
Lower
Flint
Ochlockonee

SUMMARY: The Council's vision and goals for the Lower Flint-Ochlockonee Water Planning Region guided the Council in the development of this Water Development and Conservation Plan.

Section 1. Introduction

[Initial text to be provided by EPD]

1.1 The Significance of Water Resources in Georgia

[*Initial text to be provided by EPD & Figure 1-1 map of water planning regions*]

1.2 Statewide Priorities

[Initial text to be provided by EPD]

1.3 State and Regional Water Planning Process

[*Initial text to be provided by EPD and Figure 1-2 planning process*]

1.4 The Lower Flint Regional Vision and Goals

The Lower Flint-Ochlockonee Water Planning Council adopted the following statement to describe its vision for the future of the planning region's water resources:

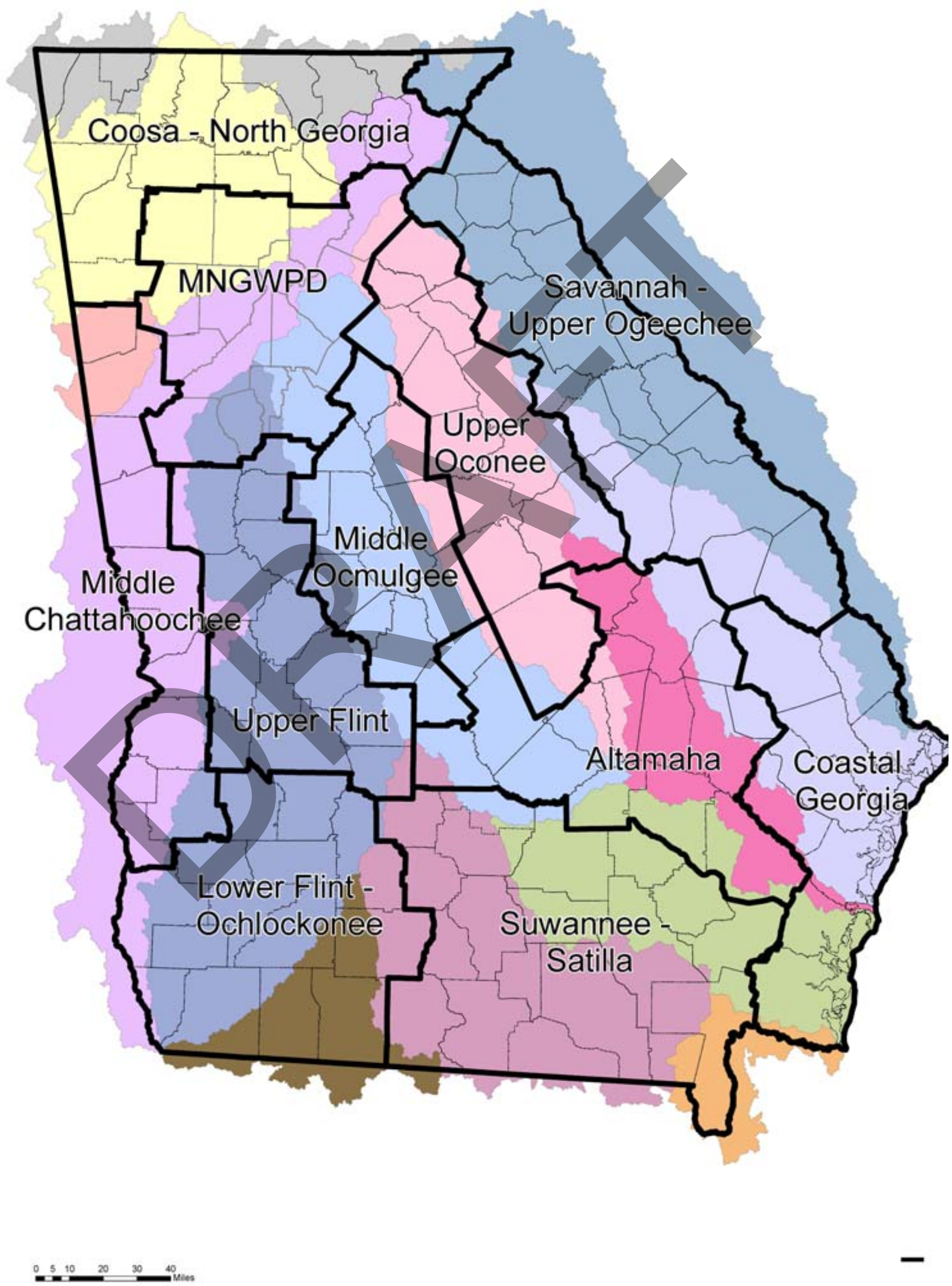
> *The Lower Flint-Ochlockonee Water Planning Council will manage water resources in a sustainable manner to support the region's economy, to protect public health and natural systems, and to enhance the quality of life for the region's citizens.*

The Council adopted the following goals to support its vision:

1. Ensure access to water resources for existing and future water users in the Lower Flint-Ochlockonee Region.
2. Sustain the region's aquifers, the Floridan, the Claiborne, the Clayton, and the Cretaceous, in a healthy condition that will continue to support the natural systems and economic activities of the Lower Flint-Ochlockonee Region.
3. Maintain the production-agriculture-based economy of the Lower Flint-Ochlockonee Region.
4. Support sustainable economic growth in the region.

The Council's vision and goals were adopted in order to guide the Council in developing this regional Water Development and Conservation Plan. While the Council does not directly manage water resources in the region, the vision and goals address resource management in order to indicate the Council's priorities and inform Council decision-making in the planning process. The regional vision and goals were used by the Council to guide the selection of water management practices, which are discussed in Section 6.

FIGURE 1-1: Georgia Water Planning Regions



SUMMARY: The Lower-Flint Ochlockonee region is largely rural, and the predominant sector of the economy and water use is agriculture. Existing State policies specific to agricultural water use in the Flint River Basin and the Federal Endangered Species Act are important to water resource management in the region.

Section 2. The Lower Flint-Ochlockonee Water Planning Region

2.1 History and Geography

The Lower Flint-Ochlockonee water planning region encompasses over 6,014 square miles in southwest Georgia and includes 14 counties (Baker, Calhoun, Colquitt, Decatur, Dougherty, Early, Grady, Lee, Miller, Mitchell, Seminole, Terrell, Thomas and Worth counties) as well as 50 towns and cities partially or fully within these counties (Figure 2-1). River basins in the region include the Chattahoochee, Flint, Ochlocknee, and Suwannee.

Agriculture is the leading economic sector and water user in the region. According to the University of Georgia's 2009 Georgia Farm Gate Value Report (AR-10-01), the counties comprising the Lower Flint-Ochlockonee council generated an agricultural production value of $1.9 billion (compiled by Boatright and McKissick, May 2010). In the 19th century, agricultural development in southwest Georgia was driven by the development of the cotton gin, and major crop diversification began in the 1930's due to farm mechanization advances, New Deal policies, and cotton yield reductions caused by the Boll Weevil. Widespread use of irrigation in the region began to develop in the 1970's.

2.2 Characteristics of the Region

The Lower Flint-Ochlockonee Region is largely rural, with over 43% of the land in row crops and pasture and an additional 34% in forest. Although row crop and pasture cover has decreased slightly in the past few decades, and low-intensity urban development has increased, the region is anticipated to remain a predominantly agricultural. However, recent land use trends may signal an increasing presence of industrial and commercial uses. Land use in the region is illustrated in Figure 2-2.

Natural features in the region provide habitat for an abundance of flora and fauna as well as areas critical for recharging the region's aquifers (see map in Appendix X). The region is located in Georgia's coastal plain physiographic region, south of the fall line. The coastal plain "is underlain by relatively soft, weakly consolidated rocks and unconsolidated sediments deposited by the sea or streams when the shoreline was at or near the fall line between 80 and 100 million years ago" (Flint River Water Development and Conservation Plan, March 2006).

FIGURE 2-1: Lower Flint-Ochlockonee Water Planning Region

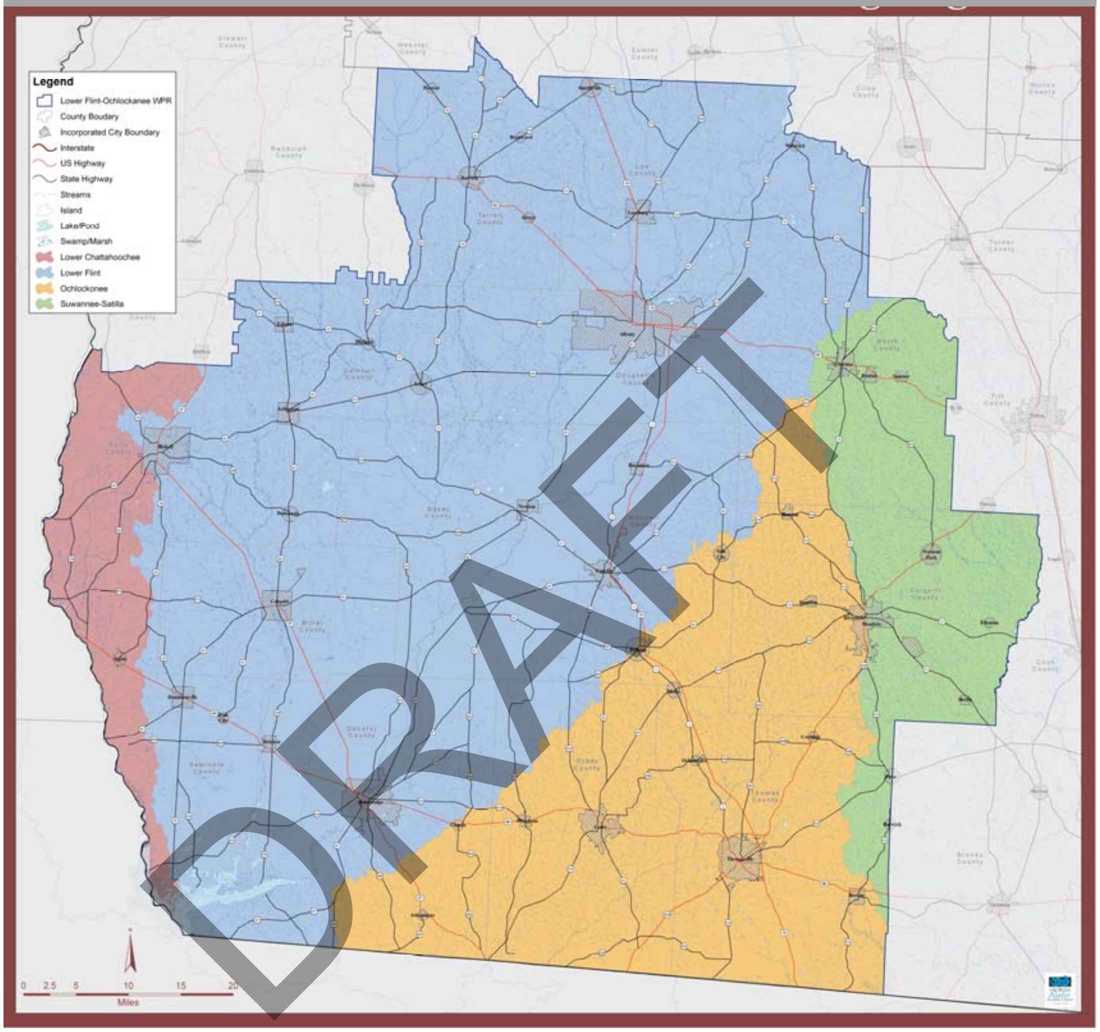
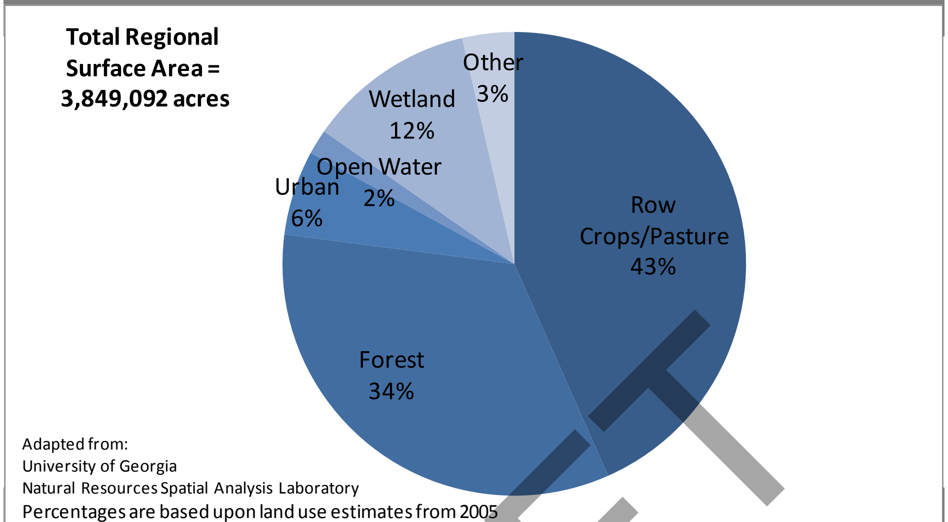


Figure 2-2: Lower Flint-Ochlockonee Land Use Percentages



Aquifers in the region include the Clayton, Claiborne, and Floridan aquifer systems. A large area of the Floridan aquifer in this region is in hydraulic connection with the Flint River. In this area, known as Subarea 4 (see map in Appendix X), surface water streams receive or lose water to the aquifer depending on the head difference between the streams and the aquifer. The major mechanisms of transfer include diffusion through streambeds or stream banks and discharge from in-channel springs, commonly known as blue-springs, which can discharge on the order of tens of millions of gallons per day. Subarea 4 includes the Flint River Basin south of Dooly County, part of the lower Chattahoochee River Basin, and a narrow strip on the eastern side of the Ochlockonee and Suwannee River Basins.

At the southern end of this region, Lake Seminole affects groundwater levels on a localized scale. A 2004 U.S. Geological Survey (USGS) hydrologic model mimicked pre- and post-impoundment, during drought conditions, to determine differences in the potentiometric surface and flow direction of the Floridan aquifer associated with Lake Seminole. The impoundment was shown to increase groundwater levels surrounding the lake by as much as 26 feet, but the overall impact was relatively localized, with groundwater level increases of “less than 2 feet beyond linear distances from Jim Woodruff Lock and Dam of about 35 miles along the Chattahoochee and Flint Rivers, and 20 miles along the Apalachicola River.”[1]

[1] Jones, L. Elliott, and Torak, Lynn J., 2004, Simulated Effects of Impoundment of Lake Seminole on Ground-Water Flow in the Upper Floridan Aquifer in Southwestern Georgia and Adjacent Parts of Alabama and Florida: U.S. Geological Survey, Scientific Investigations Report 2004-5077, p. 22.

2.3 Local Policy Context

The Lower Flint-Ochlockonee Region is subject to several overlapping layers of water resource management by state and federal agencies. State permitting programs for water withdrawals and wastewater dischargers affect all water users (including O.C.G.A. §§12-5-32, 12-5-30(a), 12-5-30(b), 12-5-96, 12-5-105; DNR Rules 391-3-6-.06, 391-3-6-.07, 391-3-2-.03), In this region, the following laws, regulations, and programs are also directly relevant to water management:

- The Flint River Water Development and Conservation Plan of 2006 is the basis for agricultural water use permit issuance by the Georgia Environmental Protection Division (EPD). The Plan was developed under the authority of the Water Quality Act (O.C.G.A. §12-5-31(h)) and Groundwater Use Act (O.C.G.A. §12-5-96(e)) in response to a prolonged drought, increased agricultural irrigation in southwest Georgia since the 1970's, and scientific studies that predicted severe impacts on streamflow in the Flint River Basin due to withdrawals from area streams and the Floridan aquifer (Flint River Water Development and Conservation Plan, 2006). The Lower Flint-Ochlockonee Water Conservation and Development Plan builds on the existing 2006 plan for the Flint River Basin as a whole. The 2006 plan provides a scientific and policy foundation for water resources planning in the Flint River Basin.

- The Flint River Drought Protection Act (O.C.G.A. §12-5-540) and its impementing rules (DNR Rule 391-3-28) provide for demand management through agricultural irrigation suspension in times of drought.

- Federal Energy Regulatory Commission (FERC) licensing requirements for privately-owned hydroelectric impoundments apply to Lake Chehaw in the Lower Flint-Ochlockonee Region.

- Under the federal Endangered Species Act, six species of freshwater mussels have been listed as endangered or threatened in the Lower Flint-Ochlockonee Region:

  Endangered: Shinyrayed pocketbook, Gulf moccasinshell, Ochlockonee moccasinshell, Oval pigtoe, Fat threeridge

  Threatened: Purple bankclimber

  Additionally, the Gulf sturgeon is listed as threatened, and flow requirements for the Gulf sturgeon affect the management of the Apalachicola-Chattahoochee-Flint System, as a whole. The Endangered Species Act prohibit takings of these species and sets requirements for the protection of the species and their critical habitats.

- The U.S. Army Corps of Engineers (USACOE) operates five federal reservoir projects on the Chattahoochee River (Lake Sidney Lanier, West Point Lake, Walter F. George Lake, George W. Andrews Lake, and Lake Seminole). The operation of these projects affects the Upper Flint in the parts of the region that are within the Chattahoochee Basin, but also in that the management of these reservoirs is a key component of water management in the Apalachicola-Chattahoochee-Flint (ACF) System as a whole. The Revised Interim Operating Plan for the Chattahoochee Basin is currently being revised by the USACOE.

Additionally, the ACF system is the subject of protracted litigation over the management and allocation of water resources among the Florida, Georgia, and Alabama and other interested parties. This litigation is currently subject to a 2009 ruling that gave the states until 2012 to resolve water sharing disputes or revert to 1970's allocations for water withdrawals from Lake Lanier. As the states have not resolved these issues, this plan is based on current conditions and will be revised as appropriate in the future to reflect any final agreements reached by the three states.

With regard to water quality regulation, the U.S. Environmental Protection Agency (EPA) is currently developing nutrient standards for free flowing streams and lakes in Florida as a result of a federal lawsuit under the Clean Water Act. If promulgated as proposed, these criteria will require increased control of nutrients in Georgia in order to meet downstream standards. These new nutrient standards could have substantial implications for water quality management in this region and other regions with river systems that cross into Florida.

*SUMMARY: This section assesses the **current** use, capacity, and condition of water resources in the Lower Flint-Ochlockonee Region.*

Section 3. Current Assessment of Water Resources of the Lower Flint-Ochlockonee Region

3.1 Major Water Uses in the Region

Current water use information for this region was compiled as a part of the development of water use forecasts for major categories of water use, including:

- **Municipal** water use is water withdrawn by public and private water suppliers and delivered for a variety of uses. Water-using industries were compiled separately in the “industrial” category.
- **Industrial** water use includes fabrication, processing, washing, and cooling for facilities that manufacture products, including steel, chemical and allied products, paper, and mining.
- **Energy** production uses water to generate electricity, mainly for cooling purposes at thermoelectric plants.
- **Agriculture** uses water to irrigate row and orchard crops as well as most vegetable and specialty crops that cover more than 95 percent of Georgia's irrigated land. Nursery water use estimates are also included. Animal operations and golf courses with agricultural water use permits are not included in the forecasts, but estimates of current use are available and provided in Appendix X.

As shown in Figure 3-1, groundwater is the predominant source of water in the Lower Flint-Ochlockonee Region. Figures 3-2 and 3-3 show that the use of surface water is roughly equal for industry, energy, and agriculture in the region, while most groundwater use is for agriculture. Figure 3-4 shows that the leading method for treating wastewater is by treatment facilities with point source discharges. These discharges are largely from power generating and industrial facilities.

For planning purposes, it is important to understand the amount of water that is not returned to the hydrologic system after it is used. Consumptive use is the difference between the total amount of water withdrawn from a defined hydrologic system and the total amount of the withdrawn water that is returned to the same hydrologic system. In this planning process, on-site sewage treatment and land application systems are treated as 100 percent consumptive. Similarly, agricultural water use is treated as 100 percent consumptive. While water may be returned to the hydrologic system from these treatment methods and from irrigated farm land, it is not returned within a timeframe that allows for it to offset the impacts of related withdrawals.

Figure 3-1:Water Supply by Source Type

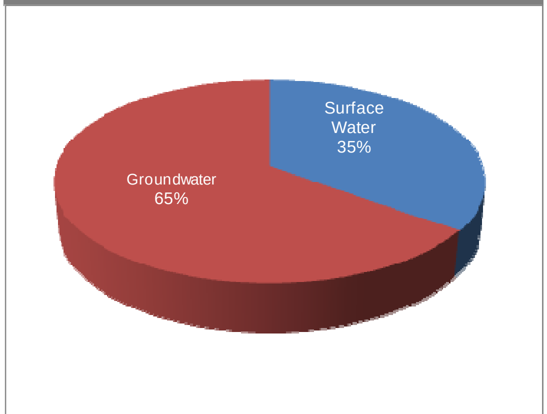


Figure 3-2:Surface Water Use by Category

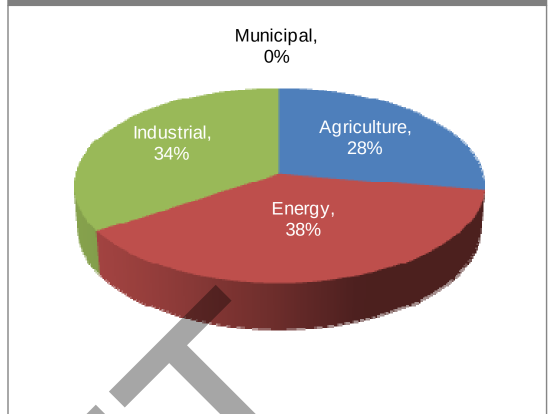


Figure 3-3:Groundwater Use by Category

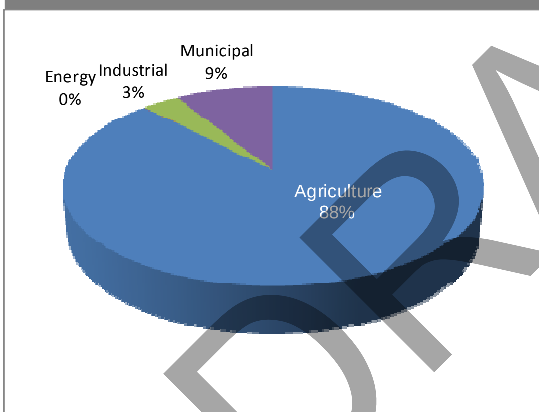
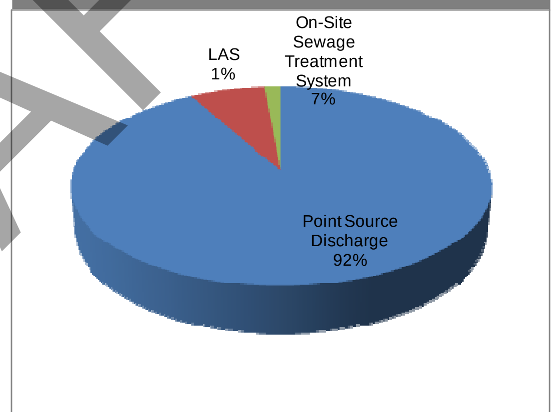


Figure 3-4:Wastewater Treatment by Category



Many members of the Lower Flint-Ochlockonee Water Council expressed concern over the model assumption that agricultural water use is 100 percent consumptive. The Council and its Technical Ad Hoc Committee discussed this issue in detail. The following points summarize their conclusions:

- The level of consumptive use by agriculture varies widely depending on field and other conditions.
- Timing of returns to the stream is important for the surface water availability model. While more water is returned over a longer period of time, for this effort, a shorter time frame must be evaluated.
- At this time, the selection of an alternative estimate of consumptive use for agriculture would be arbitrary.

Based on the recommendation of the Technical Ad Hoc committee, the Council decided to proceed based on the 100 percent consumptive use assumption for this plan. However, the Council notes concern that the assumption of 100 percent consumptive use by agriculture leads to modeling results in the Flint River basin that show a larger shortfall (at the Bainbridge node) than would occur if the assumption were less than 100 percent.The Council also notes that great improvements in agricultural water use efficiency have been made in recent years, and while efficiency gains can decrease the amount of water used, they also decrease the percentage of return flow from agriculture and thereby increase the level of consumptive use (as a percent of water withdrawn), because more water is used by the plant and unavailable to return to the hydrologic system.

3.2 Resource Assessments

For this planning process, the Georgia Environmental Protection Division (EPD) developed three resource assessments for the state's water resources: ***surface water availability, groundwater availability and surface water quality.*** These assessments estimated the capacity of streams and aquifers to meet water consumption demands and of streams to meet wastewater discharge demands, both within sustainability criteria described by EPD. The resource assessments were conducted on a resource basis (river basins and aquifers). The results of these assessments for ***current*** conditions are summarized in this section, as they relate to the Lower Flint-Ochlockonee water planning region. Section 5 describes the ***future*** conditions projected by the resource assessment models. Full details of each resource assessment can be found at the following website: http://www.georgiawaterplanning.org/pages/resource_assessments/index.php

3.2.1 Surface Water Availability

The surface water availability assessment determined the flow response of surface water streams to meeting current and forecasted future municipal, industrial, agricultural, and thermal power water consumptive uses. Flow responses were evaluated at selected points to determine the frequency and magnitude with which consumptive use caused the resulting stream flows to fall below sustainability criteria for flows established by EPD. The points of evaluation occurred at planning nodes, which are located at stream gages where the effect on stream flows of cumulative upstream consumptive uses of water (i.e., withdrawals minus returns) and authorized reservoir operations can be evaluated. Critical inputs for the model include: desired flow of the river system, expected return of treated wastewater to the system, water supply demands, and desired reliability of the water supply.

In unregulated portions of a basin, the sustainability criteria established by EPD for flows are monthly 7Q10 (lowest seven day average flow in a ten-year period) or natural inflow, whichever is lower. In regulated portions of a basin, the sustainability criteria for flows are set only where an explicit flow requirement is specified, such as by the U.S. Army Corps of Engineers. Otherwise, in regulated nodes, the ability to meet demands is evaluated relative to the availability of storage to meet demands and any downstream flow criteria.

The Flint River Basin has two unregulated nodes: Montezuma and Bainbridge. Montezuma is located in the Upper Flint Region, and Bainbridge is located in the Lower Flint-Ochlockonee Region. While Bainbridge is close to the southern boundary of the Lower Flint-Ochlockonee Region, Montezuma is not at the southern border of the Upper Flint Region. Therefore, parts of the Upper Flint Region, including all of Webster and Sumter Counties and portions of Marion, Macon, Dooly, Schley, and Crisp Counties, occur within the Bainbridge planning node.[1]

The resource assessment evaluated how water usage (and reservoir operation, where applicable) would impact water availability at the nodes if these use levels were held constant over the 1939 to 2007 period of record. It identifies the times at which a *shortfall* occurs between the resource capacity and demand. The period of record represents the longest and most complete range of historical stream flow data available in Georgia, and it was selected in order to provide a representation of the range of stream hydrology likely to be experienced throughout the planning horizon.

The results in this section concern current conditions. Current water use data used in the model was based on observed withdrawal data over the 2002 to 2007 time period. Reservoir operation data used in the model, where applicable, was that which is currently in effect for the major reservoirs.

Given ***current*** water use in the Flint River Basin, the model indicated that flows would only fall below the sustainability criteria on two days in the period of record (25,202 days) at Montezuma. At Bainbridge, however, the shortfall was much larger. Modeled flows fell below the sustainability criteria on 3,276 days in the period of record (13% of the time). The average shortfall on those days was 352 cfs (227 MGD). The maximum shortfall was 1,376 cfs (889 MGD).

The shortfall at Bainbridge is created by consumptive use of water in the Bainbridge node and by the effects of modeled diversion for storage upstream in the Montezuma node. The Council disagreed with the assumptions regarding upstream diversions and is concerned about the impact of these assumptions on public perception of the shortfall estimates. For a more complete discussion of this model assumption, see Appendix X.

The Bainbridge node results are affected by the use of both surface water and groundwater. Groundwater use with an impact on the Bainbridge node occurs in Subarea 4 of the Dougherty Plain of the Upper Floridan Aquifer, where interconnection with the surface water system is high. Subarea 4 includes the Flint

[1] A map of the planning nodes is provided in Appendix X.

River Basin south of Dooly County, part of the lower Chattahoochee River Basin, and a narrow strip on the eastern side of the Ochlockonee and Suwannee River Basins (see map in Appendix X).

In the Ochlockonee basin at Concord, flows were below the sustainability criteria 2,268 days in the period of record (9% of the time). On those days, the average shortfall was 26 cfs, and the maximum was 60 cfs. At Quincy, flows were below the sustainability criteria on 1,260 days in the period of record (5% of the time). The average shortfall on those days was 5 cfs, and the maximum shortfall was 11 cfs. Flint and Ochlockonee surface water availability assessment results are provided in Table 3-1.

Part of the Lower Flint-Ochlockonee Region falls in the Chattahoochee watershed, and water management in the region occurs in the context of the larger Apalachicola-Chattahoochee-Flint (ACF) system, and therefore, Chattahoochee conditions are reported here.[2] The Chattahoochee River Basin has several regulated nodes. In the Chattahoochee, the model results showed no shortfalls in meeting flow targets. Downstream needs for water use and flow could be met using available conservation storage in the system's reservoirs. The model results estimated that amount of conservation storage remaining when storage reached its lowest in the period of record. At that time, aggregate conservation storage in the system's major reservoirs was 40% of available conservation storage.[3] Table 3-2 provides the surface water availability assessment results for the Chattahoochee.

Table 3-1 Summary of Current Surface Water Availability Results: Flint and Ochlockonee Rivers

Node	Percent of Time Flow is Below the Sustainability Criteria	Average Shortfall (cfs)	Long-Term Average Flow (cfs)	Maximum Shortfall (cfs)	Flow Regime Target Corresponding to the Maximum Shortfall (cfs)
Montezuma	<0.01	<1 (0.6 MGD)	3,421 (2211 MGD)	1 (0.6 MGD)	593 (383 MGD)
Bainbridge	13	352 (227 MGD)	7910 (5113 MGD)	1376 (890 MGD)	2506 (1620 MGD)
Concord	9	26 (17 MGD)	1,107 (715 MGD)	60 (39 MGD)	68 (44 MGD)
Quincy	5	5 (3 MGD)	264 (171 MGD)	11 (7 MGD)	11 (7 MGD)

Source: Georgia EPD Technical Memorandum: Summary Current Resource Assessment in Apalachicola – Chattahoochee – Flint (ACF) River Basins, July 2010

[2] Results for the Suwannee, which includes portions of the Lower Flint-Ochlockonee Planning Region but which are not subject to significant use in the region, are included in Appendix X.
[3] A more complete discussion of the surface water availability model results for the Flint and Chattahoochee can be found in Appendix X.

Table 3-2: Summary of Current Surface Water Availability Results: Chattahoochee River

Node	Demand Shortage (cfs)	At-site Flow Requirement Shortage (cfs)	Minimum Reservoir Conservation Storage (acre-feet)	Minimum Percentage Reservoir Conservation Storage	Basin-wide Flow Requirement Shortage
Whitesburg	0	0	540,021	50%	None
Columbus	0	0	14,310	5%	None
Columbia	0	0	41,076	17%	None
Woodruff	0	0	652,974 at Buford, WP, & WFG	40% at Buford, WP, & WFG	None

Source: Georgia EPD Technical Memorandum: Summary Current Resource Assessment in Apalachicola – Chattahoochee – Flint (ACF) River Basins, July 2010

3.2.2 Groundwater Availability

The groundwater availability assessment estimated the sustainable yield for prioritized groundwater resources based on existing data. EPD prioritized the aquifers based on the characteristics of the aquifer, evidence of negative effects, anticipated negative impacts and other considerations.

The groundwater availability assessment estimated the sustainable yield, or the volume of groundwater that can be used without causing adverse impacts, including: limiting use of neighboring wells (drawdown), reducing flow in nearby streams (base flow), and permanent reduction of aquifer levels. Sustainable yield estimates were determined by simulating withdrawals from existing wells and, where applicable, hypothetical new wells. Results of the assessment indicate a range for sustainable yield for each assessed aquifer, as shown in Table 3-3.

A map of these aquifers is included in Appendix X. The Lower Flint-Ochlockonee Region includes the Claiborne, the Dougherty Plain of the Upper Floridan, and the South-Central Georgia Upper Floridan. The results in Table 3-3 indicate that in the Claiborne and the Dougherty Plain, current use is within or above the sustainable yield range. In the Dougherty Plain, the sustainable yield results were defined by the impact of groundwater withdrawals on surface water flows, rather than on the condition of the aquifer itself, and therefore, these results relate closely to those observed in the surface water availability assessment at the Bainbridge node. The impact of withdrawals on aquifer levels in the Dougherty Plain predicted by the model is not substantial (less than five feet).

Table 3-3 Groundwater Results for Assessed Aquifers in Lower Flint-Ochlockonee Region – Current Conditions

Aquifer	Estimated Current Groundwater Withdrawal (mgd)[1]	Sustainable Yield of Individual Aquifer (Min/Max, mgd)
Claiborne Aquifer	123-148 (190-229 cfs)	100-250 (155-387 cfs)
South-Central Georgia Upper Floridan	282-366 (436-566 cfs)	622 – 836 (962-1293 cfs)
South-Central Georgia & Eastern Coastal Plain Upper Floridan Aquifer	469-580 (726-897 cfs)	868 – 982 (1343-1519 cfs)
Upper Floridan Aquifer in the Dougherty Plain	450-587 (696-908 cfs)	237 – 328 (367-507 cfs)

Source: Georgia EPD, July 2010

1 The lower end of the range for withdrawals includes agricultural withdrawals in a moderate year, while the upper end includes agricultural water use in a dry year.

3.2.3 Surface Water Quality

The water quality assessment estimated the capacity of Georgia's surface waters to assimilate pollutants without unacceptable degradation of water quality. The term assimilative capacity refers to the ability of a water body to naturally absorb pollutants without exceeding state water quality standards or harming aquatic life.

The water quality assessment results focus on available assimilative capacity for oxygen consuming wastes (affecting dissolved oxygen), nutrients (specifically nitrogen and phosphorus) and chlorophyll-a (a green pigment found in algae; the concentration of chlorophyll a is used to assess lake water quality). Assessment of the ability to assimilate oxygen consuming wastes is important because aquatic life is dependent upon the amount of residual dissolved oxygen available in the stream.

Determining assimilative capacity is dependent on multiple parameters and requires information on the streamflow, in-stream water quality, wastewater discharges, water withdrawals, existence of land application systems, weather information, land use, stream hydrology, topography, and the state's water quality standards. Figure 3-5 shows the dissolved oxygen (DO) assessment results for current discharges given critical, low flow (7Q10), high temperature conditions. Stream segments that have no available assimilative capacity under these conditions are shown in red. Those with DO levels in excess of state water quality standards are blue. Naturally low DO waters that have DO below 5.0 mg/L in the summer will typically be in the yellow to red range.

[Placeholder for nutrient and chlorophyll a results from watershed model.]

3.3 Ecosystem Conditions and Instream Uses

3.3.1 303(d) list and TMDLs

The state of Georgia assesses its water bodies for compliance with water quality standards, as required by the federal Clean Water Act (CWA). Waters of the state are monitored by EPD, USGS, and other local authorities contracted by EPD. If an assessed water body is found not to meet standards, then it is considered “not supporting” its designated uses and it is included on a list of impaired waters. Impairments must be addressed through the development of a Total Maximum Daily Load, which sets a pollutant budget and outlines a strategy for corrective action. Several stream reaches in the Lower Flint-Ochlockonee Region are on the state’s list of impaired waters. A list of impaired waters in the region is provided in Appendix X.

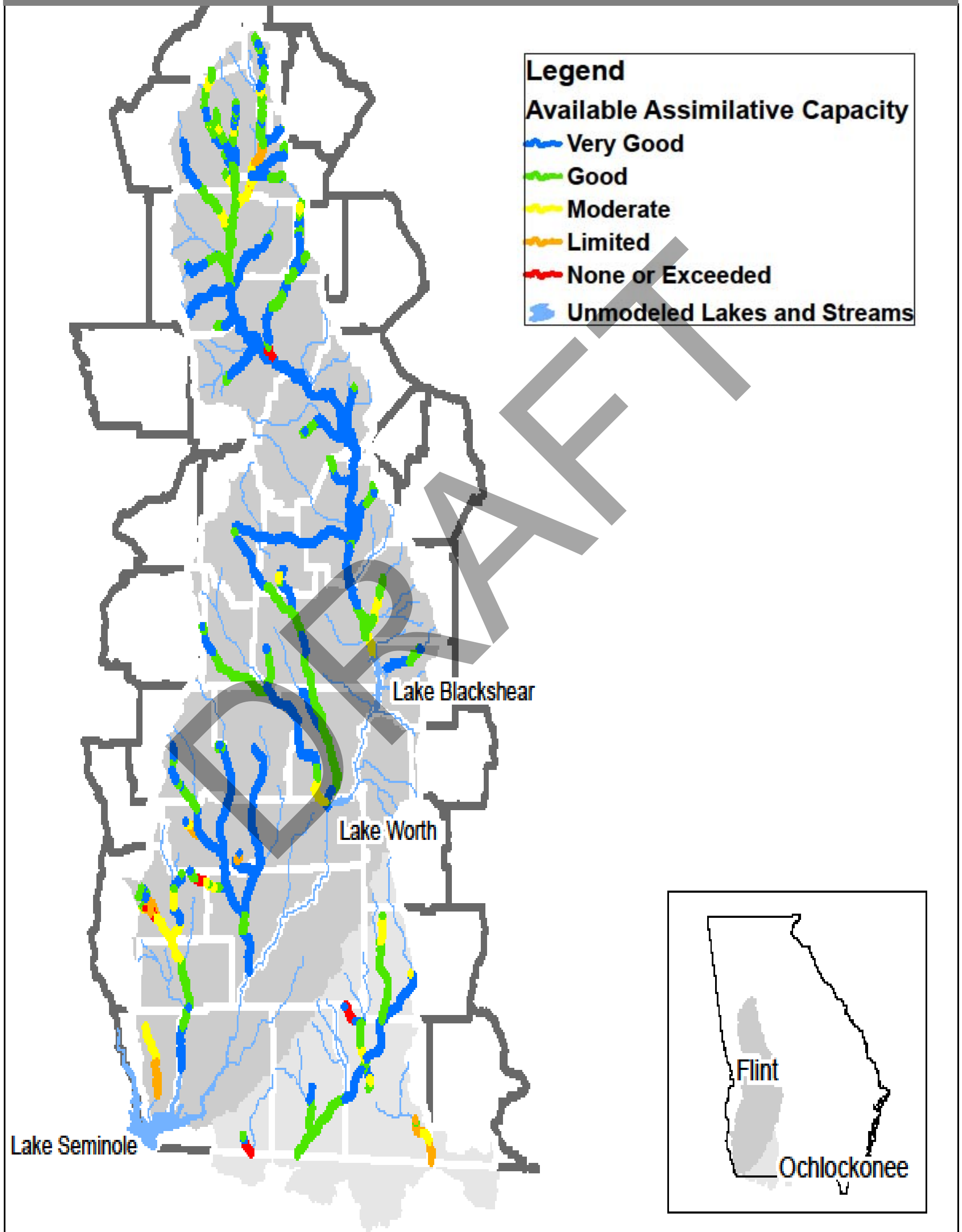
3.3.2 Wildlife and Fisheries Resources

In 2005, Georgia’s Wildlife Resources Division (WRD) published *A Comprehensive Wildlife Conservation Strategy for Georgia,* which outlines a plan “to conserve Georgia’s animals, plants, and natural habitats through proactive measures emphasizing voluntary and incentive-based programs on private lands, habitat restoration and management by public agencies and private conservation organizations, rare species survey and recovery efforts, and environmental education and public outreach activities.” The strategy divides the state into several ecoregions, and the Lower Flint-Ochlockonee Region falls within the southeastern plains ecoregion. In the southeastern plains, a total of 85 high priority animal species, 145 high priority plants species, and 27 high priority habitat types were identified. Detailed listings of critical species and habitats are available through the Georgia Department of Natural Resources.

3.3.3 Recreational Uses

The Lower Flint-Ochlockonee Region provides boaters, fishermen, and other outdoor enthusiasts with a diverse and easily accessible river environment. Lake Blackshear offers boating and fishing opportunities. The crystal blue springs of the lower part of the region are a unique recreational resource. Camping, hunting, and hiking trails are recreational options across the region. The Department of Natural Resources manages State Parks and Historic sites, Public Fishing Areas, and Wildlife Management Areas throughout the Lower Flint-Ochlockonee Region.

Figure 3-5: Available Assimilative Capacity Results from Dissolved Oxygen Assessment: Current Conditions



Georgia EPD, May 2010

SUMMARY: This section forecasts ***future*** *demands for water and wastewater treatment in the region*. Between 2010 and 2050, water demands are forecasted to increase by 13% and wastewater treatment demands are forecasted to increase by 5% in the Lower Flint-Ochlockonee Region.

Section 4. Forecasting Future Water Resource Needs

4.1. Municipal Forecasts

4.1.1. Municipal Water Forecasts

Municipal water and wastewater forecasts are based on population projections that were developed by Governor's Office of Planning and Budget (OPB). The OPB population projection results by county are shown in Appendix X. In summary, population in the Lower Flint-Ochlockonee Region is projected to increase from 374,935 in 2010 to 541,265 in 2050. This increase reflects growth of 44.4%.

The municipal water forecasts were calculated by multiplying an estimate of per capita water use by the population to be served. Estimates of per capita water use by county for the Lower Flint-Ochlockonee Region are included in Appendix X. Per capita use rates are adjusted to reflect expected water savings over time from the transition to ultra low flow toilets (1.6 gallons per flush maximum), required by federal and state laws. Additional details regarding development of the municipal water forecasts, including the per capita rate and plumbing code savings, are provided in the *Municipal and Industrial Water and Wastewater Forecasting Memorandum* (Appendix X). The resulting municipal water forecasts are shown in Appendix X. In summary, the demand for municipal water is forecasted to increase from 52 MGD (80 cfs) in 2010 to 68 MGD (105 cfs) in 2050 in the region. Of this amount, 80% is forecasted to be sourced from groundwater by municipal systems, and 20% is forecasted to be drawn from groundwater by private wells (self-supply). None is expected to be withdrawn from surface water.

4.1.2. Municipal Wastewater Forecasts

Municipal wastewater forecasts were calculated based on forecasted municipal water with adjustment for outdoor water use (not treated) and inflow and infiltration into municipal systems. Wastewater may be treated by one of three disposal systems: municipal wastewater treatment plant to point source discharge, municipal wastewater treatment to land application system, or onsite sanitary sewage system (OSSMS), also called septic systems. For the forecasts, the current mix of discharge to point source facilities versus land application systems was held proportionate to current conditions. Additional details regarding development of the municipal wastewater forecasts can be found in the *Municipal and Industrial Water and Wastewater Forecasting Memorandum* (Appendix X).

The resulting municipal wastewater forecasts for the region are provided in Appendix X. In summary, the demand for municipal wastewater treatment is forecasted to increase from 48 MGD (74 cfs) in 2010 to 62 MGD (96 cfs) in 2050 in the region. Of this amount, 4% is forecasted to be treated by land application systems, 51% by systems with point source discharges, and 45% by septic systems.

Wastewater generation forecasts allocated to central system disposal (i.e. land application and point discharges) include an inflow and infiltration (I/I) estimate of 20%, a typical value for municipal systems. (However, the increase in anticipated wastewater flows associated with I/I was not utilized in the surface water quality assessment since the model is being used as a tool to determine gaps during dry, low flow conditions.)

4.2. Industrial Forecasts

Industrial water and wastewater demand forecasts anticipate the future needs for industries in the region. Industries require water for use in their production processes, sanitation, cooling, as well as employee use and consumption. The forecasts presented in this section are based upon estimates of the rate of growth in employment for specific industrial sectors, estimates of the rate of growth in the units of production for specific industrial sectors, or other relevant information provided by specific industrial water users. The industrial demands forecasted in this section include major industrial water users and wastewater generators, many of which supply their own water and/or treat their own wastewater. Many other industrial users with lesser demands are serviced by municipal water and wastewater systems, and these demands are included in the municipal forecasts.

4.2.1. Industrial Water Forecasts

Industrial water forecasts were calculated using information and data specific to each of the major water using industries. For industries where information was available on water use per unit of production, water forecasts were based on production. For industries where product based forecasts were not possible, industry-specific workforce projections were assumed to reflect the anticipated growth in water use within the industry. A summary of the employment projections is included in Appendix X. The employment projections for the Lower Flint-Ochlockonee Region indicate that overall employment from major industrial water using industries is forecasted to increase by 25% over the 2010-2050 planning horizon.

The resulting forecasts of industrial water demands for the region are provided in Appendix X. In summary, industrial demand for water is forecasted to increase from 130 MGD (201 cfs) in 2010 to 133 MGD (206 cfs) in 2050 in the region. Of this amount, 82% is forecasted to be sourced from surface water, while 18% is forecasted to be sourced from groundwater.

4.2.3. Industrial Wastewater Forecasts

Industrial wastewater forecasts were calculated for each sector by multiplying the industrial water forecast by the ratio of wastewater generated to water used for that industrial sector. The primary mechanism for deriving the wastewater to water ratios was through a state-wide analysis of multiple years of actual annual average water return and withdrawal data for permitted users. Information provided by industrial stakeholder groups was also used to adjust ratios within a region or industry, as appropriate. Further detail regarding the industrial water and wastewater forecasts are included in the *Municipal and Industrial Water and Wastewater Forecasting Memorandum* (Appendix X). The resulting forecasts of industrial wastewater demand for the region are provided in Appendix X. In summary, industrial wastewater treatment is forecasted to increase from 127 MGD in 2010 to 129 MGD in 2050 in the region. Of this amount, 2% is forecasted to be treated by land application systems, while 98% is forecasted to be treated by systems with point source discharges.

4.3. Agricultural Forecasts

Agricultural water use forecasts, developed by the University of Georgia, provide a range of irrigation water use under dry, medium and wet climate conditions. In collaboration with industry stakeholders, the University of Georgia also forecasted water use for the nursery industry and estimated water use by golf courses with agricultural withdrawal permits. Water use by animal operations is not included in the forecasts, but the estimates of current use are included in the current agricultural use estimates in Section 3. Water use by golf courses with agricultural withdrawal permits is included in the forecasts, but use by these operations is held constant at current levels throughout the planning horizon. The agricultural water use forecast results are provided by county in Appendix X. In summary, dry year agricultural water use is forecasted to increase by 17% from 2010 to 2050. Dry year use estimates for agriculture correspond to the 75th percentile of use estimates across a range from lowest to highest use levels. An abbreviated breakdown of agricultural use by source type over the planning horizon is as follows:

- 2010 Annual Average 75th Percentile Use = 612 MGD (947 cfs)
    - Groundwater Use = 524 MGD (811 cfs)
    - Surface Water Use = 88 MGD (136 cfs)
- 2050 Annual Average 75th Percentile Use = 715 MGD (1106 cfs)
    - Groundwater Use = 609 MGD (942 cfs)
    - Surface Water Use = 106 MGD (164 cfs)

4.4. Thermoelectric Power Production Water Demand Forecasts

Estimates of future amounts of water expected to be consumed in the production of thermoelectric energy are being generated by a consultant under contract to EPD.

When available, these estimates will be factored into the appropriate resource assessments.

4.5. Total Water Demand Forecasts

In the Lower Flint-Ochlockonee Region, agricultural water use makes up the largest proportion of water use by a significant margin, and as shown in Figures 4-1 through 4-3, agriculture is forecasted to be the largest water user in the region in 2050. Recent drought years have exemplified the challenges facing the region in balancing economic viability of food and fiber production while maintaining environmental streamflows.

Figure 4-1: Water Users in 2010 and 2050 (AAD-MGD)

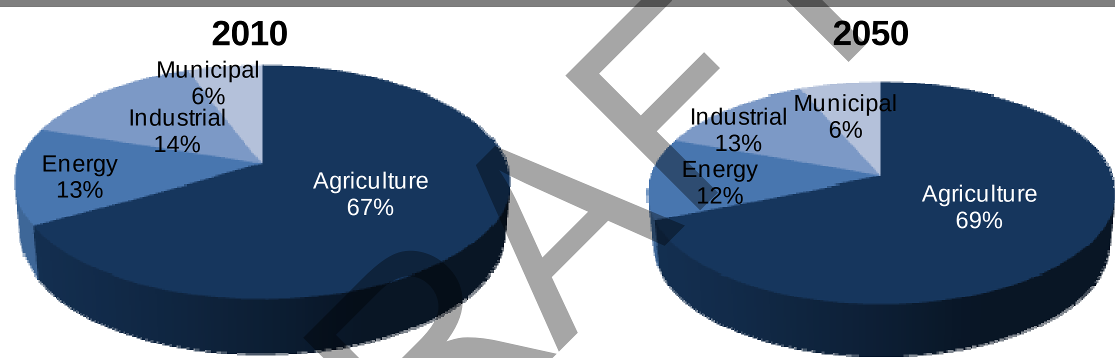
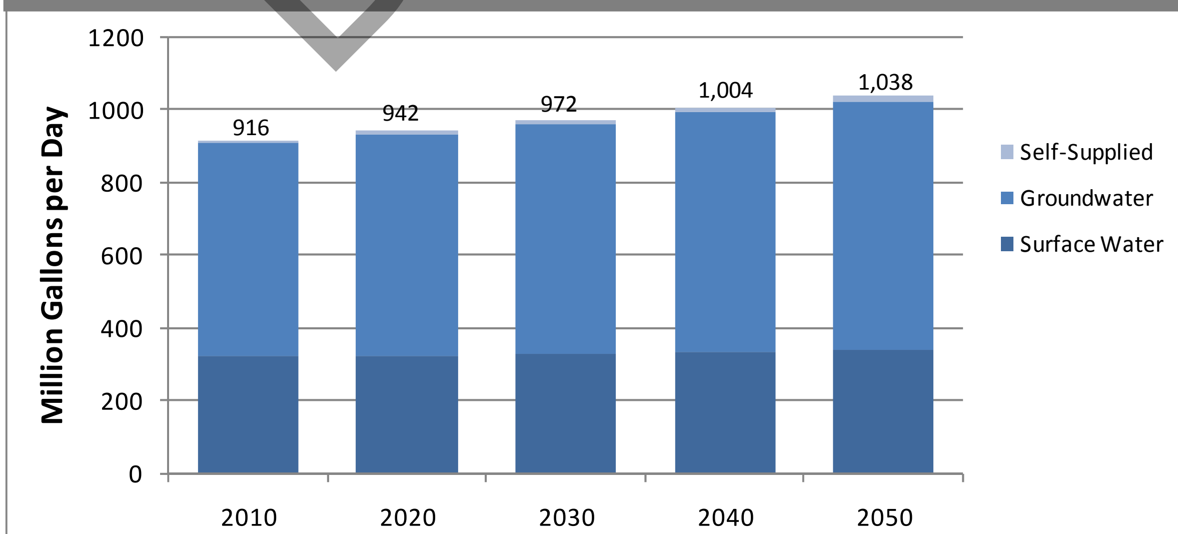
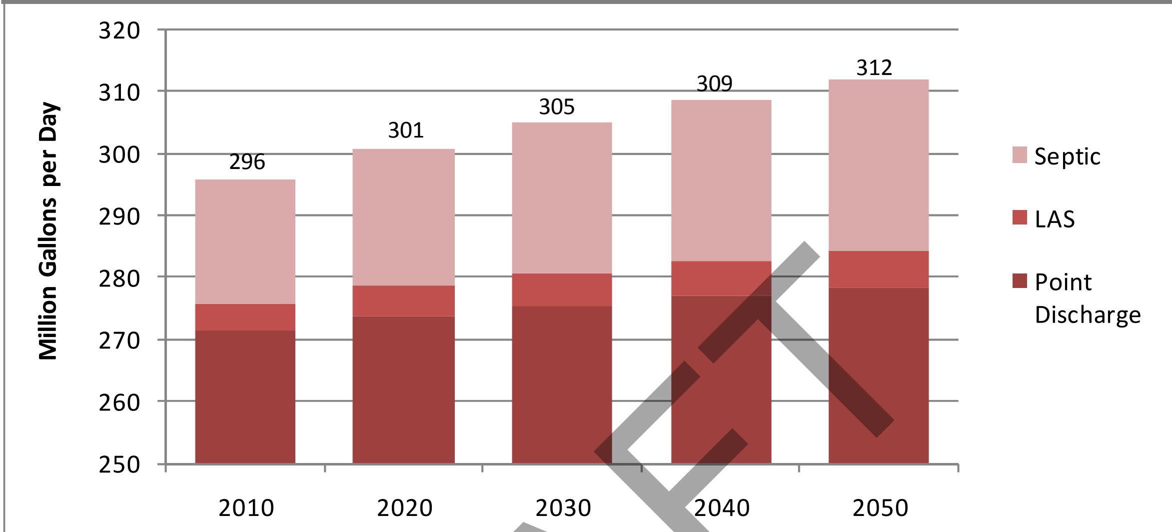


Figure 4-2: Total Water Use Forecast



Notes: Values represent forecasted annual average; Conversion of MGD to CFS is CFS=MGD * 1.5472

Figure 4-3:Total Wastewater Generation Forecast



Notes: Values represent forecasted annual average; Conversion of MGD to CFS is CFS=MGD * 1.5472

SUMMARY: This section compares water resource capacities and future demands for water and wastewater treatment in the region. It discusses how the Council considered gaps identified between needs and resource capacities.

Section 5. Comparison of Water Resource Capacities and Future Needs

This section compares forecasts of water and wastewater needs in the region (Section 4) with the capacities of the water resources. This comparison supported the Council in assessing where gaps exist between water resource needs and capacities. It provided the Council with a basis for selecting appropriate management practices (Section 6) that will help the region to meet its future water needs, protect water resources, and meet the Council's vision and goals for the region. Where gaps were identified, the Council considered the potential adverse impacts, both environmental and economic, of the gap and of closing that gap. Management practice selection was guided by the Council's understanding of such gaps in the region, as well as by the Council's vision and goals for the region (see Section 1).

5.1 Surface Water Availability Comparisons

The surface water availability assessment model described in Section 3.2.1 was run using 2050 forecasted water demands. The results for 2050 are similar to those under current demand conditions (discussed in Section 3.2.1). In the Flint, at Montezuma, EPD sustainability criteria for in-stream flows were met almost 100% of the time during the period of record used in the model under 2050 demand conditions. A significant shortfall between resource capacity and demand persists at Bainbridge in 2050. The shortfall occurs 13% of the time in the period of record, and the average shortfall on those days was 355 cfs (229 MGD). The maximum shortfall was 1,295 cfs (837 MGD). In the Ochlockonee, shortfalls in meeting EPD sustainability criteria for in-stream flows exist at Quincy and Concord under 2050 conditions, as well as current conditions. See Table 5-1. Although the gaps at the Ochlockonee nodes are much smaller in magnitude than the gap at Bainbridge, they are substantial relative to average flows at these nodes.

As noted in Section 3.2.1, part of the Lower Flint-Ochlockonee Region falls in the Chattahoochee watershed, and water management in the region occurs in the context of the larger Apalachicola-Chattahoochee-Flint (ACF) system, and therefore, Chattahoochee conditions are reported here.[1] In the Chattahoochee under 2050 demand conditions, in-stream flows do not fall short of the EPD sustainability criteria, but storage levels fall lower to meet in-stream needs and demands than under 2010 conditions. The model results estimated that amount of conservation storage remaining when storage

[1] Results for the Suwannee, which includes portions of the Lower Flint-Ochlockonee Planning Region but which is not subject to significant use in the region, are included in Appendix X.

reached its lowest in the period of record. At that time, aggregate conservation storage in the system's major reservoirs was 35% of available conservation storage (vs. 40% under 2010 demand conditions).[2] See Table 5-2.

For the Bainbridge node, the shortfall is affected both by consumptive use of surface water and by withdrawals from the Floridan Aquifer in Subarea 4 of the Dougherty Plain, where interconnection with the surface water system is high. Subarea 4 includes the Flint River Basin south of Dooly County, part of the lower Chattahoochee River Basin, and a narrow strip on the eastern side of the Ochlockonee and Suwannee River Basins. The shortfall at Bainbridge also results from modeling assumptions used to project diversion of water to reservoirs upstream (see Appendix X), with which the Council has expressed disagreement and concern (see Section 3.2.1). Net consumptive water use in the Bainbridge node is forecasted to increase by 16% between 2010 and 2050.

Table 5-1: 2050 Surface Water Availability Results: Flint and Ochlockonee Rivers

Node	Percent of Time Flow is Below the Sustainability Criteria	Average Shortfall (cfs)	Long-Term Average Flow (cfs)	Maximum Shortfall (cfs)	Flow Regime Target Corresponding to the Maximum Shortfall (cfs)
Montezuma	0%	<1 (0.6 mgd)	3409 (2203 mgd)	1 (0.6 mgd)	593 (383 mgd)
Bainbridge	13%	355 (229 mgd)	7904 (5108 mgd)	1295 (837 mgd)	2506 (1620 mgd)
Concord	10%	37 (24 mgd)	1100 (711 mgd)	86 (55 mgd)	97 (63 mgd)
Quincy	11%	8 (5 mgd)	257 (166 mgd)	20 (13 mgd)	20 (13 mgd)

Source: Georgia EPD Technical Memorandum: Summary Future (2050) Resource Assessment in Apalachicola – Chattahoochee – Flint (ACF) River Basins, July 2010 and Georgia EPD Technical Memorandum: Summary Future (2050) Resource Assessment in Ochlocknee, Suwannee, Satilla and St. Mary's (OSSS) River Basins, July 2010.

[2] A more complete discussion of the surface water availability model results for the Flint and Chattahoochee can be found in Appendix X.

Table 5-2: 2050 Surface Water Availability Results: Chattahoochee River					
Node	Demand Shortage (cfs)	At-site Flow Requirement Shortage (cfs)	Minimum Reservoir Conservation Storage (acre-feet)	Minimum Percentage Reservoir Conservation Storage	Basin-wide Flow Requirement Shortage
Whitesburg	0	0	424,998	39%	None
Columbus	0	0	14,269	5%	None
Columbia	0	0	45,770	19%	None
Woodruff	0	0	565,765 at Buford, WP, & WFG	35% at Buford, WP, & WFG	None
Source: Georgia EPD Technical Memorandum: Summary Future (2050) Resource Assessment in Apalachicola – Chattahoochee – Flint (ACF) River Basins, July 2010					

5.2 Groundwater Availability Comparisons

Section 3.2.2 discussed the groundwater resource sustainable yields and current use of assessed aquifers. A comparison of sustainable yields and forecasted 2050 demands from those aquifers is included in Table 5-1 below. The results indicate that in the Claiborne and Upper Floridan Dougherty Plain, forecasted 2050 use will be within or above the sustainable yield range for these aquifers. In the Dougherty Plain, the sustainable yield results were defined based upon the impact of groundwater withdrawals on surface water flows, rather than on the condition of the aquifer itself, and therefore, these results relate closely to those observed in the surface water availability assessment at the Bainbridge node.

5.3 Surface Water Quality Comparisons

In Section 3, Figure 3-5 shows the availability of assimilative capacity under ***current*** conditions for flow and oxygen consuming wastes that affect levels of dissolved oxygen. Forecasted wastewater flows for 2050 were compared to and found to reasonably approximate existing permitted discharge capacity. Therefore, the model was run at permitted conditions as a reasonable approximation of future increased wastewater flows being directed to the existing treatment plant discharge locations. Figure 5-1 shows the availability of assimilative capacity for these pollutants under ***permitted*** conditions (i.e., current permit limits for flow and oxygen consuming wastes). These results show where modeled conditions predict that water quality standards would be exceeded under critical conditions. It is important to note treatment plants usually operate below their permit limits (not at their limits), and future permit limits are likely to be different than current permit limits. Figure 5-1 indicates that the number of stream miles where assimilative capacity is exceeded or unavailable will increase from 9 miles

Table 5-1 Groundwater Results for Assessed Aquifers in Lower Flint-Ochlockonee Region – 2050 Conditions

Aquifer	Estimated 2050 Groundwater Withdrawal (mgd)[1]	Sustainable Yield of Individual Aquifer (Min/Max, mgd)
Claiborne Aquifer	146-174 (225-270 cfs)	100-250 (155-387 cfs)
South-Central Georgia Upper Floridan	371-471 (573-729 cfs)	622 – 836 (962-1293 cfs)
South-Central Georgia & Eastern Coastal Plain Upper Floridan Aquifer	608-739 (941-1143 cfs)	868 – 982 (1343-1519 cfs)
South-Central Georgia & Eastern Coastal Plain Upper Floridan, Claiborne, & Cretaceous Withdrawing Together	980-1160 (1517-1795 cfs)	1066-1229 (1649-1902 cfs)
Upper Floridan Aquifer in the Dougherty Plain	521-681 (806-1054 cfs)	237 – 328 (367-507 cfs)
Source: Georgia EPD, July 2010		

1 The lower end of the range includes agricultural withdrawals in a moderate year (50^{th} percentile), while the upper end includes agricultural water use in a dry year (75^{th} percentile).

under current conditions to approximately 145 miles in the Flint River basin by 2050, assuming future flows and loads equal to current permit limits. In the Ochlockonee, stream miles where assimilative capacity is exceeded or unavailable will increase from 7 miles to 9 miles over the same period and assuming future flows and loads equal to current permit limits. Water quality concerns also exist where water quality standards are violated. These impaired waters are discussed in Section 3 and mapped in Appendix X.

5.4 Summary of Potential Gaps between Resource Capacities and Future Needs

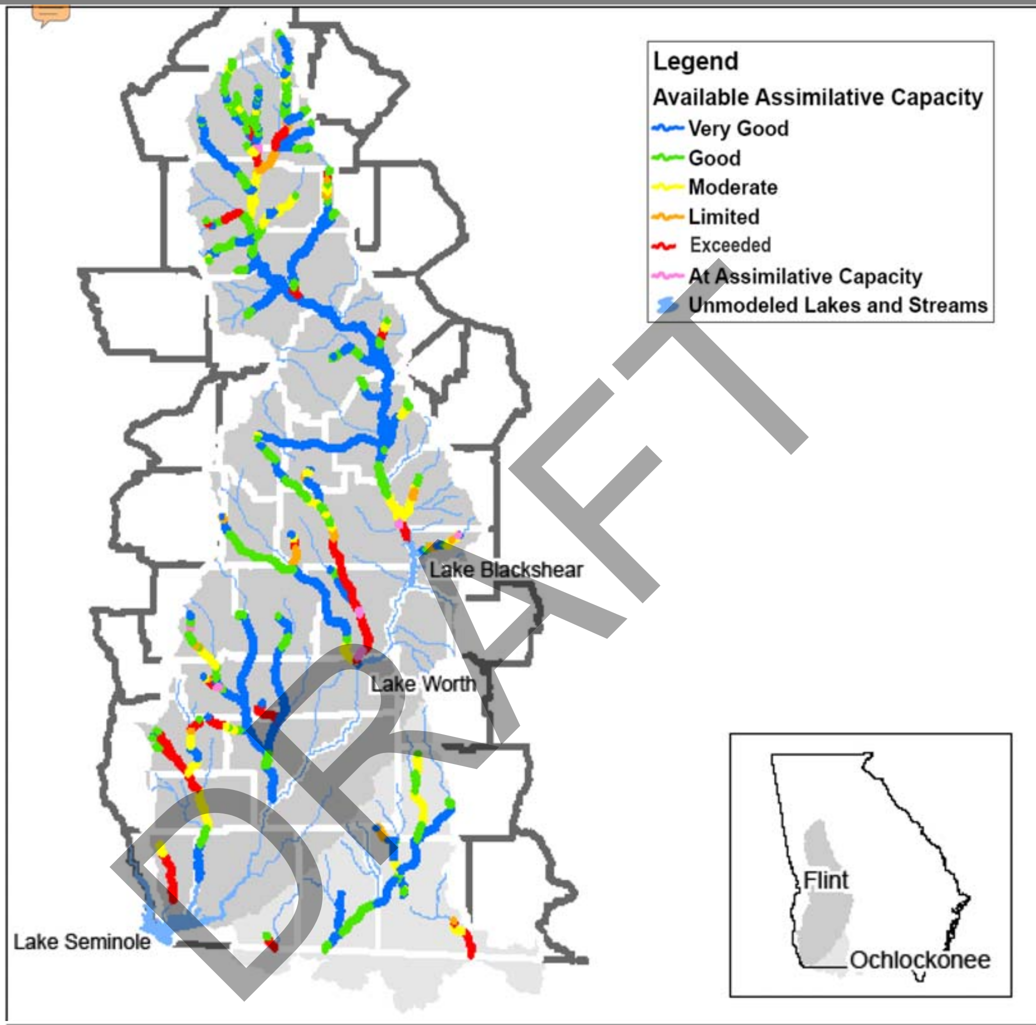
The results discussed in this section have identified the following as gaps between resource capacity and future needs from those resources:

- Shortfalls in meeting EPD's sustainability criteria for surface water flows at in the Flint at Bainbridge and in the Ochlockonee at Quincy and Concord under both current and forecasted demands.
- Groundwater use at or above the sustainable yield for the Claiborne and Upper Floridan Dougherty Plain aquifers.
- Decreasing capacity of streams to assimilate wastewater.

The Council has considered these gaps and their potential adverse impacts on the region, both environmentally and economically. In order to meet the Council's vision and goals for the region, given the results considered in this section, the Council developed the rest of this plan to address these gaps as follows:

- Surface water availability: Close the gap with conservation and supply augmentation practices as much as possible, while also collecting better information to support more thorough evaluation of the resource capacity and impacts of potential gaps on instream and downstream uses.
- Groundwater availability: The impact of groundwater withdrawals in the Dougherty Plain on surface water flows in the Flint River should be a determining factor in guiding the location and amount of groundwater use in this region. Reliance on the Claiborne aquifer should limited or restricted as necessary to protect the sustainable yield of this resource. Collect better and more geographically specific information on groundwater resource capacity, as needed to evaluate specific uses and management practices.
- Surface water quality: Implement practices targeted especially toward nonpoint source of pollutants to improve assimilative capacity in the region's streams and lakes. Also, it is expected that EPD will adjust point source permit limits over time as needed to address assimilative capacity constraints. Collect more complete information to support the targeting of management practices for water quality in the future.

Figure 5-3: Surface Water Quality (Assimilative Capacity) Comparison



Model Run	Basin	Available Assimilative Capacity (Total Mileage)				
		Very Good	Good	Moderate	Limited	None or Exceeded
Baseline	Flint	572	275	75	29	9
	Ochlockonee	47	61	12	8	7
Permitted	Flint	472	197	112	33	145
	Ochlockonee	66	34	22	4	9

Source: Council Meeting 6. EPD. 06/15/2010.

SUMMARY: This section presents the water management practices recommended by the Lower Flint-Ochlockonee Council in order to address gaps between resource needs and capacities and to fulfill the Council's vision and goals.

Section 6. Addressing Water Needs and Regional Goals

6.1. Identifying Water Management Practices

In order to select management practices for this plan, the Council considered:

1) *Existing plans and practices*: The Council conducted a comprehensive review of existing local and regional water management plans and relevant related documents to frame the selection of management practices. When possible, successful management practices already planned for and/or in use in the Region formed the basis for the water management practices selected by the Council.
2) *Gaps identified by the comparison of resource needs and resource capacities*: See Section 5.
3) *Council's Vision and Goals*: See Section 1.
4) *Results of a survey of Council members on management practices and criteria for evaluation*: The survey asked council members to rate an extensive list of management practices and to rank criteria to guide management practice selection. See Appendix X and Table 6-1 for results of the survey.
5) *Public Input*: The Council implemented a Public Involvement Plan to inform stakeholders and local government officials about the planning process and to engage them in providing input to the Council as it developed its plan (see Appendix X).

The process of selecting management practices was preceded by the following steps that formed the foundation for later planning:

- Development of vision and goals
- Review of water and wastewater demand forecasts
- Review of resource assessment results on resource capacity
- Review of existing plans, practices, and pending regulations
- Development of a comprehensive list of management practices

The comprehensive listing of management practices (See Appendix X) was developed using several documents:

- Georgia's Water Conservation and Implementation Plan (EPD, March 2010)
- Georgia Water Stewardship Act of 2010
- Manual for Erosion and Sediment Control in Georgia (GSWCC, 2000)
- Best Management Practices for Georgia Agriculture (GSWCC, 2007)
- Georgia's Best Management Practices for Forestry (GFC, 2009)

- Georgia Stormwater Management Manual (Blue Book)
- Mining Association Best Management Practices
- Nursery Best Management Practices

Management practice selection by the Council proceeded as follows:

1) Survey of council members on management practices and selection criteria
2) Creation of Water Quality and Water Quantity Committees to develop recommendations to the full council on management practices
3) Iterative development, review, and revision of Water Quality and Water Quantity "strawman" documents of management practice recommendations by the committees
4) Presentation of recommendations to the full council for consideration
5) Incorporation of Council comments
6) Incorporation of management practices into plan template

The Council's decision making process to adopt sets of recommendations was consensus-based, where possible, according to the Council's Operating Procedures and Rules for Meetings. In cases where consensus could not be reached, decisions were approved by voting.

In order to coordinate beyond the region, Council members met with representatives of neighboring councils to discuss shared resource issues on multiple occasions. In these meetings, the Council worked with its neighbors toward adoption of coordinated or complementary management practices.

The Council sought to coordinate with local governments and build support for the regional plan through implementation of the Council's Public Involvement Plan (see Appendix X). As a part of this plan, the Council provided opportunities for input from local government officials and the public at each meeting and announced and documented meetings on the Council website. Additionally, Council members worked individually to inform their own communities about the regional plan.

The Council identified several uncertainties that could impact plan implementation, including:

- Revision of the U.S. Army Corps of Engineers water control manual for the Apalachicola-Chattahoochee-Flint (ACF) basin (scheduled completion: June 2012)
- Pending EPA promulgation of final nutrient criteria for Florida's lakes and flowing waters and resulting requirements for Georgia permittees
- Potential state regulatory changes (e.g., revisions to the state dissolved oxygen standard)
- Information needs to address water quality data gaps for water bodies in the region
- Information needs regarding impacts of identified gaps between resource capacities and demands
- Information needs regarding baseline best management practices implementation in the region

- Coordination needs with other councils, particularly the Upper Flint, Middle Chattahoochee, and the Metropolitan North Georgia Water Planning District

Despite these uncertainties, the Council proceeded with plan development based on the best information currently available. The Council intends that adaptive management will be employed in future revisions of the Lower Flint-Ochlockonee Water Development and Conservation Plan to improve upon the current plan when possible and to meet the Council's vision and goals for the region.

Table 6-1: Results of Council Member Survey on Management Practices

Management Practices Most Highly Rated by Council Members			
Demand Management Practices	Supply Management Practices	Enhanced Water Quality Standards and Monitoring Practices	Enhanced Pollution management Practices
• Practices to Reduce Water Waste and Loss • Golf Course Water Conservation Management Practices and Strategies • Agricultural Water Efficiency and System Management • Drought Planning	• New Groundwater Sources • New Surface Water Storage Reservoirs • Increase Existing Surface Water Storage Reservoirs	• Groundwater Recharge Protection • Source Water Supply Protection • Actions to protect/manage source water quality and quantity	• Protect Sensitive Land • Coordinated Environmental Planning • Pollution Prevention Programs
Evaluation Criteria Ranking			
1. Economic/Financial (Capital Cost, Operation and Maintenance Cost, Life Cycle Costs) 2. Social (Public Perception, Impact on Public) 3. Technical (Efficiency, Reliability) 4. Environmental (Water Quality, Restoration of Impaired Waters)			

6.2. Selected Water Management Practices for the Lower Flint-Ochlockonee Region

The management practices selected by the Council are summarized in the following table, categorized into water quantity and water quality management practices. A discussion of the management practices follows the table.

Table 6-2: Water Management Practices Selected for the Lower Flint-Ochlockonee Water Planning Region

Management Practice	Description/Definition of Action
WATER QUANTITY	
Demand Management to Address In-Stream Flow Sustainability Criteria *Gaps Addressed: Surface Water Availability, Groundwater Availability* *Council Goals Addressed: 1, 2,3,4*	
Implement Tier 1 and 2 non-farm water conservation practices in the region	Tier 1 and 2 water Conservation practices include those required by existing law or anticipated in upcoming state rule-making: • Submittal of water conservation plans by withdrawal permittees (391-3-6-.07 and 391-3-2-.04(11) • Landscape irrigation limits (4pm to 10am), as required by Water Stewardship Act of 2010 (with exemptions) (12-5-7) • Even-odd watering restrictions for non-irrigation outdoor water uses (391-3-30) • Public car wash facility regulations, which require best management practices (391-31) • Demonstration by water withdrawal permittees of progress toward water conservation goals or water efficiency standards (State Water Plan, Section 8) • International Water Association standards and practices required for drinking water providers (Water Stewardship Act, Section 3). • Amendment of local building codes to require sub-metering in multi-tenant buildings, installation of high efficiency plumbing fixture in all new construction, and installation of high-efficiency cooling towers in new construction (Water Stewardship Act, Sections 7, 8, & 9)
Implement Tier 3 and 4 non-farm water conservation practices in the region with the support of incentive programs	• Utilize existing incentive programs to support the use of these practices.
Implement Tier 1 and 2 agricultural water conservation practices in the region	Tier 1 and 2 water Conservation practices required by existing law or anticipated in upcoming state rule-making: • Implementation of conservation requirements under the Flint River Basin Plan (2006) • Compliance with forthcoming requirement (established by Water Stewardship Act of 2010) regarding active, inactive, and unused permits.
Implement Tier 3 and 4 agricultural water conservation practices in the region with the support of incentive programs	• Incentive funding is available from the Soil and Water Conservation Districts and the Georgia Soil and Water Conservation Commission. • The Council endorses the following benchmark for this practice: ***By January 2012, all new, and by January 2020, all existing agricultural irrigation systems should have***

	application efficiencies of 80% or greater. • A focus on a desired performance outcome will support increased conservation while allowing farmers to select what practices and approach will work best for their own operations. • Practices that farmers can use to attain this benchmark include low-pressure/full-drop nozzle irrigation systems, Variable Rate Irrigation, conservation tillage, irrigation scheduling, drip irrigation, as well as other conservation measures not listed here that best suit an individual farmer's operation.
Use irrigation suspension only through implementation of the Flint River Drought Protection Act and only by voluntary means, which will require adequate funding to support implementation of the Act	• In some years, irrigation suspension may be needed in order to sustain in-stream flows in particularly dry periods. • The Council supports voluntary implementation of the Flint River Drought Protection Act through an irrigation suspension auction, when absolutely necessary in dry periods. • Adequate funding is not currently available for implementation of the Act and will be needed if implementation becomes necessary. • The Council recommends notification to farmers of irrigation suspension earlier than the March 1 drought declaration deadline.
Continue to improve agricultural water use efficiency through innovation	• Irrigation efficiency has greatly improved over the past several decades as a result of innovations in equipment and practices. • This trend is expected to continue and economic, environmental, and regulatory pressures drive further innovation in water conservation for agriculture. • While the benefits of specific innovations cannot be predicted at this time, the Council expects that the future benefits of innovation will be substantial.
Evaluate the costs and benefits of agricultural water withdrawal permit quantification in Georgia as a potential management option for the future	• Future quantification of agricultural water withdrawal permits may have some value as a long-term management option. • Quantification of permits is possible due to implementation of agricultural water use meter program. • Quantification of permits would not reduce demand directly, but would support more direct management of agricultural demand in periods of water scarcity. • Quantification of permits is a difficult initiative to implement.
Evaluate the costs and benefits of the establishing agricultural irrigation institutions in Georgia as a potential management option for the future	• Irrigation institutions, such as irrigation districts, are used in other states to support farmers in sharing resources and developing common supply infrastructure. • Such institutions can also be used to manage water demand among multiple operations and provide for flexibility in management.
Supply And Flow Augmentation to Address In-Stream Flow Sustainability Criteria *Gaps Addressed: Surface Water Availability, Groundwater Availability* *Council Goals Addressed: 1, 2,3,4*	
Evaluate streamflow augmentation via direct pumping from aquifers in order to support in-stream	• In dry periods, streamflow might be augmented through direct pumping of groundwater into surface water streams. • Several factors could limit the potential use of this practice, including: groundwater yields, water quality, cost, aquifer

flows in dry periods	impacts, and streamflow impacts of aquifer pumping. • Implementation of this practice could be beneficial, but requires thorough evaluation to ensure that adverse environmental impacts are avoided and implementation is cost-effective.
Replace surface water withdrawals with groundwater withdrawals, where site specific evaluation indicates that this practice is practical and will not harm environmental resources	• This practice could support increased in-stream flows in some places in the region. • The Council recommends that this practice be implemented with incentives. • The practice should only be used where it will not adversely impact other environmental resources, especially groundwater. • The Council recommends that for permittees that implement this practice, the affected permits will maintain their status prior to conversion; grandfathered surface water withdrawal permits would be converted to groundwater withdrawal permits with the same regulatory status as before conversion with respect to conservation requirements, seniority, and potential interruption.
Use Aquifer Storage and Recovery (ASR) as needed for future water supplies in the region, with thorough evaluation of potential impacts	• ASR could be used in the region to withdraw and store surface water during periods of high flow and provide augmentation for flows or supply in dry periods. • The feasibility of an ASR projects can vary greatly depending on location, condition of the receiving aquifer and water quality considerations. • ASR is probably best suited to provide water supply storage; its capability to provide for in-stream flow augmentation has not been directly evaluated. • The Council recognizes the need for further evaluation of specific proposals for ASR in the region on a case-by-case basis. • The Council recommends that any ASR proposal be thoroughly evaluated for its environmental and other impacts.
Continue development of farm ponds in the region through existing incentive programs	• On-farm water storage that is filled in periods of high flow can replace direct pumping from surface streams or wells during drought periods. • Impacts on flows through intercepted drainage and evaporative loss should be considered to minimize adverse impacts on surface water availability. • Incentive funding is available from the Soil and Water Conservation Districts and the Georgia Soil and Water Conservation Commission.
Do not preclude interbasin as an option for future water management in the region, as needed	• Interbasin transfer (IBT) of water can provide supply or flows to a receiving basin where water is needed. • IBTs are used in many places in Georgia at this time. • The Council urges policymakers not to preclude IBT as an option for future water management in the region, as needed and following thorough scientific evaluation. • The Council does not endorse any specific proposals for future IBTs at this time.

Evaluate reservoir storage options in the Flint River Basin that can provide for flow augmentation in dry periods	• Addressing the surface water availability gap at Bainbridge may require the addition of storage that can be used to augment flows in the Flint River Basin. • The evaluation of reservoir options for the Flint River Basin should include assessment of feasibility, siting, costs, benefits, and environmental and economic impacts.
WATER QUALITY	
Enhanced Pollution Management Practices *Gaps Addressed: Water Quality Violations* *Council Goals Addressed: 1, 4*	
Improve enforcement of existing permits and regulations and implementation of existing plans and practices	The Council recommends the following: • Improved enforcement of existing discharge permits • Improved enforcement of erosion and sediment control regulations • Support for existing management plans and practices, such as the TMDL plans for specific stream reaches to address specific parameters • Advocating for a study of methods for coordinating and applying existing state resources to comprehensively address water quality
Improve implementation of non-point source controls	The Council recommends the following: • Encourage adoption of the Georgia Stormwater Management Manual by local municipalities • Increasing implementation of best management practices throughout the region for all industries • Improving documentation of best management practices throughout the region for all industries • Advocate for an scientific assessment of agricultural BMP implementation • Encouraging delegation of erosion and sediment control review and inspection to local municipalities supported by professional engineering resources
Increased implementation of pollution prevention	• Encourage industries to utilize P2AD, UGA Department of Agriculture, and other state resources that provide pollution prevention support • Recommend that state evaluate commercially available phosphate concentrations in laundry and other retail detergents
Enhanced Water Quality Management Practices *Gaps Addressed: Water Quality Violations* *Council Goals Addressed: 1, 4*	
Improve water quality monitoring	• Provide the data for water quality improvements in the future • Increase number of collection sites • Increased monitoring frequency • Increase parameters sampled
Continue coordination and cooperation with adjacent water councils	• Continue efforts initiative in the planning process to work across Council boundaries to address shared resource concerns.
Apply coordinated state	• Coordinate implementation across agencies (regional, state,

resources to address water quality	and federal) to improve program implementation

The Council selected these management practices to apply to the whole Lower Flint-Ochlockonee water planning region. Although the region's boundaries encompass multiple surface water and groundwater resources, the Council believes that the management practices will be beneficial to all of these resources and that within the region, issues across different water resources are similar enough that the selected practices are appropriate to be applied across the whole region.

The selected management practices were adopted by the Council because they address identified gaps between resource needs and resource capacities, discussed in Section 5. The practices were also selected in order to fulfill the Council's vision and goals for the region (see Section 1). The Council has discussed the gaps identified for surface water availability and groundwater availability extensively. The model results indicate substantial gaps for these resources in the region, in the Flint and Ochlockonee River Basins and in the Upper Floridan Dougherty Plain. The identified gaps, including that in the Dougherty Plain aquifer, relate to the depletion of surface water flows in drought periods, as a result of consumptive use of surface water and groundwater in this region and neighboring regions. At many points in the period of record, the magnitude of the gap can is sufficiently large that it cannot be addressed without drastic suspension of consumptive water use or the construction of large-scale storage.

The Council requested additional modeling from EPD to determine the scale of storage that would be needed to offset the gap at the Bainbridge node identified by the surface water availability assessment. The resource assessment model was run with this objective, and it was determined that the amount of storage needed to offset flow shortfalls at Bainbridge is 162,223 acre-feet. This amount accounts only for the volume needed to offset the flow shortfall. It does not include additional volume that would be necessary (e.g., to offset evaporation, seepage, and other loss factors) or that might be added to provide for additional purposes (e.g., recreation). According to the model results, in 2007, a reservoir of 162,223 acre-feet would have been emptied completely. Furthermore, it would not have completely offset the modeled flow shortfall because of evaporation and seepage losses. Therefore, this estimate is not a design estimate for a reservoir. It does, however, indicate that a reservoir of significant size would be needed to close the Bainbridge gap.

Given the Council's vision and goals, it selected management practices to address these gaps. However, the implications of these gaps for downstream users and instream needs is not fully understood, and without a more complete understanding of severity of these impacts, the Council would violate its own vision and goals if it were to recommend complete closing of the gaps at this time. Complete closure of the gaps through consumptive use cessation would have severe economic impacts for water users in the region, especially agriculture, and construction of large-scale storage requires further evaluation to ensure environmental protection and cost-effectiveness.

As the planning process evolves, the Council recommends the development of more precise measures of the health of its water resources. This recommendation is explored further in Section 7.

SUMMARY: This section presents the Lower Flint-Ochlockonee Council's roadmap for the implementation of the water management practices identified in Section 6. Implementation actions and responsible parties are described, and schedules and costs are specified, where appropriate.

Section 7. Implementing Water Management Practices

7.1 Implementation Schedule and Roles of Responsible Parties

Table 7-1 ties the resource shortfalls and the needs specified by the Council and the corresponding management practices detailed in Table 6-2 to the parties who will implement those practices. This table also describes the timeframe for implementation and the actions required for implementation. Near-term practices are those which will be implemented or encouraged over the five year timeframe leading up to the next update of this Water Development and Conservation Plan. Long-term management practices vary in duration and scope and will require further study and development to define time requirements. As noted in Section 6, the Council selected these management practices to apply to the whole Lower Flint-Ochlockonee water planning region. Although the region's boundaries encompass multiple surface water and groundwater resources, the Council believes that the management practices will be beneficial to all of these resources and that within the region, issues across different water resources are similar enough that the selected practices are appropriate to be applied across the whole region.

7.2 Fiscal Implications of Selected Water Management Practices

Table 7-2 describes the fiscal implications of this plan. Cost estimates for implementation are included, to the extent possible based on available information. Sources of potential funding are also listed.

The availability of funding is a critical determinant in the ability of the responsible parties to successfully implement the management practices identified in this plan. In general, sources of funding for individuals, such as farmers, include investment by the individual and grants and incentive programs. Sources of funding for implementing management practices at the local government or utility level could come directly from revenues generated by water and wastewater providers, local government general funds raised through property taxes, or service fees charged by local governments to citizens. Local governments and utilities can also apply for loans and grants to finance implementation. Affected authorities and individuals in the region will be responsible for determining the best method for funding and implementing applicable management practices.

7.3 Alignment with Other Plans

The development of this plan by the Lower Flint-Ochlockonee Water Planning Council builds upon the knowledge base of previous planning efforts by state and local governments and authorities. Existing water resources related plans and information sources that were consulted include:

- Flint River Basin Regional Water Development and Conservation Plan, Georgia EPD, March 20, 2006
- Watershed Assessments and Watershed Protection Plans;
- Water Quality in Georgia 2006- 2007 (305(b)/303(d) Report)
- TMDL Implementations Plans
- Nonpoint Source Implementation Plans
- Water and sewer master plans
- Stormwater master plans
- Georgia's Water Conservation and Implementation Plan, Georgia EPD, March 2010
- Georgia Water Stewardship Act of 2010

The council also ensured alignment with other regional Water Development and Conservation Plans was achieved by participating in a series of joint meetings, especially with the Upper Flint and Middle Chattahoochee Councils. In these meetings, council members discussed shared issues relating to resource availability and quality and policy, regulatory, and funding issues. As a result of this collaboration, where possible, the councils coordinated their plans. No conflicts between these regional plans have been identified.

Alignment with the existing Flint River Basin Regional Water Development and Conservation Plan (2006) was discussed extensively by the Council throughout the planning process. While the Council recommendations will improve upon the 2006 plan, none of its recommendations conflict with that plan.

7.4 Recommendations to the State

The Lower Flint-Ochlockonee Water Planning Council has identified several recommended actions that would improve water resource management and planning in this region and that state as a whole. These include the following:

- Evaluate the environmental and other impacts of low flow conditions modeled at the Bainbridge planning node; determine a low flow criteria below which adverse ecosystem impacts are predicted.
- Improve implementation of the agricultural water withdrawal metering program of the Georgia Soil and Water Conservation Commission by:
  - Completing comprehensive installation of meters
  - Ensuring the meters are functioning properly through regular maintenance inspection
  - Increasing data collection on parameters including monthly use, crops, inputs
  - Reporting aggregate results annually to permittees and policymakers

  - o Preparing collected data in a manner that will facilitate use in future resource assessments
- Assess baseline implementation of water conservation and water quality BMPs by agricultural producers.
- Encourage the U.S. Army Corps of Engineers to reevaluate the required minimum flow requirements for maintaining healthy aquatic ecosystems below Jim Woodruff Lock and Dam in the Apalachicola River.

Table 7-1: Implementation Schedule

Management Practice	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions: Further Action to Complete Implementation and Associated Date(s)	For Long-term Actions: Further Action to Complete Implementation and Associated Date(s)	Responsible Parties
WATER QUANTITY				
Demand Management to Address In-Stream Flow Sustainability Criteria Gaps Addressed: Surface Water Availability, Groundwater Availability Council Goals Addressed: 1, 2,3,4				
Implement Tier 1 and 2 non-farm water conservation practices in the region	Complete DNR Board Rule Making for new conservation requirements by June 2011	Comply with existing and new rules by dates specified in rules	Continue implementation of existing programs (on-going)	DNR Board, EPD, Municipal Surface Water and Groundwater Withdrawal Permittees
Implement Tier 3 and 4 non-farm water conservation practices in the region with the support of incentive programs	Continue implementation of existing programs (on-going)	Continue implementation of existing programs (on-going)	Continue implementation of existing programs (on-going)	Municipal Surface Water and Groundwater Withdrawal Permittees
Implement Tier 1 and 2 agricultural water conservation practices in the region	Continue implementation of Flint River Basin Water Development and Conservation Plan (2006) and Water Stewardship Act (on-going)	Continue implementation of Flint River Basin Water Development and Conservation Plan (2006) and Water Stewardship Act (on-going)	Continue implementation of Flint River Basin Water Development and Conservation Plan (2006) and Water Stewardship Act (on-going)	EPD, Agricultural Surface Water and Groundwater Withdrawal Permittees

Table 7-1: Implementation Schedule

Management Practice	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions: Further Action to Complete Implementation and Associated Date(s)	For Long-term Actions: Further Action to Complete Implementation and Associated Date(s)	Responsible Parties
Implement Tier 3 and 4 agricultural water conservation practices in the region with the support of incentive programs	Continue implementation of existing incentive programs (on-going)	Attain benchmark: New irrigation systems should have application efficiency of 80% of greater by December 2012	Attain benchmark: Existing irrigation systems should have application efficiency of 80% of greater by December 2020	Agricultural irrigators, Georgia Soil and Water Conservation Commission, Soil and Water Conservation Districts, US Department of Agriculture Natural Resource Conservation Service
Use irrigation suspension only through implementation of the Flint River Drought Protection Act and only by voluntary means, which will require adequate funding to support implementation of the Act	Continue implementation of Flint River Drought Protection Act (on-going)	Identify funding source for voluntary suspension implementation by June 2012	Continue implementation of Flint River Drought Protection Act (on-going)	EPD, Agricultural Surface Water and Groundwater Withdrawal Permittees
Continue to improve agricultural water use efficiency through innovation	Continue research on irrigation technology and methods (on-going)	Continue research of irrigation technology and methods and adopt new technology and methods (on-going)	Continue research of irrigation technology and methods and adopt new technology and methods (on-going)	Agricultural irrigators, Georgia Soil and Water Conservation Commission, Soil and Water Conservation Districts, US Department of Agriculture Natural Resource Conservation Service, University researchers

Table 7-1: Implementation Schedule

Management Practice	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions: Further Action to Complete Implementation and Associated Date(s)	For Long-term Actions: Further Action to Complete Implementation and Associated Date(s)	Responsible Parties
Evaluate the costs and benefits of agricultural water withdrawal permit quantification in Georgia as a potential management option for the future	Initiate evaluation by December 2011	Report to Council and policymakers by December 2012	Implement per recommendations of evaluation	Council, University researchers
Evaluate the costs and benefits of the establishing agricultural irrigation institutions in Georgia as a potential management option for the future	Initiate evaluation by December 2011	Report to Council and policymakers by December 2012	Implement per recommendations of evaluation	Council, University researchers
Supply And Flow Augmentation to Address In-Stream Flow Sustainability Criteria Gaps Addressed: Surface Water Availability, Groundwater Availability. Council Goals Addressed: 1, 2,3,4				
Evaluate streamflow augmentation via direct pumping from aquifers in order to support in-stream flows in dry periods	Initiate feasibility study by December 2011	Report to Council and policymakers by December 2012	Implement per recommendations of study	Council, University researchers/consulting firms

Table 7-1: Implementation Schedule

Management Practice	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions: Further Action to Complete Implementation and Associated Date(s)	For Long-term Actions: Further Action to Complete Implementation and Associated Date(s)	Responsible Parties
Replace surface water withdrawals with groundwater withdrawals, where site specific evaluation indicates that this practice is practical and will not harm environmental resources	Initiate feasibility study by December 2011	Report to Council and policymakers by December 2012	Implement per recommendation s of study	Council, University researchers/cons ulting firms
Use Aquifer Storage and Recovery (ASR) as needed for future water supplies in the region, with thorough evaluation of potential impacts	No specific action	No specific action	Evaluate potential impacts of any ASR proposal thoroughly	EPD, Underground injection permit applicants (for ASR systems), Municipal or industrial water users that pursue ASR
Continue development of farm ponds in the region through existing incentive programs	Continue implementation of existing incentive programs (on-going)	Continue implementation of existing incentive programs (on-going)	Continue implementation of existing incentive programs (on-going)	Georgia Soil and Water Conservation Commission, Soil and Water Conservation Districts, U.S. Department of Agriculture Natural Resources Conservation Service

Table 7-1: Implementation Schedule

Management Practice	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions: Further Action to Complete Implementation and Associated Date(s)	For Long-term Actions: Further Action to Complete Implementation and Associated Date(s)	Responsible Parties
Do not preclude interbasin as an option for future water management in the region, as needed	No specific action	No specific action	No specific action	Georgia General Assembly, EPD
Evaluate reservoir storage options in the Flint River Basin that can provide for flow augmentation in dry periods	Initiate evaluation by December 2011	Report to Council and policymakers by December 2013	Implement per recommendations of study	Council, Neighboring councils, University researchers/consulting firms
WATER QUALITY				
Enhanced Pollution Management Practices. Gaps Addressed: Water Quality Violations. Council Goals Addressed: 1, 4				
Improve enforcement of existing permits and regulations and implementation of existing plans and practices	Continue implementation of existing programs (on-going); Request increased funding for enforcement; Initiate study of coordination by December 2011	Continue implementation of existing programs (on-going); report results of coordination study by December 2012; deploy additional enforcement personnel by December 2012	Continue implementation of existing programs (on-going); implement recommendations of coordination study	EPD

Table 7-1: Implementation Schedule

Management Practice	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions: Further Action to Complete Implementation and Associated Date(s)	For Long-term Actions: Further Action to Complete Implementation and Associated Date(s)	Responsible Parties
Improve implementation of non-point source controls	Continue implementation of existing programs; Initiate assessment of agricultural BMPs by June 2012	Encourage adoption of Georgia Stormwater Management Manual and delegation of erosion and sediment control review and inspection to local authorities by December 2013; report results on agricultural BMP assessment by December 2013	Continue implementation of existing programs (on-going)	Georgia Soil and Water Conservation Commission, EPD, local governments
Increase implementation of pollution prevention	Continue implementation of existing programs (on-going); initiate study of phosphate concentrations in retail detergents by June 2012	Continue implementation of existing programs (on-going); report results and implementation recommendations of study of phosphate concentrations in retail detergents by June 2013	Continue implementation of existing programs (on-going)	P2AD, UGA Agricultural Pollution Prevention Program, wastewater treatment permittees, agricultural and forestry operations

Table 7-1: Implementation Schedule

Management Practice	For All Actions: Initial Implementation Step(s) and Associated Date(s)	For Short-term Actions: Further Action to Complete Implementation and Associated Date(s)	For Long-term Actions: Further Action to Complete Implementation and Associated Date(s)	Responsible Parties
Enhanced Water Quality Management Practices. Gaps Addressed: Water Quality Violations. Council Goals Addressed: 1, 4				
Improve water quality monitoring	Develop plan for increased monitoring by June 2012	Request funding for increased monitoring; implement monitoring plan by June 2013; incorporate monitoring results into plan revision process by January 2015	Continue implementation of increased monitoring (on-going)	EPD
Continue coordination and cooperation with adjacent water councils	Continue implementation of joint council coordination (on-going)	Continue implementation of joint council coordination (on-going)	Continue implementation of joint council coordination (on-going)	Council and neighboring councils
Apply coordinated state resources to address water quality	Initiate study of opportunities for improved agency coordination by December 2011	Implement study recommendations per results	Implement study recommendations per results	EPD, Georgia Soil and Water Conservation Commission

Table 7-2: Cost Estimates for the Implementation Responsibilities

Management Practice	Identified and Other Costs	Funding Sources and Options	Notes and Sources for Costs
WATER QUANTITY			
Demand Management to Address In-Stream Flow Sustainability Criteria *Gaps Addressed: Surface Water Availability, Groundwater Availability* *Council Goals Addressed: 1, 2,3,4*			
Implement Tier 1 and 2 non-farm water conservation practices in the region	Costs vary based on practice	Water and wastewater revenues	
Implement Tier 3 and 4 non-farm water conservation practices in the region with the support of incentive programs	Costs vary based on practice	Water and wastewater revenues; incentive programs	
Implement Tier 1 and 2 agricultural water conservation practices in the region		Individual investment; incentive programs (Georgia Soil and Water Conservation Commission; Soil and Water Conservation Districts)	
Implement Tier 3 and 4 agricultural water conservation practices in the region with the support of incentive programs		Individual investment; incentive programs (Georgia Soil and Water Conservation Commission; Soil and Water Conservation Districts)	
Use irrigation suspension only through implementation of the Flint River Drought Protection Act and only by voluntary means, which will require adequate funding to support implementation of the Act	$15-20 million for voluntary irrigation suspension in one year		
Continue to improve agricultural water use efficiency through	Unknown	Individual investment; incentive programs (Georgia Soil and	

innovation		Water Conservation Commission; Soil and Water Conservation Districts)	
Evaluate the costs and benefits of agricultural water withdrawal permit quantification in Georgia as a potential management option for the future	$500,000	Federal or state research funding	
Evaluate the costs and benefits of the establishing agricultural irrigation institutions in Georgia as a potential management option for the future	$250,000	Federal or state research funding	
SUPPLY AND FLOW AUGMENTATION TO ADDRESS IN-STREAM FLOW SUSTAINABILITY CRITERIA *GAPS ADDRESSED: SURFACE WATER AVAILABILITY, GROUNDWATER AVAILABILITY* *COUNCIL GOALS ADDRESSED: 1, 2,3,4*			
Evaluate streamflow augmentation via direct pumping from aquifers in order to support in-stream flows in dry periods	$500,000	Federal or state research funding	
Replace surface water withdrawals with groundwater withdrawals, where site specific evaluation indicates that this practice is practical and will not harm environmental resources	$50,000-$100,000 per well	Individual investment; incentive programs (Georgia Soil and Water Conservation Commission; Soil and Water Conservation Districts)	
Use Aquifer Storage and Recovery (ASR) as needed for future water supplies in the region, with thorough evaluation of potential impacts	Add ASR costs from feas study		
Continue development of farm ponds in the region through existing	Add pond costs from NRCS		

incentive programs			
Do not preclude interbasin as an option for future water management in the region, as needed	No specific costs		
Evaluate reservoir storage options in the Flint River Basin that can provide for flow augmentation in dry periods	$1,000,000 (??)		
WATER QUALITY			
ENHANCED POLLUTION MANAGEMENT PRACTICES GAPS ADDRESSED: WATER QUALITY VIOLATIONS COUNCIL GOALS ADDRESSED: 1, 4			
Improve enforcement of existing permits and regulations and implementation of existing plans and practices			
Improve implementation of non-point source controls			
Increased implementation of pollution prevention			
ENHANCED WATER QUALITY MANAGEMENT PRACTICES GAPS ADDRESSED: WATER QUALITY VIOLATIONS COUNCIL GOALS ADDRESSED: 1, 4			
Improve water quality monitoring			
Continue coordination and cooperation with adjacent water councils			
Apply coordinated state resources to address water quality			

SUMMARY: This section presents benchmarks for evaluation of implementation of this Water Development and Conservation Plan.

Section 8. Monitoring and Reporting Progress

8.1 Benchmarks

The benchmarks prepared by the Lower Flint-Ochlockonee Council and listed in Table 8-1 below will be used to assess the effectiveness of this plan's implementation and identify required revisions. As detailed below, the Council selected both qualitative and quantitative benchmarks that will be used to assess whether the water management practices are closing identified gaps between resource capacity and demand over time and allowing the water planning region to meet its vision and goals. The benchmarks will be used to evaluate the effectiveness of this plan at the next 5-year plan review.

Table 8-1: Benchmarks for Water Management Plans

Management Practice	Benchmark	Measurement Tools	Time Period
Implement Tier 1 and 2 non-farm water conservation practices in the region	Compliance with permit requirements	Progress reporting required for permittees	Annual
Implement Tier 3 and 4 non-farm water conservation practices in the region with the support of incentive programs			
Implement Tier 1 and 2 agricultural water conservation practices in the region	Compliance with permit requirements	Permit enforcement actions	On-going
Implement Tier 3 and 4 agricultural water conservation practices in the region with the support of incentive programs	New irrigation systems should have application efficiency of 80% of greater by December 2012; existing irrigation systems should have application efficiency of 80% by 2020	Incentive program implementation reporting; NRCS/Extension agent estimates	Annual
Use irrigation	Implementation as	Drought declaration,	As needed

suspension only through implementation of the Flint River Drought Protection Act and only by voluntary means, which will require adequate funding to support implementation of the Act	needed	irrigation suspension auction results, availability of funding	dependent on climatic conditions
Continue to improve agricultural water use efficiency through innovation			
Evaluate the costs and benefits of agricultural water withdrawal permit quantification in Georgia as a potential management option for the future	Completion of evaluation; implementation of recommendations	Final report of study; post-study evaluation of implementation	Evaluation complete by December 2012
Evaluate the costs and benefits of the establishing agricultural irrigation institutions in Georgia as a potential management option for the future	Completion of evaluation; implementation of recommendations	Final report of study; post-study evaluation of implementation	Evaluation complete by December 2012
Evaluate streamflow augmentation via direct pumping from aquifers in order to support in-stream flows in dry periods	Completion of evaluation; implementation of recommendations	Final report of study; post-study evaluation of implementation	Evaluation complete by December 2012
Replace surface water withdrawals with groundwater withdrawals, where site specific evaluation indicates that this practice is practical and will not harm environmental resources	Number of withdrawal conversions; evaluation of groundwater impacts		Evaluation complete by December 2012
Use Aquifer Storage and Recovery (ASR) as needed for future			

water supplies in the region, with thorough evaluation of potential impacts			
Continue development of farm ponds in the region through existing incentive programs	Number of farm ponds constructed	Incentive program implementation reporting (Georgia Soil and Water Conservation Commission, Soil and Water Conservation Districts)	Annual
Do not preclude interbasin as an option for future water management in the region, as needed	No adoption of new policies that prohibit IBTs	State policy	On-going
Evaluate reservoir storage options in the Flint River Basin that can provide for flow augmentation in dry periods	Completion of feasibility study; implementation of recommendations	Feasibility study; reservoir permitting and construction	
Improve enforcement of existing permits and regulations and implementation of existing plans and practices	Increase in enforcement inspections; de-listing of impaired streams	Enforcement inspection reporting; 303d/305b report	Annual for inspections activity; triennial for impaired streams listing
Improve implementation of non-point source controls	De-listing of impaired streams	303d/305b report	Triennial
Increased implementation of pollution prevention	Increased implementation of pollution prevention practices	Level of participation in state pollution prevention programs	Annually
Improve water quality monitoring	Increased availability of monitoring results that can be used in planning		2014 (prior to next planning iteration)
Continue coordination and cooperation with adjacent water councils	Coordination of recommendations and implementation	Joint meetings; review of plans for conflicts	On-going
Apply coordinated state resources to address water quality	Coordination of efforts among state agencies	Results of study of coordination	December 2011

8.2 Plan Updates

Meeting current and future water needs will require periodic review and revision of this plan. The State Water Plan and associated rules provide that each Regional Water Development and Conservation Plan will be subject to review by the appropriate Regional Water Planning Council every five years and in accordance with this guidance provided by the Director, unless otherwise required by the Director for earlier review. These reviews and updates will allow an opportunity to adapt this plan based on changed circumstances and new information arising in the five years after EPD's adoption of these plans. These benchmarks will guide EPD in the review of this Water Development and Conservation Plan.

8.3 Plan Amendments

{Language TBD -- Councils may provide recommend language here e.g. "triggering events" to the degree the Council has discussed and has opinions on this topic.}