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Drought in Georgia: water scarcity issues and implications

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DROUGHT IN GEORGIA: WATER SCARCITY ISSUES AND IMPLICATIONS

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Abstract

Population growth and hydrological drought threaten the water supply of Atlanta, Georgia. In Georgia, water policy changed rapidly due to stress on the resource, regulation increased, and the state promoted a “culture of conservation” to combat water scarcity. This study examines how regulatory measures, including legislative acts and Governor’s executive orders, have impacted the population’s attitudes and behaviors towards water consumption. Furthermore, public spaces are used to measure public perception of water policy, and serve as a physical representation of the culture shift.

Chapter 1
Introduction

Georgia faced a major drought starting in 2007 that garnered national media attention, although droughts have plagued the state since before 1980. These intermittent occurrences have become more troublesome due to legal conflicts over the two major river basins located in the state with neighboring Florida and Alabama. Furthermore, water consumers have increased in Georgia's largest metropolitan area, Atlanta. Throughout the droughts and interstate conflicts, Georgia attempted to mitigate water scarcity through legislation, interstate compacts, and later conservation measures. However, despite these attempts, droughts continued to highlight water scarcity as recently as 2009. This research discusses a series of water resource events since 1970 that have shaped the water culture in the state of Georgia.

Geographers Emel and Brooks asserted that laws of reasonable use changed little over time in governing groundwater resources, despite increased stress on the resource, while the institutions enforcing these laws changed significantly. They noted that water policy, which was based in common law definition of property and decided upon in court cases, evolved from discretionary standards to administrative regulation. These conclusions were based on an analysis of three states in the American Great Plains.[1] Does their model apply to another, more humid area of the United States, where water scarcity was not specifically addressed early on and interstate competition intensified natural stresses?

In order to answer this question, this thesis explores how Georgia's government reacted to drought, and seeks to determine if it has it been successful in mitigating the effects of water scarcity. First, this research identifies causes of drought in Georgia. Next, it traces the evolution of water policy to determine how water scarcity has shaped policy and regulation. Furthermore,

[1] Jacque L. Emel and Elizabeth Brooks, "Changes in Form and Function of Property Rights Institutions under Threatened Resource Scarcity," *Annals of the Association of American Geographers* 78, no. 2 (1988): 241-252.

this thesis considers how outside actors shaped water policy within Georgia. This research also aims to measure how these drought and policy changes, especially water conservation, influenced the public's attitudes and behaviors towards water consumption. This is measured through consumption trends, as well as through an analysis of public spaces in Atlanta, which are guided by the public opinion. This thesis explores how Georgia's state government and the public react to drought situations.

As identified by this research, factors of water scarcity in Georgia include an increase in demand because of the population growth of Atlanta, conflicts with neighboring states over Georgia's largest water supply, the Chattahoochee River, increasingly frequent droughts, and government policies that did not adequately prepare the state for these stresses. This research asserts that these factors are interconnected and should be addressed as so in order to move forward with an effective water policy in Georgia.

Lake Sydney Lanier, which supplies water for most of metro Atlanta, is formed by Buford Dam which is an Army Corp of Engineers administered structure on the Chattahoochee River, part of the Apalachicola-Chattahoochee-Flint River Basin (ACF). Much of this thesis focuses on the ACF River Basin, including the water scarcity issues and conflicts which impact it.

Organization of Chapters

This thesis describes the path of Georgia's water policies since the 1970s. This introductory chapter provided an orientation to the key research questions, including population growth and water conservation, and serves as an orientation to the study area, including the importance of Buford Dam. In addition, this chapter situates the research in similar geographic

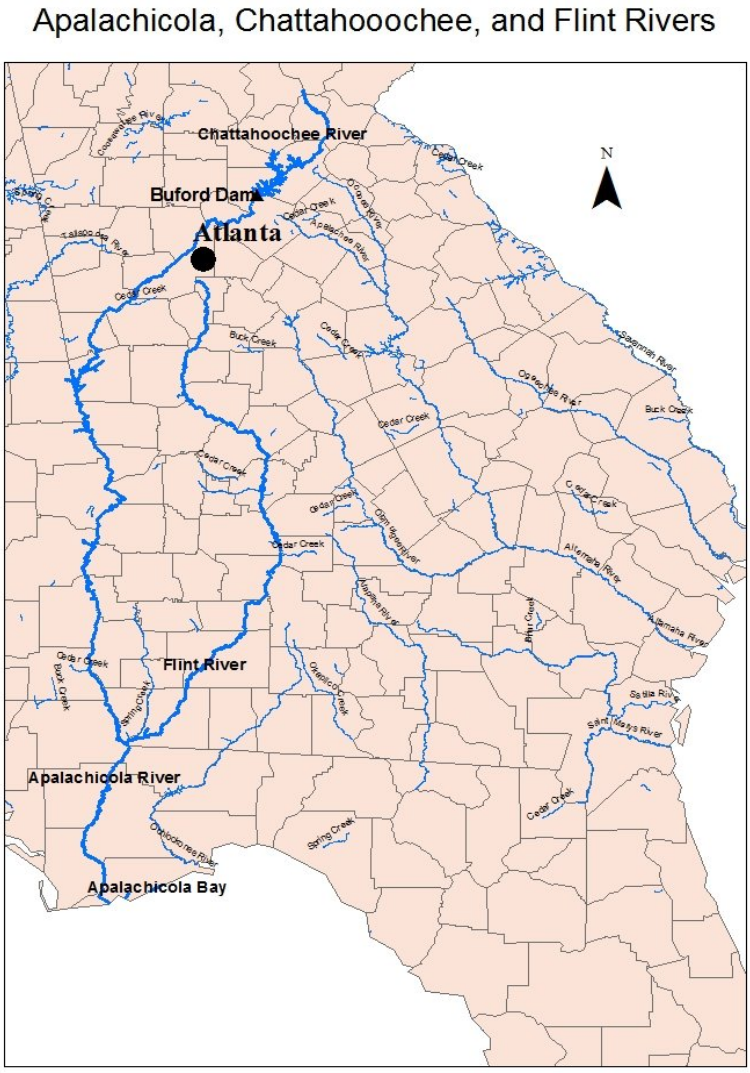

Figure 1. Relationship of Buford Dam, on Chattahoochee River, to Atlanta, Georgia.[2]

studies. Chapter two traces the historical development of water policies until 1970 and outlines the state's actions in water issues since 1970 to the year 2000. This chapter follows Georgia's water legislation history to show a trend from a tradition of riparianism to a conservationist push of the 2000s. Chapter three discusses drought occurrences since 1954, their effects, and some measures taken to resolve these effects. Additionally, this chapter aims to relate this discussion

[2] Map created in ArcMap using free ArcGIS datasets. Mapping courtesy of Shaun Williams.

of drought to literature and to provide an explanation for the drought by using measures such as the Palmer Drought Hydrological Index and annual precipitation of Georgia. Chapter four discusses water conflicts among Georgia, Alabama, and Florida. The fourth chapter provides a history of the Tri-state Water Wars in order to relate this legal struggle with the overall issues of water scarcity in Georgia and greater discussions of environmental conservation. Finally, chapter five outlines the state's water policy adjustments since 2000, and provides a case study on the "culture of conservation" in public spaces in Atlanta. Water consumption trends are used to show effectiveness of conservation measures.

Dam Conflicts

Buford Dam provides the Army Corps of Engineers control over Lake Lanier and the Chattahoochee River, and thus, water infrastructure is an important factor of water scarcity in Georgia. In fact, watershed projects have a long history in Georgia. Large watershed projects started in Georgia after the Federal Flood Control Act of 1944. The first in Georgia was in the Coosa River Watershed and affected twenty counties and 1.5 million acres of land.[3] Construction on Buford Dam, which forms Lake Sydney Lanier, began in 1950 and continued until 1957. Congress authorized the Buford project in 1947 and the Army Corps of Engineers administers the site to this day. Buford Dam's official purpose was water storage for downstream power production, but over time it served additional needs such as navigation and urban water supply. [4] By the 1970s, Lake Lanier's purposes included flood reduction, water supply for municipal and industrial uses, and navigation. In 1978, it also provided an important recreation area and was the most visited facility administered by the Army Corps with

[3] Harold R. Brown, *The Greening of Georgia: The Improvement of the Environment in the Twentieth Century* (Macon, GA: Mercer University Press, 2002), 123.
[4] Lori I. Coleman, "Our Whole Future Is Bound Up in This Project: The Making of Buford Dam" (History Thesis, Paper 30, Georgia State University, 2008), 37-44. http://digitalarchive.gsu.edu/history_theses/30.

16,290,700 visitors annually. Three reservoirs authorized on the Flint River, including the Sprewell Bluff, Lazer Creek, and Lower Auchumpkee Creek, provide flood control, power generation, and recreation. These projects received criticism from conservationists who feared adverse changes in the natural environment. Proponents of the projects value their economic and recreational potential and their power and flood control capacities.[5]

Rivers have been altered for the benefit of humans for centuries, however, the impacts water infrastructure have on the environment is not fully understood. Dams can provide benefits to the public, but the costs to the "physical, chemical, and biological process within the aquatic ecosystems" may outweigh these benefits.[6] Before the 1950s, public opposition to dams was not prevalent, and therefore opposition to the damming of the Chattahoochee was not an issue. In the 1950s the Sierra Club, a nonprofit environmental organization, led a crusade to block dam construction in the United States. Even President Jimmy Carter, formerly the Governor of Georgia, openly questioned the intelligence of large scale watershed projects through his term as President in the late seventies.[7]

Since the 1970s, concerns and activism for waterway restoration has grown significantly. For example, Congress passed the Wild and Scenic Rivers Act in 1968 in order to preserve rivers which exhibit exceptional recreation or scenic value in their free flowing state without dams.[8] Grass-roots organizations have emerged throughout the country for individual waterways, as well as national scale efforts. In Georgia, The Upper Chattahoochee Riverkeeper, a part of the

[5] R. S. Howard, Jr., Director of Environmental Protection Division, "The Flint River: Progress or Pork Barrel?" May 1972, Environmental Protection Division of the Georgia Department of Natural Resources, Director's Subject Files, Georgia State Archives, Morrow, GA.
[6] William R. Lowry, *Dam Politics: Restoring America's Rivers* (Washington D.C.: Georgetown University Press, 2003), 39.
[7] Ibid., 40-41.
[8] U.S. Congress, *The Wild and Scenic Rivers Act,* Public Law 90-542 (Washington D.C.: U.S. GPO, October 2, 1968).

international Waterkeeper Alliance, has been active in the protection of the Chattahoochee River Basin since 1994.[9]

On the other hand, one Georgian leader, R. S. Howard, Director of the Department of Natural Resource, was a staunch proponent of watershed projects through the seventies. In a letter to then Governor Carter in 1972, Howard spoke of his disdain for "environmentalist" opposition to man-made lakes in support of the Sprewell Dam on the Flint River. Despite the public oppositions, Howard argued that human-made lakes provide opportunities for recreation that the natural lakes of the state cannot.[10] R. S. Howard also took issue with the Georgia League of Conservation Voters who opposed dam projects Howard was fighting for. Howard considered himself to be conservationist, but not the kind of conservationist of the League.[11] R.S. Howard, speaking in 1973 of negative reactions to the West Point Dam project, again displayed disdain to public opposition to the project and the "self proclaimed environmentalists who promote a negative ethic against almost every public works project conceived to benefit man-kind."[12] The West Point Dam and Reservoir, according to Howard, was necessary in order to provide flood control, hydroelectric energy, and also to conserve water for public supply, industrial development, and recreational activities. [13] In fact, Director Howard made a stance on the creation of recreational areas as a primary goal for Georgia's waterways.

Buford Dam is an important, albeit controversial, aspect in the history of Georgia's waterways and therefore essential to this research. Opposition to Buford Dam is just one

[9]Upper Chattahoochee Riverkeeper, "Mission and History," http://www.chattahoochee.org.
[10] R. S. Howard, Jr. to Jimmy Carter, November 28, 1972, Environmental Protection Division of the Georgia Department of Natural Resources, Director's Subject Files, Georgia State Archives, Morrow, GA.
[11] R. S. Howard, Jr. to Sam Nunn, November 1, 1972, Environmental Protection Division of the Georgia Department of Natural Resources, Director's Subject Files, Georgia State Archives, Morrow, GA.
[12] Editorial on the West Point Dam and Reservoir: Interview with R. S. Howard to Channel 3, Columbus, July 26, 1973, Environmental Protection Division of the Georgia Department of Natural Resources, Director's Subject Files, Georgia State Archives, Morrow, GA.
[13] Ibid.

example of the conflict between environmentalism and the need for economic growth in Georgia. Likewise, water supply issues took the same route later in the century. In Georgia, there is a constant need to balance environmental interests and economic benefits.

Watersheds

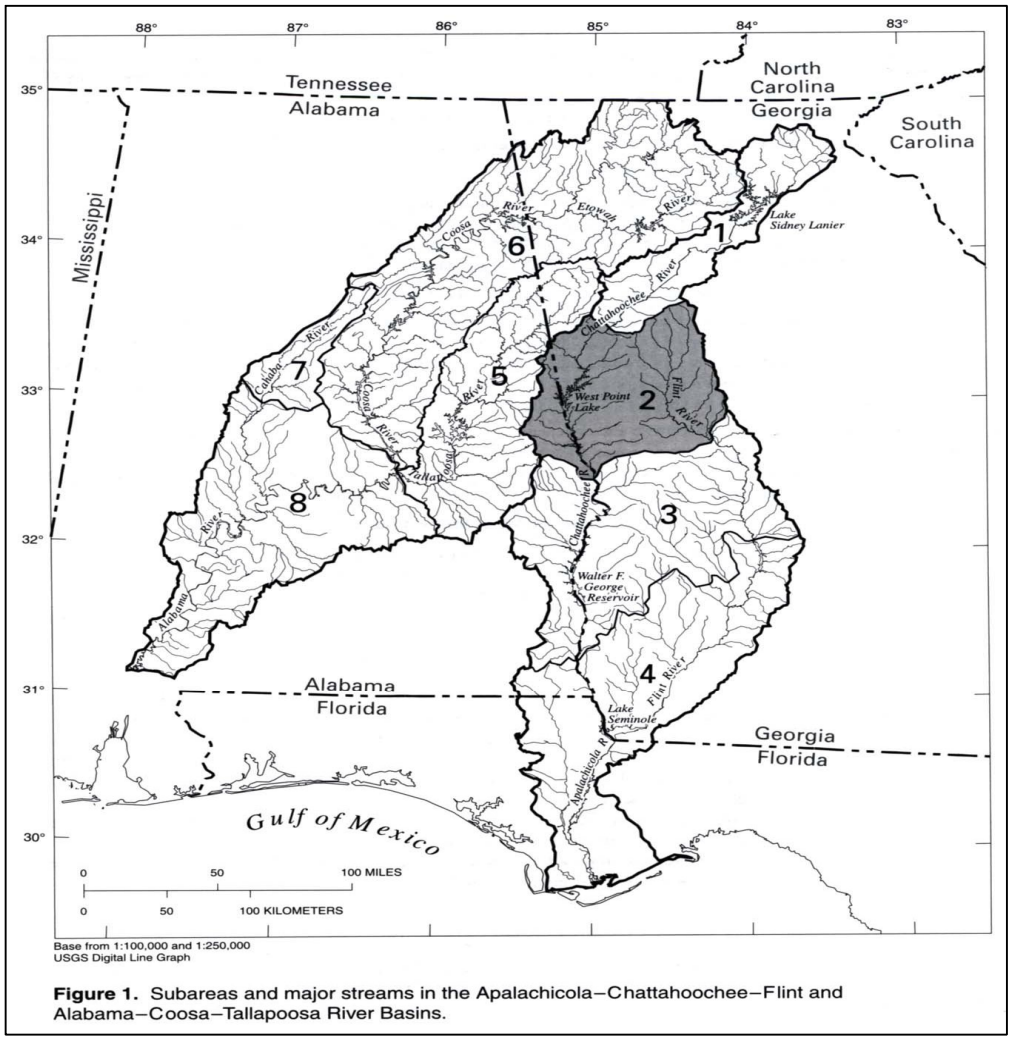

Figure 2. Apalaichicola-Chatahoochee-Flint and Alabama-Coosa-Talapoosa River Basins.[14]

Watersheds in Georgia are important to this research since they provide the public water supply at issue. The rivers of Georgia function as two major separate watersheds. The Apalachicola-Chattahoochee-Flint River Basin (ACF) provides the water supply for the

[14] Image from USGS, Open File Report 96-492, Ground-Water Resources of The Middle Chattahoochee River Basin in Georgia and Alabama, and Upper Flint River Basin in Georgia-Subarea 2 of the Apalaichicola-Chatahoochee-Flint and Alabama-Coosa-Talapoosa River Basins, http://pubs.usgs.gov/of/1996/ofr96-492/pdf/ofr96-492.pdf.

metropolitan Atlanta, as well as numerous recreational opportunities and an incalculable economic value to the citizens of Georgia, and has also been ingrained in the cultural identity of its citizens. The ACF extends 385 miles from northeast Georgia to the Gulf of Mexico. The ACF drains 19,600 square miles of land, 8,770 along the Chattahoochee, 8,460 along the Flint, and 2,370 along the Apalachicola River. The ACF basin is located in four physiographic provinces: the Ridge and Valley, Blue Ridge, the Piedmont, and the Coastal Plain. The Chattahoochee River flows southwest from the Blue Ridge Mountains for 120 miles, and then follows a southerly course for 200 miles. This stretch forms a part of the boundary between Georgia and Alabama, as well as Georgia and a part of Florida. The Flint River originates just south of Atlanta, and joins the Chattahoochee at the Georgia-Florida line, where it becomes the Apalachicola River, and empties into the Apalachicola Bay. There are five reservoirs located on the Chattahoochee River operated by the Corps of Engineers, and an additional nine non-Federal reservoirs.[15]

The Alabama-Coosa-Tallapoosa River Basin traverses more miles in Alabama, but its waters originate in northwestern Georgia. The Coosa and Tallapoosa and their tributaries unite and form the Alabama River near Montgomery, Alabama. The Alabama River empties into the Gulf of Mexico near Mobile, Alabama. [16] The ACT River Basin is not as predominant on the landscape of Georgia, but is similarly a point of conflict with neighboring state Alabama, and thus been a factor in Georgia's water policy evolution.

Geography and Water Supply

Georgia's water issues are defined in part by the physical geography of the state. There are few natural lakes in Georgia. Above the fall line, water is predominately supplied by surface

[15] ACT/ACF Comprehensive Water Resources Study, September 1995, Governor-Tristate Water Compact Commission Collection, Georgia State Archives, Morrow, GA.
[16] USGS Map. http://viewer.nationalmap.gov/viewer/

water, save small water wells that are only acceptable for private use. Atlanta, along with most of Georgia's population, is located in this region and thus consumed surface water from the Chattahoochee and Lake Lanier. Southern Georgia is Georgia's agricultural region. Groundwater provides the water supply for this region, and irrigation is southern Georgia's largest water use.[17]

The major geologic regions in Georgia are the Ridge and Valley, Blue Ridge Mountain, Piedmont, and Coastal Plains Provinces.[18] In the Ridge and Valley Province, the presence of dolomite makes groundwater possible. All of Georgia's main rivers originate within Georgia's state boundaries, including the Chattahoochee, Flint, and Apalachicola. The headwaters of most rivers are in the Blue Ridge Mountain and Piedmont provinces in northern Georgia. The bedrock of the Blue Ridge and Piedmont Provinces are composed of granite, gneiss, and marble, which are not soluble in water, and also are largely impermeable; therefore, major groundwater sources do not exist in this area. Groundwater is found in fractures in the rock, but in a smaller quantity than in the Ridge and Valley Province. The Coastal Plain Province contains water-bearing formations that include the Florida aquifer, the Cretaceous Sand aquifers, and the Clayton aquifers. There are few natural lakes in Georgia, and the ones that do exist are in the southern half and were formed by the dissolution of limestone. Rivers, in the past, flowed to the sea and over the Georgian landscape, which wore away natural barriers that would create lakes.[19] In contrast to the north's reliance on surface water, southern Georgia primarily uses groundwater for agriculture industry, and domestic users.

Georgia's water supply is determined by geology and climate. The capital city, Atlanta, is located in a region without extensive groundwater. The northern part of Georgia is "underlain by

[17] James E. Kundell, *Georgia Water Resources: Issues and Options* (Athens: Institute of Government, University of Georgia, 1980), 1-3.
[18] Ibid.
[19] Ibid., 4-9.

hard, crystalline, compact rocks which do not form extensive aquifers." [20] In northwest Georgia, in the Ridge and Valley Province, there is some groundwater but it varies in quality and quantity. The limited groundwater found in this part of the state may be useful for small consumers, but is not a solution to supply problems of the larger metropolitan areas. Furthermore, Atlanta is situated in a geologically old area without large natural lakes. It is also located near the headwaters of the streams that provide its water supply, and therefore, these rivers pass through the industrial and most populated areas before reaching their full capacity.[21] In addition to the physical geography of the state, other environmental factors dictate water supply.

Climate

Georgia's climate is moist and temperate, which makes water scarcity issues difficult to comprehend. The state's average annual precipitation is 50 inches, but varies across the state. More precipitation falls in the northeastern portion of the state and least in the Augusta area. Precipitation also varies seasonally; it is lowest during the fall months. Intensity of precipitation, temperature, and relative humidity also affect the quantity of potable precipitation. Seventy percent of annual rainfall, or 35 inches, returns to the atmosphere by evaporation and transpiration. Approximately 18 percent, 9 inches, of the annual precipitation becomes surface water runoff. The remaining 12 percent, or 6 inches, infiltrates the soil and percolates downward to recharge the state's aquifers. This water may serve as recharge for surface water or, if not withdrawn, it discharges to the ocean. Furthermore, Georgia is the location of a major drainage divide. Water west of the divide flows west toward the Gulf of Mexico; water to the east of the divide flows to the Atlantic.[22] Georgia's climate plays a part in the water supply of the state.

[20] Ibid., 5.
[21] Ibid.
[22] Ibid., 2-3.

Population

Burgeoning population growth in the northern half of the state offers one explanation for water scarcity in Georgia. A study conducted in 2009 concluded that the 2005 to 2007 drought in the southeastern United States was not a result of anthropogenic climate change, but rather an increase in consumption.[23] Georgia's population increased from 4,589,575 in 1970 to 9,687,653 as of the 2010 census. [24] However, not all of Georgia's population withdraws water from the public water supply. From 1990 to 2005, the total population served by Georgia's public supply increased from 5,150,000 people to 7,470,000.[25]

Although the population within Atlanta city limits has actually decreased since 1970, the population of the Atlanta metropolitan statistical area (MSA) has almost tripled from 1,390,164 in 1970 to 4,247,981 in 2010.[26] Atlanta's MSA expanded in 2003 to include twenty-eight counties.[27] In the decade leading up to 2010, Atlanta metropolitan area grew 24 percent, making it the second fastest growing metropolitan area in the United States. Atlanta's metropolitan area accounted for over 68 percent of Georgia's population growth during this time. As of 2010, Atlanta included over half of Georgia's total population.[28]

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[23] Richard Seager, Alexandrina Tzanova, and Jennifer Nakamura, "Drought in the Southeastern United States: Causes, Variability over the Last Millennium, and the Potential for Future Hydroclimate Change," *Journal of Climate* 22, no. 19 (2009): 5021-5045.

[24] U.S. Census Bureau, *Census of Population, 1970, vol. 1, Characteristics of the Population Part 12.* (Washington, DC: GPO, 1973), 35, http://www.census.gov/prod/www/abs/decennial/1970cenpopv1.html; U.S. Census Bureau, *2010 Census Interactive Population Search*, http://2010.census.gov/2010census/popmap/ipmtext.php.

[25] USGS, "Estimated Water Use in the United States in 1990: Public Supply Freshwater Use." http://water.usgs.gov/watuse/tables/pstab.st.html; USGS, "Estimated water use in the United States 2005," Table 5, http://pubs.usgs.gov/circ/1344/pdf/c1344.pdf.

[26] U.S. Census Bureau, *Census of Population, 1970, vol. 1, Characteristics of the Population Part 12*, 35, http://www.census.gov/prod/www/abs/decennial/1970cenpopv1.html; Paul Mackun and Steven Wilson for the U.S. Census Bureau, *Population Distribution and Change: 2000 to 2010, 2010 Census Briefs*, (March 2011), 6, http://www.census.gov/prod/cen2010/briefs/c2010br-01.pdf.

[27]Metro Atlanta Chamber of Commerce, *Atlanta MSA Growth Statistics,* http://www.metroatlantachamber.com/macoc/business/img/MSAGrowthStatsReport2006.pdf.

[28] Mackun and Wilson for the U.S. Census Bureau, *Population Distribution and Change: 2000 to 2010,* 4.

The Apalachicola-Chattahoochee-Flint River basin is the smallest watershed serving a major metropolitan area in the United States.[29] The Chattahoochee forms Lake Sydney Lanier at Buford Dam approximately 40 miles northeast of Atlanta. In the five counties surrounding Lake Sydney Lanier, population grew over 40 percent since 2000, which is twice as fast as the counties below Buford Dam.[30] Therefore, population growth is essential to consider in water policy.

Literature Review

Drought as a Hazard

This research explores how society identifies, reacts, and adapts to drought and considers drought as a hazard. Hazards are events that pose a threat to humans and what they value; therefore, hazards are socially constructed and humans "contribute to, exacerbate, and modify them."[31] Geography is valuable to the study of hazards because of the importance of scale in understanding them, and because geography links the physical processes that cause hazards with the human element.[32] Susan Cutter's *American Hazardscapes* also recognizes drought as a hazard and discusses two types: meteorological and socioeconomic. Meteorological drought occurs when there is a decrease of precipitation. Socioeconomic drought occurs when the demand for a water supply is higher than the supply. Drought experienced in Atlanta and Georgia can be attributed to both. Droughts are not dependent on high temperatures, and Cutter distinguishes wildfires and extreme heat from droughts for this reason.[33]

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[29] Upper Chattahoochee Riverkeeper, *Water Crisis*, http://www.chattahoochee.org/water-crisis.php.
[30] Bruce A. Seaman, Bleakley Advisory Group, and PBS&J, "Lake Sydney Lanier Economic Impact Analysis." (1071 Coaliton, 2010), http://lakelanier.org/wp-content/uploads/2011/01/Lake-Lanier-Economic-Impact-Analysis-Final-Report.pdf
[31] Susan L. Cutter, "Societal Responses to Environmental Hazards," *International Social Science Journal 48*, no. 4 (1996): 525.
[32] Ibid., 530.
[33] Susan L. Cutter, *American Hazardscapes: The Regionalization of Hazards and Disasters* (Washington, D.C.: Joseph Henry Press, 2001), 97.

Drought is a hazard because of the economic losses it can cause. According to the National Climatic Data Center, drought cost the United States $60 billion between the years 1980 and 1989.[34] In 2008, widespread drought across the southern United States cost $2 billion in losses and damage.[35] Drought affects both agricultural and recreational economies in Georgia. The non-profit organization 1071 Coalition, which aims to keep Lake Lanier at a sustainable level, studied the economic aspect of drought in December 2010. Its study assessed the economic impact of low lake levels on Lanier's surrounding areas during the 2007 through 2009 drought. According to the study, recreational spending decreased by $87.6 million due to low lake levels.[36] Georgia's agriculture is vital to the state's economy and is harmed by water scarcity. In 1981, 10,500 farmers applied for $515 million in federal emergency loans due to crop losses caused by drought.[37] In 1986, Georgia Farm Bureau Federation showed crop losses due to the drought at 533.6 million for 12 major commodities. Each day of the drought literally resulted in millions of dollars lost. [38] During a drought in the summer of 1993, the U.S. Agriculture Department declared 154 counties in Georgia disaster areas and gave farmers access to $2 billion to cover up to half of their losses. [39] In the summer of 2000, U.S. Secretary of Agriculture Dan Glickman declared Georgia a disaster area due to a three-year drought. The declaration gave farmers the ability to apply for low interest loans and access to $1.4 million put aside to provide emergency water assistance for livestock.[40] Thus, drought in Georgia is costly.

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[34] Ibid., 97-99.
[35]NOAA, "Billion Dollar U.S. Weather/Climate Disasters," http://www.ncdc.noaa.gov/oa/reports/billionz.html.
[36]Bruce A. Seaman, Bleakley Advisory Group, and PBS&J,"Lake Sydney Lanier Economic Impact Analysis."
[37] David Corvette, "Georgia Better Prepared Than in Earlier Droughts," *Atlanta Journal-Constitution*, May 18, 1986, sec. C.
[38] Tom Hallman, "Ga. Farms Out Half Billion on Drought," *Atlanta Journal-Constitution*, July 31, 1986, sec. A.
[39]Jingle Davis, "Georgia Farmers Ready to Reap Federal Drought Aid," *Atlanta Journal-Constitution*, August 11, 1993, sec. A.
[40] Kathey Pruit and John McCash, "Drought Officially a Disaster in Georgia," *Atlanta Journal-Constitution*, July 15, 2000, sec. A.

Climate Variability

Vulnerability to extreme drought is increasing along with increasing climate variability. Because of this, it is necessary to study how people respond to droughts in order to "prepare, mitigate, and instill policies" to combat their impacts.[41] Impacts of climate variability mean more extreme weather patterns, including drought.[42] Climate models indicated temperatures trended upwards in the southeastern United States in the past, and projected temperatures will increase at even greater rates over the next century. Coupled with the likelihood of less frequent rainfall, the frequency, duration, and severity of droughts are also likely to increase.[43] In general, climate change is capable of effecting water quality, by changing temperatures, runoff rates, and the ability of watersheds to dilute pollutants. These factors can strain water supplies, even without changes in precipitation. These greater strains will cause further competition between agricultural, industrial, and residential water users.[44] Furthermore, the rate of increasing water consumption in domestic and industrial sectors is greater than the rate of growth for agricultural use, which causes growing cities, such as Atlanta, to be especially vulnerable to shocks in water supplies caused by climate variability.[45] However, climate change does not need to be a threat to

[41] Georgina Endfield, *Climate and Society in Colonial Mexico: A Study in Vulnerability* (Malden, MA: Blackwell Publishing, 2008), 5-6.
[42] Olli Varis, "More Urban and More Aged: Demographic Pressures to Global Water Resources by 2050," in *Water Management in 2020 and Beyond*, ed. Asit K. Biswas et al. (Berlin: Springer, 2009), 35-63; Van Walsum et al. "Spatial Planning for Adapting to Climate Change." *Water Science & Technology* 51, no. 5(2005): 45-52; Lawrence D. Frank, et al, "The Urban Form and Climate Change Gamble," *Planning* 73, no. 8 (2007): 18-23.
[43] U. S. Global Change Research, "Global Climate Change Impacts in the United States a State of Knowledge Report from the U.S. Global Change Research Program," (Cambridge: Cambridge University Press, 2009), http://downloads.globalchange.gov /usimpacts/pdfs/climate-impacts-report.pdf.
[44] P. K. Aggarwal and A. K. Singh, "Implications of Global Climatic Change on Water and Food Security," *Water Resources Development and Management* 1 (2010): 49-63.
[45] Claudia Ringler, et al., *Water and Food Security under Global Change* (Berlin: Springer, 2010), 3-15.

water supply issues. Authorities responsible for spatial planning need to recognize the possible outcomes of climate change and implement planning with water resources in mind. [46]

Georgia's State Climatologist, David Emory Stooksbury, accounted for climate variability in his recommendations for drought management. Stooksbury acknowledges it would not be beneficial to ignore possible shifts in climate. Although, climate prediction is not exact, he proposes that in order to address possible climate variability, it is necessary to include "modernizing and maintaining high quality long-term climate data" as a top priority.[47]

Similar Case Studies

Hazards, including droughts, are often a social construction as much as they are physical events. Therefore, in order to fully understand their impact, archival sources are especially valuable to environmental history studies.[48] For example, Georgina Endfield's work in Guanajuato, Mexico uses archival evidence to explore the response to drought and flood occurrences from the sixteenth century to the eighteenth century. Endfield's research asserts that these hazards can act as a stimulus to social change. According to the article, the fear of drought fueled various lawsuits over "water monopolization, deprivation, usurpation, and over-use." [49] For example, the research identified cases over the diversion of streams used for agricultural irrigation. Conflicts over water distribution during the study time were prominent in court filings; however, in some cases the communities developed water sharing systems to combat scarcity.[50] In her case study, reaction to drought included "laws with water restrictions, rationing programs,

[46] P. E. V. Van Walsum, J. Runhaar, and J. F. M. Helming, "Spatial Planning for Adapting to Climate Change," *Water Science & Technology* 51, no. 5 (2005): 45-52.
[47] D. E Stooksbury, "Historical Drought in Georgia and Drought Assessment and Management," Proceedings of the 2003 Water Resources Conference, ed. K J Hatcher, April 23-24 2003, Athens GA.
[48] Georgina H. Endfield, Isabel Fernández Tejedo , Sarah L. O'Hara, "Conflict and Cooperation: Water, Floods, and Social Response in Colonial Guanajuato, Mexico," *Environmental History* 9, no. 2 (2004), 222.
[49] Ibid., 228.
[50] Ibid., 228-229.

conjunctive use of surface and ground water, watershed management, and recycling projects."[51] Furthermore, since there is no universal way to define a drought, when using archival sources, and even recent newspaper articles as I have in this research, there can be a disconnect between physical and perceived droughts.[52] Using similar methods, this thesis aims to link archival resources to drought which is a physical occurrence.

Emel and Brooks study examined the social implications of changing regulation and traced the evolutionary pattern of the High Plains Aquifer and groundwater laws in the west in general. In this study, the pattern follows that first, during development, government involvement in the management of the resource is limited to private disagreements settled in courts. After the development period, there is a period of "congestion and conflict as individuals pursue" their own interests. [53] Thus, the legal system is vital to resolving disagreements. Groundwater regulation in the west followed a pattern of common law based on reasonable use as defined by the courts. However, as use of the resource increased in the 1940s and 1950s due to agricultural interests, there was more awareness of rights and increased conflict over the right to use groundwater. Later regulation prohibited wasteful and injurious (to other users) use. The laws managing groundwater evolved from common law standards decided in courts on a case to case basis, to uniform rules and regulations that do not consider individual circumstances. [54]

As a resource becomes scarce, it becomes necessary to define rights to use and enforce those rules. Conservation measures, or means to reduce waste and increase efficiency, are "generally the only management tool acceptable to existing users for reduction of demand." [55]

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[51] Ibid., 239.
[52] Ibid., 222-223.
[53] Jacque L. Emel and Elizabeth Brooks, "Changes in Form and Function of Property Rights Institutions under Threatened Resource Scarcity," *Annals of the Association of American Geographers* 78, no. 2 (1988): 242.
[54] Ibid., 243-251.
[55] Ibid., 245.

Similar to Emel and Brooks work, this thesis aims to relate periods of water scarcity to regulatory change, especially conservation measures.

Resource conservation is a key component of this research. Conservation became a prominent part of Georgia's reaction to drought conditions after the interstate legal compacts dissolved and droughts continued. Studies on reaction to water scarcity, including conservation and pricing practices, exist for the southwest United States. For example, a case study of Layton, Utah found that the primary source of wasteful watering was programmed irrigation systems. The study concluded that residential areas, rather than business areas, are more likely to partake in water conserving practices. Also, the utility of landscapes are not solely based on how much they are watered, but also on things they are used for, such as recreational use.[56]

Another study, done in Aurora, Colorado, explores outdoor water restriction policies and pricing practices as mechanisms for driving consumption, which can be used in times of drought. An important concern raised by the author is that these measures are rarely done in isolation, and therefore the effects of them on consumption are difficult to determine. The article concludes that these measures are not necessarily complementary of each other, and that pricing effectiveness varies between customer use.[57]

Resource governance is particular to a person or group, and therefore there is no single way of understanding any natural system.[58] Drought and water allocation in general is especially unique to place. For example, in a case study done in Puebla, Mexico, Liverman finds that the best way to avoid drought in the region is through irrigation. She also asserts that reported

[56] Joanna Endter-Wada, et al.,"Situational Waste in Landscape Watering: Residential and Business Water Use in an Urban Utah Community," *Journal of the American Water Resources Association* 44, no. 4, (2008): 902-20.
[57] Douglas S. Kenney et al., "Residential Water Demand Management: Lessons from Aurora, Colorado," *Journal of the American Water Resources Association* 44, no. 1, (2008): 192-207.
[58] Michael Cox, "Balancing Accuracy and Meaning in Common-Pool Resource Theory," *Ecology and Society* 13, no. 2 (2008): http://www.ecologyandsociety.org/vol13/iss2/art44/.

drought severity and patterns do not always necessarily match the meteorological data.[59] Similarly in Georgia, drought occurrences reported through media outlets and recognized by state agencies do not necessarily coincide with drought indexes.

Although Georgia's climate and water supply issues are very different than western states, it is important to note that studies about water scarcity do exist in the United States. Also, culturally, the eastern and western states are similar and the federal government is involved in regulating interstate conflicts. Western states have dealt with water shortages, by sheer nature of their climate, for much longer than the eastern states.

Western Water Wars

Water issues have been well represented in geographic and related literature. However, in the United States, drought and water management studies have largely focused on the arid western states. Logan (2006) and Sheridan (1981) offer historical analysis to the water structure of the west. Logan's book, *Desert Cities*, is an environmental history that emphasizes the role of competition between Phoenix and Tucson in the environmental and water allocation of the region. According to Logan, the "winner" of the competition was the city with the greatest population, Phoenix. This population growth would not have been possible without evolving water management practices. [60] According to Sheridan, the arid west was able to support phenomenal growth because of such practices as "mining of groundwater" (not replenishing what is pumped out), damming rivers, and transporting of water over long distances (from abundance to scarcity). Damming rivers requires large capital, supplied by the federal government, an example of how national actors influence water policy. These measures have not

[59] D. M. Liverman, "Drought and Agriculture in Mexico: The case of Sonora and Puebla in 1970," *Annals of the Association of American Geographers* 80, no. 1 (1990):49-72.
[60]Michael F. Logan, *Desert cities: The Environmental History of Phoenix and Tucson* (Pittsburgh: University of Pittsburgh Press, 2006).

solved the fundamental issue, scarcity, and have caused environmental degradation in the form of salinization of the soil. [61] Water scarcity in the west is a staple of the climate. However, a similar historical and social approach can be used to explain scarcity in the east.

Donald J. Pisani's *To Reclaim a Divided West* treats the western states not as one entity, but as diverse parts which must be understood before "sense can be made of the whole."[62] Pisani traces water policy history in the west from 1842 up until the Reclamation Act of 1902. Pisani noted that in California, the prior appropriation doctrine indicative of western states added to the degradation and over use of water during the boom and bust periods until 1866, and discusses the politics, competition, changes in water policy in a historical context, and the politics of and competition between individual states over water.[63]

David Worster's work *Rivers of Empire* describes the American West "as a modern hydraulic society," that has "a social order based on the intensive, large-scale manipulation of water and its products in an arid setting." [64] A hydraulic society, a term borrowed from Karl Wittfogel, a Marxist historian of Ancient Chinese civilization, is used to describe a phenomena in a desert which as dams and "more elaborate canal networks were built, political power came to rest in the hands of an elite, typically ruing class of bureaucrats." Worster argues that literature dealing with irrigation and cultural evolution ignores the study of civilizations from the past hundred years, and that this is a deficit. Worster asserts that the reason American settlers in Utah, California, and Colorado, including the Mormons of Utah, initially intensified irrigation in

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[61] David Sheridan, "The Underwatered West," *Environment: Science and Policy for Sustainable Development 23*, no. 2 (1981): 6.
[61] Donald J. Pisani, *To Reclaim a Divided West: Water, Law, and Public Policy, 1848-1902* (Albuquerque: University of New Mexico Press, 1992), 332.
[61] Ibid., Chapters 2 and 3.
[61] Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West (*New York: Pantheon Books, 1985), 7.
[62] Pisani, *To Reclaim a Divided West*, 332.
[63] Ibid., Chapters 2 and 3.
[64] Worster, *Rivers of Empire*, 7.

order to create a "paradise" in the arid climates. This paradise was eventually taken over by the federal government's need to reclaim nature for its benefit, and "big organizations," which were damaging to the environment.[65] Likewise, agriculture, federal influence, and economic benefits influenced the development of water infrastructure development in Georgia.

Vulnerability and Adaptability

Vulnerability to extreme drought is thought to be increasing all over the world due to increasing climate variability. Vulnerability is the "degree to which human and environmental systems are likely to experience harm due to" stress.[66] Hazards interact with cultural, social, and institutional processes in such a way as to provoke public response, and so vulnerability leads to adaptability. The vulnerability of a society changes due to adaptive measures, and some actions may make the society more vulnerable.[67]

Social vulnerability can be defined as exposure to "stress as a result of the impacts of environmental change."[68] Stress can include disruption to livelihoods and force adaptation changes in the physical environment.[69] In the social context, stresses are related to the social situation, including socioeconomic factors. In natural ecosystems, vulnerability is caused by stress or irreversible changes through environmental change. Resilience is the capacity to cope with stress. Social resilience is the "ability of communities to withstand external shocks to their social infrastructure."[70] This concept is particularly important in resource-dependent communities as their livelihoods are so greatly shaped by stresses including environmental, social, political, and economic variability. Resource dependent communities are those in which

[65] Ibid., 332.
[66] Endfield, *Climate and Society*, 3.
[67] Ibid., 4-5.
[68] Neil W. Adger, "Social Capital, Collective Action, and Adaptation to Climate Change," *Economic Geography* 79, no. 4 (2003): 387.
[69] Ibid.
[70] P. M Kelly and W. N. Adger, "Theory and Practice in Assessing Vulnerability to Climate Change and Facilitating Adaptation," *Climatic Change* 47, no. 4 (2000): 325-52.

the "social order, livelihood, and stability are a direct function of their resource production and local economy."[71] Water supply is inherently important to the survival of any community, and therefore, stresses on this resource in Georgia have vast implications for the state.

One way to mitigate vulnerability to hazards is through adaptation. According to Adger, adaptation is a "process of deliberate change in anticipation of or in reaction to external stimuli and stress."[72] There are two views of adaptation, actor-centered and resilience. The actor-centered approach is most common, and focuses on social actors and the reduction of vulnerabilities. The resilience approach focuses on the system, not the individual actor. Adger also suggests four broad measures to help the most vulnerable: poverty reduction; risk-spreading through income diversification; the preservation of common property management rights; and the promotion of collective security.[73] Georgia's government made attempts to adapt starting in 2003, and the impacts of these adaptations which will be discussed in a later chapter.

Methods

This research is based on archival research pertaining to Georgia's water resources found in Georgia's State Archives and the University of Georgia Archives. Both depositories have collections dedicated to Georgia's water resources. Using finding aids, I was able to locate and identify these collections, and after exploring their contents, was able to pick out key events of Georgia's water policy evolution. Also, newspaper articles from the *Atlanta Journal-Constitution* documenting water scarcity in the state provided insight into the public's perception of and adaptation to drought. To identify relevant articles on drought and water scarcity, I used the newspaper's online archives keyword search. Atlanta's Piedmont and Centennial Parks

[71] Neil W. Adger, "Social and Ecological Resilience: Are They Related?" *Progress in Human Geography* 24 (2000): 352.
[72] Adger, "Social Capital, Collective Action, and Adaptation to Climate Change," 387.
[73] Ibid.

appeared throughout the research of the archives and newspaper articles, and so I focused on these parks to further exemplify the water culture of Georgia. In addition, government policies collected from the Georgia General Assembly legislative documents, the Governor's executive orders, and policies of the Environmental Protection Division (EPD) show the state's attempts to mitigate the effects of droughts. Hydrological droughts are measured using data provided by the National Oceanic and Atmospheric Administration and precipitation measurements obtained from the Southeast Regional Climate Division. This data was analyzed using line graphs to identify trends and drought occurrences. For the case study, I explored the idea that the conservation methods that became prevalent in the 2000s can be seen in public spaces, or public parks in and around Atlanta, Georgia. I visited these spaces, the Centennial Park, Piedmont Park, and Chattahoochee National Recreational Areas, and also spoke with representatives of their management teams. To further explore the role of conservation, I also graphed water consumption data obtained from the Atlanta Department of Watershed Management and the USGS to expose trends.

Chapter 2
Water Policy History in Georgia Until 2000

Water policy is a reactive and ongoing process. Georgia's legislature adopted laws in the twentieth century in order to address existing issues, from ownership and rights conflicts, to pollution, and shortages. Past laws and regulations are not abandoned but rather altered to meet current needs. Before discussing Georgia's recent water problems, water policy history concerning quantity and quality demands attention to set the context. First, allocation issues of Georgia's water will be addressed and compared to policies of western states in order to provide a context as to how quantity conflicts are managed. Second, quality issues, such as pollution and sedimentation, are traced through legislation.

Allocation

As with most eastern states, Georgia historically relied on a riparian doctrine to govern its waters. In contrast to western states, which imposed a well defined system of water allocation laws, riparian laws treat water as a common property.[74] Riparian laws protect the rights of landowners with land adjacent to or crossed by a water body.[75] Georgia's water rights law is based on English common law in that past judicial decisions guide evolution and application of the law.[76] Before 1972, Georgia's legislature had a limited role in the management of its water resources. Instead, court decisions determined water allocation.

The Georgia Code of 1933 established the rules of riparian rights for those who had land bordering a non-navigable stream. Navigable streams were not subject to riparian laws, but still

[74] Joseph W Dellapenna, "United States: The Allocation of Surface Waters," in *The Evolution of the Law and Politics of Water,* ed. Joseph W. Dellapenna and Joyeeta Gupta. (Doredrecht: Springer, 2009), 199.
[75] James E. Kundell, *Georgia Water Resources: Issues and Options* (Athens, Georgia: Institute of Government, University of Georgia, 1980), 17.
[76] Bryan M. Storey, *The Study of the Riparian and Proper Appropriation Doctrines of Water Law, with Particular Reference to the Situation in Georgia* (Athens, Georgia: Institute of Law and Government, University of Georgia, 1955), 1.
[4] Ibid., 2.

subject to quantity and quality issues.[77] Groundwater, or diffused percolating waters, belonged to the owner of the soil. So when a landowner dug a well, he could continue pumping until the well was dry, even if this affected a neighbor.[78] The only exception to this was that one could not take water from a well to maliciously waste it or with intent to harm another user.[79] Groundwater flows through channels below the surface, but was also subject to the riparian doctrine. Georgia's riparian rights are expressed in the 1933 Georgia Code:

> Running water, while on land, belongs to the owner of the land, but he has no right to divert it from the usual channel, nor may he so use or adulterate it as to interfere with the enjoyment of it by the next owner. [80]

And:

> The owner of land through which non-navigable watercourses may flow is entitled to have the water in such streams come to his land in its natural and usual flow, subject only to such detention or diminution as may be caused by a reasonable use of it by of other riparian proprietors. The diverting of the stream in whole or in part from its natural and usual flow, or the obstructing thereof so as to impede its course or cause it to overflow or injure the land through which it flows or any right appurtenant thereto, or the polluting thereof so as to lessen its value to the owner of such land shall constitute a trespass upon the property.[81]

Under the past riparian law of Georgia, a riparian land owner is entitled to have the water flow without diminished quality or quantity, except by the use of riparian landowners upstream. Thus, owners further upstream are given more access to the resource. If followed strictly, this would render a stream useless. So, court decisions addressed stream use long as it was "reasonable in relation to the character and size of the stream and the nature of the use, the quantity of water used, and other uses to which the stream is adapted, and many other relevant factors." [82] For example, in one case, the court denied an upstream industrial kaolin processor the authority to divert water to process kaolin and then return the water to the stream. The action

[77] Storey, *The Study of the Riparian and Proper Appropriation Doctrines of Water Law*, 4.
[78] Ibid., 2-3.
[79] Statutory Law of Georgia, Georgia Code of 1933, 5.
[80] Kundell, *Georgia Water Resources*, 17.
[81] Ibid.
[82] Ibid., 6.

would have ruined the fertility of downstream users' land because of "dirt, chalk, kaolin, chemicals, and other debris" which polluted the soil.[83]

Statutes for water management indicate a doctrine of water as a common resource, and these values carried through Georgia's water policy evolution. However, the original riparian doctrine that governed Georgia's waters became what Dellapenna terms a regulated riparianism, defined as a system in which the government has been entrusted with the management of a resource for the public's good.[84] Regulated riparianism in Georgia is characterized by the issuance of permits as a means of water allocation for surface and groundwater.

Regulated riparianism in Georgia began in 1972 with the Groundwater Use Act. The Act required any user of more than 100,000 gallons of groundwater per day obtain a permit from the Environmental Protection Division (EPD), with tougher procedures for those wishing to receive a permit for consumptive use, use that does not return the water back into the groundwater system. Also in 1972, the Georgia General Assembly passed the Executive Reorganization Act, creating the Department of Natural Resources and Environmental Protection Division, and charged the Environmental Protection Division with the responsibility of protecting the quality of the state's water and centralized water quantity management within the EPD. Before its creation, multiple agencies held responsibilities of water management and regulation. Five years later, the State Surface Water Management Act of 1977 amended the Water Quality Control Act of 1974. This amendment gives the EPD the authority to allocate the State's surface water and to issue permits for all withdrawals over 100,000 gallons per day.[85] This combined the major

[83] Ibid., 18. See Roughton v. Thiele Kaolin Co. 209 Ga. 577 (1953), 74, S.E. 2d 844.
[84] Dellepenna, "Allocation of Surface Waters," 200.
[85] U.S. Army Corp of Engineers, Savannah District, Metro Atlanta Area Water Resource Management Study, Summary Report, February 1981, Environmental Protection Division, Director's Subject Files, Georgia State Archives, Morrow, GA.

surface water quality and quantity requirements within one agency, which was uncommon,[86] so that water management could be cooperative and efficient.

In contrast to eastern states, water laws in most western states have developed from a different perspective and mostly follow a doctrine of prior appropriation. Other western states may have some form of riparian rights doctrine, but in these cases, the doctrine is regulated to the point of being unrecognizable. Prior appropriation, like riparianism, is based on the notion of public ownership. For example, in the Colorado constitution "every natural stream not heretofore appropriated, within the state of Colorado, is (…) declared to be the property of the public and the same is dedicated to the use of the people of the state."[87] However, appropriative rights are primarily statutory in Western states and water can be used only for a beneficial purpose. The prior appropriation method of the West treated water as a commodity. Riparian owners do not hold rights to quantities of water, but rather the resource is treated as a common. [88]

Quality Issues

In addition to water rights, quality issues, including sedimentation and pollution, plagued Georgia state authorities and they addressed these issues through multiple actions long before quantity issues. Water scarcity was not initially handled in legislation because it was not seen as a threat until increasing water scarcity due to multiple droughts in the 1980s. Policy makers reacted to issues at hand, and did not foresee the scarcity issues of the future. Therefore, Georgia water laws were not sufficient for future stresses.

Georgia's water supply evolved from water quality issues to quantity concerns. This evolution is notable because the quality and quantity of water are fundamentally linked. When

[86] James E. Kundell, *Integrated Water Management: The Case of Georgia,* James E. Kundell Collection, University of Georgia Archives, Athens, GA
[87] Storey, *The Study of the Riparian and Proper Appropriation Doctrines of Water Law,* 6.
[88] Ibid.

water is polluted, the supply of usable water decreases. Furthermore, during times of water scarcity, pollution can further reduce the supply, and thus exacerbate drought occurrences. Sedimentation decreases the holding capacity of important reservoirs of the state, and the condition of the soil is furthermore linked to the quality of water sources in close proximity. Therefore, by addressing quality issues early on, Georgia's government unintentionally mitigated some water scarcity impacts that became significant later.

Sedimentation Control

Land use is inextricably linked with water quality, but this relationship is not always considered in water policy. In Georgia, soil conservation gained momentum in the 1930s, at the same time as the passage of the federal law establishing the Soil Erosion Service, which Congress established to evaluate land use. Congress created the federal Soil Conservation Service (SCS) the following year, and the agency is now known as the Natural Resource Conservation Service. The SCS received authority to establish programs to conserve the nation's soil with federal financial aid.[89]

The Georgia General Assembly authorized Soil Conservation Districts in 1937 and a supervisory State Soil Conservation Committee. Through this act, state legislatures wanted to encompass more than just soil quality. The law also aimed to "preserve natural resources, control floods, prevent impairment of dams and reservoirs, assist with the navigability of rivers and harbors, (…) and protect and promote the health and welfare of the people of the State."[90] Although its implementation did not accomplish all that it intended, the Soil Conservation Committee and Districts helped farmers develop conservation plans and reduce soil erosion. The SCS and Soil Conservation Districts also initiated watershed projects between farmers. The

[89] Harold R. Brown, *The Greening of Georgia: The Improvement of the Environment in the Twentieth Century* (Macon, Ga: Mercer University Press, 2002), 79-80.
[90] Ibid., 79-80.

cooperative efforts of the SCS and State Soil and Water Conservation districts were successful for Georgia in that, by 1950, over 6 million acres had been treated for erosion and more than half of the farmland in the state had management plans prepared by the SCS.[91] Soil Conservation efforts continued throughout the century and were most visible between 1940 and 1960, during which time public outreach and education for farmers about erosion prevention were popular. As an early attempt to promote consideration and stewardship of the natural environment, the Georgia Association of Soil and Water Conservation Districts Supervisors also used religious sermons to stress environmental stewardship obligations.[92] Similarly, Georgia officials later utilized public outreach during water conservation activities in the 2000s.

The Georgia General Assembly put soil conservation into law in 1975. The Erosion and Sedimentation Act identified that "erosion and sediment deposition result in pollution of State waters and damage to domestic, agricultural, recreational, fish and wildlife, and other resource uses."[93] The Act required that persons performing land-disturbing activities, or activities that "result in soil erosion from water or wind and the movement of sediments into State water," must first obtain a permit to do so from the county. The Act essentially provided county level governments with guidelines for erosion protection and gave them the power to enforce them.[94]

Another issue in sedimentation control is the amount of sedimentation in streams. Streams naturally have a turbid appearance because of eroded soil particles carried in suspension. However, there is a limit to how much sedimentation should be present. Soil erosion decreased since the 1930s, from 300-400 milligrams per liter to less than 50 milligrams per liter in 2002.[95] However, the relative clarity of streams today cannot be attributed solely to regulation and better

[91] Ibid., 80.
[92] Ibid., 82-83.
[93] Georgia General Assembly, *Erosion and Sedimentation Act of 1975*, law number 599, HB 174 (April 24, 1974).
[94] Ibid.
[95] Brown, *The Greening of Georgia*, 124-125.

erosion practices, since there are substantially less acres used for agriculture than in the first part of the twentieth century. Also, the construction of ponds and lakes provided settling basins for sediment. A reservoir that holds 10 percent of the water that flows through it in a year is capable of trapping eighty 5 percent of the sediment flow.[96]

Pollution Control

Water scarcity magnifies pollution problems. As late as 1964, municipalities discharged 90 percent of all municipal sewage, and industries discharged 97 percent of all industrial wastewater without treatment.[97] The 1964 Georgia Water Quality Control Act identified the importance of the waters of the state for "public and private water supply and for agricultural, industrial and recreational uses" and that the "water resources of the State shall be utilized prudently to the maximum benefit of the people in order to restore and maintain a reasonable degree of purity,"[98] and consequently, maintain the highest possible quantity. This Act created the Division for Georgia Water Quality Control and a State Water Quality Control Board within the Department of Public Health. The Water Quality Control Board's responsibilities were to develop a plan for preventing further pollution, establish standards for pollution, issue permits to entities wishing to discharge waste, and generally administer and enforce the regulations enacted in the act and afterwards. The Board planned to conduct research, cooperate with the Federal government and state agencies, and enter into compacts with other states in order to ensure water quality standards. As a second attempt at quality control, the 1964 Act repealed the Water Control Act of 1957, but the 1964 act addressed sewerage and waste issues only, albeit for the purposes of water supply and recreation. In the 1960s, the State Water Quality Control Board initiated a pollution abatement program on the Chattahoochee. The program analyzed multiple

[96] Ibid., 127-128.
[97] Ibid., 122-123.
[98] Georgia General Assembly, *Water Quality Control Act 1964*, law No. 870, HB 730 (March 11, 1964).

streams in the 1960s. The program selected these streams due to foul odors and visible signs of pollution.[99] The results of this study, discussed during a Conference of Interstate Pollution of the Chattahoochee River in 1966, found that the Chattahoochee was grossly polluted for 100 miles below Atlanta from sewage and industrial wastes. Also, below West Point and Columbus there were serious risks to health from bacterial contamination associated with sewage. R. S. Howard, EPD's then Executive Secretary, noted that the larger polluters included Atlanta and Columbus, but smaller polluters, especially industrial wastes were just as threatening. [100]

In 1973, South River in DeKalb County was critically polluted from twenty-three known discharges of treated and untreated municipal and domestic sewage. At this point, the EPD took measures to reduce phosphorus and nitrogen levels, but did not address urban runoff from roads and developments which adds organic material, debris, and silt to the pollution. Joe D. Tanner, commissioner of the Georgia Department of Natural Resources expressed his hope that legislation would be adopted that year to address urban runoff.[101]

The 1973 Metropolitan River Protection Act addressed the urban runoff issue. The Act recognized the importance of protecting stream corridors which provide the water supply to metropolitan areas. The act called for the protection of water quality, control of erosion, and the reduction of flood hazards specifically in areas with a population of more than 1,000,000 people within a Metropolitan Statistical Area.[102]

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[99] Brown, *The Greening of Georgia*, 128.
[100] R. S. Howard, Jr. Executive Secretary, "Report on Pollution of the Chattahoochee River," Georgia Water Quality Control Board's Statement at Conference on Interstate Pollution of the Chattahoochee River, Georgia-Alabama, July 14, 1966. Environmental Protection Division of the Georgia Department of Natural Resources, Director's Subject Files, Georgia State Archives, Morrow, GA.
[101] Joe D. Tanner Commissioner, Department of Natural Resources to Dr. E.R. Jennings Secretary of Altamaha River Basin Commission, January 2, 1973, Environmental Protection Division of the Georgia Department of Natural Resources, Director's Subject Files, Georgia State Archives, Morrow, GA.
[102] Georgia General Assembly, *Metropolitan River Protection Act*, law no. 66, HB 1093 (March 16, 1973).

State laws continued to establish rules for water pollution. Three years after the passage of the federal law of the same name, Georgia passed its own Safe Drinking Water Act in 1977. This act provided the "drinking waters of the State shall be utilized prudently to the maximum benefit of the people and that the quality of such waters shall be considered a major factor in the health and welfare of all people in the State of Georgia."[103] Rather than outlining specific regulations for affluent discharge or water treatment facilities, the Act instead gives the authority to the EPD and its director to make discretionary decisions that are conducive with the policies of the act, including the issuance of permits for the operation of public water systems.[104] The flexibility of the law allowed the EPD to react to new situations. For example, the Water Quality Control Act, enacted in 1964 and amended numerous times, established a uniform regulation for phosphorous levels specifically in the Chattahoochee River between Buford Dam and West Point Reservoir. The amendment stipulated that waste water discharged could not contain "more than 0.75 milligrams of phosphorus per liter of waste water on a monthly average basis."[105]

The Water Well Standards Act of 1976 addressed pollution caused by well construction and established the starting point for regulation of groundwater usage and created an Advisory Council to conduct studies on the "construction, operation, maintenance and abandonment of water wells."[106] The Water Well Standards Act of 1985 substantially revised the original, and included substantial licensing requirements for those constructing water wells, as well as standards for the proximity to potential pollution points and for materials used.[107] Similarly, the Safe Dam Act of 1978 stipulated all persons operating a dam must obtain a permit from the EPD

[103] Georgia General Assembly, *Georgia Safe Drinking Water Act*, law no. 231, HB 23 (March 16, 1977).
[104] Ibid.
[105] Georgia General Assembly, "Chattahoochee River-Phosphorus Limits for Waste Water Discharged into the River," law no. 555, HB 643 (April 12, 1991).
[106] Georgia General Assembly, *Water Well Standards Act 1976*, law no. 1139, HB 422 (March 21, 1976).
[107]Georgia General Assembly, *Water Well Standards Act 1985*, law no. 673, HB 32 (April 10, 1985).

and also, the demolition of dams in the state be approved by the Director. The Safe Dam Act focused on dangers to property and to the lives of people downstream, which water structures pose through the construction, neglect, and failure of dams, rather than the quality of the water the dam may alter, which previous legislation addressed. The Act defined a dam as any structure which impounds or diverts water and is "is twenty-five feet or more in height from the natural bed of the stream" and "has an impounding capacity at maximum water storage elevation of fifty acre-feet or more."[108] The Safe Dams Act is important to note since Buford Dam's construction and operation play a vital role in the water supply of Atlanta and other parts of Georgia.

The first instance of water conservation within the Georgia State Assembly was a state construction law passed in 1978, over twenty years after the 1954 drought, it required new construction to only install water closets or shower heads which use less than 3.5 gallons per flush or per minute, respectively. This law did not expressly include water conservation as an important value of Georgia or cite drought as a contributor to the policy, but is the first example that is identifiable of the culture that would take hold later.[109] Prior to this state law, on a local level, in 1976 DeKalb and Douglas counties both adopted ordinances requiring water-conserving plumbing features.[110]

Thus, water issues have a long history in Georgia's policy and legislation, albeit mostly in the form of pollution abatement. Policies first addressed water scarcity as a side effect of pollution. The General Assembly did not address water scarcity as an issue in itself until droughts threatened the water supply in the 1980s.

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[108] Georgia General Assembly, *Safe Dams Act of 1978*, law No. 796, HB 914, (March 7, 1978).
[109] Georgia General Assembly, "State Construction-Plumbing Fixtures, etc." law 909, HB 546, (March 14, 1978).
[110] U.S. Army Corp of Engineers, Savannah District, Metro Atlanta Area Water Resource Management Study, Summary Report, February 1981, Environmental Protection Division, Director's Subject Files, Georgia State Archives, Morrow, Georgia.

Water Regulation during Drought

As a result of the 1986 drought, the Chairman of the Georgia House of Natural Resources and Environmental Committee created the Metro Atlanta Water Resources Subcommittee (HNREC). This Subcommittee examined water quality and quantity issues in Metro Atlanta and the rest of the state and reported to the HNREC during the 1987 session with findings on three issues. First, the 1986 drought provided a test for the withdrawal and water quality laws, and the Committee aimed to measure how the state managed the drought. Second, the Committee evaluated alternatives to Metro Atlanta's water supply, including a reregulation dam downstream from Buford Dam. Third, the Committee sought to increase cooperation among state, local, and federal levels of government. Similarly in 1991, Georgia's House passed a resolution creating the Water Resource Conservation Management Study Committee. The Resolution tasked the Committee with undertaking a study and addressing issues such as industrial and population growth, recent droughts, and conservation management. At this time, Georgia's state legislature took an interest in the scarcity issues of the state, but did not pass any laws to combat the droughts of the 1980s. These commitments to perform studies provided no real solution to the problems at hand.

Similarly, neighboring states Alabama and Florida committed to assessing water supply issues. In 1997, the three states respective legislative bodies passed Interstate Compacts for the ACF and ACT River Basins after years of threatened litigation. Like the measures first taken in to combat drought, these compacts were merely promises to study and resolve the issues later. These issues will be discussed further in chapter 3.

Conclusion

Georgia's water culture from 1970 to 2000 shows an increasing awareness of water problems in the state. Water policy started as a means of codifying ownership and rights to the resource. Then, traditional riparian rights morphed into regulated riparianism through allocation measures. Also, pollution became more important to lawmakers in the 1960s and 1970s, coinciding with an increased awareness on the national level. As the perception of droughts evolved, water scarcity was not as topical as it is today since drought occurrences in the first half of the century were less pervasive than those of the later part. In part, droughts impacted more due to the population boom in metro-Atlanta in the second part of the century. More people, more frequent drought occurrences, and increasing pressures from neighboring states forced Georgia's leadership to take a new approach to water management in the state.

Chapter 3
Drought in Georgia 1956-2009

The state of Georgia is not lacking in surface water. However, like in any region, Georgia and the American southeast are prone to episodes of dryness. These episodes, coupled with explosive population growth, have created prolonged periods of droughts which shaped the relationship Georgians have with their water supply. In this chapter, I explore drought as it relates to people of the state.

The history of Georgia's droughts is an important aspect of how water policy has, and has not, adapted. Hydrological droughts occurred in 1954 to 1956, 1981, 1985 to 1988, 1998 to 2002, and again in 2007 to 2009. After each drought, the state took measures to resolve issues caused by droughts and to mitigate the damages of future water shortages, including the completion of Buford Dam, attempts at cooperative management between Alabama, Florida, and Georgia, and finally conservation. However, preparing for drought is a complicated task. Droughts are perhaps the least recognized hazard in the United States, despite their immense economic impacts on agriculture and recreation. They are unpredictable and usually are not recognized until they become severe. These factors have created a difficult situation for Georgia's policy makers.

Drought: Definitions

Because of its unpredictability, defining drought is a difficult task. According to Donald Wilhite, a leading authority on drought and the founder of the National Drought Mitigation Center, the importance of drought is its impact. Droughts typically form slowly. In the United States, unlike the rest of the world, droughts seldom result in the loss of life. Drought causes property damage, especially in agriculture, but tends to be less traumatic than flood damage.

Still, drought affects more people than any other hazard. The effects of drought may linger for years, and impacts of drought are less obvious; therefore, effective relief efforts are more difficult to apply. Aridity is a permanent feature of some areas and is characterized by low precipitation. Nonetheless, drought occurs in places with both high and low precipitation totals and is a normal feature of all climates.[111]

According to Wilhite, there are four types of drought: meteorological, hydrological, agricultural, and socioeconomic. Meteorological drought deals solely with the level of dryness in relation to normal precipitation levels and the length of time the conditions persist. The reasons for dryness vary from place to place. Agricultural drought is relative to plant needs, and is less relevant in this discussion. Hydrological drought is characterized by the effects of low precipitation on surface and groundwater. Surface streams experience low stages, while groundwater levels also fall. During drought, competition for hydrological resources increases.[112] Human demands are not meteorological but are just as significant to the demands placed on water bodies such as Lake Lanier, Atlanta's source of water.

Socioeconomic drought is the most relevant to the discussion of Georgia and is characterized by supply and demand for human consumption. Water supply is a result of natural processes; while demand is a factor of population growth and per capita consumption. Therefore, socioeconomic drought is the relationship between drought and human activities. Reaction to droughts, such as temporarily limiting public water use, without long-term preventative measures may increase vulnerability.[113] Wilhite treats drought as a naturally occurring phenomenon but recognizes that social factors are the variables which we can control. Similar to Wilhite, Hunt and Gordon's view on drought is divided between natural and social

[111] Donald Wilhite, "A Methodology for Drought Preparedness," *Natural Hazards* 13, no. 3 (1996): 229-52.
[112] Ibid.
[113] Ibid.

variables. They recognize two types of drought: naturally-occurring drought and forced drought. Naturally occurring drought is regionally defined and occurs in normally drought-free situations. In other words, it is drought without aridity. Forced drought is large scale and has a clear persistent source, such as aridity.[114]

Measuring drought is also difficult. Discrepancies in the methodology of drought identification and interpretation exist in almost all areas. The accuracy and reliability of mapping drought related information can sometimes be questionable.[115] Also, means of predicting drought in early onset warning systems can be complicated and prone to human error. Also, drought is difficult to assess.[116] Because of these variables and the increasing uncertainties of climate, historical data on waters scarcity is not reliable, and alternate future predictions should account for this.[117]

In Atlanta, water availability is a function of two variables: deviation from normal pool levels in Lake Lanier and deviation from normal precipitation. Since stream flow correlates with rainfall, it is not used in the Drought Index calculations.[118] In Georgia, the most significant recharge period for reservoirs and the soil is during the winter season from December to early spring due to low evapotranspiration rates, decreased cover from trees, and higher monthly rainfall averages. Weather systems during this time tend to be more widespread and far reaching.

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[114],B. G. Hunt and H. B. Gordon,"The Problem of 'Naturally'-Occurring Drought," *Climate Dynamics* 3, no. 1 (1988): 19-33.
[115]Kirstin Dow, Richard L. Murphy, and Gregory J. Carbone, "Consideration of User Needs and Spatial Accuracy in Drought Mapping," *Journal of the American Water Resources Association* 45, no. 1 (2009): 187-97.
[116] Dustin Garrick, Katharine Jacobs, and Gregg Garfin, "Models, Assumptions, and Stakeholders: Planning for Water Supply Variability in the Colorado River Basin," *Journal of the American Water Resources Association* 44, no. 2 (2008): 381-98.
[117] Ibid.
[118] Chris White, DNR EPD, to Mayor of Cumming, February 4, 1985, Environmental Protection Division of the Georgia Department of Natural Resources, Director's Subject Files, Georgia State Archives, Morrow, GA.

The flooding season, or hurricane season, lasts from the June 1 to November 30; however, rain is not widespread and evapostranspiration rates are higher.[119]

Drought is difficult to define, prevent, and even measure. For example, droughts perceived by the public and hydrological drought do not always match. Therefore, for this research, drought is identified by the mathematical calculations named Palmer Severity Drought Index (PSDI) and the Palmer Hydrological Drought Index (PHDI). The Palmer Severity Drought Index (PSDI) measures long-term drought, and allows for better measures of changes in drought conditions due to meteorological factors and cumulative factors of previous months, but does not take into account reservoir and groundwater levels. The PSDI is determined from precipitation, temperature, and soil moisture data, and does not consider human use.[120] The PDHI measures long term drought, like the PSDI, but also quantifies hydrological effects such as reservoir and groundwater levels. Since reservoir levels are essential in the discussion of drought in Georgia, and in order to further validate drought occurrences, I use both indexes. The PSDI and PHDI data in this research is from NOAA's Climatic Region 2 in Georgia, which encompasses Lake Lanier and metro-Atlanta, and is the year-to-date average. [121] These indices range from below -4.00, which represent a severe drought, to above 4.00, which denote extremely moist conditions (Table 1).[122] In addition, since deviation from normal precipitation is useful when discussing severity of drought, average yearly precipitation is another measure. Georgia average

[119] Todd Hamill, "Drought Evolution in the Southeast from 2006 to Now," Proceedings of the 2009 Georgia Water Resources Conference, held April 27-29 at the University of Georgia, http://www.srh.noaa.gov/media/serfc/presentations/drought0608.pdf.
[120] The National Drought Mitigation Center, "Comparison of Major Drought Indices: Palmer Drought Severity Index," http://drought.unl.edu/Planning/Monitoring/ComparisonofIndicesIntro/PDSI.aspx.
[121] NOAA, National Climatic Data Center, "Palmer Hydrological Drought Index," http://www.ncdc.noaa.gov/temp-and-precip/time-series/index.php?parameter=phdi&month=12&year=2011&filter=ytd&state=9&div=2,http://www.ncdc.noaa.gov/temp- and-precip/time-series/index.php?parameter=pdsi&month=12&year=2011&filter=ytd&state=9&div=2.
[122] NOAA, *Climate of 2012 – January: U.S. Palmer Drought Indices,* www.ncdc.noaa.gov/oa/climate/ research/prelim/drought/palmer.html.

precipitation for a year is 50.8 inches.[123] Stream flow, stream levels, and lake levels are also used to describe drought effects; however, uniform data for these measures is not given for all occurrences. For further reference, Table 1 in the appendix provides a list of these measures for selected years.

Table 1: Palmer Severity Drought Index and Palmer Hydrological Drought Index Explanation of Measures. PSDI and PHDI use same values. [124]

PSDI and PHDI Values	
Extreme drought	-4 and below
Severe drought	-3 to -3.99
Moderate drought	-2 to -2.99
Mid-range	-1.99 to 1.99
Moderately moist	2 to 2.99
Very moist	3 to 3.99
Extremely moist	4 and above

[123] Georgia Department of Natural Resources Environmental Protection Division, Georgia Geologic Survey, Status Report , The Accelerated Ground-Water Program Accomplishments for FY 1979 Planned Activities for the Future, October 1979, page 1, Environmental Protection Division of the Georgia Department of Natural Resources, Director's Subject Files, Georgia State Archives, Morrow, GA.
[124] Ibid.

Droughts in Georgia: A History[125]

Before 1954

Although this research does not specifically deal with droughts before 1970, it is necessary to note that droughts have been a normal feature of the climate. Furthermore, a short history on these events reveals a pattern of increasing frequency. The USGS monitored drought conditions in Georgia since the 1890s using stream flow gauging stations. These stations increased from twenty stations in 1910 to 135 continuous-recording gauges in 2000. [126] By this measure, the earliest USGS recorded drought lasted from 1903 to 1905. Drought recorded between 1924 and 1927 was most severe in the Altamaha, Chattahoochee, and Coosa River basins. Rivers in these areas were at their lowest stages recorded up to that time, and water scarcity affected Georgia's industry and agriculture. Droughts in 1930 to 1935 plagued the same areas in central and southeastern Georgia. [127]

Droughts: 1954 through 1981

Using only rainfall as a measure, the 1954 to 1956 drought is more severe compared to the drought of 1981. One gauging station, located on the Chestatee River, was operational for both of these droughts. According to the data from this station during periods in 1955, 1980, and 1981, there was little difference in how much the stream level dropped during the two drought periods.[128] However, the drought of 1980 caused a significant decrease in stream flow rates,

[125] Historical drought information is taken from multiple sources, and therefore, multiple measurements are used to exhibit drought conditions.
[126] Nancy Barber and Timothy Stamey, "Droughts in Georgia," USGS, http://pubs.usgs.gov/of/2000/0380/pdf/ofr00-380.pdf.
[127] Ibid.
[128]Nancy Barber and Timothy Stamey, "Droughts in Georgia."

reservoir pool levels, and groundwater levels.[129] Concerned residents of Georgia who had mostly forgotten about the water issues of the 1950s expected Buford Dam to make subsequent droughts more manageable in the northern part of the state. Farmers in the southern part of the state had dealt with a drought that lasted from 1977 to 1978. Farmers had traditionally relied upon rainfall or surface waters for irrigation, and experienced significant crop losses.[130]

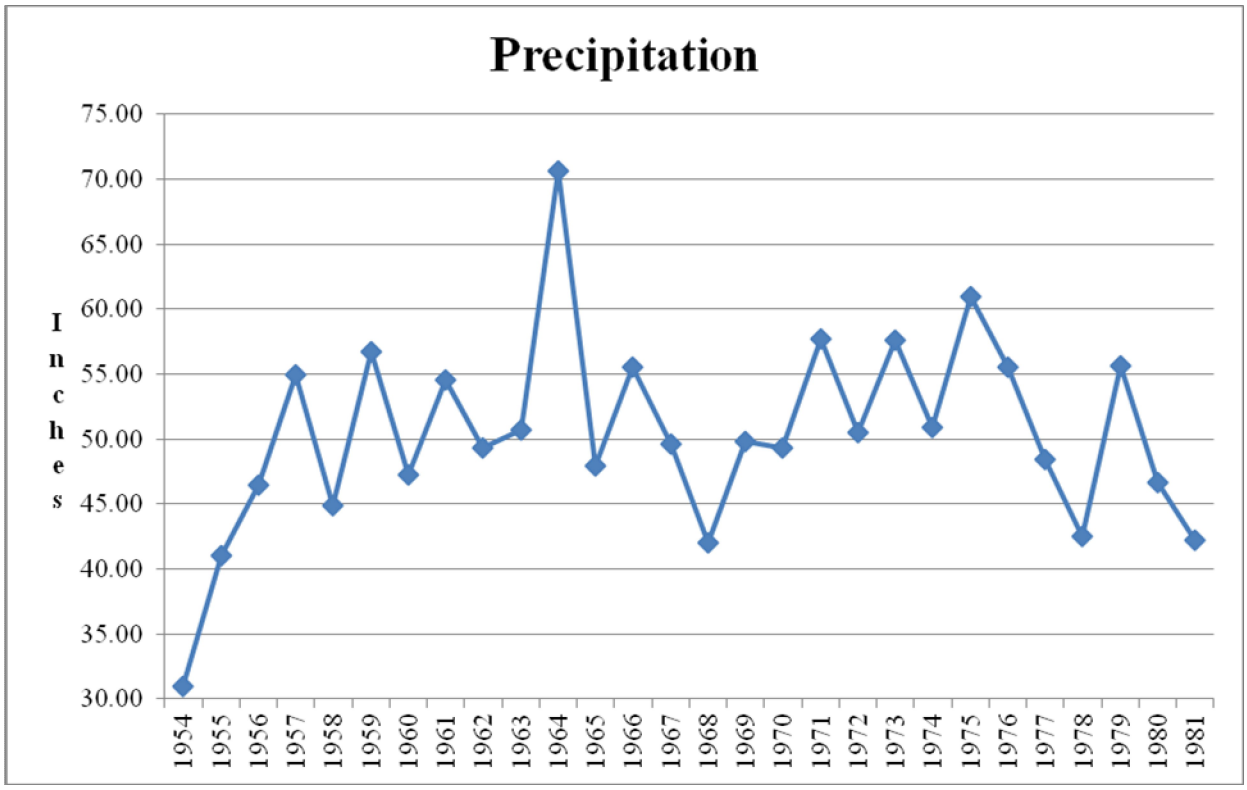

Figure 3. Georgia precipitation in inches for selected years. [131] Average annual precipitation is approxiamtely 50 inches.

[129] Mobile District Corps of Engineers, 1984, "Draft Report on Investigation for Relationship between Rainfall and Streamflow for Chattahoochee Basin above Buford Dam," 1-3, Environmental Protection Division, Water Resources Management Subject Files, Georgia State Archives, Morrow, Georgia.
[130] Georgia Department of Natural Resources Environmental Protection Division, Georgia Geologic Survey, Status Report, page 1, Georgia State Archives.
[131] Southeast Regional Climate Center, "Georgia State Averaged Precipitation Data," http://www.sercc.com/climateinfo_files/monthly/Georgia_prcp.html.

In 1980, every month registered drought index values from the low water supply alert to the severe drought ranges of the scales. In 1981, rainfall was at a 6.7 inch deficit.[132] Continued low rainfall and low pool levels resulted in three months with severe drought ratings in the last part of the year.[133] The drought caused the lowest pool level (1052.7) at Lake Lanier since its inauguration in 1957.[134] The shortage drew down lake levels to the point that floating marinas at Lake Lanier were cut loose.[135] Buford Dam enabled water officials in 1981 to sustain water supplies downstream in the Chattahoochee. The use of Buford Dam to control stream levels during drought is important because it is another example of the impact water infrastructure has on the livelihood of the area. By incorporating the dam into drought mitigation measures, Georgia's policy users attach the wellbeing of the area to the control of Buford Dam, as well as Lake Lanier and this has implications that will be seen with the conflict over control of the reservoir. Lower stream levels affected navigation along the basin and the recreational use of the reservoirs, reduced hydropower and municipalities and so industries implemented water conservation measures.[136] The 1981 drought lasted from June 1980 to September 1981 and during this time, Atlanta received 35.8 inches of rainfall. The drought ended following heavy rains in January and February of 1982. [137]

In June 1983, as a result of the severity of the 1980 drought, the governors of Florida, Alabama, and Georgia signed a Memorandum of Agreement (MOA) to develop a water management system for the ACF basin and included an Interim Drought Management Plan

[132]David Corvette, "Georgia Better Prepared Than in Earlier Droughts," *Atlanta Journal- Constitution,* May 18, 1986, sec. A.
[133] See Figures 3 and 4.
[134] Mobile District Corps of Engineers, 1984, "Draft Report on Investigation for Relationship," Georgia State Archives.
[135] Corvette, "Georgia Better Prepared Than in Earlier Droughts."
[136] Mobile District Corps of Engineers, 1984, "Draft Report on Investigation," Georgia State Archives; and Corvette, "Georgia Better Prepared Than in Earlier Droughts."
[137] Mobile District Corps of Engineers, 1984, "Draft Report on Investigation," Georgia State Archives.

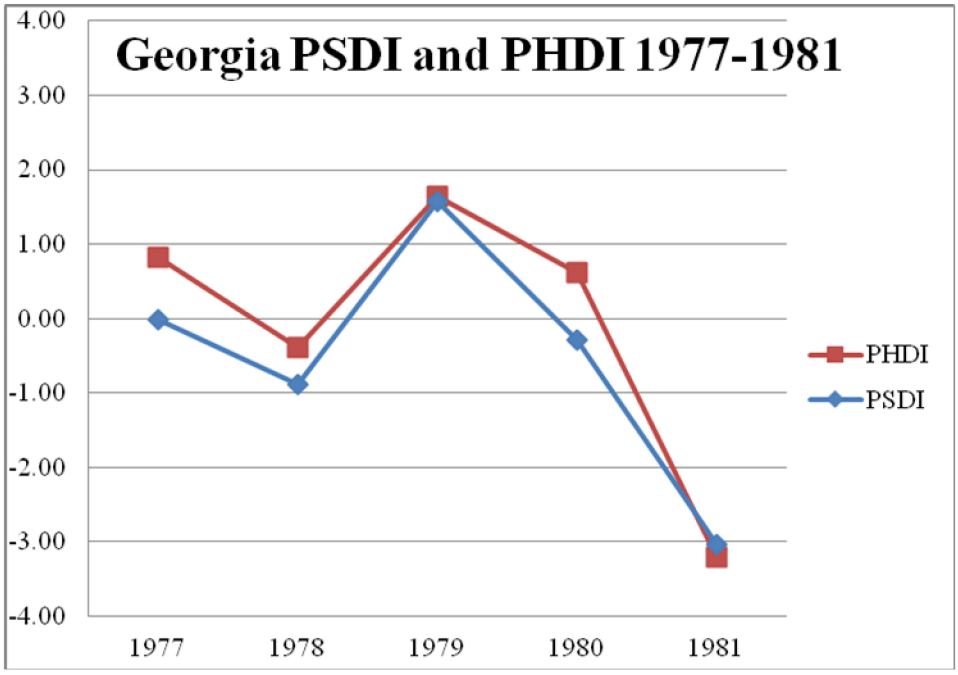

Figure 4. Climate Region 2, includes Atlanta MSA, PHDI and PSDI for Years 1977-1981[138]

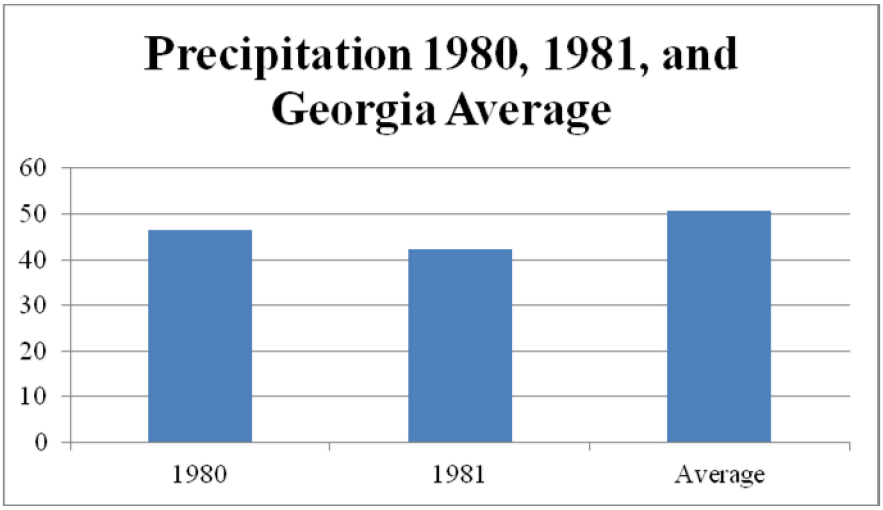

Figure 5. Georgia Precipitation for 1980 and 1981[139]

completed in 1985. The authors intended the Interim Drought Management Plan (IMDP) to provide increased coordination with the specific water users and the public as well as identify

[138] NOAA, National Climatic Data Center, "Palmer Drought Severity Index," http://www.ncdc.noaa.gov/temp-and-precip/time-series/index.php?parameter=phdi&month=12&year=2011&filter=ytd&state=9&div=2, http://www.ncdc.noaa.gov/temp-and-precip/time- series/index.php?parameter=pdsi&month =12&year=2011&filter=ytd&state=9&div=2.

[139] "Georgia Monthly Precipitation," http://www.sercc.com/climateinfo_files/monthly/Georgia_prcp.html.

water allocation priorities.[140] The 1983 MOA included preparation of a water assessment, a navigation maintenance plan, and a plan of study to develop a long range water budget and water management strategy. The Interim Drought Management Plan emphasizes sharing of the responsibility for water shortage management among the three states. The IMDP also created a Drought Management Committee with members from the Corps of Engineers, Alabama, Florida, and Georgia agencies and outlined a public information program. Major water uses addressed by the IMDP included water supply and quality, hydropower, navigation, recreation, irrigation, and fish and wildlife.[141] In a 1985 correspondence to the Mayor of Cummings, the EPD noted that competing demands for the ACF basin made a coordinated management approach during drought situations essential. These initial cooperative planning efforts created a sense of preparedness for the next occurrence. At the onset of the 1986 drought, Pat Stevens, environmental planner for the Atlanta Regional Commission stated, "We've got better facilities and better management than we had then (in 1981), and we also have better exchanges of information now. We're in much better shape than we would have been, immeasurably better."[142]

Hydrological drought returned to north Georgia in 1986. This occurrence was particularly hard felt because 1985 had also been dry year.[143] Consequently, water levels had not returned to normal levels before extreme drought conditions set in during the first part of 1986. However, rainfall is not spatially uniform. By July, north Georgia had a total 20 inch rainfall shortage over an 8 month period, but in Columbus, Georgia, rainfall was about 70 percent of average at the same time. The major newspaper *Atlanta Journal-Constitution* reported that the first five months

[140] "ACT/ACF Comprehensive Water Resources Study," Status Report, September 1995, page 16, Governor-Tristate Water Compact Commission Collection, Georgia State Archives, Morrow, Georgia.
[141] Chris White, DNR EPD, to Mayor of Cumming, February 4, 1985, Georgia State Archives.
[142] Corvette, "Georgia Better Prepared Than in Earlier Droughts."
[143] See Figure 4

of 1986 were the driest in 100 years of records.[144] Ken Bergman, a meteorologist in the NOAA climate analysis center said, "the current drought in the Southeast is an extremely unusual event."[145] Tree ring analysis was used to measure the severity of an historic drought in 1711 as well as "the great southern droughts" of 1924-1925, both of which were deemed more severe than the drought of 1986.[146]

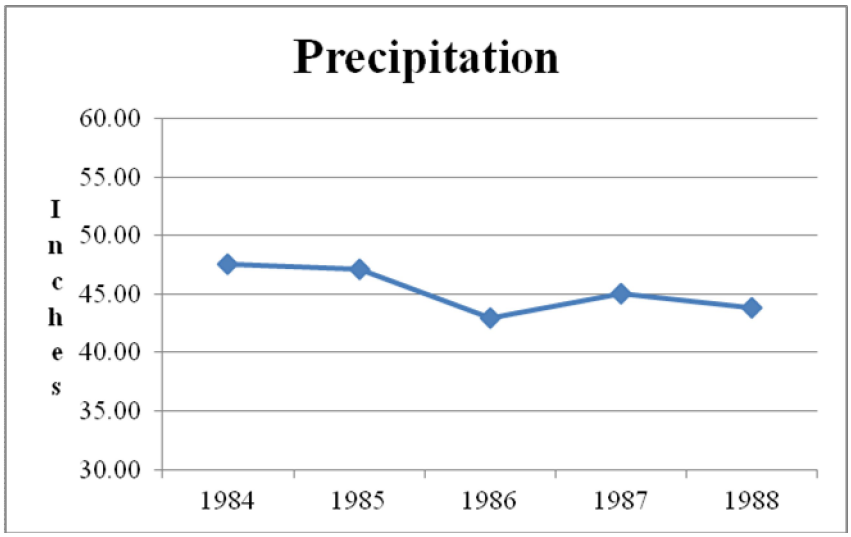

Figure 6. Georgia Precipitation for selected period 1984-1988[147]

The 1988 drought started during December of 1987, and some referred to it as the most severe natural disaster on record in Georgia and affected a larger area than previous droughts. Low river levels altered navigation in Georgia until September of 1988. The Corps developed a "navigation window," to allow for shipments to occur on a schedule by releasing water from Buford Dam. [148] This further embedded the significance of Buford Dam during low stream levels. Eight rivers, from South Carolina to Wisconsin, recorded all time low levels. As a result

[144] Corvette, "Georgia Better Prepared Than in Earlier Droughts."
[145] Mike Toner, "Drought May be Worst Since Colonial Times: Growth Rings in Centuries-Old Trees Help Climatologists Piece Together the Past," *Atlanta Journal-Constitution*, December 13, 1986, sec. A.
[146]Ibid.
[147] http://www.sercc.com/climateinfo_files/monthly/Georgia_prcp.html.
[148] "ACT/ACF Comprehensive Water Resources Study," Status Report, September 1995, Georgia State Archives.

of this drought, Congress approved $3.9 billion aid package for farmers. The aid would make payments of 65 percent of loss of crops for those who have lost more than 35 percent of their crops due to drought or another damaging occurrence. [149]

Due to the droughts from 1985 to1989, stream flows measured at the lowest of the twentieth century. Water supply shortages first occurred in 1986 in Atlanta metro systems. As the drought went on, more systems in the southern part of the metro area also had shortages, along with municipalities in northern and central Georgia.[150] After the drought of 1986, the Corps and Georgia, Florida, and Alabama established a Drought Management Committee which meant to open up communication among the stakeholders to prepare for future supply stresses.[151]

In 1990, Joe Frank Harris, then Governor of Georgia, proposed a network of lakes that would "drought proof" the Atlanta region and support new construction until 2050. However, Alabama expressed disapproval of this plan and recognized that Atlanta's quickly growing population would eventually affect Alabama's water supply. Alabama also filed a federal lawsuit in June of 1990 to contest a 50 percent increase in withdrawals from the Lake Lanier for metro Atlanta. [152]

Drought: 1998 to 2002

During the time period between 1998 and 2000, stream flow averaged between 50 to 80 percent of normal. The rainfall deficit in 1999 was close to 11 inches (see figures 5 and 6). From January to August 2000, more than forty wells statewide, mostly in the southwest parts of

[149] "$3.9 Billion Drought Aid Bill Goes From House to Reagan," *Atlanta Journal-Constitution*, August 10, 1988, sec. A.
[150] Nancy Barber and Timothy Stamey, "Droughts in Georgia."
[151] ACT/ACF Comprehensive Water Resources Study," Status Report, September 1995, page 15, Georgia State Archives.
[152] Carrie Teegardin, "Ala. Trying to Dry Up Ga. `Drought-Proofing' Plan Fears Reservoirs Would Hurt Its Supply," *Atlanta Journal-Constitution*, December 13, 1990, sec. A.

Georgia, recorded low water levels. Shortages in the summer of 2000 prompted The Georgia Department of Natural Resources to institute statewide restrictions on outdoor water use, such as watering landscapes and washing cars.[153]

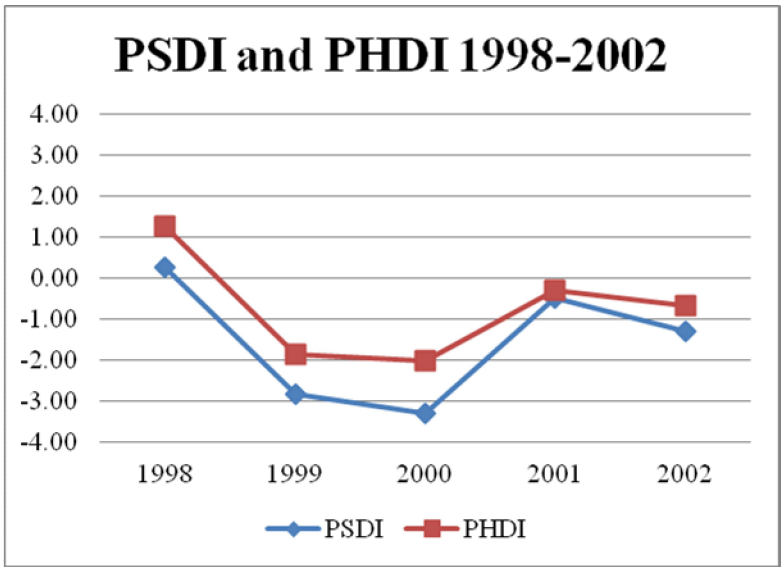

Figure 7. Georiga Climate Region 2 PSDI and PHDI 1998-2002[154]

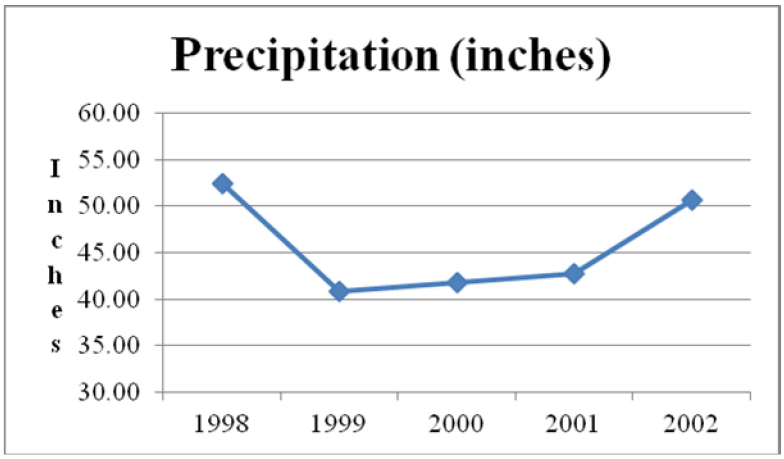

Figure 8. Georgia Precipitation in inches 1998-2002[155]

[153] Barber, Nancy, and Stamey, Timothy. "Droughts in Georgia."
[154]NOAA, National Climatic Data Center, http://www.ncdc.noaa.gov/temp-and-precip/time-series/index.php?parameter=phdi&month=12&year=2011&filter=ytd&state=9&div=2, http://www.ncdc.noaa.gov/temp-and-precip/time-series/index.php?parameter=pdsi&month=12&year=2011&filter=ytd&state=9&div=2.

Droughts are also costly in terms of energy. For the Georgia Power Company, adjustments are automatically made to bills when utility costs exceed $30 million in a six month period. During 1998, $18.7 million was assessed by Georgia Power to its customers. In 2000, utility costs were raised due to a 30 percent decrease in electricity production from 16 hydroelectric plants caused by lower water levels. Even though extreme heat does not always accompany drought; in this case, extreme heat in the area put electrical air conditioning more in demand. Additionally, coal fired plants, which product 75 percent of electricity were running less efficiently. Since they use river water to cool plant production, and this water was warmer than usual due to extreme heat. [156]

Drought: 2007 to 2009

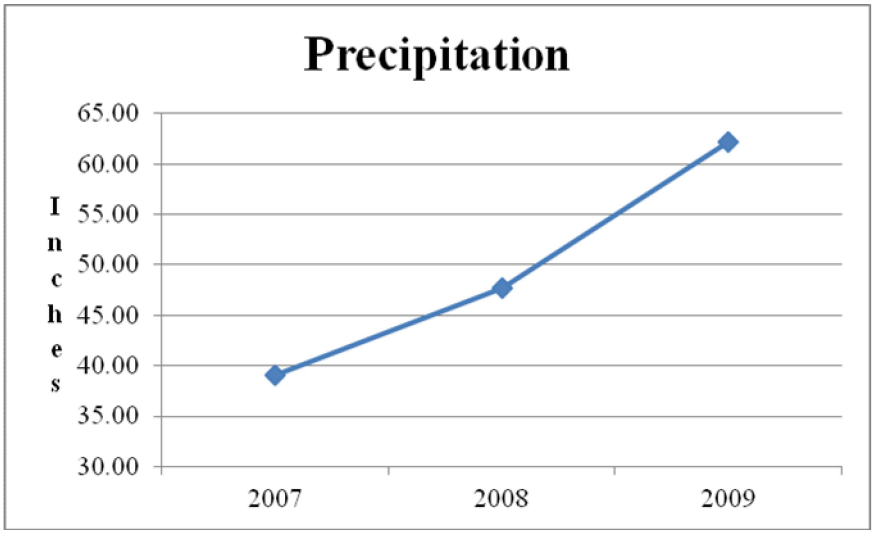

Figure 9. Georgia Precipitation in inches for 2007-2009[157]

[155] http://www.sercc.com/climateinfo_files/monthly/Georgia_prcp.html.
[156] Matthew C. Quinn, "Ga. Power to Bill Customers for Drought-Related Costs," *Atlanta Journal-Constitution*, July 21, 2000, sec. A.
[157] http://www.sercc.com/climateinfo_files/monthly/Georgia_prcp.html.

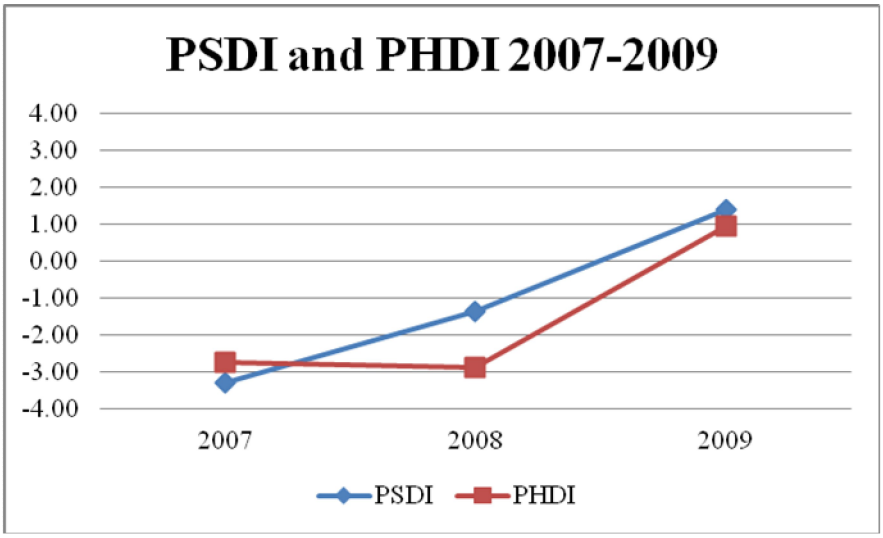

Figure 10. Georgia Climate Region 2 PSDI and PHDI measures 2007-2009. [158]

Beginning in 2006, extreme heat and a severe rainfall deficit led to a historic drought in the Southeast. The drought lasted longer than most previous events and was similar in length and pattern to a drought occurrence from 1949 to 1953. The drought began developing during the winter of 2006, commencing a long span with below normal precipitation and continuing through the winter season of 2008. During this time, the summer of 2007 was especially hot and wildfires plagued southern Georgia. Tropical systems did not affect north Georgia during the hurricane season, but the drought of southern Georgia ended with tropical storm Barry in 2007.[159]

Governor Sonny Perdue issued a declaration of disaster and asked for federal aid for the 85 counties affected by the "historic" drought. The Governor hoped that this declaration would enable President Bush to "order less water released from Lake Lanier, make federal funds

[158] NOAA, National Climatic Data Center, http://www.ncdc.noaa.gov/temp-and-precip/time-series/index.php?parameter=phdi&month=12&year=2011&filter=ytd&state=9&div=2, http://www.ncdc.noaa.gov/temp-and-precip/time-series/index.php?parameter=pdsi&month=12&year=2011&filter=ytd&state=9&div=2.
[159] Todd Hamill, "Drought Evolution in the Southeast from 2006 to Now," Proceedings of the 2009 Georgia Water Resources Conference, held April 27-29, at the University of Georgia.

available to state and local governments, and offer low-interest loans to Georgia businesses hurt by the drought."[160] Despite the drought, the federal government, through the Corps, continued to allow waters from Lake Lanier to flow to oyster farms in Florida. In May of 2008, Lake Lanier was 13 feet below its full level. Governor Perdue banned car washing and recreational watering, and encouraged drought resistant landscaping.[161] Lake Lanier's historic low, recorded on December 26, 2007, was 1050.79 feet, which was 20.21 feet below full pull level.[162]

Figure 11. Lake Lanier at historic low December 26, 2007.[163]

Figure 12. Lake Lanier at normal capacity.[164]

[160] Mary MacDonald, "Water-hungry Homeowners Know the Drill, Demand for Wells Has Swelled in Georgia, as Those Who Can Afford the Cost of $4,000 and Up Jump at the Chance to Irrigate with Impunity," *Atlanta Journal-Constitution*, October 21, 2007, sec. D.
[62] Stacy Shelton and Rhonda Cook, "2008 Summer Drought Survival Guide: Where We Are with the Water," *Atlanta Journal-Constitution*, May 25, 2008, sec. A.
[162]USGS, Andrew E. Knaak, Timothy K. Pojunas, and Michael F. Peck, "Extreme Drought to Extreme Floods: Summary of Hydrologic Conditions in Georgia," (2009), http://pubs.usgs.gov/fs/2010/3101/pdf/fs2010-3101.pdf.
[163] Photos from USGS. http://pubs.usgs.gov/fs/2010/3101/pdf/fs2010-3101.pdf
[164] Ibid.

After drought conditions in northern Georgia ended due to above normal precipitation in 2009, flooding caused nearly $220 million in damages and attributed to 12 fatalities. In some areas, precipitation measured as high as 20 inches during the incident period from September 18 to 22, 2009.[165]

Perceptions of Drought

According to Stooksbury, Georgia's State Climatologist and Professor at the University of Georgia, drought is a normal component of Georgia's, and the American southeast's, climate. The droughts experienced from the 1950s to mid 1990s were actually "benign" in comparison to previous climatic records. Using tree ring analysis and the Palmer Drought Severity Index, the only long term, lasting two years or more, droughts that were present since mid-twentieth century occurred from 1954 to 1956 and 1998 to 2002. Stooksbury argues that state drought plans should include an expectation of a prolonged drought of two years or more every 25 years, and this is without increased demands being placed on water resources.

In a study conducted in 1985 in the Ogalla Aquifer region of the Great Plains, an area which extends from the bottom of Wyoming to Texas, researchers measured the perception among farmers in Colorado, Texas, Oklahoma, Nebraska, and Kansas of drought occurrences. Farmers tended to recall the most recent droughts or the most prolonged droughts. Their recollections varied by factors such as age, and therefore number of droughts experienced, and their perception of normal "wetness" dictated by their first experiences as farmers. Younger farmers tended to feel that they had a better handle on managing drought, since, according to the author, they had not experienced a true severe drought. They identified drought based on what

[165] USGS, "Extreme Drought to Extreme Floods: Summary of Hydrologic Conditions in Georgia."

they were accustomed and also with crop loss or failure.[166] Wilhite has said that meteorological droughts do not necessarily coincide with periods of agricultural drought, and Liverman also found that drought conditions did not always match meteorological measurements. Measurements like the Palmer Index show deviations from long term conditions, while agricultural drought definitions are based on plant water demand.[167] Regardless of meteorological measure, the memory and perception of drought is particular to a person and is therefore shaped by an individual's experiences and values.

Hydrological drought does not always match perceived drought. For example, in 1983, precipitation totaled 45.84 inches, less than a five inch deficit from normal. Both the PSDI and PHDI placed the year in the mid-range, and therefore not a drought. However, in Georgia, 154 of 159 counties were declared drought disaster areas the by U.S. Agriculture Department and crop losses were reported by farmers to be significant.[168]

Table 2. [169]

1993 Drought Indicators	
Precipitation	45.84
PSDI	0.22
PHDI	0.89

[166] Jonathan G. Taylor, Thomas R. Stewart, and Mary W. Downton, "Perceptions of Drought in the Ogallala Aquifer Region of the Western U. S. Great Plains," in *Planning for Drought: Toward a Reduction of Societal Vulnerability*, ed. Donald A. Wilhite, (Boulder: Westview Press, 1987): 409.
[167] Ibid., 409-421.
[168] Jingle Davis, "Georgia Farmers Ready to Reap Federal Drought Aid," *Atlanta Journal-Constitution*, August 11, 1993, sec. A.
[169] NOAA, National Climatic Data Center, http://www.ncdc.noaa.gov/temp-and-precip/time-series/index.php?parameter=phdi&month=12&year=2011&filter=ytd&state=9&div=2; http://www.ncdc.noaa.gov/temp-and-precip/time-series/index.php?parameter=pdsi&month= 12&year=2011&filter=ytd&state=9&div=2.

Perception of droughts could play a part in the manner in which Georgia has dealt with drought conditions since 1980. The 1956 drought was a distant memory by the time the occurrences of the 1980s threatened metro Atlanta, and in most newspaper articles covering the droughts of the 1980s, little mention was given to the less severe droughts in the 1970s. There was no mention in limiting Atlanta's economy or population booms, by either the press or state officials.

Conclusion

Droughts cannot be considered an anomaly in Georgia's climates. Recent droughts in Georgia are more frequent than in the beginning of the second half of the twentieth century but are not extreme when comparing of drought indices and precipitation measurements. Factors such as increasing population and ineffective water management and shortage planning are causing the increase and frequency of water shortages, rather than simply meteorological and hydrological conditions. Policy measures taken after droughts were reactionary and did not set to prepare for future droughts, and certainly did not anticipate more frequent droughts. Adaptation attempts will be discussed more thoroughly in the following chapters.

Chapter 4
Tristate Water Wars: External Struggles

The legal battle among Georgia, Alabama, and Florida over the Apalachicola-Chattahoochee-Flint and Alabama-Coosa-Tallahassee river basins is commonly known as the "Tri-state Water Wars." Disagreements over the two river basins, especially the ACF, which includes Lake Lanier, complicated water policy in Georgia. All three states claim rights to the resource, and the federal government claims final decision-making power.

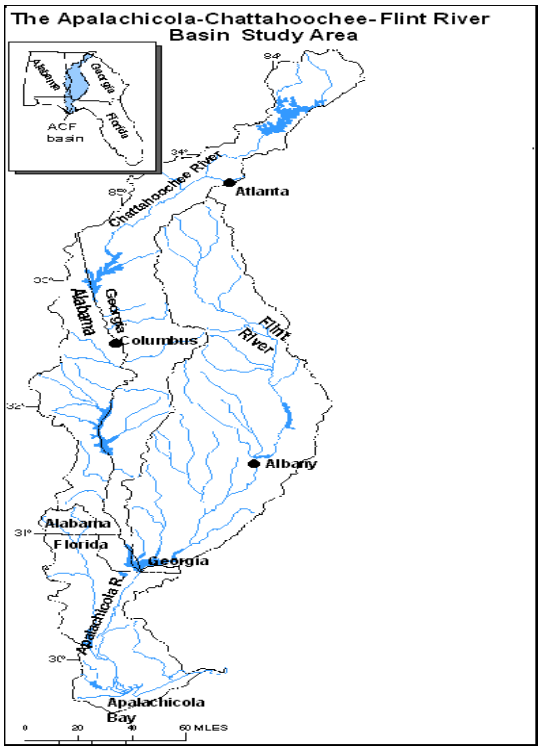

Figure 13. Apalachicola-Chatahoochee-Flint River Basin and state boundaries.[170]

Water availability from the ACF is critical to all three states. The Chattahoochee River, the same river that forms Lake Lanier and supplies water to metro Atlanta, also forms about 200 hundred miles of the Georgia-Alabama state border. The Chattahoochee and Flint rivers join in Florida and empty into the Apalachicola Bay in the Gulf of Mexico**.** The Apalachicola Bay is the

[170] http://ga.water.usgs.gov/nawqa/graphics/map.basin.gif.

home to an oyster habitat worth more than $16 million annually which supplies 10 percent of the nation's oysters.[171] In addition to supplying water to Georgia's growing urban populations, the ACF serves navigation, hydroelectric, industry, and agriculture in Georgia and Alabama.

The Rivers and Harbors of 1945 authorized construction of Buford Dam, which forms Lake Lanier, for flood control and navigation purposes.[172] However, Congress' intent for the reservoir has been debated by Georgia, Alabama, and Florida for over twenty years. The original intent for the dam was not for a water-supply project.[173]

In early 2009, U. S. District Judge Paul Magnuson ordered Atlanta to reduce its use of Lake Lanier for Atlanta's supply needs by 2012 and froze withdrawals from the reservoir at the levels of the time of the decision. In addition, he acknowledged factors that led to litigation:

> Too often, state, local, and even national government actors do not consider the long-term consequences of their decisions. Local governments allow unchecked growth because it increases tax revenue, but these same governments do not sufficiently plan for the resources such unchecked growth will require. Nor do individual citizens consider frequently enough their consumption of our scarce resources, absent a crisis situation such as that experienced in the ACF basin in the last few years. Only by cooperating, planning, and conserving can we avoid the situations that gave rise to this litigation.[174]

Rivers are unaware of political boundaries, but are subject to multiple users and conflicting policies.[175] Resource managers treat watersheds and rivers systems as one entity; since the actions of one user affect all users. The management decisions of the three states bordering the ACF are inextricably linked. This chapter addresses competing interests over

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[171] Benjamin L. Snowden, "Bargaining in the Shadow of Uncertainty: Understanding the Failure of the ACF and ACT Compacts," *New York University Environmental Law* 134, no. 13 (2005): 1-3.
[172] *River and Harbor Act of 1945*; Public Law 14, 79th Cong., 1st sess. (March 2, 1945).
[173] "Tri-State Water Rights Litigation." *639 F Supp 2d 1308*, 2009.
[174] Ibid.
[175] William R. Lowry, *Dam Politics: Restoring America's Rivers.* (Washington D.C.: Georgetown University Press, 2003), 3.

Atlanta's water supply and emphasizes the importance of local identity and perceptions of the environment in the implementation of water management.

Commons

Lake Lanier, as part of the Chattahoochee, is a resource funded and administered by a federal agency, the Army Corps of Engineers and thus, has multiple users and interests. Therefore, the waters of Lake Lanier can be described as a common resource. Garret Hardin originated the commons concept in 1968. The concept, in its simplest form, implies that individuals are more inclined to maximize their own well being, without regard to the system as whole.[176] According to Ostrom, the term commons refers to a system in which limiting access is difficult. In a commons, it is understood that one person's use does not necessarily take away a certain quantity from another's use.[177]

This research treats water resources as a common-pool resource and aims to explore the relationship of water with its users. Although common-pool resource (CPR) literature seeks to distinguish itself from Hardin's work, it is a variation of it. In CPRs, an individual's use of the resource takes away from the benefits other users may have. Ostrom argues Hardin's analysis of the commons is incorrect because Hardin "confused open-access commons with commons that are the joint property of a community."[178] Common-pool resources are open-access, meaning anyone has access to them. Examples of CPRs, as given by Ostrom, include fisheries, groundwater basins, pastures, lakes, oceans, and the Earth's atmosphere.[179] Lake Lanier fits within this definition. Ostrom's analysis shows the successful management of CPRs by governments, private sectors, and communities is a function of the CPRs unique situation.

[176] Garrett Hardin, "The Tragedy of the Commons." *Science* 162 (1968): 1243-48
[177] Elinor Ostrom, "The Challenge of Common-Pool Resources," *Environment* 50, no.4 (2008):10.
[178] Ibid., 11.
[179] Ibid.

Ostrom further identifies five effective principles in the governance of commons: accurate and relevant information needs to be collected and distributed; conflicts are inevitable, a system should be implemented which identifies and resolves them quickly; rules should be established and enforced; change and adaptation should be accepted as inevitable; and necessary infrastructure should be smart and maintained over time.[180] This challenge of governing commons, creating and maintaining infrastructure based on Ostrom's five principles, remains a major concern of water supply managers and one of the greatest water challenges of the future will be to address the aging and ongoing maintenance of infrastructure of water supply, sewerage, wastewater management, and irrigation.[181]

In Georgia, there are multiple users of the ACF, including neighboring states, cities, and agriculture. Common resource policy is not transferable to all resources in all contexts, and systems can change over time. So it is important to understand a common in its own setting.[182] Transboundary resources, which include water sources, are resources used outside of the recognized zone or area where they originate. There is a spatial dimension to resource domains and the assignment of rights, making up the "common problem."[183] Common conflicts, especially transboundary resources, involve space and place, and hence these are geographic concerns.

Like infrastructure and transboundary resources, the ability to use, access, and manage a resource, defined as rights, proves another major concern with dealing with common-pool resources. There are several important factors when understanding rights. Local stakeholders better manage resources because of their first-hand knowledge and have more at stake, so there is

[180] Ibid., 8.
[181] Olli Varis, "More Urban and More Aged: Demographic Pressures to Global Water Resources by 2050," 35-63.
[182] Mark Giordano, "The Geography of the Commons: The Role of Scale and Space," *Annals of the Association of American Geographers* 93, no. 2 (2003): 356-375.
[183] Ibid., 369.

a growing trend toward community-based management. Common-pool resources are made more resilient by features already present in society, including "norms, practices, and law, the extension of social, encouragement of innovation, the sharing of information, and the recruitment of new skills and knowledge." [184] Furthermore, policy making is an ongoing process, and rights to resources can change overtime. [185] Using these understandings of commons and their conflicts, this research explores property rights and stakeholders feelings of entitlement to the resource.

Water Compacts

Transboundary water compacts have characterized western US water management for many years. Humid states are seeing needs for similar compacts due to shortages caused by increased demand and persistent drought. Western arid states entered into interstate compacts as early as 1925. In order to receive federal funding for the construction of dams under the Reclamation Act of 1902, western states resolved interstate conflicts over the water to be used.[186] For the most part, these water compacts were reached before the 1970s, with little regard for pollution control or ecological management, and were usually solely allocation agreements.[187] Litigation is only as a mechanism for enforcing measures agreed upon in the compact. Eastern states, in contrast to western states, have created interstate water compacts due to shortages due to demand and also because of the increasing reliance of highly consumptive irrigation practices in the latter half of the twentieth century. Since eastern states' experience with these compacts

[184] Simon Carter, "Research and Policy Implementation for More Equitable and Sustainable Use of Common-Pool Resources," *Society and Natural Resources, An International Journal* 21, no. 2 (2008): 155.
[185] Ibid.
[186] E. Schlager and T. Heikkila, "Resolving Water Conflicts: A Comparative Analysis of Interstate River Compacts," *Policy Studies Journal* 37, no. 3 (2009): 367-392.
[187] Joseph W. Dellapenna, "Transboundary Water Sharing and the Need for Public Management," *Journal of Water Resources Planning and Management*. 133, no. 5 (2007): 398.

came decades after western states, their compacts also deal with pollution and ecological issues rather than just allocation.[188]

In water compacts, the spatial relationship among states characterizes their role within the interstate compact. The uppermost state usually claims a larger portion of the water for itself; this state usually sees the river basin belonging to it, without regard to its action's effect on downstream users. The lowest state in the basin usually claims the water course should maintain integrity, or purity, effectively requiring users upstream to limit their use in order to prevent degradation in quality and quantity downstream. If there is another state between the upper and lower, that state will usually tailor its argument to which state it is addressing. Eventually, all states involved must come to a mutual agreement that shares the water,[189] or inevitably conflict continues indefinitely.

These agreements, or compacts, act as treaties among states or as, "self-governing institutional arrangements."[190] Compact authors address conflicts through institutional changes which come in the form of strategies, norms, or rules. Historically, states prefer interstate agreements over federal interference in interstate water resources. However, interstate agreements must be approved by the Federal government, Congress, and thus become federal law.

Tri-state Battle

Prior to 1980, disputes over allocation of the ACF River Basin waters arose from conflicting economic interests of the states. Commercial navigation development, which would

[188] Ibid., 399.
[189] Dellapenna," Transboundary Water Sharing and the Need for Public Management," 398.
[190] Schlager and Heikklila, "Resolving water conflicts," 369.

benefit Georgia and Alabama interests, was detrimental to the tourism and fishing economies of Florida.[191]

The Tri-state water battle, as it continues today, began in 1980. That year, Army Corps of Engineers conducted allocation studies to address reallocation requests from the Atlanta Regional Commission. Atlanta sought to increase allocation from Lake Lanier and the Chattahoochee. Other municipalities and counties wanted to withdraw water from Carters Lake and Lake Allatoona, which are both located in the Alabama-Coosa-Tallapoosa (ACT) river basin.

Major droughts in the 1980s clearly demonstrated the limits of this common-pool resource and sparked increasing conflict, but at the same time provided multiple opportunities for the three states to cooperate in developing a water management system. Hydrologic droughts occurred in 1981, 1986, and 1988; these dry periods created greater competition among water users. Drought in 1981 caused the lowest pool level (1052.7) at Lake Lanier since its inauguration. From October 1980 to September 1981, Atlanta, Georgia received 35.8 inches of rainfall. Low stream levels disrupted navigation along the basin and recreational use of the reservoirs. As a result, municipalities and industries implemented water conservation measures. Both 1985 and 1986 were exceptionally dry. Consequently, water levels did not recover to normal levels before extreme drought conditions set in during the first part of 1986. By July, north Georgia recorded eight-month rainfall shortages of 20 inches. Another drought lasted from December 1987 to 1988 and was disastrous for the state's agricultural economy.[192] Droughts and

[191] James E. Kundell, *Georgia Water Resources: Issues and Options*, 8.
[192] "ACT/ACF Comprehensive Water Resources Study," Status Report, September 1995, Governor-Tristate Water Compact Commission Collection, Georgia State Archives, Morrow, Georgia.

their effects put more pressure on Georgia policy makers, as well as the neighboring states, to secure sufficient water for their people.

As a result of these droughts, cooperative measures developed among the states, beginning after the 1985 Interim Drought Management Plan among Alabama, Georgia, and Florida. The plan expressed intent to increase coordination among the specific water users and the public and identify priorities in water allocation. The 1986 Drought Management Committee included interests from all three states. These cooperative actions were opportunities to allocate waters form the two river basins to each state without litigation.[193] At this time, it seemed possible to allocate the ACF and ACT waters without a battle.

Cooperation ended in 1989, when Governor Hunt of Alabama, with the support of the Alabama Congressional Delegation, wrote to the Corps of Engineers to stop a decision on an Atlanta request to reallocate a larger portion of Lake Lanier and by other municipalities to reapportion Carter Lake and Lake Allatoona. The Corps agreed to reallocate Carter Lake to provide water supply for the City of Chatsworth, Georgia in May 1990. In June of the same year, the State of Georgia requested a permit from the Corps to construct a reservoir on the Tallapoosa River five miles from the Alabama-Georgia State line. Later that same month, Alabama filed litigation against the Corp challenging the reallocation of Carter's Lake, Lake Allatoona, and Lake Lanier.[194]

Georgia became sensitized by the droughts of the 1980s. Droughts caused major problems: recreation revenue declined, navigation schedules changed, and farmers lost crops.

[193] Ibid.
[194] Ibid., 17-18.

The media began to characterize the issue as the "Water Wars."[195] Alabama's media was critical of Georgia and its perceived greediness and lack of concern for other state's needs. Florida's government was concerned with the Apalachicola River and Bay, which is a National Estuarine Research Reserve and seafood producer.[196] Alabama, Georgia, and Florida held meetings and had discussions throughout 1990. All parties agreed litigation would not be in the best interest of any of the states, and therefore on September 14, Alabama requested to defer the litigation in order to reach a settlement through negotiations. [197]

At this point, an amicable conclusion to the conflict remained possible. Congress funded a Comprehensive Water Resources Study of the two basins in 1990 to address long-term water need issues. Alabama, Georgia, and Florida signed a Letter of Agreement on April 29, 1991, which called for cooperative measures. In January of 1992, the three states signed a Memorandum of Agreement (MOA) expressing they would work together equally to resolve the water supply issues and to complete a Comprehensive study. The three states "committed to a process of cooperative management and development of water resources."[198] The states renewed the MOA in 1994 and 1995.[199]

Georgia, Alabama, and Florida state legislatures signed the Apalachicola-Chattahoochee-Flint Compact in 1997. Georgia and Alabama representatives also signed the Alabama-Coosa-Tallapoosa compact. The two agreements are almost identical in form, except for the inclusion of Florida in the ACT Compact. These compacts essentially set the MOA into law. The compacts established a commission composed of the state's governors and a representative of the federal government to interpret studies conducted by the Corps of Engineers and reach an allocation

[195] Ibid., 19.
[196] Ibid., 19-20.
[197]Ibid., 20.
[198] Ibid., 21.
[199] Ibid., 21.

agreement, all while existing water allocation remained the same. The compacts were little more than an agreement to work it out, with the decisions to be made by the three states. The federal government had the ability to veto an allocation formula but only if it somehow violated federal law. The compacts gave the states an initial deadline of December 1998 to establish an allocation agreement, but the Governors of the respective states extended the deadline until 2003.[200]

Opposition and Ownership

Although approved by the state legislatures, non-profit stakeholders showed opposition to the compacts. For instance, The Sierra Club gave significant public opposition to the compacts, arguing the process did not include public participation and failed to legitimately address environmental concerns of the management of the river basins.[201] Similarly, the Upper Chattahoochee Riverkeeper, also a nonprofit, did not feel the compacts provided an opportunity for meaningful public participation. The Riverkeeper took part in discussions for the compacts for four years before being allowed access to a draft and asked for comments. Participation in meetings, according to the Riverkeeper, was not a sincere attempt to include Georgia's stakeholders in the negotiations.[202] The Riverkeeper also worried about the compacts' language. Since the compacts did not adequately address the core values of the organization, the Riverkeeper did not support the passage of the compacts. These core values included environmental protection, water quality, ecology, and biodiversity, water conservation and meaningful public participation.[203]

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[200] Joseph W. Dellepenna, "Transboundary Water Allocation in the Twenty-First Century: Colloquium Article: Interstate Struggles Over Rivers: The Southeastern States and the Struggle Over the 'Hooch," *New York University Environmental Law Journal* 828 (2005): 14-15.
[201] Ibid., 14.
[202] Sally Berthea, Upper Chattahoochee Riverkeeper, letter to Harold Reheis, December 17, 1996, Governor-Tristate Water Compact Commission Collection, Georgia State Archives, Morrow, Georgia.
[203] Ibid.

Other stakeholders in Georgia were reluctant to give up rights to govern waters within their state's borders.[204] As early as 1976, Linda Billingsley, Vice Chairman of the Board of Trustees of the Georgia Conservancy, stated the waters of Georgia should be declared solely "the property of the people of Georgia." Billingsley was also a proponent of a permit system that limited maximum pumping rates and special fees to fund water conservation programs in the state.[205] Also, the Riverkeeper noted the compacts did not include the concerns of the "citizens of the State of Georgia who have property and public use rights to these waters."[206]

Federal interests were reluctant to allow too much state autonomy on the matter. Although the Corps was initially indifferent to the outcome of the conflict,[207] by 1996 the federal government had a vested interest in seeing the issues resolved. In one draft of the ACF compact, article VIII stated "the United States does not have any permanent, vested, or perpetual rights to any of the water resources of the ACF Basin, but the Army Corps of Engineers operates certain projects within the ACF Basin that may influence the water resources."[208] In a letter to the governors of the three states involved, Lois J Schiffer, Assistant Attorney General of the Environment and Natural Resources Division, expressed concern over this language. Schiffer expressed interests of the federal government in the waters of Georgia. Since, it has authority over navigable water systems that superseded state laws, and there were federal riparian water rights in the ACF basin where the Corps owns land underlying and adjacent to the dams and

[204] Dellepenna, "Transboundary Water Allocation in the Twenty-First Century," 15.
[205] Statement from State Water Resources Study Committee Statement, June 4, 1976, Environmental Protection Division of the Georgia Department of Natural Resources, Director's Subject Files, Georgia State Archives, Morrow, Georgia.
[206] Sally Berthea letter to Harold Reheis, December 17, 1996, Governor-Tristate Water Compact Commission Collection.
[207] Dellepenna, "Transboundary Water Allocation in the Twenty-First Century," 13.
[208] J. Schiffer, Assistant Attorney General US Department of Justice Environment and Natural Resources Division, Memorandum for the Attorney General. Southeast Water Compact Negotiations: Response to the Governors of Alabama, Georgia, and Florida, January 2, 1996, Governor-Tristate Water Compact Commission, Georgia State Archives, Morrow, Georgia.

reservoirs.[209] Thus, the federal government stepped in to resolve the conflict among the states and exerted the federal supremacy over the waterways of Georgia.

After Florida chose not to renew the ACF compact in 2003, essentially voiding it, there has been little effort for cooperation without litigation. Water compacts defy the concept of policy making as an ongoing process and thus, complicate and inhibit future cooperation efforts. Even though Georgia, Alabama, and Florida initially chose cooperation over litigation to solve their management issues, they were unable to successfully negotiate among themselves, leaving only the courts to solve the conflict.

And, it seems that the conflict will continue to play out in the courts. Georgia appealed the U.S. District Courts decision to stop Atlanta's withdrawals from Lake Lanier and won. The federal appeals court disagreed with Magnuson's ruling that Buford Dam was not intended to supply water to Atlanta. In the decision, it is noted that at the time of the dam's construction the Chattahoochee was already the major source of water for Atlanta, and Congress clearly did not mean to threaten the city's supply. Alabama is appealing the decision.[210]

This chapter has situated water issues in Georgia within commons literature in order to provide context to the management issues faced by the state. Lake Lanier, the major supplier of drinking water to the large metropolitan Atlanta area, is a common-pool resource since it is possible for Georgia to diminish potential benefits to neighboring states, and therefore, a CPR framework is relevant to its management. If not properly managed, Georgians are at risk of depleting this resource. Water compacts provide a means to manage, but as I have shown, have proven to be ineffective in the Chattahoochee context. In relation to drought, conflict with neighboring states has inhibited Georgia's ability to manage its own water supply. However,

[209] Ibid.
[210] Bill Rankin, "11th Circuit Hands Georgia Victory in Water Wars Case," *Atlanta Journal-Constitution,* June 29, 2011, http://www.ajc.com/news/atlanta/1111th-circuit-hands-georgia-991143.html.

because of these battles, Georgia has been forced to plan for a worst-case scenario and has been successful in galvanizing conservation methods. In the following chapter, I will discuss the shift of focus of Georgia's stakeholders from ownership of Georgia's resources to thoughtful conservation.

Chapter 5
Adaptive Changes since 2000: A Culture of Conservation

This study explores how people react to drought through adaptations. The Tri-state water battles, failed compacts, and multiple droughts complicated Georgia's water-supply issues. The dissolution of the ACF and ACT compacts and subsequent decisions put a premium on conservation methods within the state of Georgia. The most visible actor in promoting this conservation ethos is the Georgia State Legislative Assembly. Although conservation methods were present in legislation as far back as the 1970s, Georgia's government took a more aggressive stance on instilling a "culture of conservation" in recent years.

Adaptation is specifically applied to the concept of water through adaptive management. Adaptive water management is the integration of "legal and institutional approaches for managing water resources, monitoring, modeling, assessing the outcomes of those outcomes of those management approaches, and updating and revising management decisions according to this process."[211] The problem with adaptive management is that, although resource managers are usually familiar with the concept, legal and institutional frameworks do not use specific adaptive management tools and procedures. For effective adaptive management, three things are needed. First, experiences in adaptive water management need to be studied and lessons learned. Second, pilot projects can evaluate whether certain procedures can be developed for other situations. Third, there needs to be a way to develop and implement legal and institutional frameworks to facilitate adaptive water management. Still, adaptive management remains only one tool to be used by societies in adaptation; improvement on early warning ability and

[211] Carl Bruch, "Adaptive Water Management: Strengthening Laws and Institutions to Cope with Uncertainty," in *Water Management in 2020 and Beyond*, eds. Asit K Biswas., Cecilia Tortajada, and Rafael Izquierdo-Avino, (Berlin: Springer, 2009): 92.

emergency response is also needed. Water management is "dynamic, complex, and non linear," and therefore, laws and institutions need to be adaptive in order to be effective.[212]

Adaptive management is used as a broad term referring to decisions intended to avoid environmental harm, acknowledge uncertainty in foreseeing anthropogenic impacts on nature, and embrace learning by experiment. There are four elements to adaptive management. First, policies and actions are experiments, and failures can be used for learning. Second, policies should be sufficiently flexible so that they can be adjusted.[213] The economic and ecological interests in Georgia make this difficult. For example, agriculture operations alter the waters that commercial fisheries depend on. These two users have immediate needs at specific times, which cause conflict between the two users. Third, policies and practices allow for incorporating missing information and a thoughtful analysis of management incomes. Fourth, decisions have a consensus-based approach, including government agencies and non-governmental organizations (NGOs).[214] An example of Georgia's failure of this, decision makers of the ACF and ACT water compacts did not allow the Riverkeeper to have meaningful participation in formation of the compacts[215] In Georgia, governmental organizations made these decisions based on political popularity and economic development pressures, mainly of Atlanta.[216] In the 2000s, Georgia legislature made more attempts than ever before to adapt to drought conditions. These efforts were more efficiently linked to conservation practices than previous efforts. The following section traces these measures.

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[212] Ibid.
[213] David Lewis Feldman, "Barriers to Adaptive Management: Lessons from the Apalachicola-Chattahoochee-Flint Compact," *Society and Natural Resources* 21, no. 6 (2008): 516.
[214] Ibid.
[215] Sally Berthea, Upper Chattahoochee Riverkeeper, letter to Harold Reheis, December 17, 1996, Georgia State Archives.
[216] Feldman, "Barriers to Adaptive Management," 517.

Georgia Legislation

In 2001, while the ACF compact was still in place, Georgia's legislative body adopted Senate Resolution 142, creating the Joint Comprehensive Water Plan Study Committee and later, the Water Plan Advisory Committee. The first committee included some members of the Georgia State Senate and House, and one member each from county government, city government, wildlife conservation groups, and agricultural interest groups. This committee conducted studies of water quantity and quality and to make recommendations for a future Comprehensive Water Plan. The second committee included non-elected officials, or "members of the scientific community, business community, agricultural community, environmental advocacy groups, professions with expertise in water quality and management, the academic community, representative citizen groups in each of the state´s river basins, the outdoor recreation community, and the commercial fisheries community"[217] and they assisted the Water Plan Committee. Senate resolution 142 expressed concern over salt water intrusion in the Florida Aquifer in southern coastal Georgia, the droughts of 1998, 1999, and 2000, and storm water runoff.[218]

In the 2001-2002 legislative session, another planning act, named the Comprehensive State-Wide Water Management Planning Act, made the Environmental Protection Division (EPD) responsible for creating a plan to be consistent with provisions of the law and required that the plan be put into law by the General Assembly. Language used in this Act included implementation of sustainable practices and the incorporation of local and regional innovation, implementation, adaptability, and responsibility for watershed and river basin management, and

[217] Georgia General Assembly, "Comprehensive Water Plan, Joint Study Committee and the Water Plan Advisory Committee; Create," Senate Resolution 142, (April 6, 2001), 4, http://www.legis.ga.gov/Legislation/en-US/display/20012002/SR/142, 4
[218] Ibid.

participation from all stakeholders, including the citizens. The Act called for all citizens to "have a stewardship responsibility to conserve and protect the water resources of Georgia."[219]

In addition to the increase in conservation awareness by state officials, Lake Lanier's pool levels became a target for adaptation. In 2001, the House expressed concern over the low levels of Lake Lanier. Backed by the Lake Lanier Association and the Forsyth County Board of Commissioners, Georgia's officials demanded that the Corps provided a meaningful explanation of why the increased precipitation experienced in 2000 had not resulted in a full pool level at Lake Lanier. The resolution further requested the Corps give a detailed accounting of all requests for discharges from the Buford Dam, the parties which made the requests for discharges, and the reasons given by those parties to request those discharges from Lake Lanier.[220] State officials were increasingly aware of the prolonged troubles with neighboring states and saw the levels of Lake Lanier as the battlefront for the conflicts.

The Georgia Water Bill of Rights, proposed in 2001 but not adopted, is probably the most obvious example of conservation efforts within the state legislature. The Upper Chattahoochee Riverkeeper, an influential non-profit, led the effort.[221] The Bill of Rights included nine water-use guidelines for state and government employees. The proposed resolution stated Georgia's waters were "public resources and are vital areas held by the state as a trustee charged with the duty to manage these waters in the best interests of the public."[222] It also called for full transparency of water related government decisions. This effort had support among the public. Supporters held a Rally for Georgia's Water Bill of Rights on September 30, 2000 at Atlanta

[219] Ibid.
[220] Georgia General Assembly, House Resolution 118EX2, (proposed September 21, 2001), http://www.legis.ga.gov /Legislation/en-US/display/2001EX2/HR/118.
[221] Upper Chattahoochee Riverkeeper. "Withering Drought Highlights Water Management Problems," *River Chat*, Summer 2000, http://www.chattahoochee.org /downloads/summer2000.pdf.
[222] Georgia General Assembly, House Resolution 28, (proposed January 11, 2001), http://www.legis.ga.gov/ Legislation/en-US/display/20012002/HR/28, 1.

Memorial Park along the banks of Peachtree Creek,[223] and the *Atlanta-Journal Constitution* termed it "refreshingly simple." However, the Bill of Rights received criticism from "business interests and property rights proponents."[224] The bill carried over to the next session because of disagreements over the public trust sections. [225]

Furthering the state's dedication to sedimentation control, a 2003 amendment to the Control of Sedimentation and Erosion Act provided better control of "practices in land clearing, soil movement, and construction activities" resulting in the pollution of the state's waters. Senate Resolution in 2004 created the Joint Water Conservation Committee to conduct a water study for the explicit purpose of finding conservation measures throughout the entire state during drought and non-drought periods. The resolution cited worries over future water allocation due to issues with Alabama, Florida, and South Carolina. From 2004 to 2007, the General Assembly proposed a few acts regarding river basin management and interbasin transfers but none passed. Then, in 2007, the General Assembly proposed and passed several drought related resolutions and legislation, including section one of Senate Bill 342 named the Water Conservation and Drought Relief Act. Section two, known as the Georgia Water Supply Act of 2008, required the Georgia Environmental Facilities Authority Water Supply Division to evaluate feasible sites for construction of new reservoirs in the state and in anticipation of these new sites.[226]

Georgia's General Assembly proposed and adopted multiple solutions to drought conditions in the 2007 session. Senate Resolution 123 urged the Corps of Engineers to raise the full pool level of Lake Lanier, 1,071 feet above sea level, to 1073 feet, and a separate resolution

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[223], "Rally for Georgia's Water Bill of Rights," Georgia Bill of Rights Collection, University of Georgia Archives, Athens, Georgia.
[224] "It's Georgians Turn to Govern Water Use," *Atlanta Journal-Constitution*, March 14, 2001, sec. A.
[225]Georgia Branch, Association of American Contractors, *Government Affairs,* http://www.agcga.org/page.ww?name=2001%20Legislative%20Issues&section=Legislative%20Issues.
[226] Georgia General Assembly, Senate Bill 342, (April 4, 2008), http://www.legis.ga.gov/Legislation/en-US/display/20072008/SB/342

requested all Corps reservoir levels be raised as an alternative to building a new, costly reservoir. The resolution argued that the increase would allow economic growth in Georgia, as well as allow Florida "more water for endangered species."[227] Additionally, two bills introduced, but not passed, in the 2007 legislative session called for regulating plants in order to combat drought. One of these, House Bill 1322, meant to make it a crime for neighborhood associations to prohibit xeriscaping, which is landscaping that does not require supplemental irrigation. The bill stated "prohibiting xeriscaping is declared to be against the public policy of this state."[228] In another example of plant-based conservation measures, proposed Senate Bill 501 aimed to provide protection for consumers of landscaping plant seeds, specifically against false claims of "certified drought tolerant plants." The bill also stated it was the intent of the General Assembly to provide information to the public regarding plant species and the best practices of landscaping to adapt to "drought conditions in this state."[229]

The General Assembly also passed House Bill 1281 in 2007 which allowed local governments to impose more strenuous watering restrictions than imposed by the state through the Georgia Drought Management Plan. Likewise, the law also stated that a local government could apply to the Environmental Protection Division for an exception to any state imposed, non-statutory, restriction on water use as long as the entity was able to provide good cause.

[227] Georgia General Assembly, "U.S. Army Corps of Engineers; Urged to Begin Study of the Costs/Effects of Raising the Full Pool for Lake Lanier," Senate Resolution 123, (February 13, 2007), http://www.legis.ga.gov/Legislation/en-US/display/20072008/SR/123.
[228] Georgia General Assembly, "Property; Land Covenants which Prohibit Xeriscaping," House bill 1322, (Proposed February 28, 2008) http://www.legis.ga.gov/Legislation/en-US/display/20072008/HB/1322.
[229] Georgia General Assembly, "Seeds/Plants; Certification; Drought Tolerant Plant species; Revise Certain Provisions," House Bill 501, (Proposed February 20, 2008), http://www.legis.ga.gov/Legislation/en-US/display/20072008/SB/501.

Furthermore, the law provided swimming pools were not to be considered outdoor watering use, and therefore not subject to bans.[230]

Finally, The Water Stewardship Act of 2010 put Georgia's "culture of water conservation" into law and recognized an "imminent need to create a culture of water conservation in the State of Georgia."[231] The Act ordered state agencies to work together to promote and develop water conservation programs, but did not give specific guidelines.[232]

The preceding examples of state legislation show a path to an identifiable awareness of the state's government of water issues. Georgia's general assembly continued regulation of water sedimentation in order to ensure the highest amount possible of water for public consumption. These measures also reflect an increasing awareness of the value of water conservation practices to contend with water scarcity, going as far as legally protecting a citizen's right to use xeriscaping. Georgia's government not only saw a need to create laws enforcing conservation practices as an adaptation to water scarcity in the state through the legislative body, but also by the executive branch.

Governor Perdue

Governor Sonny Perdue served the state of Georgia from 2003 to 2011. Perdue entered office immediately following one drought, and held office during the drought of 2007. Perdue enacted multiple executive orders to try to combat the effects of these droughts.

Perdue used executive orders throughout his term to implement fast acting measures to combat drought impacts. These measures most clearly align with the adaptive management

[230] Georgia General Assembly,"Water Resources; Local Government Restrictions; More Restrictive Than State; Prohibit," House bill 1281, (May 14, 2008), http://www.legis.ga.gov/Legislation/en-US/display/20072008/HB/1281.
[231] Georgia General Assembly, "Water; Examine Practices, Programs, Policies; Develop Programs for Voluntary Water Conservation; Reports of Measurable Progress," Senate Bill 370, (June 1, 2010), http://www.legis.ga.gov/Legislation/en-US/display/20092010/SB/370, 1.
[232] Ibid.

framework since they are able to be altered at any point. For example, Governor Sonny Perdue asked Georgia's state agencies to lead by example in water conservation practices. First, citing increases in population, economic development, irrigated agriculture, and periodic droughts as major challenges to the implementation of water laws, Perdue created the in Georgia Water Resource Council in 2003. The Council contained the heads of the Department of Natural Resources, Environmental Protection Division, Soil and Water Conservation Commission, Department of Community Affairs, Department of Agriculture, Georgia Forestry Commission, and Georgia Environmental Facilities Authority. The Council's purpose was to ensure coordination, cooperation, and communication among state agencies and their water related program activities.[233] Later, in 2007, an executive order discontinued installation of all new landscaping on state facilities, stopped washing the state's transportation fleet, and ordered state agencies to comply with water bans and restrictions. [234]

On April 24, 2008, an executive order created Conserve Georgia, a multi-agency marketing and public education effort to promote conservation of energy, land, and the water, the prevention of litter and the promotion of recycling in order to create a "culture of conservation." The order cited the importance of conserving Georgia's natural resources and instilling a sense of stewardship and conservation as justification for the campaign. The measure specifically tasked the government with the responsibility of changing the values of the population and stated that the government should "lead by example." It also noted that land use and energy consumption that impacts the water supply should be addressed. Leaders from existing state agencies serve as

[233]Governor Sonny Perdue, Executive Order, Georgia Water Resources Council, (October 20, 2003), http://sonnyperdue.georgia.gov/gov/exorders/2003/oct/10_20_03_01.pdf.
[234] Governor Sonny Perdue, Executive Order, Water Conservation of State Agencies (October 20, 2007), http://gov.georgia.gov/00/press/detail/0,2668,78006749_96092834_96285033,00.html.

the decision makers for Conserve Georgia. [235] The responsibility of the state for instilling change in the water resources conservation was further confirmed when the Governor's 2008 Water Conservation Challenge ordered state agencies to reduce their water consumption by 5 percent over the next two years, and then 2 percent every year thereafter until 2020. The order encouraged local governments to match the state's pledge. [236]

With regard to the tri-state water wars, Governor Perdue was in office when Judge Magnusson issued his 2009 court decision to have Atlanta reduce withdrawals from Lake Lanier. To deal with the decision, Purdue outlined four actions: appeal the ruling, negotiate a water allocation scheme with Florida and Alabama, pursue congressional reauthorization to continue withdraw from Lanier, and develop a contingency plan in case all else fails. Purdue commissioned the contingency plan by creating the Water Contingency Planning Task Force in October of 2009. The task force recommended that conservation measures begin immediately, regardless of the outcome of the Lake Lanier court case since the task force estimated Atlanta would lose $26 billion if there was no resolution. The task force also determined if Atlanta lost Lake Lanier as a source of water, there would be a net loss of 280 million gallons a day. With conservation measures, the task force estimated that 30 to 80 million gallons per day could be saved. Therefore, the task force concluded Lake Lanier remained necessary to the water supply of Atlanta. The Task Force published its findings and recommendations.[237] Regardless, in case Atlanta did lose the right to use Lake Lanier, the task force developed contingency plans for

[235] Governor Sonny Perdue, Executive Order, "Creating Georgia Conservancy," (April 24, 2008), http://gov.georgia.gov/00/press/detail/0,2668,78006749_92321069_92330774,00.html.
[236] Governor Sonny Perdue, Executive Order, "Governor's Water Conservation Challenge," (October 31, 2008), http://gov.georgia.gov/00/press/detail/0,2668,78006749_101951868_126635478,00.html.
[237] James L Snipes, "Georgia's Water Woes: Is Atlanta's Water Gauge Really Running on Empty?" *Planning* 76, no. 4 (2010): 21.

2015 and 2020. The plan recommended for 2015, in the absence of Lake Lanier water, that Atlanta should pump treated wastewater back upstream to be reused. This plan would require extensive investments in pipes and pumps that would carry the water upstream and estimated that water costs would increase 20 percent. The more economical 2020 plan called for new reservoirs to be built along with increased conservation methods. [238]

Governor Perdue was obviously a proponent of water conservation during his term, but water bans during droughts were not mandated by executive orders. Instead, the Environmental Protection Division created a framework for immediate conservation during droughts.

Water Bans

Georgia's Environmental Protection Division adopted the Georgia Drought Management Plan in 2003. The plan outlined procedures for declaring drought, an authority held by the EPD, and drought responses.[239] According to this document, during times when drought conditions do not exist, non-prohibited outdoor water use is restricted to even number addresses on Mondays, Wednesdays, and Saturdays, and odd numbered addresses Tuesdays, Thursdays, and Saturdays. During drought occurrences, depending on the severity as defined by the EPD on a scale of one to four, the EPD restricts water use to specific times, and prohibits an increasing number of activities (see table 3).[240]

In addition, the plan recommended that local governments and water providers practice conservation pricing, defined as a system in which unit price increase as quantity increases or imposes surcharges during peak water consumption times designed to reduce consumption.

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[238] Ibid., 22.
[239] Georgia Environmental Protection Division, *Georgia Drought Management Plan*, March 26, 2003, http://www.gaepd.org/Files_PDF/gaenviron/drought/drought_mgmtplan_2003.pdf, 13.
[240] Georgia Environmental Protection Division, *Rules of Georgia Department of Natural Resources Environmental Protection Division Chapter 391-3-30 Outdoor Water Use*, (May 26, 2004), http://www.gaepd.org/Files_PDF/rules/rules_exist/391-3-30.pdf.

During droughts, the state responsibility, as defined by the plan, is to insure water quality standards. Local governments are responsible for implementing and educating the public on water conservation measures.[241]

This Drought Management Plan is a formula for responding to drought, not necessarily reducing the probability or severity of future drought occurrences. In September 2007, Carol Couch, Director of the Environmental Protection Division, suggested prohibiting watering exceptions for commercial users, such as landscapers, in order to further reduce consumption during the perceived historical drought. Outlined bans and pricing practices were already in place at this time, but the EPD feared they would not be enough.[242]

Table 3. Georgia Drought Management Water Restrictions [243]

Georgia Drought Management Plan Water Restrictions		
Drought Level	**Times**	**Prohibited**
Pre-drought	Not restricted	Not restricted
Level 1	12am to 10am, 4pm to 12 midnight	Use of hydrants for any purpose other than firefighting, public health, safety or flushing is prohibited.
Level 2	12am to 10am	Washing hard surfaces, such as streets, gutters, sidewalks and driveways except when necessary for public health and safety.
Level 3	12am to 10am	1-Filling installed swimming pools except when necessary for health care or structural integrity, 2-Washing vehicles, such as cars, boats, trailers, motorbikes, airplanes, golf carts. 3-Washing buildings or structures except for immediate fire protection, 4-Non-commercial fund-raisers, such as car washes, 5 Using water for ornamental purposes, ie fountains, reflecting pools, and waterfalls except when necessary for aquatic life
Level 4	Restricted	No outdoor water use is allowed, other than for activities exempted in 391-3-30-.05, or as the EPD Director may order

[241] Georgia EPD, *Georgia Drought Management Plan*, 18.
[242] Matt Kempner, "And Keep 'em Off 24/7: New Ban Spares Only Certain Businesses and Food Gardens, and May Soon Get Tighter Still," *Atlanta Journal-Constitution*, September 29, 2007, sec. A.
[243] Georgia Environmental Protection Division, *Rules of Georgia Department of Natural Resources Environmental Protection Division Chapter 391-3-30 Outdoor Water Use.*

Public Space

During the research through newspaper articles and legislative acts related to drought, two public parks, Centennial and Piedmont, stood out as prominent sites. Piedmont served as the sight for the rally for Georgia's Bill of Water Rights. Both parks made headlines in the *Atlanta Journal-Constitution* for well exploration. Also, both parks received media coverage because of their noticeable use of water to attract visitors through waterfalls, fountains, and pools. The presence of recreational water use in these public spaces made them a target for public scrutiny during the water bans of the 2007 drought. The following discussion highlights newspaper coverage of conservation measures undertaken by these parks, and relates their significance to a broader literature which values the study of public spaces a measure of culture.

Geographers interpret public spaces for what they can say about culture and societies. This research builds on the idea that parks are representative of cultures and identities of people. In this case, public parks are representatives of the culture of conservation. I contend urban parks are a means of place preservation; they preserve nature and represent its value in the built urban environment.[244] Landscapes can be read as a representation of society. In public urban spaces, cultural landscapes are "produced, manipulated, and understood by designers, politicians, users and commentators within changing historical, political, and sociopolitical contexts."[245] In this vein, Low studied Costa Rican plazas using interviews of users of the spaces, managers of relevant local institutions, and gained an understanding of the planning and design of the areas.[246] Low also referred to media reports and determined that urban plazas reflect cultural meanings and understandings about Costa Rican life. Low's analysis determined outside forces,

[244] Setha Low, "Urban Public Spaces as Representations of Culture," *Environment and Behavior* 29, no. 1 (1997): 8.
[245] Ibid., 6.
[246] Ibid., 8.

such as the Spanish and church, impacted public spaces.[247] Furthermore, the urban park is a representation of the political and cultural atmosphere of the moment. For example, Matt Gandy's study of Central Park shows that use of Central Park is shaped by the public's preferences. Central Park was originally conceived by Olmstead to be a wild space, with emphasis to be attractive to the elite of New York. In time, Central Park became a space that represents the city as a whole.[248]

Similar to public parks, and at the core of this research, Buford Dam alters the natural environment. Watershed projects can provide insight into the cultural values of a place. Cosgrove's work deals with the impact the imagery the English country side has on the identity of its people. His work on the Ladybower Reservoir and the Rutland Water Reservoir in England uses landscape interpretation to situate the two projects, construction of which was forty years apart, within the context of the values of their times. Both projects were integrated into wild landscape as lakes in order to fit within the national context. Watershed projects are notoriously controversial within preservation and environmentalist movements concerned with the alteration for the natural landscape.[249]

Parks in Atlanta, Georgia were selected based on their visibility and relation to droughts in the media. These spaces were evaluated in the context of water conflict in order to gain a perspective of public perception of Georgia's water issues and determine if the culture of conservation was becoming part of the landscape of Atlanta. I interviewed representatives of Centennial and Piedmont Park and searched media reports of the parks adaptation to droughts.

[247] Ibid., 31-32.
[248] Matthew Gandy, *Concrete and Clay: Reworking Nature in New York City* (Cambridge: MIT Press 2002), 113.
[249] Denis Cosgrove, Barbara Roscoe, Simon Rycroft, "Landscape and Identity at Ladybower Reservoir and Rutland Water," *Transactions of the Institute of British Geographer* 21, no 3. (1996): 534-551.

Atlanta has a rich history steeped in its public space. Piedmont Park has been a key venue for midtown festivals since the early twentieth century. Centennial Park became an Atlanta icon after the city hosted the Olympic Games in 1996. Additionally, to provide a context for the recreational and economic importance of the Chattahoochee, the Chattahoochee Recreational Areas and Lake Lanier will also be discussed. Although not municipal parks, they provide the same recreational opportunities, preserve environmental resources, and make these amenities available to urban populations.[250] Chattahoochee Recreational Areas and Lake Lanier are both public areas supported by federal funds.

Centennial Park

Centennial Park is a twenty-one acre park located in downtown Atlanta operated by the Georgia World Congress Center Authority (which also operates the Georgia Dome and the Georgia World Congress Center).The State of Georgia claimed ownership of the park after the Olympic Games of 1996, of which the park still serves as a reminder of the historic event. The facility's purpose, according to its website, is to promote "events and activities that generate economic benefits to the citizens of the State of Georgia and the City of Atlanta as well as enhance the quality of life for every Georgian."[251] Centennial Park features an iconic Fountain of Rings, multiple waterfalls, and landscaped surroundings.

After the drought of 2007, newspaper reporting on wasteful water use for recreational purposes increased and highlighted the well use in Centennial Park. The Fountain of Rings is a zero-depth pool, as defined by the EPD, meaning that water restrictions during drought do not apply to its function. Therefore, Fountain of Rings remained operational during the most intense

[250] Setha M. Low, Dana Taplin, and Suzanne Scheld, *Rethinking Urban Parks: Public Space & Cultural Diversity* (Austin: University of Texas Press, 2005).
[251] Centennial Park, *Park History*, http://www.centennialpark.com/index.php/about-the-park/park-history.

Figure 14. Waterfall at Centennial Park. Photo by author.

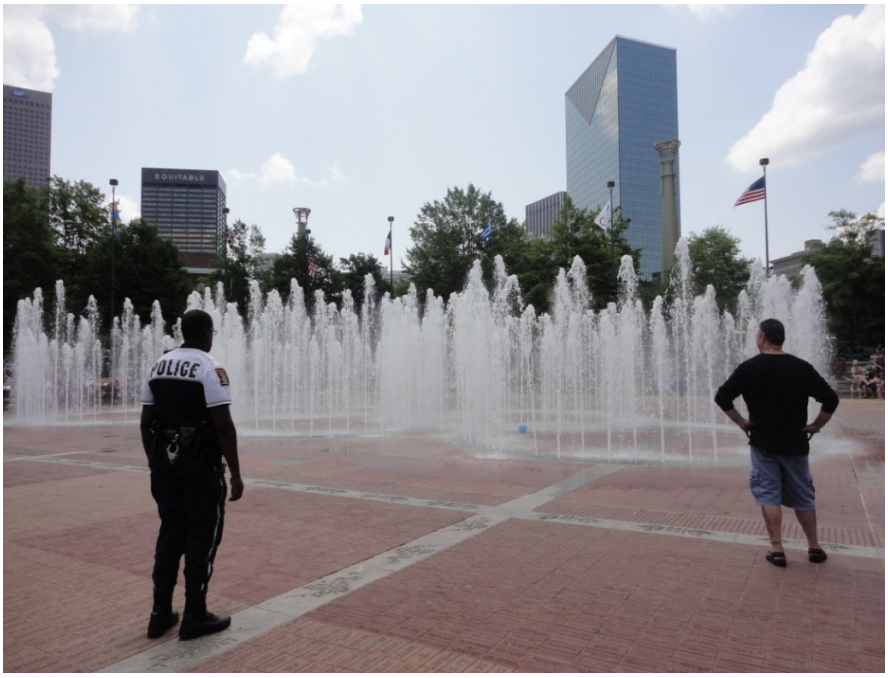

Figure 15. Fountain of Rings at Centennial Park. Photo by author.

drought months beginning in the spring of 2008. This fact was highlighted in the *Atlanta Journal-Constitution* as one opportunity to use water recreationally during the drought.[252] These fountains use domestic water, or water from public sources, but this water is not disposed. The fountain recycles water through a sand filtration system.[253] During the 2007 drought, Centennial Park imported water from Kentucky via truck in order to create an ice rink. Officially, there had not been a ban on water use for ice rinks, but officials at Centennial Park felt it was necessary to be as "civic minded as possible" and this action was also reported in the *Atlanta Journal-Constitution*.[254]

Centennial Park reportedly lost $500,000 in plants due to ornamental watering bans as well as $100,000 in costs related to lack of use of the water ponds. Additionally, park managers tuned off waterfalls due to the restrictions in October of 2007. To maintain the integrity of the park as a green space, the GWCC paid $292,000 to drill two wells under the property. The *Atlanta Journal-Constitution* also reported on the successful completion of these wells. Centennial's wells supply water for irrigation for the landscaping and for the ornamental waterfalls. [255] The waterfalls also act as holding tanks to store the pumped well water. Additionally, cisterns installed under parking decks of the Georgia Dome and convention center provide additional water supply. Centennial's management updated restrooms to utilize water-efficient features made of recycled content.[256]

[252] Leon Stafford, "Water Will Flow for Center, Fountain of Ring: Work on Wells Done for Centennial Park, Georgia World Congress Center," *Atlanta Journal-Constitution*, April 29, 2009, sec. A.
[253] Mark Banta, General Manger of Centennial Park, correspondence with author, June 22, 2011.
[254] Mark Davis, "Rink Avoids Thin Ice, Imports Water: Skates Past Problems of the Drought by Trucking in a Supply from Kentucky for Centennial Facility," *Atlanta Journal-Constitution*, November 6, 2007, sec. A.
[255] Stafford, "Water Will Flow for Center, Fountain of Ring."
[256] Mark Banta, Correspondence with author, June 22, 2011.

Local economic impact of Centennial Park, measured in the redevelopment of the area, is estimated at $2.4 billion.[257] Therefore, it is obvious why the continued quality operation of this park was essential to the area. Mark Banta, General Manager of Centennial Park, in an interview in the *AJC*, asserted that the facility had always been committed to water conservation and "best management practices related to irrigation, and despite the drought, the park did not cancel any of the 200 event days per year, or limit access to the public."[258]

Piedmont Park

Since 1989, the Piedmont Conservancy, a private-public partnership modeled after the Central Park Conservancy in New York, has been in charge of Piedmont Park.[259] Management shifted from public to private-public in part because individuals and corporations are more likely to give financial support to a non-profit organization rather than the government.[260] The privatization of public spaces may solidify the uneven relationship of power and privilege, which explains why, for example, public parks in poor areas lack funding and attention.[261]

Piedmont Park was historically the location of four major Atlanta festivals: the Atlanta Dogwood Festival, the Atlanta Jazz Festival, the Atlanta Pride Festival, and the Peachtree Road Race. In 2008, the Conservancy canceled all four of these as a result of a ban on events with more than 50,000 attendees on park grounds. The ban was put in place to protect the drought stricken landscaping of the park and publicized in articles in the *Atlanta Journal-Constitution*. [262]

[257] Ibid.
[258] Ibid.
[259] Setha M. Low and Neil Smith, *The Politics of Public Space* (New York: Routlede, 2006), 71.
[260] Ibid., 72.
[261] Ibid., 118.
[262] Chandler Brown and Ken Sugiura, "Drought Ousts 4 Big Events from Piedmont: Festivals Scramble for Alternatives," *Atlanta Journal-Constitution*, January 12, 2008, sec. A.

Similar to Centennial, the Piedmont Conservancy put aside $50,000 to explore for wells and research irrigation systems in 2008 [263] and was eventually successful in installing two wells. In addition, Lake Clara Meer, located in the park, is also used for irrigation purposes and is recharged by springs and well water. Storm water and sewage are kept separate so that storm water can also be used for irrigation. The Conservancy considered using non-potable water for irrigation purposes prior to the drought of 2007 but did not initiate the program until afterwards.[264] The Conservancy also approved the use of native plants with lower water requirements, installed porous surfaces and rain barrels to collect water, and even monitors the facilities water use. Also similar to Centennial, Piedmont Park constructions all include low flow toilets, waterless urinals, and low flow faucets. Water fountains on the property are also a closed system. [265]

Piedmont Park and Centennial Park utilized many of the same techniques to cope with the droughts and continue providing services. The economic impact of the park on Midtown is evident in the higher real estate values found around the park. Similar to Centennial, the revitalization of Piedmont affected the community surrounding it. The survival of all the amenities these public spaces provide is of great importance to their local economies. Despite not having a drought mitigation plan, the Piedmont Conservancy treats everyday like there is a drought and strives to conserve water.[266]

[263] Stacy Shelton, "Piedmont Park Drills for Water, but Not All is Well" *Atlanta Journal-Constitution*, September 14, 2008, sec. A.
[264]Chris Nelson, Executive Vice President, COO, Piedmont Conservancy, correspondence with author, October 4, 2011.
[265] Ibid.
[266] Ibid.

Chattahoochee National Recreation Area and Lake Lanier

In contrast to these locally owned public spaces, the Chattahoochee National Recreation Area and the recreational areas surrounding Lake Lanier tell a different story. These spaces are not representative of conservation, but rather the economic importance that recreational water use has on the area. Similar to the city parks discussed above, drought has an impact the utility of the areas since lowered stream and lake levels diminish their recreational value.

The Chattahoochee National Recreation Area, like the Chattahoochee's waters, is a common pool resource. Although the federal government owns and manages the land, the general public has an expectation of access to the park.[267] In 1978, Congress designated a total of 6,300 acres as the Chattahoochee River National Recreation Area with an authorization of $72.9 million dollars for acquisition.[268] Within Metro Atlanta, Chattahoochee River National Recreation Areas operated by the National Park Service to provide access to the river through parks and boat ramps along the river corridor.[269]

Both state and federal interests recognized the recreational and economic importance of the Chattahoochee River. In an Atlanta Regional Commission letter from 1980, Harry West, then Executive Director, cited consideration for the Recreation Areas as being equally as important as water supply and the State Trout Hatchery. [270] R. S. Howard, Jr., Director

[267] Martha Goeres, *Common Ground: The Struggle for Ownership of the Black Hills National Forest* (Lanham, Md: Rowman and Littlefield Publishers, 1996), 8.
[268] Jack Brinkley to James Watt, Secretary of Interior, September 24, 1982, Environmental Protection Division of the Georgia Department of Natural Resources, Director's Subject Files, Georgia State Archives, Morrow, GA.
[269] Mobile District Corps of Engineers, 1984, "Draft report on Investigation," Georgia State Archives.
[270] Harry West, Executive Director Atlanta Regional Commission, to Colonel Creel, October 29, 1980, Environmental Protection Division of the Georgia Department of Natural Resources, Director's Subject Files, Georgia State Archives, Morrow, GA.

of Department Natural Resources, also recognized the important recreational value of manmade lakes that the state's natural waters do not provide, including fishing and public parks. [271]

Figure 16. Marker for Chattahoochee Recreation Area and Boat Launch in Roswell, located 22 miles north of Atlanta. Photo by author.

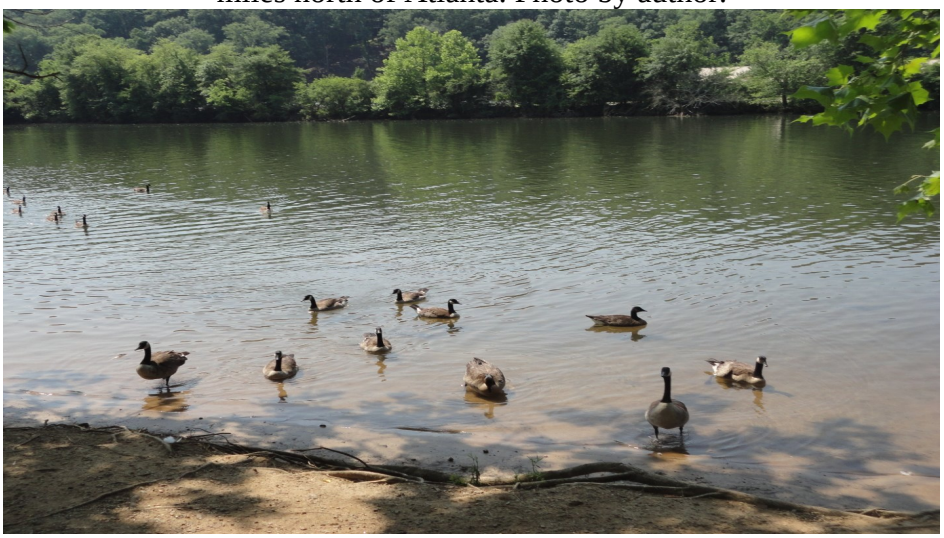

Figure 17. Wildlife at Chattahoochee National Recreation Area. Photo by author.

[271] R. S. Howard Jr., Director Department of Natural Resources, to Jimmy Carter, November 28, 1972, Environmental Protection Division of the GA Dept of Natural Resources, Director's Subject Files, Georgia State Archives, Morrow, Georgia.

Buford Dam, which forms Lake Lanier, is a federally owned structure and like the National Park Service managed Chattahoochee recreation areas, there are spaces for public recreational use surrounding the lake. The Corps considered recreation an important aspect of Lake Lanier, along with water supply, navigation, and quality. [272] In 1984, the Corps stated Lake Lanier must be kept at a level adequate to meet the "cultural, physical, and biological demands" of the water.[273] However, there are also privately owned spaces, including marinas and vacation resorts that also benefit from the federal government's interest in creating recreational opportunities.

According to a 1979 study, lake levels are associated with a volume necessary for recreational activities. Visitor levels increase as lake levels increase, and therefore, the decisions on lake level impact the recreational economy of the lakeshore.[274] The upper part of the Chattahoochee contains popular reservoirs, national forests, and national and state parks. In 1997, Lake Lanier had 16 million visitors annually. [275] In addition to recreational economy, the Chattahoochee also has a relationship to its surrounding areas similar to public parks. In 1979, the property directly adjacent to Lake Lanier was worth $1600 more than the average property in the same county. These properties are close to Atlanta, and so the lake amenities cannot completely account for the price inflation since transportation between Atlanta and the area had recently improved. [276]

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[272] U.S. Army Corp of Engineers, Savannah District, Metro Atlanta Area Water Resource Management Study, Summary Report, February 1981, Environmental Protection Division, Director's Subject Files, Georgia State Archives, Morrow, Georgia.
[273] Mobile District Corps of Engineers, 1984, "Draft Report on Investigation," Georgia State Archives.
[274] U.S. Army Corps of Engineers Savannah District, "Lake Lanier Management and Economic Impact Study, Part of the Metro Atlanta Area Water Resources Management Study By the Georgia Mountains Area Planning and Development Commission, Gainesville, GA," August 1979, 104-106, James E. Kundell Collection, University of Georgia Archives, Athens, Georgia.
[275] Chattahoochee River Basin Management Plan Draft, 1997, James E. Kundell Collection, University of Georgia Archives, Athens, Georgia.
[276] Ibid.

Recreational value of Piedmont Park, Centennial Park, Chattahoochee National Recreation Areas, and public and private areas around Lake Lanier is dependent on a sustainable water supply. Piedmont and Centennial adapted to droughts through conservation practices and

Figure 18. Property for sale directly across from Chattahoochee National Recreation Area in Roswell, GA. Sign reads “Overlooking River,” followed by information about the property. Photo by author.

Figure 19. Marina at Lake Lanier. Photo by author.

by supplementing with well water. On the other hand, the recreational economy dependent on Chattahoochee Recreation Areas and Lake Lanier are dependent on decisions made on the federal level, rather than locally.

Results of Conservation Measures: Adaptation?

Urbanization not only increases consumption of natural resources, but the culture of cities also increases per capita consumption.[277] Likewise, it can be suggested that the culture of a city can be changed in order to decrease per capital consumption. However, the adaptive measures described in this chapter are hard to evaluate in their effectiveness. Before conservation measures became the norm, water consumption trends were on the rise.

During the thirty years prior to 1982, municipal water consumption increased consistently, corresponding with increasing population. For example, water use increased by 25 percent from 1970 to 1980.[278] Consumption continued to increase, as did population, from 1990 on. From 1990 to 2005, the total population served by Georgia's public supply, including groundwater and surface water sources, increased from 5,150,000 to 7,470,000[279] and withdrawal increased by 217,000,000 gallons per day (Mgal/d) in that time period. [280] In 1995, withdrawals totaled 1150 Mgal/d for the roughly 5,900,000 users,[281] and in 2000, withdrawals totaled 1250 Mgal/d for a population of 6,730,000. [282] Between these two measures

[277] Christopher G. Boone and Ali Modarres, *City and Environment* (Philadelphia: Temple University Press, 2006), 45.
[278] "Georgia's Valuable Water Resources: How Will We Manage Completing Uses," Dr. James E Kundell Institute of Government, University of Georgia Governor's Conference on the Environment: The Challenges of New Federalism, November 9, 1982.
[279] Population figures provided by USGS are rounded and therefore not exact.
[280] USGS, "Estimated Water Use in the United States in 1990: Public Supply Freshwater Use." http://water.usgs.gov/watuse/tables/pstab.st.html; USGS, "Estimated Water Use in the United States 2005," Table 5, http://pubs.usgs.gov/circ/1344/pdf/c1344.pdf.
[281] USGS, "Public Supply, 1995," http://water.usgs.gov/watuse/pdf1995/pdf/public.pdf.
[282] USGS, "Estimated Water Use in the United States in 2000: Public Supply," http://pubs.usgs.gov/ circ/2004/ circ1268/htdocs/table05.html.

in 1995 and 2000, the population of public supply users increased by 14 percent, but water consumption only increased 8 percent. The data taken in 2005 actually shows a decrease in water consumption from 2000 to 2005 (1180 Mgal/d), while the total population and population of public supply users continued to grow. This means that the consumption slowed compared to population. In both 2000 and 2005 public water supply accounted for 82 percent of the total population.[283]

This decrease in public supply consumption can be explained by many things. First, since the data supplied by USGS for water consumption is only an estimate of water use, the data may simply be wrong. On the other hand, it is possible the regulated conservation push of the 2000s actually reduced consumption of water users in the state. Water consumption data for 2010 will not be available until 2014, and will provide more insight into the effectiveness of the conservation methods outlined in this chapter.

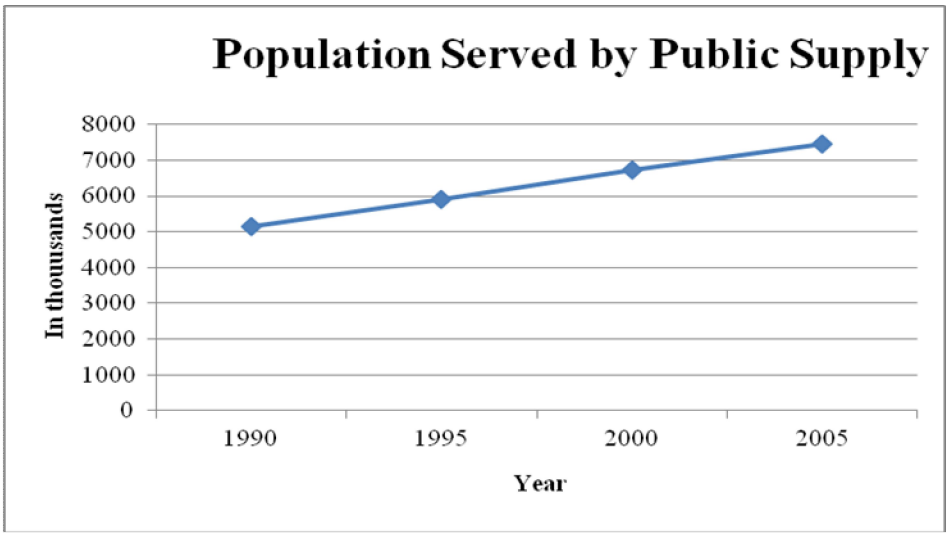

Figure 20. Population in thousands of Georgians served by the public water supply.[284]

[283] Ibid.
[284] USGS, "Estimated Use of Water in the United States in 1990. Public-Supply Freshwater Use,"

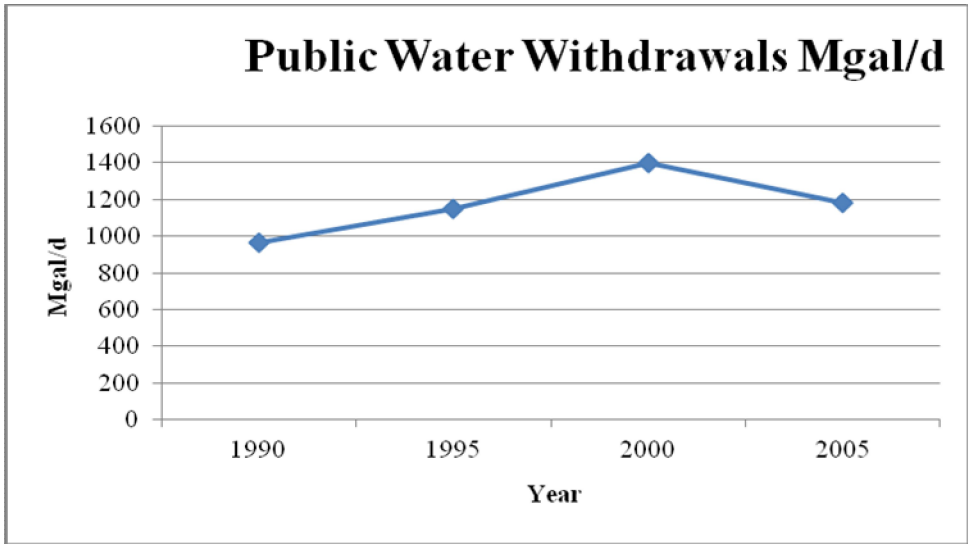

Figure 21. Public water withdrawal totals in Georgia for years 1990-2005 in Mgal/d.[285]

According to data collected by the Atlanta Department of Watershed management, single family consumption in Atlanta declined from 2006, at the start of a drought, to 2008 and leveled off in 2009 during a time of excessive precipitation (see figure 20). However, monthly consumption did not decrease from month to month.[286] Water use declined during drought conditions, which can be interpreted as evidence that government measures were successful. However, since this trend did not continue month to month or after the drought occurrence ended, it can be inferred the conservation measures described in this chapter did not provide a long term solution for Atlanta's water consumption issues.

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http://water.usgs.gov/watuse/tables/pstab.st.html; USGS, "Public Supply, 1995," http://water.usgs.gov/watuse/pdf1995/pdf/public.pdf; USGS, "Estimated Water Use in the United States in 2000: Public Supply," http://pubs.usgs.gov/circ/2004/circ1268/htdocs/table05.html; "Estimated Use of Water in the United States in 2005," http://pubs.usgs.gov/circ/1344/pdf/c1344.pdf, page 17.

[285] Ibid.

[286] See Table 1in Appendix.

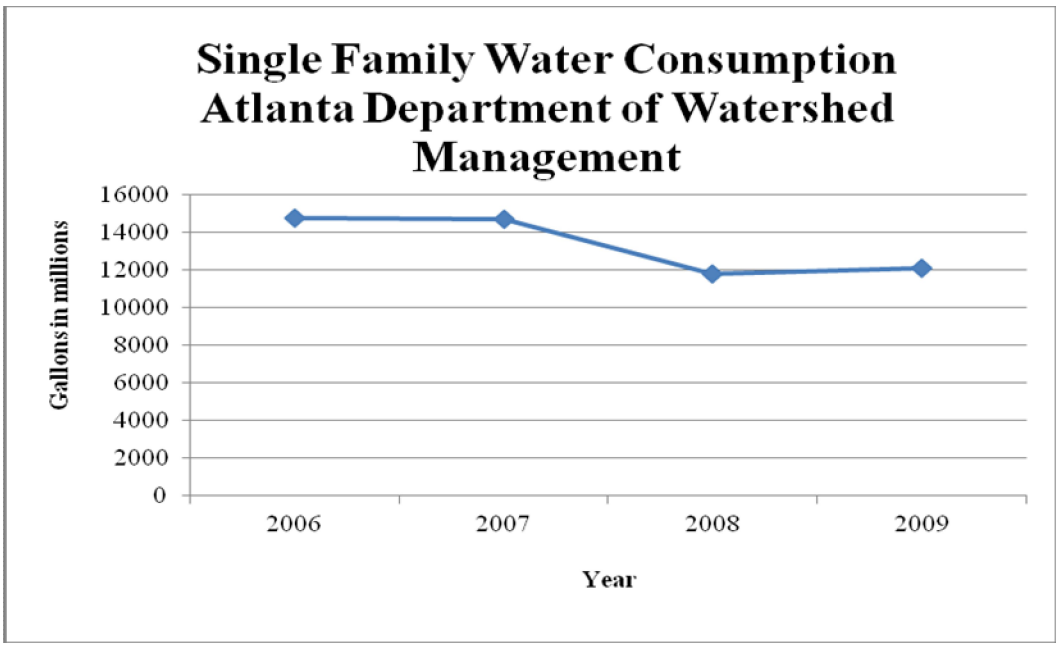

Figure 20. Summary of gallons used per year in single family households in City of Atlanta's Department of Watershed Management service area. Gallons rounded to nearest millions by author. [287]

Governor Sonny Perdue took a hard stance on water conservation during his term and the Georgia legislature took on water conservation and drought preparedness an obligation to the state's residents. Public and private entities, such as Centennial and Piedmont Parks, also took the practices set forth by Georgia's government seriously, and these policies remain in place today.

The effectiveness of Georgia's adaptive measures is hard to measure. Water consumption increased from 1980 to 2000 but at a slower rate than population. During the drought of 2007, water consumption declined during the drought months most visible to the public but did not decline consistently month to month or remain at the same level once the drought was over.

[287] Single Family Consumption Data received from Melinda Langston, City of Atlanta Office of Watershed Management.

Chapter 6
Summary and Conclusion

This research builds on the literature that shows that regulation follows water scarcity or stresses. Droughts played a key role in the development of Georgia's water policy during the second half of the twentieth century. Emel and Brooks asserted that laws of reasonable use changed little in the evolution of groundwater policy in the American Great Plains, while the institutions that regulate the resource changed significantly. In Georgia's water policy evolution, reasonable use as defined by riparianism, also did not change, but rather, was regulated by governing administrative bodies. Furthermore, interstate water wars caused federal administrative bodies to regulate Georgia's waters, specifically Lake Lanier. Lastly, Georgia's state government regulated reasonable use during water scarcity through its push for a culture of conservation among water users of the state.

The evolution of Georgia's water laws framed the ways in which the state can adapt to changes. Georgia's legislature regulated quantity and quality well before the intense conservation push of the 2000s. The original riparian laws, which protected the owner of the land containing the non-navigable stream, evolved to what is called known as regulated ripirianism. Dellepenna's term refers to a system in which the government has been entrusted with the management of a resource for the good of the public. In Georgia's case, the government agency is the Environmental Protection Division, which issued permits to limit withdrawals and later developed water bans during droughts.

In contrast to western states, which dealt with allocation issues since their inception, water policy in eastern states mostly dealt with quality. Georgia's legislature regulated quality issues, including pollution and sedimentation, throughout the twentieth century. Sedimentation

concerns began as early as the 1930s in the farms of Georgia, and continued through the 1970s in legislation. Pollution was a major concern of the state, and is particularly important since water scarcity magnifies pollution problems. The 1964 State Water Quality Control Act created agencies with the sole purpose of regulating Georgia's water quality. Quality issues remained a hot topic during the 1970s and continued to be regulated during drought in the 2000s.

Drought is an ambiguous term. This research asserts that drought is a downward deviation from normal or expected quantities of water. These deviations can be caused by both decreased precipitation and increased consumption. In order for Georgia to manage its water effectively, both causes need to be recognized. So, though indexes such as the Palmer Drought Severity Index are useful in identifying drought conditions, they do not necessarily match what is experienced by water users. Therefore, adaptive measures used to help mitigate the effects of droughts through participant observations and local knowledge. Whatever their cause, droughts are expensive in terms of agriculture and for citizens, and are therefore necessary to study.

The concept of common-pool resources are meant to place the Chattahoochee into a conceptual framework. The Chattahoochee has multiple users including Georgia, Alabama, and Florida. Within those states, users have multiple interests including recreation, navigation, power, agriculture, ecological uses, and water supply. Because of these conflicting interests, and the finite supply of the Chattahoochee, the legal battle over the river has persisted over the last thirty years and complicates Georgia's future water policy. Unfortunately, the water issues of the state are far more complicated than the legal issues of ownership. Georgia, Atlanta in particular, has been subjected to growth that the current water supply cannot sustain. The culture of conservation introduced and pushed by state officials may benefit the watershed system, but by no means can serve as a cure all to the issues of unfettered growth.

Adaptation to water scarcity was a slow process in Georgia until the twenty-first century when the state's government moved to conservation measures. In order to see how these conservation measures took hold, public parks provide insight into conservation techniques. Piedmont Park and Centennial Park are extremely visible in Atlanta. Also, exploration for wells by these parks demonstrate another adaptation to drought, but these wells are only useful to small users and therefore not a solution to the large scale issues of water scarcity. The publicity the drought of the 2007 and the adaptation measures which followed made Georgians aware of their water in a way that they were not before.

Figure 20. Fountain in Alpharetta, Georgia, just north of Atlanta. Photo by author.

Because of the droughts, the citizens of Georgia are aware of where their water comes from and how much of it they have access to.

Georgia's emphasis on conservation measures assisted in lowering consumption in the short run, but the longevity of this change remains to be seen. Future water shortages will provide more information and will further test actions taken until 2012.

This research has shown that water scarcity was an impetus for many policy changes and adaptation measures by Georgia's government since 1970. However, this research was not able to identify the successfulness of drought mitigation policies put in place by the Georgia's government. Atlanta did not deplete Lake Lanier during the drought of 2009, and consumption did decrease relative to population growth, but this cannot be tied definitely to conservation measures by this research. More thorough research is needed to determine the extent of the supply of the Chattahoochee and what measures Georgians need to take to make sure they will have enough water.

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Appendix
Extra Relevant Material

Table 4. Drought measurements for selected years. Precipitation for state of Georgia. PSDI and PHDI for Region 2 in Georgia, which includes Atlanta and Lake Lanier. [288]

Year	Precipitation (in)	PSDI	PHDI
1954	30.99	-3.29	-2.66
1955	41.02	-3.58	-3.21
1956	46.45	-2.34	-2.41
1957	54.94	0.28	-0.72
1958	44.84	0.61	0.13
1959	56.70	0.99	-0.28
1960	47.24	0.22	0.03
1961	54.59	0.71	1.89
1962	49.30	-0.26	0.88
1963	50.66	0.30	1.69
1964	70.66	3.50	3.65
1965	47.91	2.80	1.28
1966	55.52	2.22	1.20
1967	49.66	1.18	2.18
1968	41.98	-0.91	2.36
1969	49.80	0.68	1.38
1970	49.28	1.11	-0.52
1971	57.69	2.09	0.91
1972	50.54	0.95	1.21
1973	57.66	2.25	2.55
1974	50.86	1.25	1.94
1975	60.93	2.99	2.80
1976	55.54	1.69	2.63
1977	48.40	-0.01	0.82
1978	42.55	-0.88	-0.40
1979	55.60	1.57	1.64
1980	46.61	-0.29	0.61
1981	42.20	-3.04	-3.21
1984	47.54	0.94	2.38
1985	47.14	-0.94	-1.41

[288] Note: Precipitation (average in inches), Palmer Severity Drought Index, and Palmer Hydrological Drought Index, Year to Date Average for NOAA Region 2 of Georgia.

1986	42.96	-1.66	-3.33
1987	45.02	-0.78	-2.30
1988	43.80	-2.25	-3.07
1989	55.36	0.99	1.14
1990	44.13	-0.31	2.69
1998	52.48	0.26	1.28
1999	40.88	-2.82	-1.84
2000	41.75	-3.28	-2.00
2001	42.73	-0.48	-0.28
2002	50.72	-1.28	-0.66
2006	40.63	-1.86	0.02
2007	39.05	-3.26	-2.74
2008	47.75	-1.34	-2.86
2009	62.23	1.41	0.97
2010	43.64	-0.72	3.11
2011	39.29	-3.56	-0.79

Table 5[289]

City of Atlanta Watershed Department of Watershed Management Single Family Consumption				
	2006	2007	2008	2009
January	1056142900	1146068100	949943200	1024573800
February	904984700	912379100	872502800	887335200
March	886517600	1063568600	897354600	920333500
April	1005320000	1097366500	801969100	853271900
May	1131833900	1279680550	961801900	995947900
June	1569541300	1746629350	1040853100	1040818500
July	1720202200	1463157700	1070711400	1367613200
August	1670474800	1353677300	1118956300	1221755100
September	1343806500	1562751250	1049338700	1029724800
October	1237934200	1246678750	1027859500	941099400
November	1133217950	910045300	884945900	846369300
December	1078251050	915087500	1095735700	974487000
Totals	1228185592	1224757500	980997683	1008610800

[289] Data from Melinda Langston, Atlanta Watershed Management.

Vita

Samantha Chaisson was born in Baton Rouge, Louisiana in 1986 and grew up in nearby St. Francisiville, LA. She attended West Feliciana High before moving on to Louisiana State University. There she completed a Bachelor of Arts degree in history. After graduation, she began working in Baton Rouge and continued to work part-time as she completed the graduate program in geography at Louisiana State University. She will graduate in August 2012 with a Master of Arts degree.