Lower Flint-Ochlockonee Water Planning Region: Water and Wastewater Forecasting Technical Memorandum

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[1]I. INTRODUCTION

Current and future (2050) water and wastewater forecasts were developed as part of the Lower Flint-Ochlockonee Regional Water Plan, which was adopted in 2011. These forecasts are referred to as "previous" or "former" forecasts in this Technical Memorandum. As part of the 5-year review and revision of that plan required by the State Water Plan, these forecasts have been updated. The revised forecasts are referred to as "updated" or "revised" forecasts. This Technical Memorandum describes how the original forecasts have been updated to account for changes in population and water use that have occurred since the original forecasts were produced.

The basic approach to updating the forecasts starts with the same methodology used in developing the original forecasts, which is described in various technical memoranda from the previous round of forecasting[1]. Those memoranda were included as supplemental material to the 2011 Lower Flint-Ochlockonee Regional Water Plan. The purpose of this Technical Memorandum is to describe where modifications to the original forecast methodology were made to prepare the updated forecasts, and to present the results of the updated forecasts. These include the incorporation of specific input from the Council as necessary.

The basic methodology for forecasting water demand is to estimate demand separately for each major water use sector. For each sector, water demand is estimated using a 'driver' multiplied by the 'rate of use'. The driver is defined as a countable unit that can be projected in future years, such as number of people, number of employees in a business, acres irrigated or megawatts of power generated. The rate of use is defined as the quantity of water used by the driving unit per unit of time, such as gallons per person per day, gallons per day per acre, or gallons per megawatt produced.

The planning process examines and forecasts water demand for four major sectors:

[1] See "Municipal and Industrial Water and Wastewater Forecasting Memorandum," dated July 1, 2010; "Statewide Energy Sector Water Demand Forecast" Technical Memorandum, dated October 29, 2010; and Agricultural Water Use forecast prepared by Dr. Jim Hook et al. (information available at http://www.georgiawaterplanning.org/).

- **Municipal** – this sector includes domestic, commercial, and industries served by municipal utilities.
- **Industrial** – this sector includes separately permitted industries.
- **Agricultural** – this sector includes major crops such as cotton, corn, peanuts, soybean, pecans, specialty crops, and nursery and horticulture; a snapshot of major livestock water use and golf course water use.
- **Energy** – this sector includes thermoelectric power generation.

II. POPULATION FORECASTS

The 2011 Regional Water Plan incorporated population projections through the year 2050 that were prepared by UGA's Carl Vinson Institute of Government on behalf of the Governor's Office of Planning and Budget (OPB). These population projections were used as a basis for municipal water demand forecasting.

Updated population projections were provided by Georgia OPB for use in the 5-year review and revision of the Regional Water Plan. These projections were developed for all counties within the state through 2050 and were released in 2015. These projections take into account 2010 U.S. Census Bureau information and updated information on natural increase and net migration. Overall, the updated population projections show less growth than the projections used in the development of the 2011 Regional Water Plan. Figure 1 shows the statewide change in the revised population projections compared to the projections utilized in the previous round of planning.

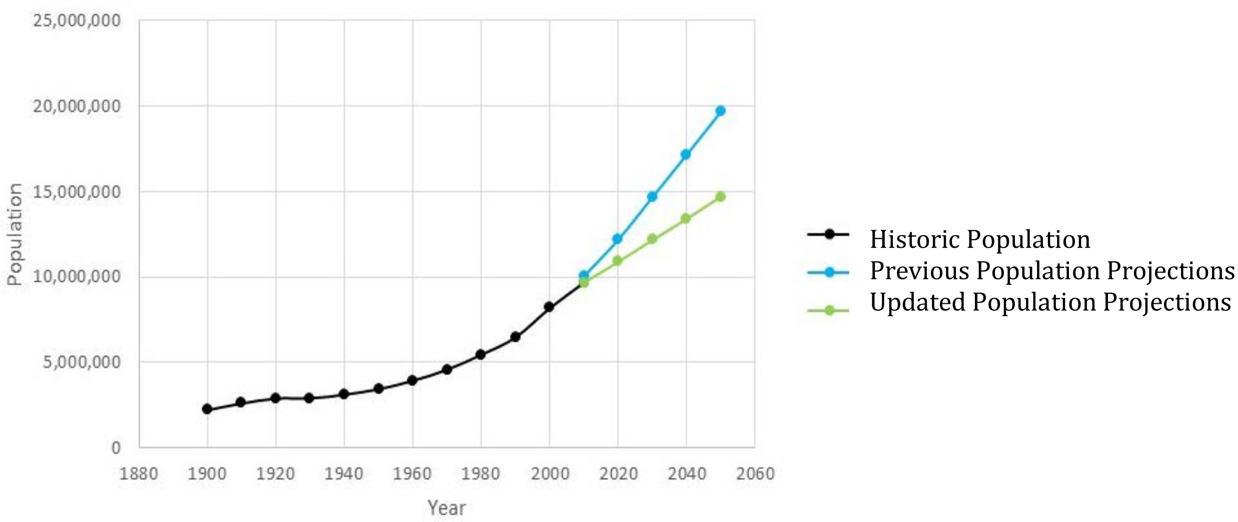

Figure 1. Previous vs. Updated Statewide Population Projections

Projected trends varied on a county-by-county basis, but the overall projections for the Lower-Flint Ochlockonee Council showed a 28% decrease in the 2050 projections from the previous projections. Figure 2 graphically illustrates this trend.

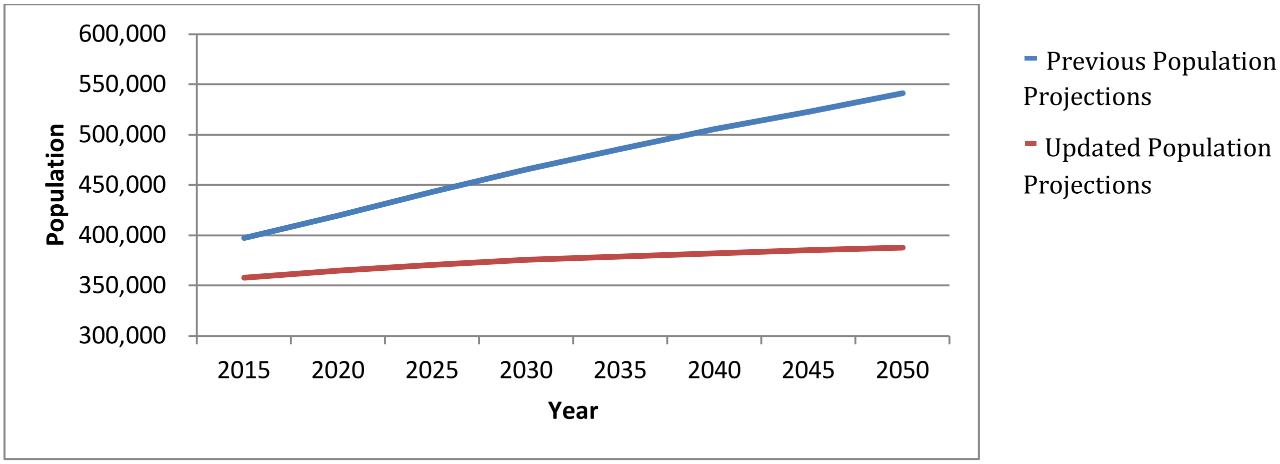

Figure 2. Previous vs. Updated Lower Flint-Ochlockonee Population Projections

Table 1 displays the revised population projections for each planning year through 2050 for each county within the Lower Flint-Ochlockonee Water Planning Council, as well as the total Council projections.

Table 1. Lower Flint-Ochlockonee Population Projections By County

County	2015	2020	2030	2040	2050
Baker	3,244	3,010	2,588	2,166	1,785
Calhoun	6,503	6,462	6,428	6,394	6,507
Colquitt	47,235	49,565	53,960	58,448	63,355
Decatur	27,566	28,029	28,470	28,258	27,730
Dougherty	93,142	93,385	92,825	90,944	88,575
Early	10,488	10,325	9,772	9,051	8,327
Grady	25,694	26,700	28,443	29,859	31,360
Lee	30,113	32,775	38,323	43,723	49,757
Miller	5,928	5,890	5,681	5,330	4,865
Mitchell	23,076	23,116	22,768	21,855	20,848
Seminole	8,951	8,961	8,893	8,657	8,514
Terrell	8,926	8,652	7,859	6,780	5,638
Thomas	45,517	47,067	49,596	51,402	52,910
Worth	21,236	21,054	20,287	19,045	17,730
TOTAL	**357,619**	**364,992**	**375,894**	**381,911**	**387,904**

III. MUNICIPAL WATER NEEDS FORECASTING

Municipal water includes uses for residential, commercial, and industrial purposes, and may be supplied by either a public or private supplier. For the previous publicly-supplied demand forecasts, preliminary per capita water use rates were calculated using the publicly-supplied water quantity and estimated population served for 2005 based on the USGS publication, "Water Use in Georgia by County for 2005 and Water-Use Trends for 1980-2005", by Fanning, J.L. and Trent, V.P. (2009). Modifications were made on a county by county basis where deemed necessary using Council feedback and additional data received. The 2009 USGS publication used a self-supplied per capita water use rate of 75 gpcd based on a Georgia Water Use Program (GWUP) conducted survey and study to estimate the self-supplied domestic water use for 2005 in Georgia.

The per capita water use rates were adjusted over the planning horizon to account for plumbing code efficiency savings. The number and mix of toilets were estimated by county using available census housing information. An estimate of a 2% change over per year of higher volume flush toilets to low volume flush toilets was assumed for the duration of the planning period. Water demand forecasts were calculated by multiplying population projections by this adjusted per capita water use rate by county for each projection year.

Adjustment of Per Capita Water Use

To obtain the per capita water use by county for the updated forecasts, GA EPD reviewed withdrawal data and estimated population served data reported to EPD by permitted municipal water systems. GA EPD then calculated adjustment factors for each county's per capita water use rate.

For each county, a per capita value for each year 2010-2014 was calculated based on actual withdrawal and estimated population served data for that county. The percent rate of change was calculated for each year interval (2010 to 2011, 2011 to 2012, 2012 to 2013, 2013 to 2014), and the average of those four values was calculated as the per capita water use adjustment factor. This adjustment factor for each county was then applied to the former per capita water use value. A summary of these adjustments can be found in Table 2.

Table 2. Per Capita Demand Values by County, gpcd

County	Former Per Capita Value	2015 Adjustment Factor	Adjusted Per Capita Value
Baker	129	3.0%	133
Calhoun	151	-4.6%	144
Colquitt	158	-3.5%	153
Decatur	199	-6.1%	187
Dougherty	181	-4.1%	173
Early	277	-0.1%	277
Grady	143	2.9%	147
Lee	119	-1.6%	117

Miller[1]	282	8.9%	145
Mitchell	172	1.4%	175
Seminole	159	-3.0%	154
Terrell	176	3.7%	183
Thomas	171	-0.7%	170
Worth	133	7.1%	142

[1]Miller County's per capita value was manually adjusted for the update to account for major changes based on 2014 demand and service population data provided.

Plumbing Code Water Efficiency Adjustment

The per capita water use rates were adjusted for plumbing efficiency savings. The adjustment was zero in 2015; the adjustment factor was applied in all future planning years to reflect the replacement of existing toilets with more efficient toilets over time. This updated per capita value with plumbing code savings was used to obtain water demand forecasts through 2050. Table 3 summarizes the adjusted per capita values by county through 2050.

Table 3. Per Capita Water Demand Values by County Adjusted for Plumbing Code Savings, gpcd

County	2015	2020	2025	2030	2035	2040	2045	2050
Baker	133	132	131	129	128	127	126	124
Calhoun	144	143	141	140	138	137	136	134
Colquitt	153	151	150	149	147	146	145	143
Decatur	187	186	185	184	182	181	180	179
Dougherty	173	172	171	169	168	166	165	164
Early	277	275	274	273	271	270	269	267
Grady	147	146	144	143	142	141	139	138
Lee	117	117	116	115	114	113	113	112
Miller	145	144	142	141	139	138	136	135
Mitchell	175	174	172	171	170	169	167	166
Seminole	154	153	151	150	149	147	146	144
Terrell	183	182	180	179	178	176	175	173
Thomas	170	169	167	166	165	163	162	161
Worth	142	141	140	138	137	136	134	133

The per capita water use rate for self-supplied customers (75 gpcd) was determined to be acceptable for use in the updated forecasting efforts. This rate and the updated population projections were used to estimate the self-supplied residential/commercial water demand.

Public vs. Self-Supply

The total municipal water demands represent the sum of the publicly-supplied and self-supplied water needs for each county. The percentage of the population within each county that uses self-supplied water is retained from the previous forecasting effort. This ratio value was obtained from the 2005 USGS report and evaluated by the Council during the previous plan review process. Figure 3 graphically displays the split between publicly-supplied and self-supplied demands for the Council.

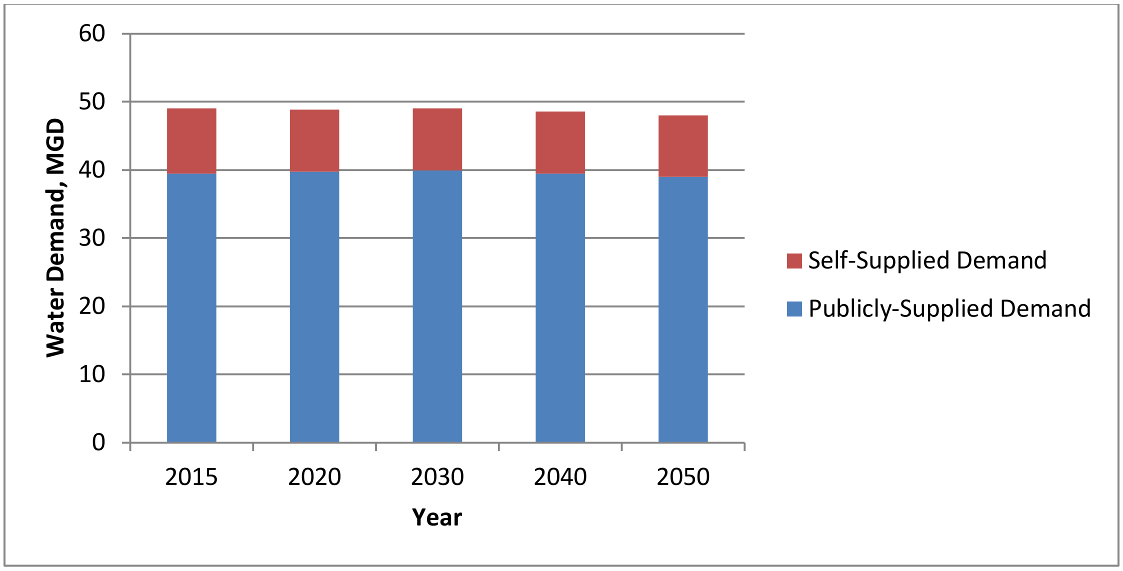

Figure 3. Publicly-Supplied vs. Self-Supplied Water Demand Projections

Additional Considerations

It is recognized that in many parts of Georgia, transient populations due to university education, military installations, or seasonal tourism can have a significant effect on water use rates. These transient and seasonal demands are embedded within historical use data and/or are accounted for by the OPB population projections used to prepare the forecasted demands. Council specific inputs were incorporated during the 2011 forecasting effort where new industry or growth patterns were believed to deviate from historical trend. These inputs were retained in the forecast updates through utilization of the previous per capita values as a base. Additional Council input was incorporated where appropriate to reflect significant changes on existing or future expected use.

2016 Municipal Water Demand Forecast Results

Table 4 shows the total annual average municipal water demand projections by county, including publicly-supplied and self-supplied demands.

Table 4. Total Municipal Water Demand Projections by County, MGD

County	2015	2020	2030	2040	2050
Baker	0.32	0.26	0.22	0.17	0.14
Calhoun	0.87	0.86	0.84	0.82	0.81
Colquitt	5.55	5.78	6.15	6.50	6.88
Decatur	3.69	3.65	3.64	3.54	3.40
Dougherty	15.80	15.70	15.34	14.78	14.14
Early	1.90	1.81	1.69	1.54	1.40
Grady	2.91	2.99	3.11	3.19	3.27
Lee	3.11	3.11	3.58	4.01	4.49
Miller	0.62	0.60	0.56	0.51	0.45
Mitchell	3.03	2.95	2.85	2.68	2.50
Seminole	0.99	0.96	0.93	0.88	0.85
Terrell	1.38	1.30	1.16	0.98	0.80
Thomas	6.58	6.71	6.94	7.06	7.13
Worth	2.27	2.20	2.07	1.89	1.72
TOTAL	**49.02**	**48.88**	**49.07**	**48.56**	**47.99**

Figure 4 graphically displays the Council's total water demand projections for each planning year in comparison with the previous projections. Overall, the municipal forecast is lower than the previous forecast due to lower population projections and per capita water use values.

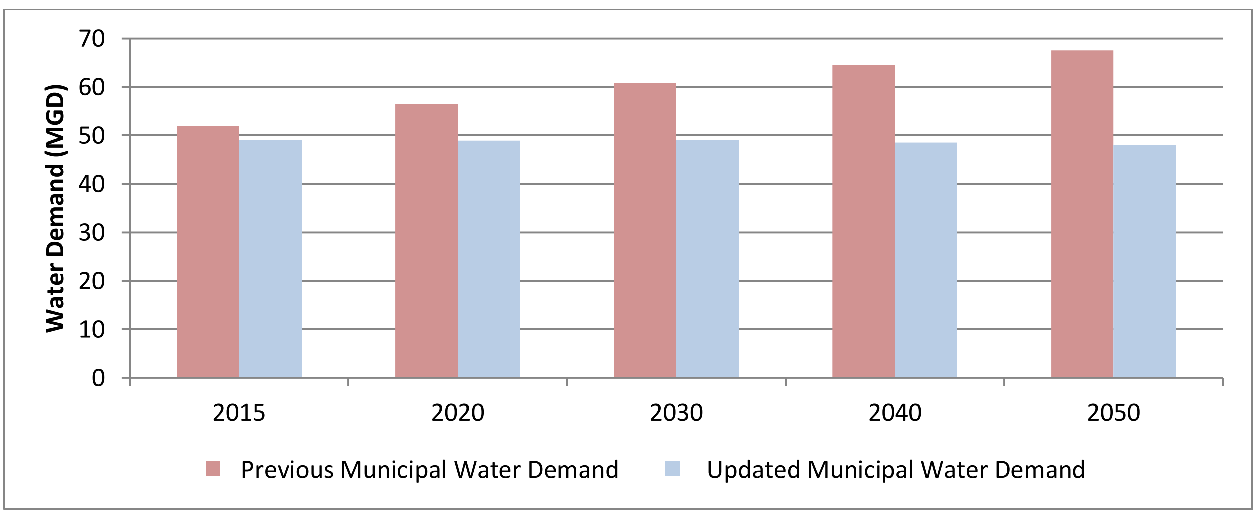

Figure 4. Lower Flint-Ochlockonee Previous vs. Updated Municipal Water Demand Comparison

Forecast Allocation

The geographical representation of water withdrawal, either from groundwater or surface water was determined using updated EPD permit information, including water use data, and input from water suppliers in some instances. The withdrawal quantities and locations were related to the

2014 historical data provided by GA EPD. The public supply water demands were assigned proportionally based on 2014 distribution of surface watersheds or groundwater sources to generate this forecast. Figure 5 shows the delineation of water planning regions and watershed boundaries, while Figure 6 shows water planning regions with aquifers. Figure 7 is a map that displays Georgia's river basins, along with the nodes that are consistent with the River Basin Planning Tool used for the Surface Water Availability Assessment.

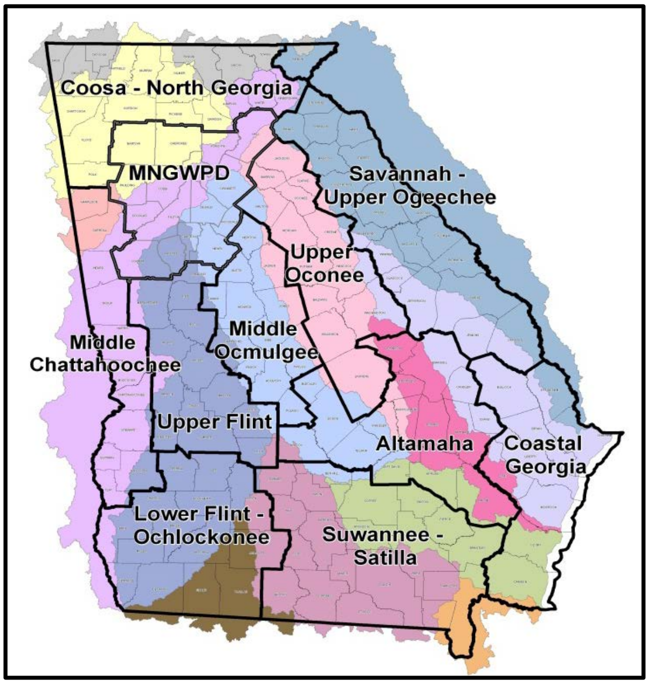

Figure 5. Delineation of Water Planning Regions (Bold Lines) and Watershed Boundaries (Colors)

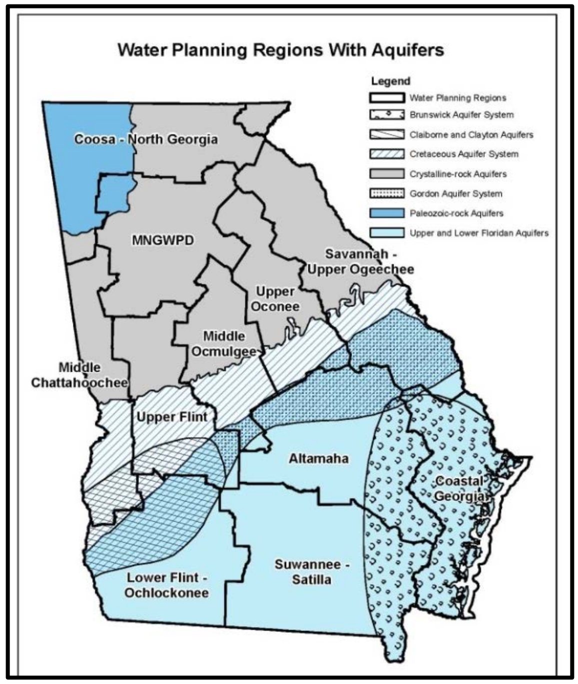

Figure 6. Water Planning Regions with Aquifers

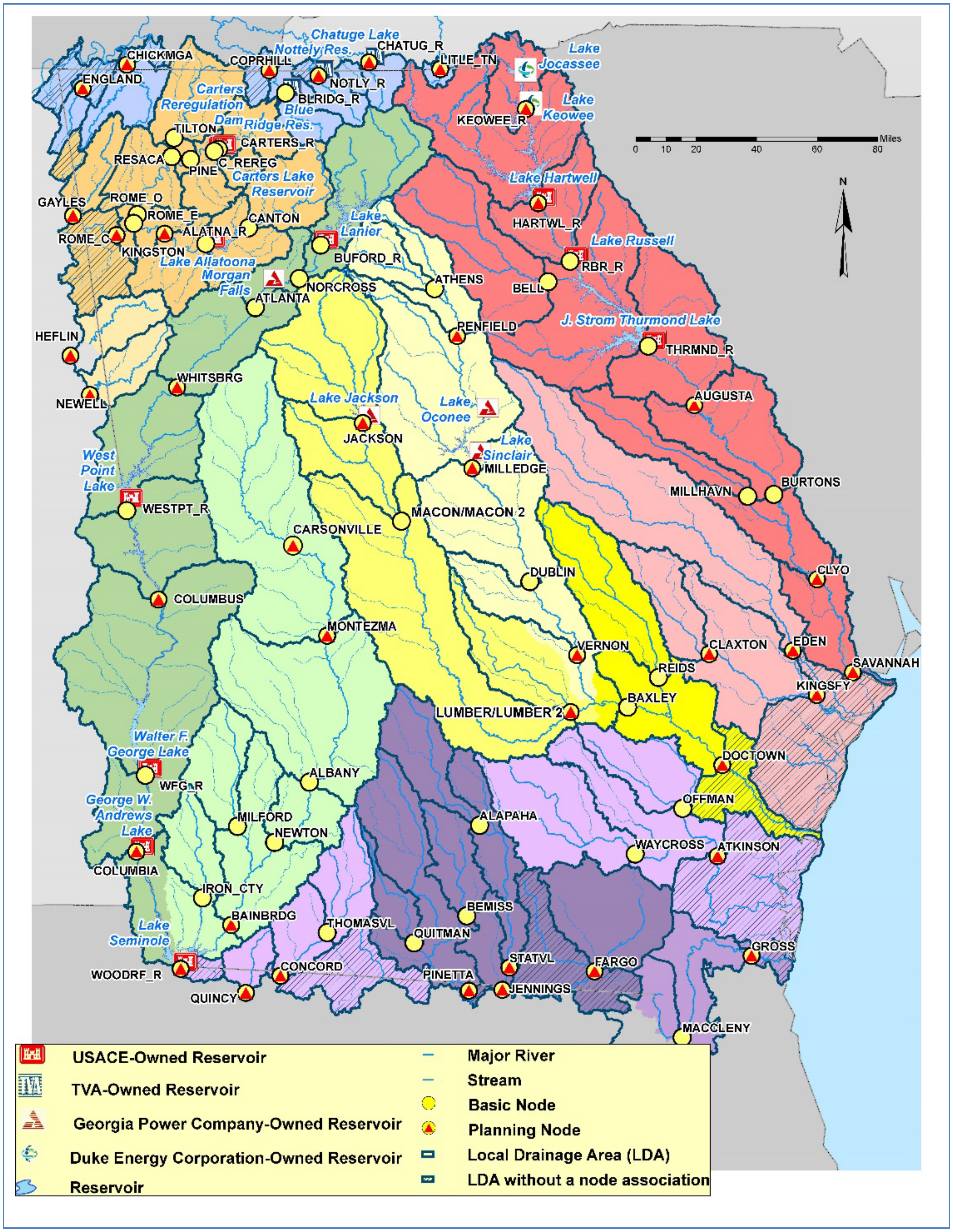

Figure 7. River Basin Map with Nodes

The municipal water demand forecasts were allocated between surface water nodes and groundwater aquifers for analysis. The allocation retains the same proportions as the previous forecasts. The distribution of locations for projected withdrawals is graphically displayed in Figure 8. The majority of municipal water demands in the region are from the Floridan and Claiborne aquifers.

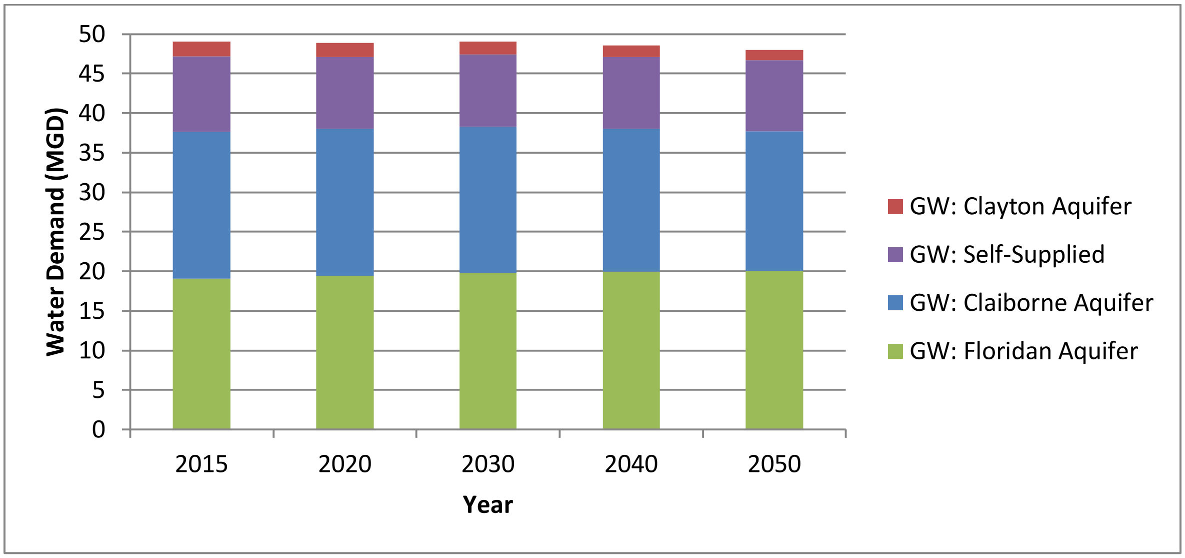

Figure 8. Water Demand Projections by Withdrawal Location

IV. INDUSTRIAL WATER NEEDS

The 2011 Regional Water Plan included industrial water demand forecasts based on employment projections produced by the Governor's Office of Planning and Budget. Updated employment projections were not available, so this update of the plan does not include any revisions to the industrial water use forecasts.

For the 2011 plan, EPD worked with stakeholders within an industrial working group to establish current and projected industrial water and wastewater needs on an industry specific basis. Employment projections were used as a basis for the industrial water demand forecasts. Industries require water for processes, sanitation, cooling, and other purposes, in addition to domestic (employee) water use. Water demand/withdrawals are largely based on production. The previous methodology forecasted industrial water demand using employment projections per industry and the 2010 water demand multiplied by the expected employment growth rate into the future for that type of industry. It should be noted that water use forecasts for any industry with a projected decline in employment remained at the level of water use before the employment growth rate began to decline.

Table 5 summarizes the annual average industrial water demands by industry type for the Lower-Flint Ochlockonee Council region, while Figure 9 illustrates industrial water demand projections by withdrawal source.

Table 5. Industrial Water Demand Projections

NAICS	Industry	SIC	2015	2020	2030	2040	2050
0	Other Industrial	0	0.53	0.54	0.57	0.60	0.64
212	Mining	14	2.20	2.20	2.20	2.20	2.20
311	Food - Food Manufacturing	20	5.07	5.07	5.41	5.67	5.92
312	Food - Beverage and Tobacco	20	2.31	2.31	2.36	2.41	2.47
313	Textiles - Textile Mills	22	0.30	0.30	0.30	0.30	0.30
322	Paper	26	114.60	114.60	114.60	114.60	114.60
325	Chemicals	28	5.35	5.42	5.54	5.67	5.83
326	Rubber	30	0.32	0.33	0.34	0.35	0.36
327	Stone and Clay	32	0.10	0.10	0.10	0.10	0.10
335	Electrical Machinery	36	0.56	0.60	0.65	0.67	0.69
TOTAL			131.10	131.48	132.07	132.58	133.12

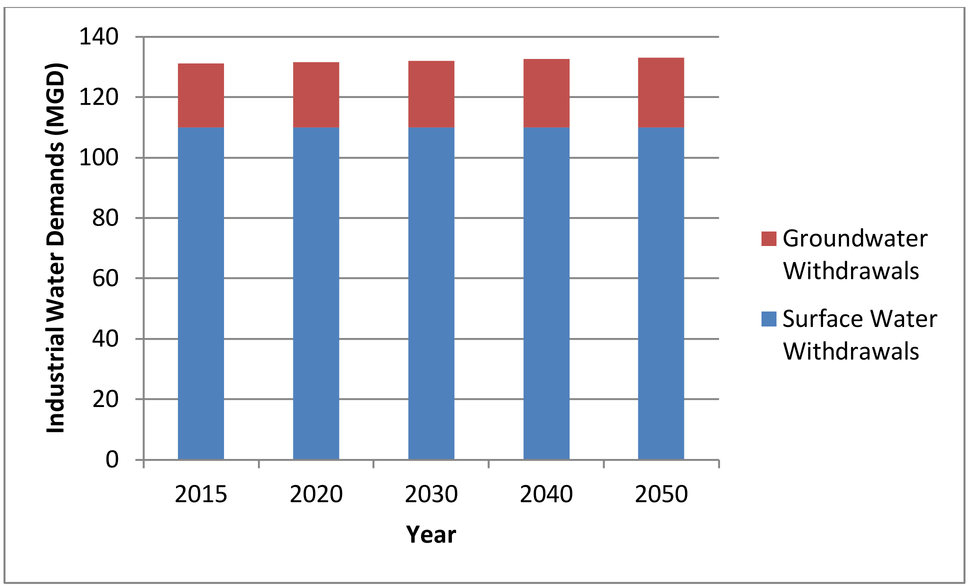

Figure 9. Industrial Water Demands by Source

V. MUNICIPAL WASTEWATER DISCHARGE FORECASTS

The previous municipal wastewater demand forecasts used the water demand projections as a basis. Indoor water use percentages were estimated and applied to the water demand forecasts, as well as estimates of infiltration and inflow, to obtain the municipal wastewater forecasts. More details regarding the previous forecasting methodology can be found in the 2011 Technical Memorandum.

All self-supplied water users were assumed to dispose of wastewater via septic systems. Wastewater generated from publicly-supplied water users was assigned a percent septic value in one of two ways: based on 1990 U.S. census data for percentage of homes on septic systems, or EPD estimates of septic systems installed by county in conjunction with 2005 U.S. Census housing stock estimates.

For the updated projections, estimates of municipal wastewater disposal were determined for each county and watershed within a planning region. Historic data provided by EPD for 2014 was utilized for forecasting future wastewater flows by county. The percent change between the updated population projection base year (2015) and each planning year (2020, 2030, 2040, and 2050) was applied to the wastewater discharge totals for each county from 2014 to obtain estimated total county discharge flows for each planning year.

Inflow and infiltration, commonly referred to as I&I, is a term used to describe the ways that groundwater and stormwater enter into dedicated wastewater or sanitary sewer systems. Inflow is stormwater that enters into sanitary sewer systems at points of direct connection to the systems while infiltration is groundwater that enters sanitary sewer systems through cracks and/or leaks in the sanitary sewer pipes. Because forecasting updates are based on historical discharge information, infiltration and inflow is inherently accounted for in the projections.

Historic data for wastewater treatment facilities was used to calculate a percentage breakdown by facility for each county. These percentages were applied to future forecasts to allocate future wastewater discharge projections by facility for each county. Forecasts were manually adjusted based on knowledge of new facilities and the decommissioning of old facilities. Facility type for centralized discharge was broken down into three categories: point discharge, Land Application Systems (LAS), and general subsurface permits. The assumption was made that future expansions during the planning period would be to point discharges.

For the updated forecasts, all self-supplied water users were again assumed to dispose of wastewater via septic systems. For the 2016 forecasting update, the percent changes in population projections for each planning year through 2050 were applied to the initial septic flow forecasts to obtain an updated septic flow projection by county for the 2016 plan review and revision.

Historical data was also used to allocate wastewater quantities by Local Drainage Area (LDA) so that quantity, disposal type, and LDA location could be summarized. Forecasts for centralized wastewater discharge projections were disaggregated based on 2014 flow percentages. Septic systems were disaggregated by node based on watershed land area percentages within each county.

2016 Wastewater Forecasting Results

Table 6 shows the forecasted total municipal wastewater discharges for each county within the Lower Flint-Ochlockonee Water Council. The following Figure 10 illustrates the breakdown between type of treatment/discharge.

Table 6. Total Annual Average Wastewater Flow Projections by County

County	2015	2020	2030	2040	2050
Baker	0.23	0.21	0.17	0.14	0.11
Calhoun	1.15	1.14	1.13	1.11	1.13
Colquitt	7.06	7.43	8.03	8.65	9.31
Decatur	1.92	1.94	1.93	1.88	1.80
Dougherty	18.90	18.95	18.79	18.37	17.85
Early	2.07	2.03	1.91	1.76	1.61
Grady	3.23	3.36	3.54	3.69	3.84
Lee	3.01	3.28	3.80	4.30	4.85
Miller	0.84	0.84	0.80	0.74	0.66
Mitchell	4.79	4.79	4.68	4.46	4.22
Seminole	1.34	1.34	1.32	1.27	1.24
Terrell	2.15	2.07	1.88	1.62	1.34
Thomas	7.86	8.14	8.53	8.79	9.00
Worth	1.23	1.20	1.13	1.03	0.93
TOTAL	**55.77**	**56.70**	**57.64**	**57.79**	**57.89**

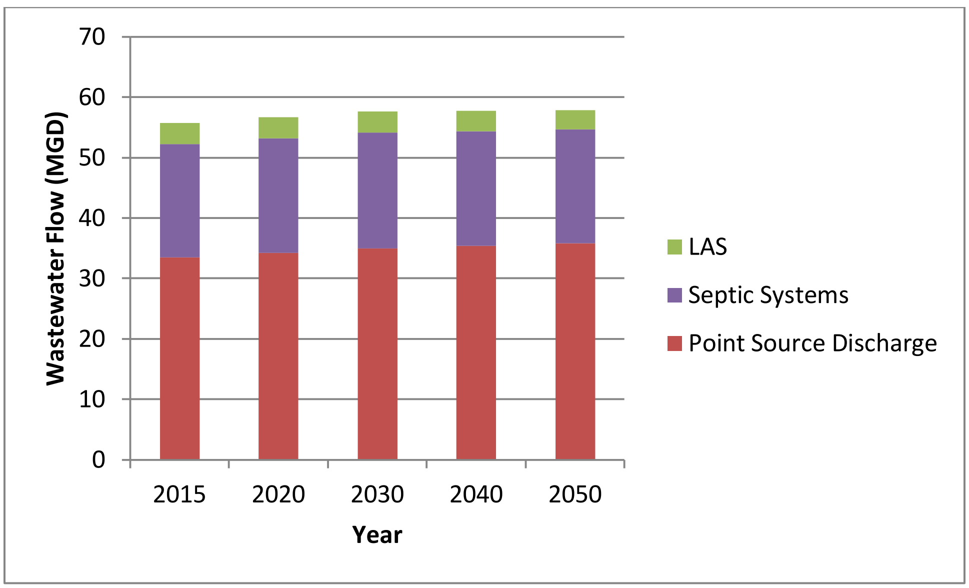

Figure 10. Lower Flint-Ochlockonee Wastewater Flow Projections by Discharge Type

VI. INDUSTRIAL WASTEWATER GENERATION AND DISCHARGE FORECASTS

The industrial wastewater generation and disposal forecasts were not modified from the 2011 Regional Water Plan. Estimates of industrial wastewater were calculated in each watershed unit within the Water Planning Regions and were retained for this plan update. Industrial wastewater volume is derived by industrial water demand for all industries based on prior water use analysis. Table 7 shows the wastewater projections for the Council for each planning year by industry. Figure 11 displays industrial wastewater discharge projections by type, centralized point source discharge or land application system.

Table 7. Wastewater Generation Projections by Major Water Using Industry, MGD-Annual Average

NAICS	Industry	SIC	2015	2020	2030	2040	2050
0	Other Industrial	0	0.32	0.33	0.35	0.37	0.39
212	Mining	14	2.20	2.20	2.20	2.20	2.20
311	Food - Food Manufacturing	20	4.63	4.82	5.14	5.39	5.62
312	Food - Beverage and Tobacco	20	2.29	2.32	2.37	2.42	2.48
313	Textiles - Textile Mills	22	0.26	0.26	0.26	0.26	0.26
322	Paper	26	114.60	114.60	114.60	114.60	114.60
325	Chemicals	28	2.46	2.50	2.55	2.61	2.68
326	Rubber	30	0.07	0.08	0.08	0.08	0.08
327	Stone and Clay	32	0.10	0.10	0.10	0.10	0.10
335	Electrical Machinery	36	0.34	0.37	0.39	0.41	0.42
TOTAL			**127.27**	**127.56**	**128.03**	**128.44**	**128.84**

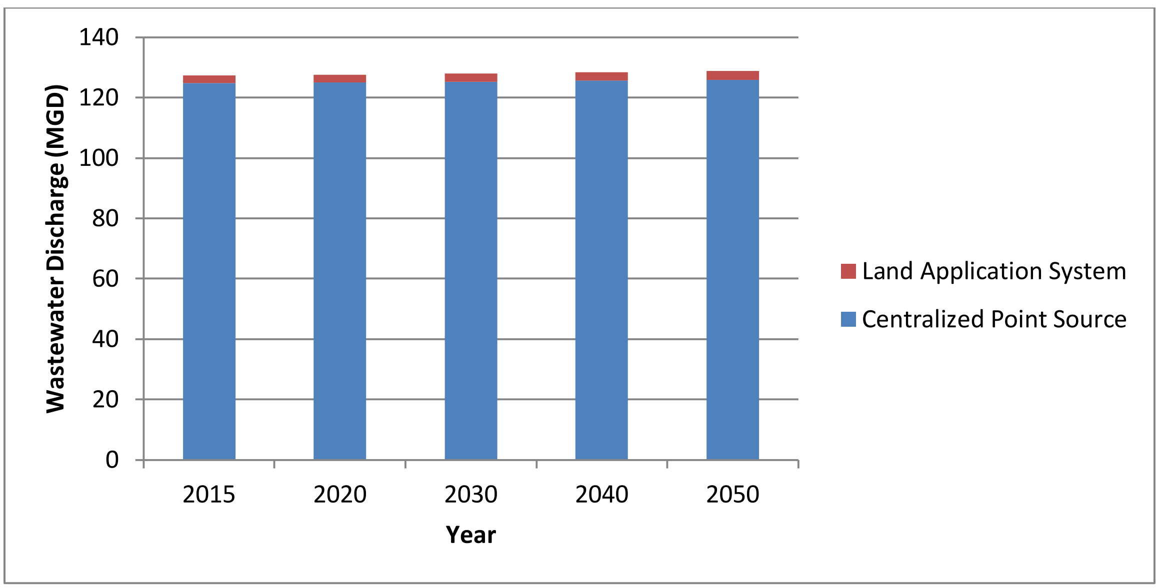

Figure 11. Industrial Wastewater Discharge Projections by Discharge Type

VII. AGRICULTURAL FORECASTS

Agricultural water demands were prepared by the Georgia Water Planning & Policy Center at Albany State University (GWPPC), with support from the University of Georgia's (UGA) College of Agricultural and Environmental Sciences. GWPPC was contracted by Georgia Environmental Protection Division (GAEPD) to prepare estimates of current and future use of water by the agricultural sector in Georgia. The projections cover row and orchard crops as well as most vegetable and specialty crops accounting for more than 95 percent of Georgia's irrigated land. Additionally, estimates of current use are made for animal agriculture, horticultural nurseries and greenhouses, as well as golf courses. The results for the Lower Flint-Ochlockonee region are summarized below; more detailed information can be found on the website or through EPD.

Estimates of current agricultural demand were calculated from data collected through the Agricultural Water Metering Program administered by the Georgia Soil and Water Conservation Commission. Agricultural water demand, both annual and monthly, was calculated using metered observations from the 2010 – 2013 growing seasons. In addition, agricultural irrigation water demand was projected for groundwater and for surface water sources for the years 2015, 2020, 2030, 2040, and 2050 using methods consistent with the first round of regional water planning. Each year's projection included a wet year, a normal year, and a dry year to simulate a range of weather conditions. Irrigated areas for each crop were projected from the baseline of year 2015 acres using economic models. Water withdrawal quantities were computed as the product of the projected irrigated area for a crop (acres), the predicted monthly irrigation application depth (inches), and the proportion of irrigation water derived from a source (fraction). While fields irrigated by wells only were assigned as 100 percent groundwater, the proportion of a county's water obtained from surface water sources was reduced to 70 percent of the estimated amount. This adjustment was applied in recognition of observed irrigation patterns since they are often limited by water available in streams or rainfall that refills ponds. The final monthly withdrawals (acre-inches) by crop were summed for each county and/or drainage area. To be consistent with other water planning efforts, the data was converted to million gallons per day (MGD).

To address the potential climate extremes in the forecasts, a range of agricultural irrigation demand scenarios were considered, including the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles. The 50^{th} percentile value represents the average rainfall conditions and the median water demand, while the 75^{th} percentile represents the dry year conditions when higher irrigation demands are expected. For planning purposes, the 75^{th} percentile values for each region are used since they represent a more conservative scenario than the median value. The agricultural water demand forecast for the Lower Flint-Ochlockonee planning region is summarized in Table 8.

Table 8. Total Agricultural Water Demand for 2015 and 2050 (MGD) for the 75th Percentile Scenario

County	Groundwater		Surface Water						
	2015	2050	Irrigation 2015	Irrigation 2050	Nursery	Golf	Livestock	Sum 2015	Sum 2050
Baker	35.025	36.394	2.107	2.119	0.119	0.000	0.139	2.365	2.377
Calhoun	15.164	19.557	11.488	12.380	0.001	0.000	0.217	11.706	12.598
Colquitt	28.763	32.985	18.296	20.310	0.350	0.000	0.681	19.327	21.341
Decatur	59.556	64.969	1.950	2.150	0.434	0.000	0.258	2.642	2.842
Dougherty	35.045	55.512	0.109	0.192	0.005	0.179	0.042	0.335	0.418
Early	27.759	29.326	6.882	7.049	0.007	0.000	0.258	7.147	7.314
Grady	11.599	13.842	6.047	6.598	6.286	0.000	0.396	12.729	13.28
Lee	38.763	50.703	4.356	4.564	0.052	0.000	0.358	4.766	4.974
Miller	49.420	50.327	0.638	0.672	0.000	0.000	0.300	0.938	0.972
Mitchell	98.127	125.373	5.113	5.650	0.018	0.000	1.236	6.367	6.904
Seminole	49.552	51.912	0.533	0.544	0.028	0.000	0.150	0.711	0.722
Terrell	18.904	21.603	6.915	7.726	0.020	0.056	0.085	7.076	7.887
Thomas	12.118	16.237	1.222	1.296	0.626	0.000	0.436	2.284	2.358
Worth	24.262	25.668	7.499	7.982	0.010	0.000	0.297	7.806	8.289
TOTAL	504.057	594.408	73.155	79.232	7.957	0.235	4.853	86.199	92.276

Note: Nursery, golf, and livestock projections are assumed to be consistent through planning years 2015-2050.

Agricultural Projection Methodology

A database of statewide irrigated acreage was updated to reflect changes that have occurred since data was compiled in 2009 to support the initial round of regional water planning. This comprehensive update was completed by the GWPPC through a combination of on-farm field mapping efforts in certain regions as well as an analysis of 2014 aerial imagery whereby visible irrigated field areas were delineated and labeled by location using standard GIS tools. The proportion of existing irrigated area of each major rotation crop was taken from the 2015 USDA National Crop Data Layer and supplemented with information from the 2012 USDA Farm Census. The projected growth rate for each year for each crop was based on the arithmetic average of projections from three economics based models as calculated by faculty at the UGA College of Agriculture and Environmental Sciences. The models predicted the total Georgia production area for each crop based on United States, Southeast Regional, and Georgia data. Five major crops—corn, cotton, peanut, soybean, and pecan—were included in these three models because they make up 85 percent of Georgia's irrigated crop area.

The water demand created by vegetables, specialty crops, and ornamental nurseries lacked the long-term data needed to make econometric projections. Therefore, projections of irrigated area for these crops were assumed to stay constant within the same areas and future growth rates would equal the aggregate growth rate of the five major crops. Therefore, water demand for vegetable and specialty crops was included with the major crops to produce the total water withdrawal demands.

Predicted monthly irrigation amounts were computed and summarized statistically to represent monthly applications that would be needed to meet normal crop water needs during wet, average, and dry years. For each major crop type, irrigation schedules and monthly totals were computed for the weather conditions that existed during each of the years from 1950 through 2007.
Finally, the proportion of water used for irrigation from a specific source was estimated using data collected in the field through GWPPC mapping efforts coupled with information from the Agricultural Permitting Unit of GAEPD as well as source data maintained by the Georgia Soil and Water Conservation Commission (GSWCC) as part of the Agricultural Water Metering Program. Groundwater sources were further broken down by aquifer (or aquifers) based on the available permitted well information.

Non Permitted Water Use Operations

State regulations require that farmers who withdraw more than 100,000 gallons per day from streams and aquifers obtain a permit from the GAEPD. While that limit means that most field irrigation withdrawals require a permit, other agricultural practices such as livestock and other animal-related operations, nurseries, and golf courses might not require permits. Therefore, the following agricultural practices were considered during the forecasting period but forecasting numbers were not developed due to the lack of reliable data.

Livestock and Other Animal Operations

The GWPPC, with input from industry experts, estimated the aggregate water use in each livestock sector for each county and planning region. These estimates were not forecasted into the future (demand values for 2015 are carried forward through 2050). The data sources used for these estimates were the same as those used in the previous planning sector.

Nurseries and Greenhouses

The GWPPC prepared estimates of current water use by horticultural nurseries and greenhouses, but these estimates were not projected into the future (demand values for 2015 are carried forward through 2050). The data used to determine the extent of these operations was the same as that used in the previous planning cycle (Georgia Agricultural Statistics Service). While the horticultural sector is diverse, these estimates are focused on parts of the sector that are substantial but not captured in other water use estimates. For example, while landscape and lawn irrigation could be considered a part of this sector and accounts for a significant portion of the State's water use and much of its consumption, it was assumed to be accounted for within other sections of the state water demand analyses.

Water use in nurseries is difficult to quantify due to the ever changing inventory and the variable water needs of each plant depending on their type and size. Therefore, in the previous planning cycle, an ad hoc group including industry stakeholders and experts developed broad categories of water use in nurseries using studies conducted by the Agricultural Water Pumping and Plant Research Plots and surveys conducted by the Cooperative Extension Service Irrigation Surveys and the Green Industry. For in-ground nurseries average annual use is estimated at 31 inches; for container nurseries, 87 inches; and for greenhouses, 121 inches. These rates were used to develop water use estimates for each county for each type of nursery operation. Greenhouse water use numbers are larger because the elevated temperatures increase water losses but water use is expected to vary very little from year to year and from dry to wet seasons because they are covered. Although not included in the industry survey, lower management nurseries, like Christmas tree farms, tend to use less water than higher production, in-ground nurseries.

Golf Courses

In counties and state water planning regions with non-municipally golf courses, their water needs were estimated with the support of the Georgia Golf Course Superintendents Association (GGCSA), GAEPD, and research on GGCSA Best Management Practices (BMPs). The data does not forecast golf course water use in the future but does provide water use estimates in an average rainfall year and in a dry year.

VIII. ENERGY FORECASTS

This section describes the methodology and results of the energy sector water demands for the Lower Flint-Ochlockonee Planning Council.

Demands forecasted in this section are associated with future energy sector utilities (NAICS 22) power generation. Water demands associated with power generation by facilities with other industry codes are captured as part of the municipal and industrial water demand forecasts discussed in previous sections.

The analysis covers both water withdrawal requirements and water consumption for energy generation. Information related to water withdrawals is an important consideration in planning for the water needed for energy production. However, water consumption is the more important element when assessing future resources because a large volume of water is typically returned to the environment following the energy production process.

Water requirements for thermoelectric power generation facilities are estimated based on future energy demands along with the water requirements and consumption rates in gallons per megawatt-hour (MWh) for different power generating configurations. For a full discussion of the original forecast methodology, see the 2010 technical memorandum "Statewide Energy Sector Water Demand Forecast" or the "Update of GA Energy Needs & Generating Facilities" memorandum. The following updates to the original methodology were incorporated into the current estimates:

- Projections of the statewide energy demand were updated using the new population projections with the relationship between population and energy demand the same as previously estimated.
- The list of existing facilities, facilities under construction, and planned and permitted new facilities was updated. In addition, some prior facilities were retired from service or converted from one generating configuration to another more efficient configuration.
- The same water withdrawal and consumptive use factors (gallons per MWh) by generating configuration were maintained as previously developed
- To meet the future energy demand, the energy generation of existing facilities is increased over time to a predetermined maximum sustainable generating capacity based on the generation configuration. As additional capacity is needed in the future, "new" capacity is added to the most likely to be developed generating configurations, but the "new" generating capacity is not assigned geographically to any specific region within the state.
- The estimated future generating capacity of existing facilities, and associated water requirements, is allocated to regions based on the location of the existing facilities.

Energy Forecast Results

Plant Mitchell in Dougherty County is being decommissioned. The remaining water users in the energy sector after 2015 include Gum Power Plant in Mitchell County and Crisp County Power (withdrawal location in Worth County). The same water withdrawal and consumptive use factors by generating configuration were maintained from the previous round of forecasting. Table 9 shows the total withdrawal and consumption values for each planning year for the Council for both the expected and the high growth scenarios. The water withdrawals are higher for the expected growth scenario because the generation configuration is different for each of those scenarios. Under the high growth scenario, a more water efficient power generation configuration is expected to be implemented.

Table 9. Energy Water Withdrawals and Consumption in MGD for the Council

County	2015	2020	2030	2040	2050
Expected Growth Scenario					
Withdrawal	87	5	5	6	6
Consumption	0	0	0	0	0
High Growth Scenario					
Withdrawal	85	4	4	5	5
Consumption	0	0	0	0	0

IX. REGIONAL SUMMARY

The total regional water demand for all sectors is included in Figure 12. This includes municipal, industrial, agricultural, and energy uses for the Lower Flint-Ochlockonee Council region. The demand is broken down by withdrawal source, including groundwater aquifers and surface water basins. Note that the expected growth scenario for energy sector demands and the 75th percentile demands for agricultural demands are incorporated into the total demands. The following figure, Figure 13, illustrates total water demand projections by sector. In addition to water demands for irrigation, Figure 13 also includes projected demands for livestock, nurseries, and golf course irrigation.

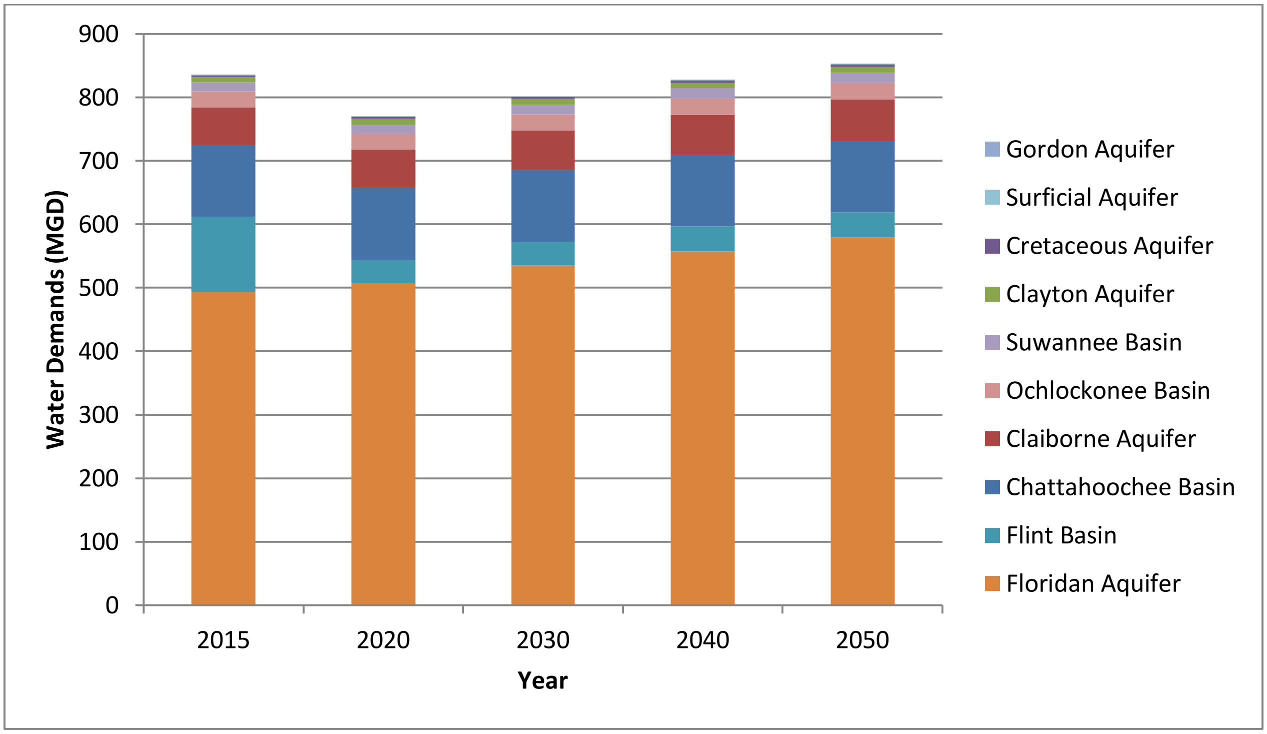

Figure 12. Water Demand Projections by Source

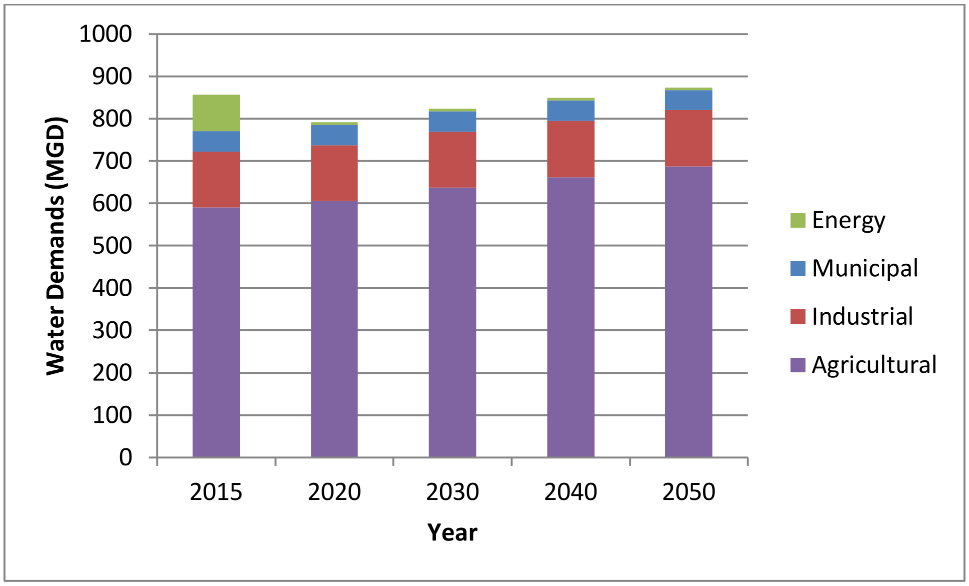

Figure 13. Water Demand Projections by Sector

The total wastewater forecasts for the Lower-Flint Ochlockonee Council are summarized in the following figures. Figure14 illustrates the total wastewater flows by basin for each planning year, while Figure 15 illustrates future projections by discharge type.

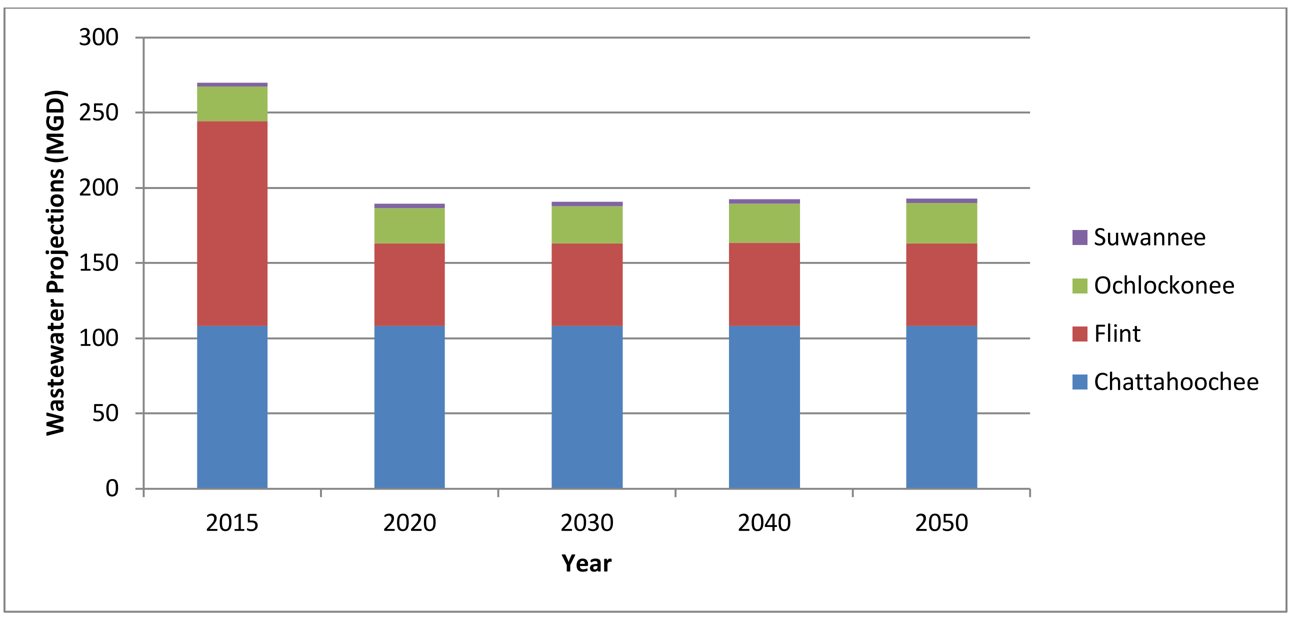

Figure 14. Wastewater Flow Projections by Basin of Discharge

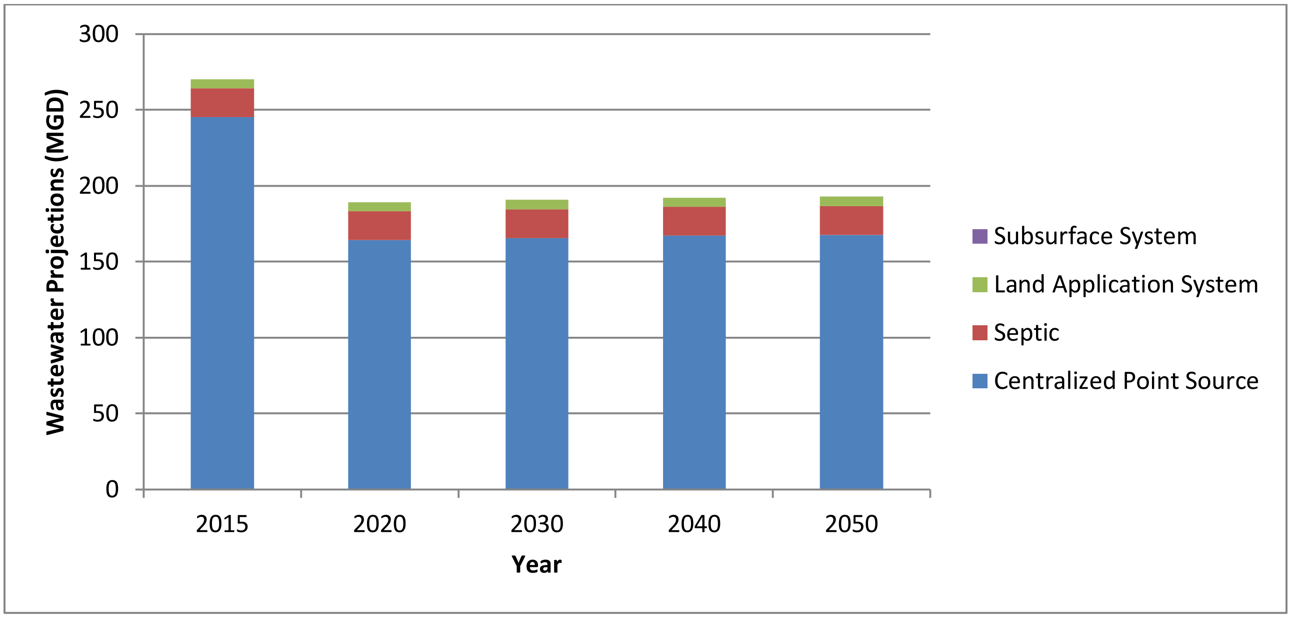

Figure 15. Wastewater Flow Projections by Discharge Type

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