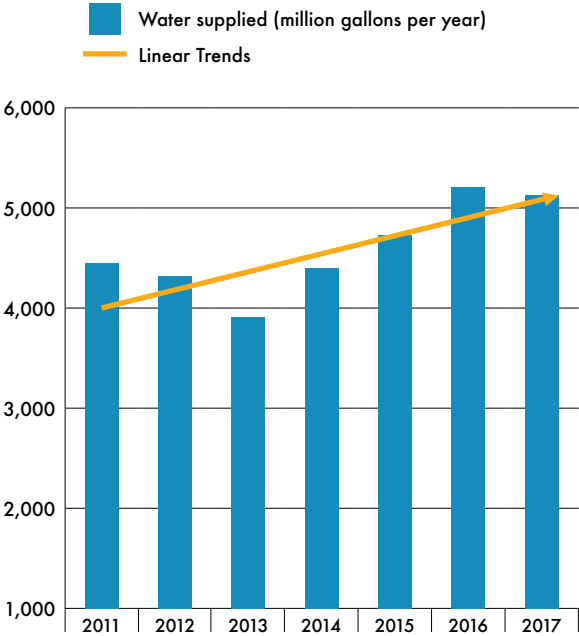
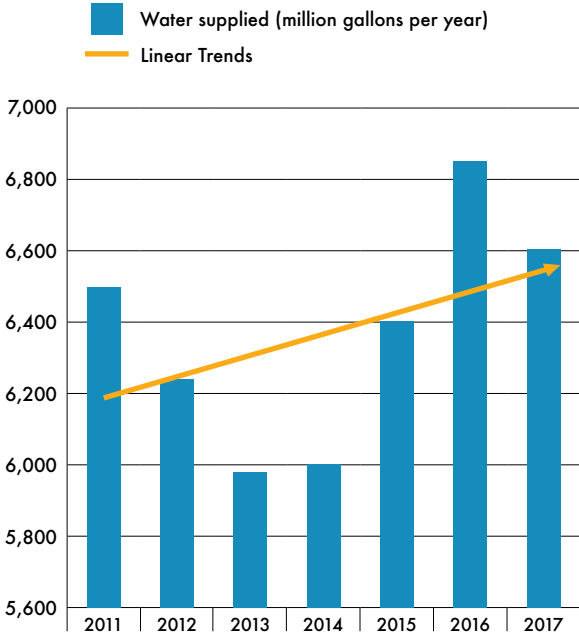


Figure 6: City of Gainesville Water Supplied (Million Gallons/Year)



Recommendation 4:

The Georgia Environmental Protection Division and the District should do more to ensure water providers are in compliance with the Georgia Water Stewardship Act.



- Chapter 6 -

Where Can We “Find” More Water?

Designing and building a new water supply source can take a decade or more, require considerable financial resources, and negatively impact stream flows and downstream users. Communities should instead consider initiatives that will “find” more water in our existing supply and delivery systems. We can find more water in plumbing fixture and appliance efficiencies, plumbing code updates, commercial water use auditing initiatives, cooling tower research, and incentives to reduce outdoor water use.

Toilets

The toilet is the highest user of water inside the home. According to a 2016 study, toilet flushing makes up about 24 percent of total indoor household water use. Given the high volume of water used by toilets—with an average of 5 flushes per day and up to 33.1 gallons per household per day, significant attention and resources have been focused on replacing inefficient fixtures with higher-efficiency toilets.⁴³

We can find more water in plumbing fixture and appliance efficiencies, plumbing code updates, commercial water use auditing initiatives, cooling tower research, and incentives to reduce outdoor water use.

New toilet designs have dramatically reduced flush volumes from the 7.0 gallon-per-flush (gpf) range of the 1950s to modern commodes with flush rates of 1.28 gpf. As a result, flush volume has decreased 29 percent since the late 1990s. In the 1990s, 8.5 percent of homes had average toilet flushes of less than 2.0 gpf, but by the mid-2000s, “37 percent of homes had average toilet flushes less than 2.0 gpf.”⁴⁴ This is an excellent trend.

[Since 2008](#), metro Atlanta jurisdictions have offered residents and customers monetary payment or bill credits to replace older 3.5 gpf toilets with 1.6 gpf (or better) high efficiency WaterSense labeled fixtures. As of January 2019, “135,000 old, inefficient toilets have been replaced with low-flow and high-efficiency models....This has resulted in a savings of 2.4 million gallons of water a day” over ten years, according to the District.⁴⁵

It’s also worth noting that in 2008, DeKalb County became the first county in the District to require a toilet retrofit-on-reconnect where any “residential properties built prior to 1993 in unincorporated DeKalb County must have low flow toilet and plumbing fixtures installed upon resale before the new homeowner can obtain water service from the County.”⁴⁶ The District has not required other

metro Atlanta communities to institute the same retrofit-on-reconnect initiative.

When it comes to toilets, have programs encouraging toilet replacements and rebates in metro Atlanta reached a peak? How many older, inefficient toilets are out there waiting to be replaced by new high efficiency toilets? The answers and the District’s data are not clear. In 2011, the District estimated that there were more than 615,000 residential homes in metro Atlanta predating 1993 still in need of retrofits.⁴⁷ If we assume an industry accepted 2% rate of retrofit (or about 11,000 toilets per year) over seven years, than approximately 523,000 homes could still have toilets eligible for retrofits. And it could take another decade to replace those toilets. But a direct installation, as soon as possible, of one toilet in each of these homes could yield between 9.7 and 5.8 million gallons per day in water savings depending on the flush rate of toilets in need of replacement.⁴⁸

What about multifamily apartment buildings? How many pre-1994 structures are out there in metro Atlanta ripe for toilet replacement? In the last few years many jurisdictions have implemented rebate programs for multifamily housing toilets, which would indicate the need exists. Clarity on the

number of eligible single-family and multifamily residences in the District and other communities in Georgia would go a long way to knowing how much water can be found.

The District’s revised water management plan includes an estimated percentage “for existing types of toilet fixtures by county.”⁴⁹ And an Alliance for Water Efficiency report estimates that natural replacement of existing inefficient toilets at a national level “could be achieved by the year 2032.”⁵⁰ While the Water Resource Plan does account for a 2% natural replacement rate, the District does not have a projected date in mind for when the region’s natural replacement may be achieved.⁵¹

In a place like the City of Atlanta where water loss is high, the natural rate of replacement may be higher than average given the number of single family home renovations and tear-downs. For example, there are a lot of vacant houses on the city’s west side that when renovated, will become more water efficient. That said, it would be helpful to have an understanding of the number of older, occupied homes that could be targeted district-wide.

Recommendation 5:

The District should clarify the toilet stock in need of replacement and determine a timeline for natural replacement. And if that timeline is lengthy, then the District should determine how to speed the process along.

State Plumbing Code Revisions Can Generate “More” Water

The toilet is not the only plumbing fixture that has been engineered to conserve and efficiently use water. Following the toilet, the second most consumptive indoor household fixture is the showerhead, which can represent up to 20 percent of total household use, or 28.1 gallons per household per day (gphd). Next is the bathroom and kitchen faucet, which can use up to 19 percent (26.3 gphd).⁵²

Georgia’s current plumbing code already includes efficiency standards for a number of fixtures including showerheads and faucets. [See Table 1] The volume of use is measured in gallons per minute (gpm). According to District research, if the current standards were revised to reflect new, more efficient technologies, than the water savings would be significant. If the code were revised and retrofits immediately implemented, then the District would save “approximately 4 billion gallons per year (10.96 million gallons daily) compared to using fixtures that only meet the current efficiency standards.”⁵³

It is quite obvious where we can find more water. Replacing a single toilet in homes with two residents could potentially “find” between 11.6 and 19.4 million gallons per day. If we also replaced a showerhead, a kitchen faucet, and a bathroom faucet, we could add 2.7 million gallons per day in savings and achieve between 14.3 and 22.2 million gallons per day.

Table 1.
Plumbing
Fixture
Standards ⁵⁴

Plumbing Fixture	Current Standard	New Efficiency Standard
Showerhead	2.5 gpm or less	2.0 gpm or less + WaterSense
Bathroom faucet	1.5 gpm or less + WaterSense	1.2 gpm + WaterSense
Kitchen faucet	2.0 gpm or less	1.8 gpm or less

Commercial Water Use

While there is good reason to focus on indoor residential water use, there is more low-hanging fruit out there. Commercial and institutional water use can vary widely among schools, medical providers, hospitals, restaurants, hotels, grocery stores, offices, etc. The size of a building, the type of onsite activity, the number of occupants, and other variables will influence commercial water consumption.

The District now requires all local water providers to identify and work with the highest volume commercial customers to conduct a water use assessment.⁵⁵ Unless a structure or building is only a few years old, it is highly likely that a water and energy assessment will generate recommendations to change plumbing fixtures, improve heating and cooling systems, and alter operations that will save money and water. Based on two local initiatives, we know assessments will result in water conservation and financial savings.

The first initiative, formally known as Grants to Green and now known as [GoodUse](#), targets non-profit operations in the Atlanta region. The goal is to help non-profit grantees find financial and utility savings that can be redirected into operations and

Recommendation 6:

The Department of Community Affairs should revise the state plumbing code without further delay to make sure Georgia remains a leader when it comes to water conservation and efficiency.



Investing in resource
efficiency for nonprofits.



ATLANTA
BETTER BUILDINGS
CHALLENGE

program delivery. Grantees like the Woodruff Arts Center, the Boys and Girls Club of Metro Atlanta, the Salvation Army of Metro Atlanta, the Atlanta History Center, the Georgia Trust for Historic Preservation, and dozens of other non-profits received grants to conduct water and energy use assessments of their facilities. Inevitably, many of the grantees discovered wasteful plumbing fixtures, poorly operating heating and cooling systems, swimming pool leaks and other operations that simply wasted water, energy, and money. After completing the assessments, the non-profits were eligible to tap a second grant source to implement recommendations. Between 2008 and 2017, program grantees saved nearly

30 million gallons of water, which is enough to fill 45 Olympic-size swimming pools.⁵⁶

The second initiative is the Atlanta Better Buildings Challenge.⁵⁷ Launched in 2011, the [Atlanta Better Buildings Challenge](#) has a goal to reduce water and energy consumption in the city's commercial, institutional, and other buildings by 20 percent by 2020. Participants—property owners and tenants—take part voluntarily in the program. They pledge to improve water and energy consumption by tracking and reporting use, and implementing conservation and efficiency measures to meet their individual goals. Since the program's inception, more than 1.3 billion gallons of water have been saved by participants including the Morehouse School of Medicine, the Atlanta Neighborhood Charter School, Emory University, the Grand Hyatt Buckhead, and dozens of others sites.⁵⁸

These two programs highlight an opportunity for metro Atlanta to move beyond the single-family toilet rebate program which is often cited as one of the region's primary tools for achieving reductions in water use. Commercial and institutional water use reduction has the potential to generate massive water savings in the metro Atlanta area and Georgia.

Comprehensive water conservation programs that engage all water customers are clearly effective and will generate water savings while building a culture of conservation.

Far from Georgia, other regions offer examples of how water conservation programs can be more comprehensive. For example, the Saving Water Partnership has an extensive water conservation program. The Partnership—comprised of 19 water utilities serving 1,300,000 people in Seattle and the surrounding county—offers rebates to owners of commercial properties to encourage retrofits and upgrades of plumbing fixtures in addition to commercial kitchen, medical, laundry, and residential irrigation equipment. In 2017, the Partnership spent \$1.8 million on program implementation. Additionally, the Partnership set a goal to reduce average annual retail water use to 105 million gallons per day by 2018 and surpassed the goal in 2017 when customers used 96.6 million gallons per day.⁵⁹

Comprehensive water conservation programs that engage all water customers are clearly effective and will generate water savings while building a culture of conservation.

Recommendation 7:

Water providers should expand commercial water auditing programs, beginning with high use customers.



Cooling Towers

If your office is air conditioned, then the facility or building's heating and cooling system likely includes a cooling tower. Cooling towers can be found at educational facilities, commercial/office buildings, retail centers, and health care centers of all sizes.

According to the Environmental Protection Agency's *WaterSense at Work: Best Management Practices for Commercial and Institutional Facilities* guidebook, "cooling towers often represent the largest use of water in institutional and commercial applications, comprising 20 to 50 percent or more of a facility's total water use." Cooling towers use water to 'condition' air and cool buildings. Water is lost in a corresponding evaporative process and during a maintenance process (called "blowdown"). To replace water lost in these processes, new "make-up water" is added to the cooling tower. Additionally, "many systems operate at two to four cycles of concentration, while six cycles or more may be possible. Increasing cycles from three to six reduces cooling tower make-up water by 20% and cooling tower blowdown by 50%."⁶⁰

In 2015, the District considered but did not pursue a proposal to target cooling tower operations as a water conservation measure. The data is clear: efficient cooling tower operations can result in significant water savings.

This is an example of a cooling tower on a Georgia State University building rooftop. ([Newcomb & Boyd](#))

Recommendation 8:

The District should invest in research, a pilot program, and data collection (i.e. cooling tower census) to determine what water and energy savings are possible as a result of new cooling tower operations.

Outdoor Water Use

Approximately 30 percent of residential water use takes place outside the home. Swimming pool filling, power washing, and landscape irrigation are examples of outdoor water use. The U.S. Environmental Protection Agency estimates about 9 billion gallons of water are used for residential landscape irrigation every day in the United States. Outdoor water use, like commercial water use, will vary significantly due to the local

conditions like soil and climate. Regardless of total use or climate, an estimated 50 percent of the water used outdoors is lost to evaporation, wind, runoff, and inefficient irrigation systems.⁶¹

If we are looking for more water savings, we can find it outdoors. In Georgia, outdoor landscapes only need about 1 inch of rain or irrigation water every week. Unfortunately, many people think their lawns need more water to keep them green. In reality, too much water is unhealthy for turf

If we are looking for more water savings, we can find it outdoors. In Georgia, outdoor landscapes only need about 1 inch of rain or irrigation water every week. Unfortunately, many people think their lawns need more water to keep them green.



grass, can result in shallow root systems, and lead to turf disease.⁶² Often irrigation systems are operating inefficiently. They require regular maintenance to avoid [wasting water outdoors](#).

The District recently took a step in the right direction. In 2017, the District implemented a new action item requiring local water providers to develop a policy that will apply to large landscapes of one acre (or 43,560 square feet) or more. These properties will need to include pressure regulators, master shut-off valves, and flow sensors to detect high flows that indicate leaks or breaks in an irrigation line. This policy applies to homeowners' associations and similar organizations, which are expected to include the total sum of their irrigated areas. The District's action item will not apply to single-family homes. It is worth noting that some jurisdictions have separate rate structures—including block or uniform rates—for residential irrigation.

If reducing outdoor irrigation is a priority for the region, there are other methods to consider.

First, water needs to be priced right. As noted elsewhere in this report, a well-designed tiered-rate structure will send conservation signals to customers through their pocketbooks.

Second, property owners need more encouragement to put the right plants in the right place.

The University of Georgia has extensive resources offering recommendations on what, where, and when to plant.⁶³ Regional horticultural and nursery businesses could consider selling only low-water demanding varieties and natives.

Subsidies and tax rebates on purchases of low water use perennials and natives might be most cost effective.

Finally, jurisdictions in California and Nevada have offered rate payers rebates to remove turf grass and other high water demand landscaping, and install low-water intensive landscaping. The California Department of Water Resources offers up to \$2,000 (or \$2.00 per square foot) to property owners and \$20,000 to institutional properties to replace high-water demand landscaping with “California native and water-efficient landscaping” to provide long-term water savings and educational opportunities.⁶⁴ The Southern Nevada Water Authority operates a similar program, and pays \$3.00 per square foot (for up to 10,000 square feet) to remove turf grass and replace it with desert plants and landscaping.⁶⁵ These types of landscape retrofit programs may not be right for Georgia. Alternatively, the Georgia legislature could target new construction by offering rebates or tax incentives to encourage first-time installation of water-appropriate landscapes.

Grass, trees, flowers, and shrubs provide important benefits to communities. Healthy landscapes provide shade and habitat for wildlife and pollinators, improve recreational



Water appropriate landscaping is one of many ways—in addition to replacing plumbing fixtures, revising the plumbing code, conducting commercial water audits, altering cooling tower operations, and enhancing outdoor water efficiencies—where we can find more water without requiring major lifestyle changes.

opportunities, enhance public health, support local economies, and protect air and water quality. Going forward, Georgians must focus on maintaining, restoring, and building outdoor landscapes that are not water intensive.

Water appropriate landscaping is one of many ways—in addition to replacing plumbing

fixtures, revising the plumbing code, conducting commercial water audits, altering cooling tower operations, and enhancing outdoor water efficiencies—where we can find more water without requiring major lifestyle changes.

Recommendation 9:

The General Assembly should consider offering individual homeowners tax incentives and rebates to encourage the installation of water efficient landscaping.

Update the Water Stewardship Act

The Georgia Water Stewardship Act moved through the General Assembly and across the Governor's desk in 2010 in the wake of natural and legal disturbances.⁶⁶

Between 2006 and 2009, the Southeast experienced one of the driest periods in recent history. Stream flows were reduced to levels not seen since the 1950s drought. In Georgia it is now considered the drought of record. In response to worsening drought conditions, the state announced a prohibition of outdoor watering across the majority of the state's 159 counties. In some areas, this was prudent policy but in other places critics complained about the state's draconian action.

Then in 2009, a judge ruled that Lake Lanier was not authorized for "water supply." In the 1950s, the U.S. Army Corps of Engineers built Buford Dam on the Chattahoochee River that fills up a massive reservoir called Lake Lanier. Beginning in the 1990s, Alabama, Florida, and Georgia engaged in legal battles—the so-called and ongoing "[water wars](#)"—over the Corps' operation of the dam and reservoir. Since metro Atlanta communities rely on the Chattahoochee River and Lake Lanier for more than 70 percent of their drinking water, the judge's ruling—which has since been reversed—set the state's leaders on a course to find more water.⁶⁷ Out of that process, a simple and cost-effective solution to the region's water woes rose to the top: implement water conservation and efficiency measures.⁶⁸



Buford Dam blocks the Chattahoochee River to fill Lake Lanier. The river and the artificial reservoir are the metro Atlanta region's primary source of drinking water. ([U.S. Army Corps of Engineers](#))

The Georgia Water Stewardship Act of 2010 was a result of these natural and legal processes. When it comes to municipal water use statewide, the Act:

- Requires all Georgia utilities serving 3,300 or more individuals to submit annual water loss audits to the Environmental Protection Division.
- Enables local governments to obtain waivers to implement more restrictive conservation measures during drought.
- Establishes statewide and universal outdoor watering rules, including a provision that outdoor watering only take place before 10 a.m. and after 4 p.m., and that the rules be translated into local ordinances. The law included numerous exceptions for food gardens, commercial and horticultural businesses, playing fields, etc.
- Requires multifamily housing units to be sub-metered.
- Requires plumbing code revisions for toilets, urinals, faucets, showerheads, and cooling towers.

Like all policy, the Water Stewardship Act can be improved if we look elsewhere for guidance. For example, a revised act could incorporate and apply statewide the District's water supply and conservation action items. This would put all communities on a level playing field, particularly in river basins engaged in transboundary water conflict, including the ACF (Apalachicola-Chattahoochee-Flint) rivers, the ACT (Alabama-Coosa-Tallapoosa) rivers, and the Savannah River plus aquifers like the Floridan.⁶⁹ More specifically, a revised act could:

- Require all water withdrawal and wastewater permittees to submit withdrawal and discharge volume data online, and make that data available to the public. This would make it easier to calculate actual water consumption rates.
- Require water utilities to adopt standardized billing categories that include single-family residential, multifamily residential, commercial, industrial and institutional. This would make water use uniformly legible and comparable statewide, thus enabling utilities and the state to better understand water use across sectors at a geographic scale for planning purposes.
- Require utilities with more than 3,300 customers to establish a landscape water efficiency program to improve and maintain water-efficient landscape and irrigation. This could be particularly useful in regions where water supply is threatened or subject to transboundary conflict.
- Require utilities to offer commercial customers water use audits. This would identify water conservation and efficiency opportunities at properties of many sizes.
- Require all public water systems with fewer than 3,300 individuals and that purchase water from another public water system to conduct water loss audits. This would have led to an earlier discovery and reduction of water loss in a community like Grantville as noted on page 12.
- Amend 12-5-7(a)(4)(a.1)(2)(F) to clarify the definitions of "installation" and "date of installation." As currently written, a property owner or manager can install turf grass or other landscaping and irrigate the completed project for a period of 30-days. There is nothing to prohibit a landscaper, during drought, from returning and simply applying more seed to the project so as to water for an additional 30-days.

Recommendation 10:

The Georgia General Assembly should update the Georgia Water Stewardship Act to continue building an equitable culture of conservation.



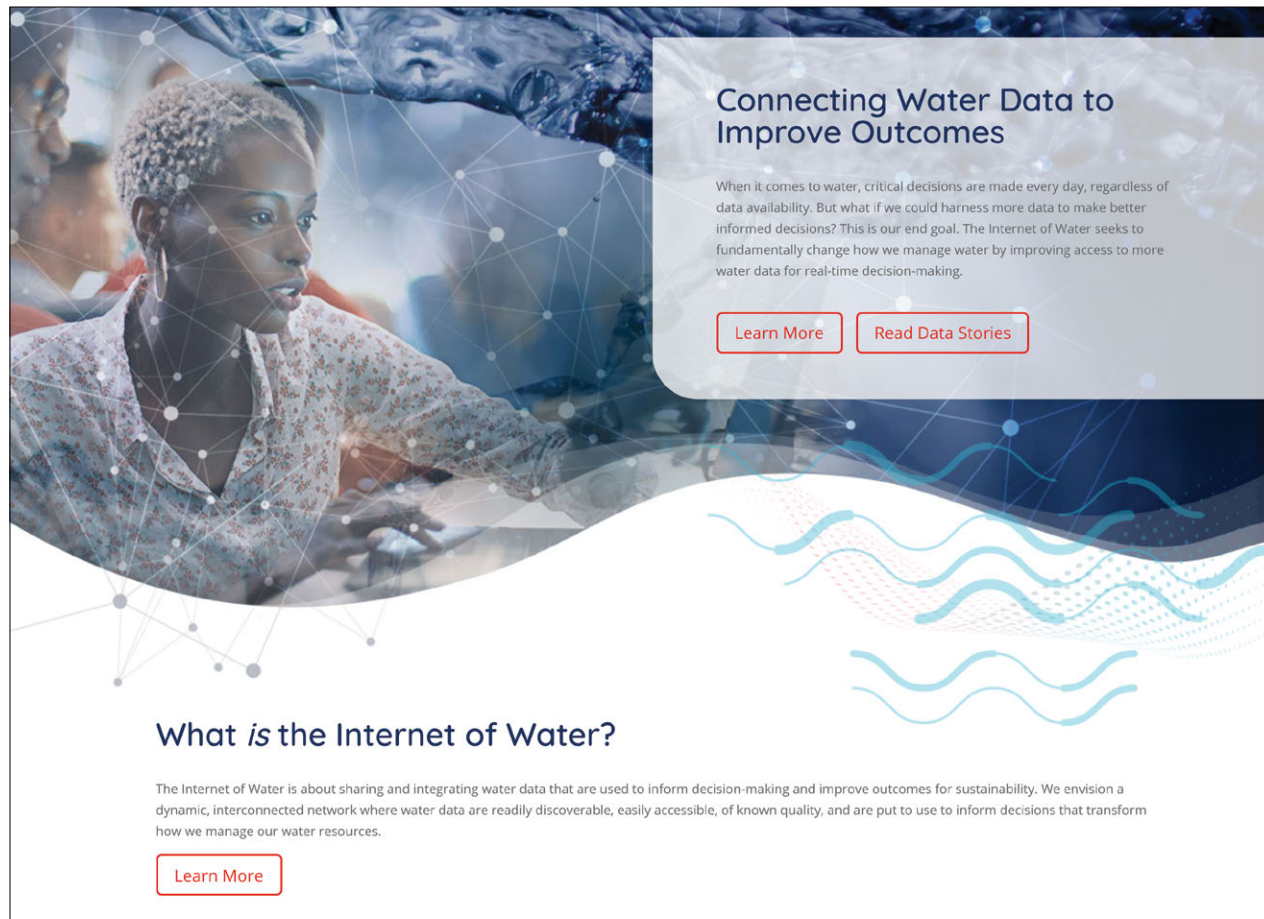
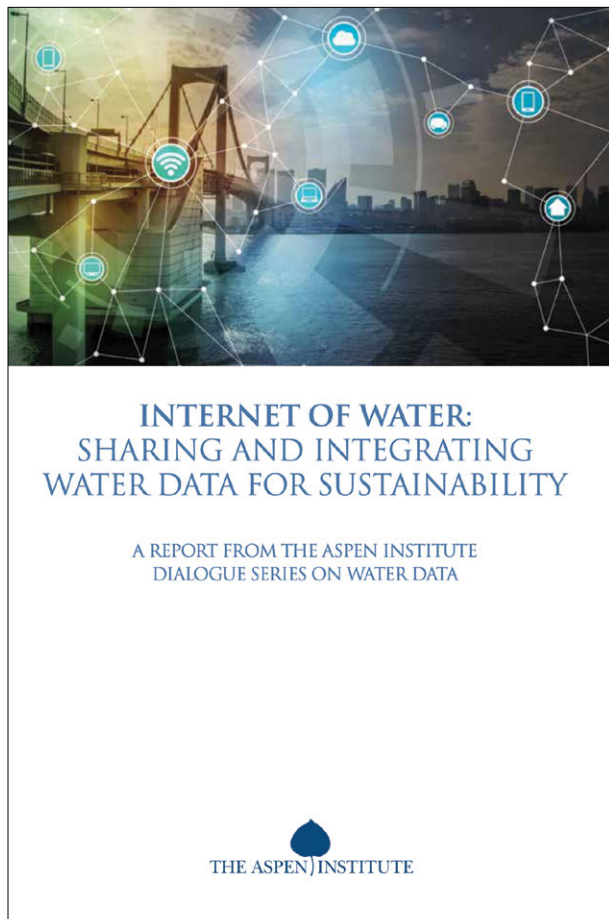
- Chapter 8 -

The Internet of Water: Better Data for Better Decision Making

After evaluating water data for many years, CRK asserts that a lack of common information and clear data is a vexing barrier to capturing an accurate picture of municipal, industrial, commercial, institutional, agricultural, and other water use. CRK is not alone in this assessment.

The metro Atlanta region is the “epicenter” of the Fintech industry and is “home to more than 50” major co-location data centers, according to the Georgia Department of Economic Development.⁷⁰ Georgia also hosts major dedicated data centers like one Facebook is building in Newton County. One of these facilities knows the value of water: Google’s data center uses recycled water from the Douglasville-Douglas County Water & Sewer Authority for 100 percent of their cooling needs.⁷¹

Big Data and financial transaction management has clearly arrived in Georgia. But from the perspective of water professionals and advocates, the lack of good publically available and useable water data is embarrassing. What difference would more data make?



Put simply, better data can lead to better decision making, which means more water security, reliability, and resilience. Better decision making during drought and flooding will protect human health and ecosystem functions. Better data can save energy and money.

But not just any data will do. It needs to be legible, discoverable, and interoperable. To achieve this, data collection, collation, and public availability

must be influenced by the decisions that need to be made. For data to be available from multiple sources and function for multiple stakeholders, it must be collected through common methods and presented in a common language.⁷²

Duke University's Nicholas Institute for Environmental Policy Solutions [recently launched](#) a new "Internet of Water" initiative to achieve those goals by building "a dynamic

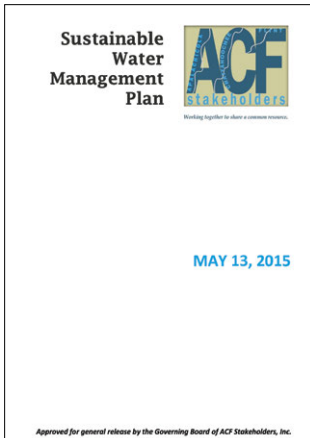
and voluntary network of communities and institutions to facilitate the opening, sharing, and integration of water data and information."⁷³

From CRK's perspective, there are two specific examples of where common and agreed upon data would be helpful.

First, common data would benefit water users in the arena of transboundary conflict.

CRK and others partners have advocated for state and federal agencies in Alabama, Florida, and Georgia to collect and present common data so the states and stakeholders in the Apalachicola, Chattahoochee, and Flint river basins can operate from the same playbook and speak a common language. To this end, the [ACF Stakeholders, Inc.](#) identified the necessity to “provide easily accessible, accurate and relevant data” for decision makers, researchers, and the public. Such data analysis would inform future and transparent directions in research, particularly in highly contested transboundary river basins.⁷⁴

A second area where better data would improve our water knowledge involves Georgia’s state water planning. As noted above, the District was created in 2001 and initiated metro Atlanta’s water planning. Comprehensive water planning for the rest of the state did not begin for another three years. Then it took



There is room for improvement in water data collection, management, and presentation in the District and Georgia. These initiatives have the ability to improve public engagement and decision making to ensure there is enough clean water for all stakeholders and interests.

another six years before the state’s water planning process divided up the rest of the state to create ten regional councils. Each regional council produced their first regional water plans in 2010 and updated them in 2017.

To this day, it is very difficult to compare the data in the District’s plan with the data in other regional plans. The data are not presented in similar formats which makes comparisons or formulation of a full water budget for a specific watershed impossible. For example, the District excluded water withdrawals (and returns) for the power generation sector from the *Water Resource Management Plan*. This omission, regardless of the stated “non-consumptive” nature of the withdrawals for cooling purposes, represents a departure from full water budgeting and the spirit of integrated water resources management. Additionally, the District could provide clear data on withdrawals, returns, and consumption by utility and basin, and incorporate interbasin transfer data. Finally, the District could present total water demands and

wastewater flows as categorized and illustrated in the Regional Water Plans for municipal, industrial, energy, and agriculture use.

In 2018, a Southface analysis of water use in the state’s energy sector determined “that water consumption numbers for regions and sectors across the state were inconsistent and the methods used to develop them were unclear.” Furthermore, the authors stated that “Georgia should develop consistent water withdrawal and consumption data” and “invest more to obtain...reliable data.”⁷⁵ Months later in another report, One Hundred Miles reviewed the Coastal Georgia Regional Water Plan and discovered a flawed data methodology that overestimated forecasted water withdrawals.⁷⁶

There is room for improvement in water data collection, management, and presentation in the District and Georgia. These initiatives have the ability to improve public engagement and decision making to ensure there is enough clean water for all stakeholders and interests.

Recommendation 11:

The Georgia Environmental Protection Division should develop and implement a robust, transparent, and statewide data collection system to improve public engagement and water related decision making.



- Chapter 9 -

Conclusion and Recommendations

Over the last few years, a prolific cottage industry has produced dozens of books about water problems in the United States and abroad. Cynthia Barnett, Juliet Christian-Smith, Heather Cooley, Charles Fishman, Robert Glennon, Peter H. Gleick, Sandra Postel, Brian Richter, David Sedlak, Seth M. Siegel and others have chronicled water quality issues and supply shortages, and offered solutions. They identified the associated social benefits and costs. And they generally conclude on an optimistic note.

We must develop a far-reaching water ethic to build a culture of conservation and the necessary political will to change course. If we don't get it right, particularly given the intensification of climate disruption, we will all be in trouble.

We have enough water. The problems and solutions will be localized, but can be informed by experiences from far away. Technology and money will be part of the solution. But of greater importance, we must develop a far-reaching water ethic to build a culture of conservation and the necessary political will to change course. If we don't get it right, particularly given the intensification of climate disruption, we will all be in trouble.

The path to water security, resilience, and sustainability is not impossible. Georgia must continue to build a strong culture of water conservation and an equitable water ethic. The following recommendations will make Georgia a leader in water conservation and efficiency, and enhance the Chattahoochee River's communities and environment in the process:

💧 Recommendation #1:

The Georgia General Assembly should empower Georgia's Regional Water Councils with statutory implementation authority and financial support.

💧 Recommendation #2:

The District should require completion of Implementation Surveys that focus on implementation of the Water Stewardship Act.

💧 Recommendation #3:

The District and the State should investigate the effectiveness of tiered conservation rate structures to determine if they are sending the appropriate "conservation signal."

💧 Recommendation #4:

The Georgia Environmental Protection Division and the District should do more to ensure water providers are in compliance with the Georgia Water Stewardship Act.

💧 Recommendation #5:

The District should clarify the toilet stock in need of replacement and determine a timeline for natural replacement. And if that timeline is lengthy, then the District should determine how to speed the process along.

💧 Recommendation #6:

The Department of Community Affairs should revise the state plumbing code without further delay to make sure Georgia remains a leader when it comes to water conservation and efficiency.

💧 Recommendation #7:

Water providers should expand commercial water auditing programs, beginning with high use customers.

💧 Recommendation #8:

The District should invest in research, a pilot program, and data collection (e.g. cooling tower census) to determine what water and energy savings are possible as a result of new cooling tower operations.

💧 Recommendation #9:

The General Assembly should consider offering individual homeowners tax incentives and rebates to encourage the installation of water efficient landscaping.

💧 Recommendation #10:

The Georgia General Assembly should update the Georgia Water Stewardship Act to continue building an equitable culture of conservation.

💧 Recommendation #11:

The Georgia Environmental Protection Division should develop and implement a robust, transparent, and statewide data collection system to improve public engagement and water related decision making.

Performance Dashboard ⁷⁷

County/System: City of Atlanta Department of Watershed Management
Primary Water Source: Chattahoochee River

Population

	2011	2017
Population (US Census)	431,729	486,290
Population served (EPD)	650,000	1,200,000
Number of active and inactive service connections	187,935	207,289

Precipitation & Water Use

	2010	2011	2012	2013	2014	2015	2016
Total annual rainfall (inches)	48.15	39.23	37.03	66.02	47.62	68.38	38.69
Annual monthly average withdrawal (MGD)	84.1	89.2	86.3	84.5	90.5	89.4	92.6
Monthly peak average withdrawal (MGD)	98.7 (Aug)	101.8 (Aug)	97.3 (Jul)	88.9 (Jun)	96.5 (Jul)	99.4 (Jul)	103.5 (Jun)

Water Loss and Control Audit Results

	2011	2012	2013	2014	2015	2016	2017
Audit validity score	58	60	60	61	74	74	74
Apprent water losses as % of water supplied	8.1%	9.0%	9.0%	7.5%	6.2%	6.6%	5.4%
Real water losses as % of water supplied	18.0%	20.1%	20.9%	22.0%	23.9%	22.5%	19.2%
Real losses per connection per day (gallons per day)	89.0	97.4	94.0	98.5	108.9	105.0	84.9

Conservation Pricing

Residential rate structure	3 increasing blocks
First block maximum (monthly gallons)	2,244
Monthly water bill/water & sewer per 5,000 gallons	\$34.53/ \$121.96
Conservation signal: water price/ 1,000 gallons after 10,000 gallons	\$8.23
Residential irrigation rate structure different from residential?	No

District Implementation Report Year

	2011	2012	2013	2014
Number of single-family toilet rebates	2,093	n/a	6,734	n/a
Number of multi-family toilet rebates	1,351	1,219	3,305	n/a

**n/a - Not available, not reported or not discernable*

Performance Dashboard ⁷⁷

County/System: Cobb County Water System
 Primary Water Source: Chattahoochee River (Purchased from Cobb County Marietta Water Authority)

Population

	2011	2017
Population (US Census)	697,433	752,783
Population served (EPD)	533,000	753,000
Number of active and inactive service connections	178,116	182,000

Precipitation & Water Use

	2010	2011	2012	2013	2014	2015	2016
Precipitation (inches), January-December	44.63	44.73	38.76	72.13	47.8	58.61	35.34
Annual monthly average withdrawal (MGD)	43.3	45.1	48.7	44.9	42.6	42.2	43
Monthly peak average withdrawal (MGD)	52.8 (Jul)	51.89 (Aug)	54.18 (Jul)	47.14 (Jun)	46.65 (Jun)	51.92 (Aug)	56.58 (Oct)

Water Loss and Control Audit Results

	2011	2012	2013	2014	2015	2016	2017
Audit validity score	68	69	69	76	72	73	70
Apprent water losses as % of water supplied	1.7%	1.5%	2.2%	1.0%	1.5%	1.1%	1.0%
Real water losses as % of water supplied	6.3%	10.7%	7.3%	14.8%	9.2%	8.6%	8.8%
Real losses per connection per day (gallons per day)	20.2	36.1	20.7	46.7	28.3	27.9	26.6

Conservation Pricing

Residential rate structure	5
First block maximum (monthly gallons)	3,000
Monthly water bill/water & sewer per 5,000 gallons	\$20.21/ 49.96
Conservation signal: water price/ 1,000 gallons after 10,000 gallons	\$4.23
Residential irrigation rate structure different from residential?	Yes, uniform rate based on meter size

District Implementation Report Year

	2011	2012	2013	2014
Number of single-family toilet rebates	6,036	n/a	2,545	1,352
Number of multi-family toilet rebates	n/a	n/a	n/a	611

**n/a - Not available, not reported or not discernable*

Performance Dashboard ⁷⁷

County/System: DeKalb County Department of Watershed Management
Primary Water Source: Chattahoochee River

Population

	2011	2017
Population (US Census)	698,304	752,088
Population served (EPD)	670,000	700,000
Number of active and inactive service connections	188,266	193,748

Precipitation & Water Use

	2010	2011	2012	2013	2014	2015	2016
Precipitation (inches), January-December	44.02	41.07	37.99	68.26	48.37	62.52	36.09
Annual monthly average withdrawal (MGD)	74.9	72.1	70.8	66.8	68.9	66.9	70.7
Monthly peak average withdrawal (MGD)	87.6 (Jul)	84.68 (Aug)	80.3 (Jul)	69.61 (Jun)	73.36 (Jul)	76.49 (Aug)	75.66 (Nov)

Water Loss and Control Audit Results

	2011	2012	2013	2014	2015	2016	2017
Audit validity score	71	72	74	47	61	50	48
Apprent water losses as % of water supplied	0.5%	0.4%	0.4%	1.8%	2.1%	2.4%	2.0%
Real water losses as % of water supplied	20.5%	20.0%	19.6%	29.3%	16.1%	1.5%	21.5%
Real losses per connection per day (gallons per day)	75.6	71.7	67.9	116.2	51.3	5.2	72.5

Conservation Pricing

Residential rate structure	4 increasing blocks
First block maximum (monthly gallons)	2,000
Monthly water bill/water & sewer per 5,000 gallons	\$16.42/ \$80.01
Conservation signal: water price/ 1,000 gallons after 10,000 gallons	\$4.36
Residential irrigation rate structure different from residential?	Yes, uniform rate based on meter size

District Implementation Report Year

	2011	2012	2013	2014
Number of single-family toilet rebates	3,060	3,574	3,118	1,874
Number of multi-family toilet rebates	No program in place	No program in place	No program in place	No program in place

*n/a - Not available, not reported or not discernable

Performance Dashboard ⁷⁷

County/System: Douglasville-Douglas County Water & Sewer Authority
 Primary Water Source: Dog River & Bear Creek
 (Chattahoochee River tributaries)

Population		
	2011	2017
City population (US Census)	31,149	33,675
County population (US Census)	133,121	143,672
Population served (EPD)	108,027	109,694
Number of active and inactive service connections	41,847	43,529

Precipitation & Water Use							
	2010	2011	2012	2013	2014	2015	2016
Total annual rainfall (inches)	46.56	44.13	40.22	69.58	48.65	62.49	39.03
Annual monthly average withdrawal (MGD)	12	11.1	10.4	10.4	10.6	11.2	11.2
Monthly peak average withdrawal (MGD)	12.3 (Jul)	11.5 (Aug)	12.1 (Jul)	11.1 (Sept)	11.62 (Aug)	12.1 (Jul)	12.9 (Jun)

Water Loss and Control Audit Results							
	2011	2012	2013	2014	2015	2016	2017
Audit validity score	70	70	66	71	77	78	78
Apprent water losses as % of water supplied	2.1%	4.1%	3.6%	3.5%	2.7%	2.4%	1.7%
Real water losses as % of water supplied	14.8%	10.7%	12.4%	11.3%	11.0%	10.2%	11.0%
Real losses per connection per day (gallons per day)	38.5	27.2	29.6	27.8	27.2	26.3	27.7

Conservation Pricing	
Residential rate structure	3 increasing blocks
First block maximum (monthly gallons)	5,000
Monthly water bill/water & sewer per 5,000 gallons	\$34.42/ \$73.26
Conservation signal: water price/ 1,000 gallons after 10,000 gallons	\$9.40
Residential irrigation rate structure different from residential?	No

District Implementation Report Year				
	2011	2012	2013	2014
Number of single-family toilet rebates	1,553	pt	pt	pt
Number of multi-family toilet rebates	n/a	n/a	n/a	n/a

*n/a - Not available, not reported or not discernable

**pt - Program terminated in 2011

Performance Dashboard ⁷⁷

County/System: Forsyth County Water & Sewer
Primary Water Source: Lake Lanier (Chattahoochee River)

Population

	2011	2017
Population (US Census)	181,812	228,588
Population served (EPD)	114,499	138,368
Number of active and inactive service connections	47,132	59,732

Precipitation & Water Use

	2010	2011	2012	2013	2014	2015	2016
Precipitation (inches), January-December	45.54	50.87	49.81	77.85	50.81	67.9	33.33
Annual monthly average withdrawal (MGD)	7.8	8.6	9.4	9.9	11.3	12.7	14.8
Monthly peak average withdrawal (MGD)	10.4 (Jul)	9.9(Aug)	12.1 (Jun)	12.5 (Jun)	14.3 (Jul)	15.9 (Aug)	18.9 (Jun)

Water Loss and Control Audit Results

	2011	2012	2013	2014	2015	2016	2017
Audit validity score	73	73	73	77	79	81	72
Apprent water losses as % of water supplied	1.3%	1.2%	1.2%	1.4%	1.4%	1.4%	1.3%
Real water losses as % of water supplied	9.4%	10.6%	13.2%	7.8%	7.7%	6.5%	10.9%
Real losses per connection per day (gallons per day)	24.3	26.2	28.6	17.8	17.9	16.5	26.1

Conservation Pricing

Residential rate structure	5 increasing blocks
First block maximum (monthly gallons)	6,000
Monthly water bill/water & sewer per 5,000 gallons	\$25.60/ \$59.80
Conservation signal: water price/ 1,000 gallons after 10,000 gallons	\$4.53
Residential irrigation rate structure different from residential?	Yes, increasing block rate based on meter size

District Implementation Report Year

	2011	2012	2013	2014
Number of single-family toilet rebates	57	53	70	53
Number of multi-family toilet rebates	No program in place	No program in place	No program in place	No program in place

**n/a - Not available, not reported or not discernable*

Performance Dashboard ⁷⁷

County/System: Fulton County Department of Public Works
Primary Water Source: Chattahoochee River

Population

	2011	2017
Population (US Census)	947,410	1,038,884
Population served (EPD)	172,533	243,000
Number of active and inactive service connections	70,000	93,539

Precipitation & Water Use

	2010	2011	2012	2013	2014	2015	2016
Precipitation (inches), January-December	45.53	43.25	39.84	69.11	48.16	63.17	36.82
Annual monthly average withdrawal (MGD)	40.1	38.7	39.2	33.2	37.7	39.1	43.6
Monthly peak average withdrawal (MGD)	52.8 (Jul)	54.3 (Aug)	50.4 (Jul)	38.4 (Jun)	48.9 (Aug)	54.1 (Aug)	55.4 (Jul)

Water Loss and Control Audit Results

	2011	2012	2013	2014	2015	2016	2017
Audit validity score	77	72	71	72	70	70	70
Apprent water losses as % of water supplied	4.5%	1.9%	1.8%	1.5%	1.6%	2.2%	2.1%
Real water losses as % of water supplied	3.9%	3.2%	7.9%	8.4%	8.0%	5.3%	6.6%
Real losses per connection per day (gallons per day)	15.6	10.6	23.4	31.0	31.1	21.7	15.4

Conservation Pricing

Residential rate structure	3 increasing blocks
First block maximum (monthly gallons)	10,530
Monthly water bill/water & sewer per 5,000 gallons	\$18.88/ \$51.46
Conservation signal: water price/ 1,000 gallons after 10,000 gallons	\$3.40
Residential irrigation rate structure different from residential?	Yes, uniform rate

District Implementation Report Year

	2011	2012	2013	2014
Number of single-family toilet rebates	530	0	1,478	711
Number of multi-family toilet rebates	No program in place	No program in place	No program in place	n/a

*n/a - Not available, not reported or not discernable

Performance Dashboard ⁷⁷

County/System: City of Gainesville

Primary Water Source: Lake Lanier (Chattahoochee River)

Population

	2011	2017
City population (US Census)	34,327	40,359
County population (US Census)	182,271	199,439
Population served (EPD)	126,620	159,000
Number of active and inactive service connections	51,085	53,000

Precipitation & Water Use

	2010	2011	2012	2013	2014	2015	2016
Total annual rainfall (inches)	49.19	48.2	51.92	80.19	49.66	68.09	34.2
Annual monthly average withdrawal (MGD)	17.5	17.6	17.1	16.2	17	17.3	18.5
Monthly peak average withdrawal (MGD)	19.9 (Jul)	20.7 (Aug)	19 (July)	17.7 (Jun)	18.8 (Jul)	19.2 (Aug)	21.7 (Jul)

Water Loss and Control Audit Results

	2011	2012	2013	2014	2015	2016	2017
Audit validity score	68	68	71	78	75	75	75
Apprent water losses as % of water supplied	1.3%	1.2%	1.2%	1.2%	3.2%	3.2%	3.3%
Real water losses as % of water supplied	14.4%	13.5%	14.1%	10.5%	12.2%	10.5%	11.7%
Real losses per connection per day (gallons per day)	50.3	45.0	44.6	32.8	40.5	35.8	37.6

Conservation Pricing

Residential rate structure	3 increasing blocks
First block maximum (monthly gallons)	7,480
Monthly water bill/water & sewer per 5,000 gallons	\$20.00/ \$69.01
Conservation signal: water price/ 1,000 gallons after 10,000 gallons	\$4.23
Residential irrigation rate structure different from residential?	Yes, uniform rate

District Implementation Report Year

	2011	2012	2013	2014
Number of single-family toilet rebates	136	262	348	133
Number of multi-family toilet rebates	No program in place	No program in place	26	11

*n/a - Not available, not reported or not discernable

Performance Dashboard ⁷⁷

County/System: Gwinnett County Department of Water Resources
Primary Water Source: Lake Lanier (Chattahoochee River)

Population		
	2011	2017
Population (US Census)	822,442	918,153
Population served (EPD)	749,722	900,000
Number of active and inactive service connections	238,299	258,516

Precipitation & Water Use							
	2010	2011	2012	2013	2014	2015	2016
Precipitation (inches), January-December	45.26	44.65	42.28	72.3	48.33	62.66	33.92
Annual monthly average withdrawal (MGD)	75.5	76.1	72.8	65.1	69.5	68.7	77.8
Monthly peak average withdrawal (MGD)	86.8 (Jul)	90.9 (Aug)	83.7 (Jun)	70.99 (Sep)	76.1 (Sep)	79.3 (Aug)	87.8 (Jun)

Water Loss and Control Audit Results							
	2011	2012	2013	2014	2015	2016	2017
Audit validity score	72	69	73	82	76	74	70
Apprent water losses as % of water supplied	6.8%	3.0%	3.0%	3.0%	1.2%	1.2%	1.2%
Real water losses as % of water supplied	5.7%	7.6%	6.8%	8.3%	6.9%	10.1%	9.6%
Real losses per connection per day (gallons per day)	17.4	21.5	17.2	22.1	17.9	27.8	25.3

Conservation Pricing	
Residential rate structure	3 increasing blocks
First block maximum (monthly gallons)	7,999
Monthly water bill/water & sewer per 5,000 gallons	\$32.10/ \$77.00
Conservation signal: water price/ 1,000 gallons after 10,000 gallons	\$7.38
Residential irrigation rate structure different from residential?	Yes, uniform rate based on meter size

District Implementation Report Year				
	2011	2012	2013	2014
Number of single-family toilet rebates	2,339	2589	2,466	2,130
Number of multi-family toilet rebates	No program in place	n/a	1,524	1,544

*n/a - Not available, not reported or not discernable

Performance Dashboard ⁷⁷

County/System: City of Roswell

Primary Water Source: Big Creek (Chattahoochee River tributary)

Population

	2011	2017
Population (US Census)	91,033	94,786
Population served (EPD)	14,300	14,300
Number of active and inactive service connections	5,291	5,600

Precipitation & Water Use

	2010	2011	2012	2013	2014	2015	2016
Precipitation (inches), January-December	45.53	43.25	39.84	69.11	48.16	63.17	36.82
Annual monthly average withdrawal (MGD)	1.1	1.1	1	0.9	1.1	0.8	1.2
Monthly peak average withdrawal (MGD)	1.16 (Aug)	1.1 (Jul)	1.04 (Jul)	1.27 (Sep)	1.26 (Jun)	1.17 (Jul)	1.945 (Jul)

Water Loss and Control Audit Results

	2011	2012	2013	2014	2015	2016	2017
Audit validity score	78	78	78	75	73	76	80
Apprent water losses as % of water supplied	7.3%	7.3%	2.9%	3.5%	8.5%	3.4%	3.3%
Real water losses as % of water supplied	4.1%	4.8%	10.5%	4.3%	4.6%	3.6%	3.9%
Real losses per connection per day (gallons per day)	12.8	14.0	28.4	11.9	13.4	10.5	10.4

Conservation Pricing

Residential rate structure	3 increasing blocks
First block maximum (monthly gallons)	5,000
Monthly water bill/water & sewer per 5,000 gallons	\$25.61/ \$56.61
Conservation signal: water price/ 1,000 gallons after 10,000 gallons	\$12.35
Residential irrigation rate structure different from residential?	Yes, uniform rate based on meter size

District Implementation Report Year

	2011	2012	2013	2014
Number of single-family toilet rebates	80	104	111	70
Number of multi-family toilet rebates	No program in place	No program in place	No program in place	No program in place

*n/a - Not available, not reported or not discernable

Performance Dashboard ⁷⁷

County/System: Columbus Water Works
Primary Water Source: Lake Oliver (Chattahoochee River)

Population

	2011	2017
Population (US Census)	195,244	193,766
Population served (EPD)	229,000	260,00
Number of active and inactive service connections	74,380	77,075

Precipitation & Water Use

	2010	2011	2012	2013	2014	2015	2016
Total annual rainfall (inches)	37.26	39.74	35.21	62.65	52.13	63.1	35.14
Annual monthly average withdrawal (MGD)	34.9	36.1	35	34.3	34.7	34.9	35.8
Monthly peak average withdrawal (MGD)	46.07 (Aug)	44.39 (Aug)	43.59 (Jun)	40.55 (May)	39.88 (Aug)	43.91 (Jul)	44.59 (Jul)

Water Loss and Control Audit Results

	2011	2012	2013	2014	2015	2016	2017
Audit validity score	75	77	77	73	80	85	82
Apprent water losses as % of water supplied	2.3%	2.8%	2.7%	3.5%	2.9%	2.5%	2.4%
Real water losses as % of water supplied	9.5%	8.8%	12.9%	14.4%	14.0%	14.3%	14.6%
Real losses per connection per day (gallons per day)	38.7	34.2	47.4	55.8	52.5	57.3	53.2

Conservation Pricing

Residential rate structure	2 Increasing Blocks
First block maximum (monthly gallons)	11,220
Monthly water bill/water & sewer per 5,000 gallons	\$16.98/ \$41.90
Conservation signal: water price/ 1,000 gallons after 10,000 gallons	\$2.24
Residential irrigation rate structure different from residential?	No

Performance Dashboard ⁷⁷

County/System: City of LaGrange
Primary Water Source: West Point Lake (Chattahoochee River)

Population

	2011	2017
City population (US Census)	29,791	30,472
Troup County population (US Census)	67,619	70,038
Population served (EPD)	41,852	41,852
Number of active and inactive service connections	19,541	19,894

Precipitation & Water Use

	2010	2011	2012	2013	2014	2015	2016
Total annual rainfall (inches), Jan. -Dec. (Troup County)	42.5	43.28	38.75	65.55	51.76	61.99	39.91
Annual monthly average withdrawal (MGD)	9.6	8.6	7.8	6.9	8.1	7.4	7.8
Monthly peak average withdrawal (MGD)	10.94 (Aug)	9.7 (Aug)	8.9 (Aug)	8.5 (Sep)	9.6 (Aug)	8.3 (Jul)	9.1 (Oct)

Water Loss and Control Audit Results

	2011	2012	2013	2014	2015	2016	2017
Audit validity score	65	67	71	69	68	71	70
Apprent water losses as % of water supplied	1.9%	2.0%	2.0%	2.3%	0.5%	0.7%	0.7%
Real water losses as % of water supplied	18.2%	13.1%	11.1%	6.4%	19.6%	12.8%	8.8%
Real losses per connection per day (gallons per day)	63.7	43.5	33.4	19.2	60.2	42.6	27.9

Conservation Pricing

Residential rate structure	Implied uniform rate w/ 5 blocks
First block maximum (monthly gallons)	25,000
Monthly water bill/water & sewer per 5,000 gallons	\$26.40/ \$51.90
Conservation signal: water price/ 1,000 gallons after 10,000 gallons	\$4.08
Residential irrigation rate structure different from residential?	No

Endnotes

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