I. INTRODUCTION

This methodology to forecast water and wastewater demands is based primarily on the continuation of existing trends and practices. It does not make a determination regarding the efficiency or inefficiency of forecasted demands, only that they are expected to occur given current trends. This forecasting effort does not take into account management practices, including water conservation, which may be adopted by regional water planning councils to reduce the expected magnitude of demand or the pending water efficiency requirements as described in Governor's Water Stewardship Bill (passed unanimously by the House and Senate of the Georgia General Assembly in March of 2010, House Bill 1094 and Senate Bill 370). Council members are encouraged to plan for and incorporate those efficiencies in the process of selecting management practices. Management practices will be considered subsequent to the delivery of these forecasts. Additionally, this forecasting effort does not change EPD requirements related to individual permitting decisions, but represents a forecast for regional water planning.

Basic Methodology

The basic methodology for determining water demand forecasts was to estimate water demand separately for each water use sector. For each sector, water demand was estimated using a 'driver' multiplied by the rate of use approach. The driver is defined as a countable unit of water use, which can be projected in future years, such as number of people, number of employees in a business, unit of production, etc. The rate of use is defined as the quantity of water used by the driving unit per time, such as gallons per household per day. As shown in Figure 1 the driver, or demographic unit, and the corresponding water use rate can be defined independently for each sector. The selection of the appropriate unit and the corresponding water use rate depends upon the data available for each sector.

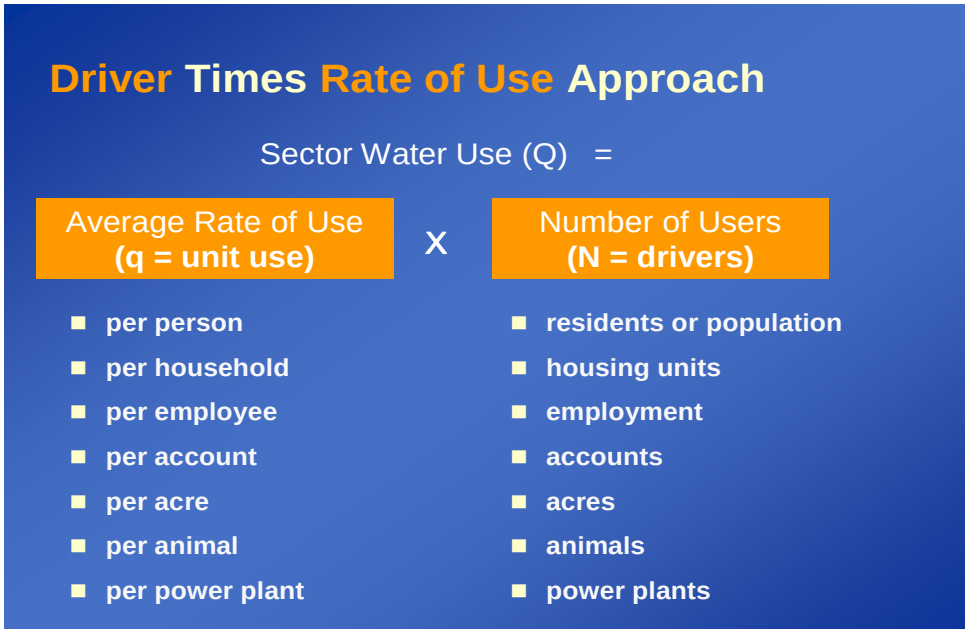

Figure 1 General Approach

A per unit rate of water use, or water use factor, can be developed for most sectors given historical water use data and a defined demographic unit. Projection of future water demand then requires having projected values of the defined demographic unit. With this approach, the water use factor of each sector can be assumed to either remain constant into the future, decrease over time due to increases in water use efficiency, or increase over time due to more intensive water use.

While trends in future water use are uncertain, reasonable assumptions can be made that provide the foundation for estimating trends in the future and scenarios can be developed that consider demands under potential alternative conditions. For municipal water and wastewater demand forecasts, population projections will provide the basis for estimates of future growth as shown in Figure 1. For industrial water and wastewater demand forecasts, employment projections will provide the basis for estimates of future growth as shown in Figure 2.

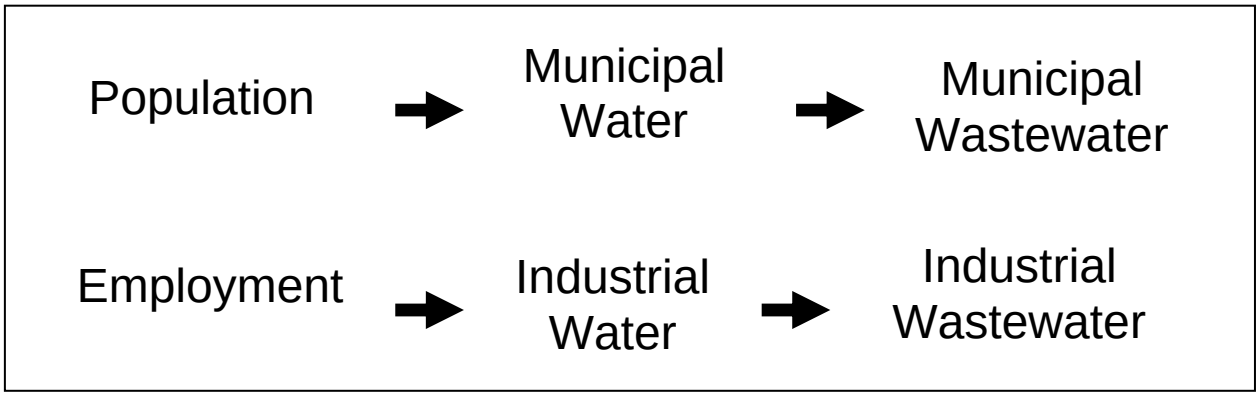

Figure 2 Conceptual Basis of Forecasts

II. Population Forecasts

The population projections were prepared by the Governor's Office of Planning and Budget (OPB), the state agency responsible for demographic data for the state, with assistance from the Applied Demography Program at the University of Georgia's (UGA's) Carl Vinson Institute of Government. Population projections were developed for each county in the state. Population projections were released on March 12, 2010 to the general public with projections through 2030 (the 20-year planning horizon is typically as far in advance as OPB releases). For water planning purposes, the complete 40-year planning horizon values determined by OPB were presented to the regional councils and stakeholders at Council Meeting 5 in March 2010. Council Ad-Hoc subcommittees were formed prior to forecast finalization consisting of selected council members representing municipal supplies and demands. Additionally, EPD worked with stakeholders within an industrial working group to establish current and projected industrial water and wastewater needs on an industry specific basis.

Forecasts for municipal water/wastewater were disaggregated based watershed/aquifer unit within the planning region as shown on Figure 3. Aquifers were divided in accordance with Figure 4. The Planning Contractors also subdivided the river basins into "Nodes" that are consistent with the River Basin Planning Tool used for the Surface Water Availability Assessments as shown in Figure 5.

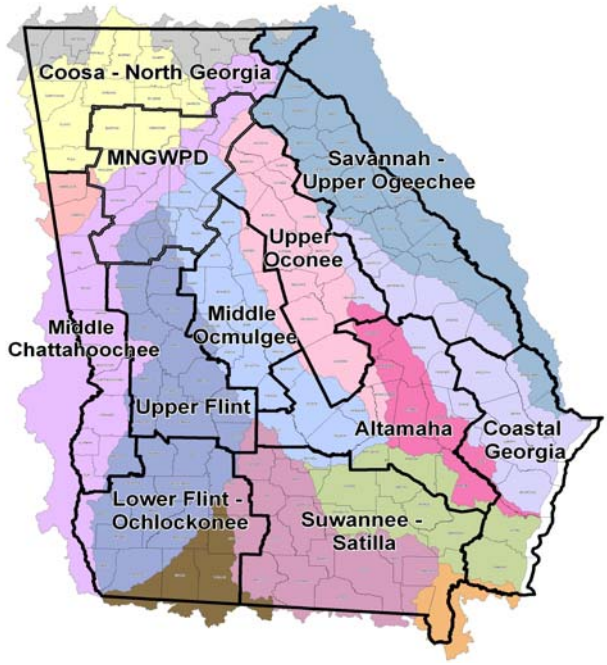

Figure 3 Delineation of Water Planning Regions (bold lines) and watershed boundaries (colors)

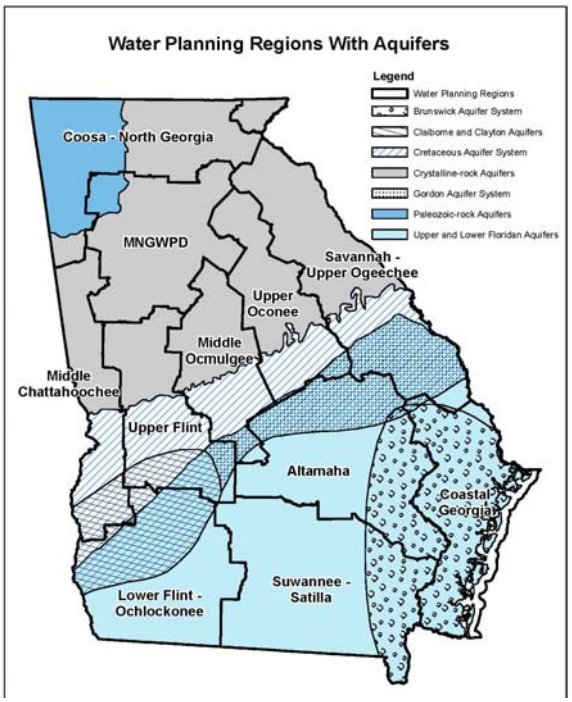

Figure 4 Water Planning Regions with Aquifers

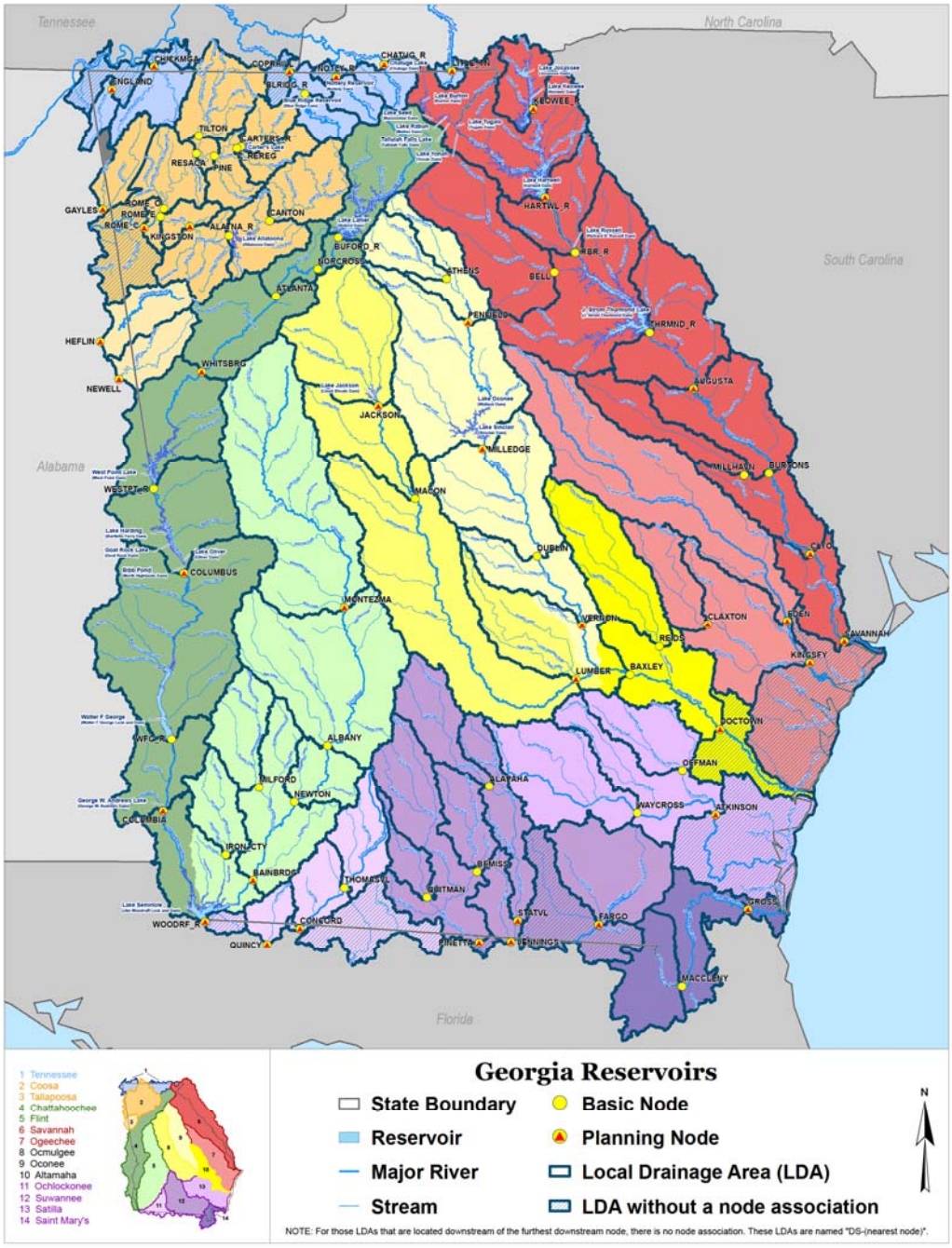

Figure 5 River Basin Map with Nodes

III. Employment Forecasts

Employment projections were prepared by Georgia EPD with assistance from the UGA. These employment forecasts were prepared for each water planning region to assist in creating forecasts of industrial water demand for the major water using industries in Georgia. The distribution of industrial was based off of historical usage trends and input from regional council members and the industrial working group.

IV. Municipal Water Needs Forecasting

This section describes the methodology for estimating the municipal water needs in Georgia for the planning horizon of 2010 through 2050. For this planning effort, municipal water includes uses for residential, commercial, and light industrial purposes, and may be supplied by either a public or private supplier, or be self-supplied.

Residential water use is defined as water used for normal household purposes. This category includes water used for drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, watering lawns and gardens, residential car washing and swimming pools. Commercial water uses include water used by hotels, restaurants, retail stores, office buildings and institutions, both civilian and military. This category also includes water for hospitals, schools, fire fighting, and recreational water uses such as water parks, as well as water losses in the treatment and distribution of water. The residential and commercial water demand and demands of small (non-major water using) industries were projected as one combined category and referred to as the residential/commercial demand. Demands for major water using industries will be projected separately and the methodology for this forecast is discussed in Section V.

Water may be provided by a public water system or large private supplier, termed “publicly supplied”, or may be self-supplied by the user. The publicly-supplied and self-supplied water

demand will be estimated separately for the 40-year planning horizon for each Water Planning Region.

Publicly-Supplied Residential/Commercial Water Demand

Publicly-supplied water demand for residential/commercial sectors was estimated for each county and for each watershed and aquifer unit within each Water Planning Region. The basis for future water demand forecasting includes:

- 2009 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.
- Reported annual average daily withdrawal quantities (both surface water and groundwater) from Georgia EPD for year 2005. Years other than 2005 were also utilized when verified anomalies were reported by council members.
- Council Member and regional stakeholder feedback was requested and incorporated where deemed appropriate. Details concerning changes and forecast results are provided in Section IX, Municipal and Industrial Water/Wastewater Forecast Results.

In addition, water demand was assigned to a particular watershed or aquifer unit. This assignment was based on base year surface water and groundwater withdrawal use data and input from water suppliers.

The future publicly supplied residential/commercial demand was calculated as follows:

*Future Publicly-Supplied Residential/Commercial Demand by County = Baseline Per Capita Residential/Commercial Water Use * (Projected County Population – Projected Self-Supplied Population)*

Determination of per Capita Water Use

A baseline per capita water use rate, on an annual average daily basis was completed for each county and applied to the projected population to obtain the projected future municipal water demand. This baseline per capita water use rate was calculated and refined in a four-step process to ensure that it is representative of the actual water use of the county and of average weather conditions of the Planning Region. The base year for this demand forecast was 2005 based on the annual average daily withdrawal quantities reported in the USGS publication. Adjustments of the 2005 per capita water use rate were made based on input from the water suppliers, council members, and from historical survey data as provided by EPD.

The four-step per capita determination process is described below.

Step 1: Estimate 2005 per Capita Water Use Rate. A preliminary per capita water use rate was calculated using the publicly-supplied water quantity and estimated population served for 2005 based on the USGS publication.

The 2005 per capita residential/commercial water use rate was calculated as follows:

Publicly-Supplied Residential/Commercial Per Capita Water Use (2005) =
(Total Publicly-Supplied Water Quantity – Major Water Using Publicly-Supplied Industrial Use) / County Population Served

The quantity of publicly-supplied water for each county and estimated population served in 2005 was obtained from Table 6 and Appendix B of the 2009 USGS publication. However, because the reported public supply (withdrawal) quantity does not differentiate between residential/ commercial, industrial water use and water wholesale to adjacent communities, the calculation of per capita residential/commercial water use for each county was refined in an effort to separate the true residential/commercial water use from major industrial water use and wholesale water quantities.

It should also be pointed out that the public supply withdrawal quantities from the USGS report include non-revenue water (NRW), which are included in the per capita water use rate for each county. NRW includes losses during the treatment and distribution of water. The term "Unaccounted-for Water" was commonly used in previous years; however, NRW is the current term recommended by the American Water Works Association. NRW includes water losses and usage that is authorized but does not generate revenues.

Step 2: Determine whether additional information is necessary. The calculated per capita water use was compared to a value that is considered typical of per capita residential/commercial water consumption in Georgia. A typical range has been determined to be between 75 and 175 gallons per day per capita (gpcd). If the calculated per capita water use value fell outside of this range, further exploration of the area was conducted including interviews with EPD staff, a survey of water providers, or other appropriate means of gathering information to investigate whether one of the following conditions may exist:

- the county's water suppliers provide water to significant industrial users
- the county imports (or purchases wholesale) much of its water from outside the county boundary
- the county's water suppliers sell water (wholesale) to a neighboring county, or
- the county's water suppliers provide service directly to neighboring county's customers and the "population served" shown in the USGS 2009 publication includes these direct customers in a neighboring county

A questionnaire was designed, as shown in Appendix A, to investigate possible reasons for atypical per capita water use values. If sufficient data was received in response to the investigation, adjustments were made to the per capita water use rate based on the data provided.

Step 3: Adjust to account for major water use quantities for large industries and water transfer between counties through selling or purchasing. Data gathered about the per capita outliers was used to adjust the public water supply quantity and the per capita water use rate accordingly. Major industrial water use as reported by public suppliers was subtracted from the total quantity, then this major industrial water use was forecasted separately. Industrial water use that is not considered to be 'major' was included in the residential/commercial per capita rate. The per capita water use rate was adjusted to account for water transfer through selling or purchasing between counties or water systems where applicable data to support the adjustment was available. The amount of water identified to be used in a different county was subtracted from the supplying county's total and added to the recipient county's water use to calculate their adjusted water use rates.

Step 4: Adjust based on historical rainfall/withdrawal quantity correlation. An appropriate "weather correction (or adjustment) factor" was considered based on historical rainfall data in the Planning Region and available raw water withdrawal records (both surface and groundwater) of representative communities in the Planning Region. Where sufficient data was available for a meaningful correlation, this factor was used to adjust the per capita water use rate with input from water suppliers.

Self-Supplied Residential/Commercial Water Demand

In order to forecast the quantity of self-supplied water use, a per capita water use rate must be determined. 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 study to estimate the self-supplied domestic water use for 2005 in Georgia. This rate was used to estimate the self-supplied residential/commercial water demand. The future self-supplied residential/commercial water demand was calculated using the following formula:

*Future Self-Supplied Residential/Commercial Demand = 75 gpcd * Projected Self-Supplied County Population*

The projected self-supplied county population in each region was determined using the USGS report. It was assumed that the percentage of self-supplied population remained constant at the 2005 level throughout the planning horizon. Customization of the future self-supplied population percentage based on local conditions and input from water suppliers and/or EPD sanitary survey data was also performed where deemed necessary.

Total Residential and Commercial Water Demand Forecast

The total future residential/commercial water demand for each county was forecasted based on the county population projections. This forecasted demand was an aggregate of publicly supplied and self supplied future water demands. The total residential/commercial water demand was estimated using the formula below:

*Total Forecasted Residential/Commercial Demand = (2005 Per Capita Residential/Commercial Water Use * (Projected County Population – Projected Self-Supplied Population)) + (75 gpcd * Projected Self-Supplied County Population)*

This projected Residential/Commercial water demand calculation was adjusted based on the effects of improved efficiencies from the plumbing code as discussed in section V.

Geographic Distribution of Projected Demands

The geographical representation of water withdrawal, either from groundwater or surface water was determined using existing EPD permit information, including water use data, and input from water suppliers. The withdrawal quantities and locations were related to the 2005 quantities from the 2009 USGS publication. The year 2005 public supply water demands were assigned proportionally based on current distribution of surface watersheds or groundwater sources to generate this forecast. Assignment of future water demands and withdrawal locations were adjusted based on input provided by the water planning councils as part of the selection of management practices.

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 accounted for by OPB projections used to prepare the forecasted demands. Council specific inputs were provided where new industry or growth deviate from historical trend or where and when planned water use is anticipated to occur otherwise not accounted for.

V. Plumbing Code Water Efficiency Adjustment

Since 1994, the national plumbing codes have mandated lower maximum flush rates for toilets available in the US, which has resulted in significant reductions in water use in Georgia and nationwide, and will continue to do so over the 40-year planning period for this forecasting. The National Energy Policy Act of 1992 (NEPAct) reduced the maximum flush volume for toilets from 3.5 gallons per flush to 1.6 gallons per flush (also called Ultra Low Flow Toilet, or ULFT) for all toilets available in the US starting in 1994. Furthermore, Georgia state code, Title 8, Section 8-2-3 states that after April 1, 1992, all residential buildings of all types shall not be constructed with a toilet that uses more than 1.6 gallons of water per flush. In addition to affecting new construction, when an older, high flush-toilet is replaced after 1992 due to remodel or replacement, it was replaced with an ULFT. This replacement of older fixtures lowers the water use rate over time.

The calculation of the per capita water use rate described in the previous section already reflects the effect of the plumbing codes over the 13-year period of 1992-2005. However, an estimate needed to be made for the effect of the plumbing code requirement due to toilet replacement over the period of 2010-2050. This section describes the methodology for estimating the reduction of the water use rate due to the effect of the plumbing code on the residential and commercial

(referred to as residential/commercial) water demand projections for the planning horizon of 2010 through 2050.

The pending water efficiency requirements as described in Governor's Water Stewardship Bill (passed unanimously by the House and Senate of the Georgia General Assembly in March of 2010, House Bill 1094 and Senate Bill 370), are not reflected in this analysis.

Methodology

The steps to estimate this reduction due to the plumbing code are described below.

Step 1. Estimate the current mix and number of toilets for each county by flush volume based on the US Census Age and number of Housing Units information. An assumed two toilets per household was utilized in the analysis. The estimate for flow volumes was based on the following timeline for different flush volume toilets in the Georgia.

- Toilets installed prior to 1980 use an average of 5 gallons per flush
- Toilets installed between 1980 and 1992 use an average of 3.5 gallons per flush
- Toilets installed after 1992 use 1.6 gallons per flush (ULFT)

Step 2. Estimate the water savings when higher volume per flush toilets are replaced with ULFTs based on an estimate of the natural replacement rate of the remaining toilets installed prior to 1992 over the 40-year planning period. This replacement rate was assumed to be 2 percent per year, which corresponds to a life of 50 years per toilet, and is consistent with other regional water planning efforts in Georgia (Metropolitan North Georgia Water Planning District).

In order to generate an actual volume of water an estimated two toilets per household was assumed. The mix of toilets (by flush volume) was estimated as previously discussed. A baseline value of annual water use was then calculated assuming 5.1 flushes per person per day. This

factor is derived from the Residential End Uses of Water study sponsored by the American Water Works Association Research Foundation (AWWARF, 1999).

Step 4. Apply the plumbing code adjustment as a reduction to the calculated per capita water use rate for each county over the planning period. This was accomplished by determining the change in annual water use associated with toilet flushing over the planning horizon as compared to the base year. For each time step the calculated number of ULFT's increased while higher volume toilets decreased. Holding the 5.1 flushes per person per day assumption constant resulted in a measurable savings as the mix of toilets changed. This savings was normalized by the population to generate savings on a per capita basis.

This adjustment to the water use rate was made prior to forecasting wastewater generation.

VI. Industrial Water Needs

Industries require water for processes, sanitation, cooling, and other purposes, in addition to domestic (employee) water use. Some industries, such as poultry processors, operate under strict USDA (U.S. Department of Agriculture) guidelines that require water use to maintain sanitary conditions within the facilities. Water need (i.e., the total water requirements of an industry, or the water withdrawals) is directly linked to production. Figure 6 illustrates the relationship of water need, production, and employment, as well as how this information can be used with estimates of future employment to project future industry water needs.

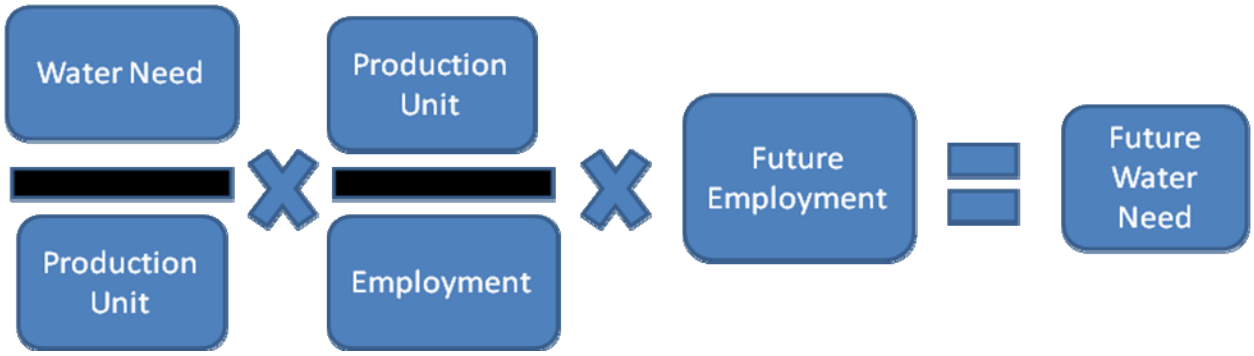

Figure 6 Industrial Water Use, Production, and Employment

If data are available to establish the water need per unit of production, and the production rate per employee, then the future water need is calculated as follows:

Future Water Need by Industry = (Water Need per Production Unit) x (Production Unit per Employee) x Future Employment

However, in many instances historical production data and estimates of future production are proprietary information.

Industry employment data are readily available, and employment is linked to production, and thus indirectly linked to water requirements. Thus, by assuming that water use per production unit, and production per employee remain the same over the forecast period, future water needs can be estimated by future employment as follows:

Future Water Need by Industry = (Water Need / Employment) x Future Employment

Since the future employment is the current employment times a rate of growth, the formula can be further simplified as:

Future Water Need by Industry = Current Water Need x Employment Growth Rate

The Georgia EPD provided employment projections for each major industrial water use sector by NAICS code for each region. Other employment, such as retail, services, government, etc. is included as part of the municipal demand, and is not included in this industrial methodology.

Industrial water use was assigned to watersheds and aquifers based on current use and/or credible input from industry leaders regarding factors used in selecting industry locations. Therefore, development of industrial water use within a region may result in an alternate scenario as described below.

In the ***base scenario***, the current (e.g., 2005, or base period) industrial water use volume within a particular basin or aquifer unit will grow in direct proportion to the projected growth in regional industrial employment for the NAICS codes shown above. *Water use for any industry with a projected decline in employment remained at the level of water use before the employment begins to decline*. The assumption is that industrial water needs may not remain tied to employment in the future and a decline in employment may not reflect a decrease in water use for the industry. Furthermore, for regional planning purposes, the regions should plan to retain current water use levels and plan for growth. This base scenario assumes that future growth in a given industry will occur in the same basin or aquifer unit locations as existing (current) industry.

An *alternative scenario* was developed to capture projections of industrial water demand within a planning region or watershed/aquifer unit when credible and defensible information as determined by EPD regarding the geographical distribution of future industrial development within the region was available. This information was unique for each water planning region and/or for each major water using industry. In this case, the scenario was based on input provided by representatives from the major water using industries and the subsequent direction of each regional water planning council. In the absence of specific credible information regarding the location of future industrial development within a planning region or watershed or aquifer unit, the methodology described in *base scenario* was the sole industrial water demand projection method employed and an *alternative scenario* was not developed.

The regional water use for each industrial sector was identified using the 2005 EPD industrial permit data and USGS 2005 listings of large industrial water users. Data from other years in accordance with readily available data was also examined.

Data was collected by performing a query of the EPD database by specific region and industry. Permit location was retained in order to determine the watershed/aquifer unit assignment within the basin. In addition, any large industrial water use extracted from municipal water use was included in the industrial water use if the industrial sector and corresponding employment were known. The water use information was summed for a given industry within a given watershed/aquifer unit to generate the demand on the resource.

The regional growth rate of employment by industry was derived from EPD employment projections. Future water use by industry was calculated by multiplying current industry water use (within a watershed and aquifer) by the industry specific rate of growth for the region. Analysis was completed to provide future projections for 10, 20, 30, and 40 year horizons through 2050. In the base scenario, industry growth was assumed to occur only at current industry locations, industry water use increases at the industry employment rate of growth, and industry water use within the region remained proportional throughout the watershed/aquifer units, as shown in the equation below:

> *Future Water Need by Industry = Industry Water Need in the Watershed or Aquifer Unit multiplied by Regional Industry Rate of Growth*

It should be noted that water use for any industry with a projected decline in employment remained at the level of water use before the employment growth rate began to decline.

Estimates of industry water use for the *alternative scenario* involves the assignment of future (new) industrial development to watershed and aquifer units within the region using geographic and other factors as directed by EPD and per input from representatives of major industrial water-using sectors and input from the regional councils. The methodology for estimating regional water use for a given industry was as follows:

- *Future Water Use by Industry in the region = Industry Water Use in the region multiplied by Regional Industry Employment Rate of Growth*

- *New Industry Water Use in the region = Future Water Use by Industry in the region as described in alternative scenario section*
- *New industry water use will be assigned to watershed and aquifer units based on relevant input from EPD, industry representatives, or council member input*

Industry Water Use in the Watershed or Aquifer Unit = Base year industry water use for that Watershed or Aquifer Unit plus that portion of the New Industry Water Use assigned to that watershed or aquifer unit

VII. Municipal Wastewater Generation and Disposal Forecasts

Estimates of both municipal wastewater generation and disposal were determined for each county and watershed within a planning region. Data sources include:

- "Georgia Water Use and Conservation Profiles", CH2MHill, March 2008, Report to EPD. The report includes water usage profile data for Douglas (City of), LaGrange, Leary, Macon, Pickens County, Reidsville, Savannah, and Toccoa.
- Current permitted wastewater treatment plant flow data and reported discharge flow as available from EPD
- The 1990 Census of Population, Social and Economic Characteristics of Georgia. The 1990 Census was the last to include survey questions to determine the number of people connected to a public sewer system versus those using onsite septic systems.
- EPD records of number of septic tank installations by county between 2000 and 2005.
- Annual housing stock estimates from the U.S. Census.

In the "Georgia Water Use and Conservation Profiles" report, values for average indoor water use were determined for the profiled cities/counties. One of those community's percent average indoor water use value was assigned to each county within the Water Planning Region. Factors considered in determining the chosen profile included water source type, population served, annual production, and housing stock. The percentage was assumed to remain unchanged

through the planning horizon. Based on the chosen profile, the wastewater generated by county was determined by multiplying the percentage average indoor water use by the total forecasted county water use. The average indoor water use was assumed to be constant for both the publicly- and self-supplied populations.

Total wastewater generated was calculated as follows:

- *Total Wastewater Generation = (Publicly-supplied water use by county x % Average Indoor Water Use) + (Self-supplied water use by county x % Average Indoor Water Use)*

The calculated total wastewater generated was distributed to either septic or centralized systems for disposal. 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:

Scenario 1: The reported 1990 U.S. Census based value for percentage of homes connected to septic systems was applied directly to the wastewater generation value.

Scenario 2: EPD provided estimates for the number of septic systems installed by county were utilized in conjunction with 2005 U.S. Census housing stock estimates to determine an updated percent septic value. Estimates for the self- and publicly-supplied populations as provided in the USGS report were inferred onto the housing stock estimates to avoid double counting septic systems in the self-supplied portion of the population. The percent septic value was determined for scenario 2 using the following calculation:

- *% Septic for wastewater generated from publicly-supplied water use = Estimated number of publicly-supplied homes with septic systems / Total number of publicly supplied homes*
- *% Septic for wastewater generated from self-supplied water use = 100%*

Scenario 2 values of percent septic were utilized as the default value unless estimates proved unrealistic due to data inconsistencies.

Centralized wastewater generation was calculated as follows:

- *Total Centralized Wastewater Generation = Wastewater generated from publicly-supplied water use x (1- %Septic)*

Centralized treatment was further broken into Land Application Systems (LAS) versus point discharges. The distribution between the two was trended forward from existing discharge data as provided by EPD. A base year discharge from 2005 was utilized unless further input or better information became available or if data gaps within the EPD data occurred. Historical data was also used to allocate wastewater quantities by Local Drainage Area (LDA) so that quantity, disposal type, and LDA location could be forecasted.

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. Since I&I can vary between regions, an average I&I percentage was determined for each county within the water planning region based on input from water utilities. If better information was not available, 20% was used as a reasonable default value. Addition of the I&I percentage was applicable only to the portion of the wastewater generated being disposed of via centralized collection systems.

The amount of wastewater generated and disposed of via centralized systems was developed using the following equation:

Total Wastewater Generation = (Water Demand from Municipal and domestic/commercial use multiplied by the Average Indoor Water Use ratio) + I&I

Factors relating to the allocation of wastewater disposal were presented to the councils during council meetings held in March 2010. Comments and input regarding the factors have been incorporated where data became available. As part of the selection of management practices,

each water planning council had the opportunity to adjust the inputs as deemed appropriate by EPD and the council.

VIII. Industrial Wastewater Generation and Disposal Forecasts

Estimates of industrial wastewater were calculated in each watershed unit within the Water Planning Regions. Industrial wastewater volume is driven by industrial water demand for all industries based on prior water use analysis (see section IV). Unless direct permit data or external input became available, industrial wastewater volumes were assigned to the watershed in which the industrial water use occurs.

Industrial water and wastewater permit data provided by EPD were compared to isolate Permittees having both water and wastewater permits and historical flow and discharge data. This was performed state-wide to provide a default ratio of wastewater generated to total permitted water demand for each industry. Multiple years of data were analyzed to determine a representative year. Where multiple Permittees were found for a given NAICS code, their average was taken. Council specific permit matching was also performed to better reflect local conditions and input from the industrial stakeholder working group was also utilized.

Using industry specific water use data and industry specific discharge data, a ratio of wastewater generated to total water demand was derived for each industry and region.

> *Industry Wastewater to Water Ratio = Regional Wastewater Generation divided by Regional Water Use*

The industry wastewater to water ratio was applied to the industrial water use forecast by watershed unit, as shown by the equation below:

> *Wastewater Volume = Industry Water Use in Unit multiplied by Industry Wastewater to Water Ratio*

In addition to volume and location, wastewater was also assigned to either point source discharge or land application. For the purposes of this forecasting effort, the future proportion of these

wastewater treatment options was assumed to be the same as current EPD records, unless specific input from industries or regional water councils was provided.

IX. Municipal and Industrial Water/Wastewater Forecast Results

Table 1. Municipal Per Capita Water Use Values in Gallons per Capita per Day

County	USGS 2005 Per Capita	Revised Per Capita	2050 Plumbing Code Adj.	Revised Per Capita Inputs
Crisp	122		-7.8	-
Dooly	286	163	-7.8	Georgia EPD system inspection based flow and population served data; City of Vienna industrial water supply removed and forecasted in the industrial model.
Macon	585	162	-8.0	Georgia EPD system inspection based flow and population served data; Jim Copland from City of Montezuma provided input concerning recent leak mitigation.
Marion	230	191	-6.4	Georgia EPD system inspection based flow and population served data; City of Buena Vista industrial water supply removed and forecasted in the industrial model.
Meriwether	143		-7.4	-
Pike	1244	142	-5.4	Georgia EPD system inspection based flow and population served data
Schley	183		-7.7	-
Spalding	163		-7.6	-
Sumter	143		-7.9	-
Talbot	37	132	-7.4	Cliff Arnett provided flow and population served data.
Taylor	166		-7.8	-
Upson	233		-8.2	USGS value is reflective of municipally supplied industrial. Industry growth is assumed to keep pace with population and not disaggregated.
Webster	137		-7.9	-

Notes:
1. USGS and revised per capita values apply to the publicly-supplied population.
2. A per capita value of 75 GPCD is applied for each county's self-supplied population unless otherwise noted.
3. 2050 plumbing code adjustments reflect the quantity by which the USGS or revised per capita value is reduced after applying a calculated rate of replacement of older, higher volume flush toilets. See section V. of this Technical Memorandum.

Table 2. OPB Population Projections					
County	**2010**	**2020**	**2030**	**2040**	**2050**
Crisp	22,615	25,383	28,335	32,251	36,550
Dooly	11,600	11,965	12,431	12,976	13,585
Macon	13,568	13,986	14,227	14,323	14,333
Marion	7,088	7,782	8,250	8,629	9,039
Meriwether	23,398	27,039	30,713	34,105	37,107
Pike	18,620	24,535	31,630	37,257	41,586
Schley	4,394	4,998	5,552	6,038	6,467
Spalding	66,203	80,296	96,851	115,797	138,074
Sumter	33,063	37,536	42,306	47,368	52,743
Talbot	6,487	6,843	6,979	7,195	7,354
Taylor	8,838	9,403	9,982	10,587	11,231
Upson	27,761	29,077	29,908	30,383	30,513
Webster	2,192	2,412	2,531	2,526	2,477
TOTAL	245,827	281,255	319,695	359,435	401,059

Table 3. Municipal Population Served Percentages		
County	**% Publicly-Supplied**	**% Self-Supplied**
Crisp	78%	22%
Dooly	66%	34%
Macon	54%	46%
Marion	72%	28%
Meriwether	43%	57%
Pike	22%	78%
Schley	84%	16%
Spalding	81%	19%
Sumter	63%	37%
Talbot	72%	28%
Taylor	53%	47%
Upson	44%	56%
Webster	54%	46%

Table 4. Municipal Water Demand Forecasts, MGD-Annual Average

County	Publicly-Supplied Surface Water		Publicly-Supplied Groundwater		Self-Supplied Groundwater (1)		Total	
	2010	2050	2010	2050	2010	2050	2010	2050
Crisp	0.00	0.00	2.16	3.26	0.37	0.54	2.53	3.80
Dooly	0.00	0.00	1.25	1.39	0.30	0.31	1.55	1.70
Macon	0.00	0.00	1.20	1.20	0.46	0.44	1.66	1.64
Marion	0.00	0.00	0.98	1.20	0.15	0.17	1.12	1.38
Meriwether	1.44	2.16	0.00	0.00	1.00	1.43	2.44	3.59
Pike	0.59	1.27	0.00	0.00	1.08	2.25	1.68	3.52
Schley	0.00	0.00	0.67	0.95	0.05	0.07	0.73	1.02
Spalding	8.72	17.34	0.00	0.00	0.94	1.77	9.66	19.11
Sumter	0.00	0.00	2.97	4.48	0.92	1.31	3.89	5.80
Talbot	0.00	0.00	0.62	0.66	0.14	0.14	0.75	0.80
Taylor	0.00	0.00	0.78	0.94	0.31	0.36	1.09	1.30
Upson	2.78	2.95	0.09	0.09	1.16	1.14	4.03	4.18
Webster	0.00	0.00	0.16	0.17	0.08	0.08	0.24	0.25
TOTAL	**13.53**	**23.72**	**10.87**	**14.36**	**6.97**	**10.00**	**31.37**	**48.08**

Notes:
1. All self-supplied water is assumed to derive from private groundwater wells.

Table 5. Municipal Wastewater Generation Factors

County	% Average Indoor Water Use (1)	% Septic (2)	% I/I (3)	% Point Discharge (4)	% LAS (4)
Crisp	83%	38%	20%	100%	0%
Dooly	85%	28%	20%	6%	94%
Macon	88%	41%	20%	100%	0%
Marion	83%	44%	20%	100%	0%
Meriwether	85%	58%	20%	33%	67%
Pike	77%	83%	20%	26%	74%
Schley	85%	71%	20%	100%	0%
Spalding	88%	51%	20%	68%	32%
Sumter	83%	10%	20%	100%	0%
Talbot	85%	82%	20%	100%	0%
Taylor	77%	28%	20%	17%	83%
Upson	85%	21%	20%	100%	0%
Webster	88%	99%	20%	0%	0%

Notes:
1. Applied to both publicly- and self-supplied water users.
2. Applied to publicly-supplied water-users. For self-supplied water users 100 % septic disposal was assumed.
3. Applied to publicly-supplied water-users. For self-supplied water users 0 % I/I was assumed.
4. Applied to all non-septic forecasted wastewater quantities. Counties with a zero percent point discharge and LAS are assumed to dispose of all wastewater via septic systems.

Table 6. Municipal Wastewater Generation Forecast, MGD-Annual Average								
	Point Discharge		LAS		Septic		Total	
County	2010	2050	2010	2050	2010	2050	2010	2050
Crisp	1.32	2.00	0.00	0.00	0.99	1.48	2.31	3.48
Dooly	0.06	0.06	0.86	0.96	0.55	0.60	1.47	1.62
Macon	0.59	0.58	0.00	0.00	0.75	0.72	1.33	1.30
Marion	0.54	0.67	0.00	0.00	0.48	0.59	1.02	1.25
Meriwether	0.20	0.30	0.41	0.62	1.56	2.28	2.18	3.21
Pike	0.02	0.05	0.07	0.15	1.21	2.54	1.31	2.74
Schley	0.20	0.28	0.00	0.00	0.45	0.64	0.65	0.91
Spalding	3.06	6.09	1.42	2.83	4.71	9.27	9.19	18.19
Sumter	2.65	3.99	0.00	0.00	1.02	1.47	3.66	5.46
Talbot	0.11	0.12	0.00	0.00	0.54	0.58	0.66	0.70
Taylor	0.09	0.11	0.43	0.52	0.41	0.48	0.92	1.10
Upson	2.31	2.45	0.00	0.00	1.50	1.51	3.81	3.96
Webster	0.00	0.00	0.00	0.00	0.21	0.22	0.21	0.22
TOTAL	11.15	16.70	3.19	5.07	14.39	22.37	28.72	44.14

Table 7. Employment Projections by Major Water Using Industry							
NAICS	Industry	SIC	2010	2020	2030	2040	2050
0	Other Industrial	0	72,432	76,744	80,356	84,130	88,598
212	Mining	14	349	350	356	363	371
311	Food - Food Manufacturing	20	1,748	2,221	2,290	2,335	2,388
313	Textiles - Textile Mills	22	744	66	7	1	0
314	Textiles - Textile Product Mills	22	433	420	420	426	435
315	Apparel	23	42	4	0	0	0
322	Paper	26	580	672	684	696	712
327	Stone and Clay	32	381	391	404	413	424

Table 8. Water Use Projections by Major Water Using Industry, MGD-Annual Average

NAICS	Industry	SIC	2010	2020	2030	2040	2050
0	Other Industrial [(1)]	0	0.65	5.19	5.22	5.25	5.30
212	Mining	14	5.46	6.11	6.75	7.40	8.05
311	Food - Food Manufacturing	20	2.27	2.89	2.97	3.03	3.10
313	Textiles - Textile Mills	22	0.09	0.09	0.09	0.09	0.09
314	Textiles - Textile Product Mills	22	0.23	0.23	0.23	0.23	0.24
315	Apparel	23	0.03	0.03	0.03	0.03	0.03
322	Paper	26	11.13	12.13	13.05	13.98	13.99
327	Stone and Clay	32	0.03	0.03	0.03	0.03	0.03
TOTAL			19.89	26.69	28.38	30.05	30.82

Notes:
1. The increase in projected water demand after 2010 is associated with input provided by Hays Arnold of the City of Thomaston. A planned industrial surface water user is anticipated to utilize an existing process water facility owned by the City of Thomaston.

Table 9. Wastewater Generation Projections by Major Water Using Industry, MGD-Annual Average

NAICS	Industry	SIC	2010	2020	2030	2040	2050
0	Other Industrial [(1)]	0	0.40	3.17	3.18	3.21	3.23
212	Mining	14	5.46	6.11	6.75	7.40	8.05
311	Food - Food Manufacturing	20	2.16	2.74	2.83	2.88	2.95
313	Textiles - Textile Mills	22	0.08	0.08	0.08	0.08	0.08
314	Textiles - Textile Product Mills	22	0.10	0.10	0.10	0.11	0.11
315	Apparel	23	0.02	0.02	0.02	0.02	0.02
322	Paper	26	9.65	10.52	11.32	12.12	12.13
327	Stone and Clay	32	0.03	0.03	0.03	0.03	0.03
TOTAL			17.89	22.76	24.31	25.84	26.59

Notes:
1. The increase in projected water demand after 2010 is associated with input provided Hays Arnold of the City of Thomaston. A planned industrial surface water user is anticipated to utilize an existing process water facility owned by the City of Thomaston.

Appendix A - Current Water Use Questionnaire

The following questionnaire is designed to aid in the development of future water needs in Georgia through year 2050. The demand projections, once completed, will be compared to available water resources (both surface water and groundwater) for the development of Georgia's regional water development and conservation plans (WDCP).

Please review the following questions carefully. The questions are designed to fine tune the per capita residential/commercial water use rate that will be used as the basis for future water demand projections. Please report both current (2008) and year 2005 quantities.

Name of Water Supplier: _____ Location: _____ County

Contact Name: _____

Contact E-mail: _____

Phone #: _____

1. Does the public supplier purchase water wholesale from outside the County boundary?

   1.1. If yes, how much? 2008 quantity _____ 2005 quantity _____

   1.2. If yes, do they plan to continue to purchase wholesale water in the future (through 2050)?

2. Does the public supplier sell water wholesale outside the County boundary?

   2.1. If yes, how much? 2008 quantity _____ 2005 quantity _____

   2.2. If yes, do they plan to continue to sell wholesale water in the future (through 2050)?

3. Does the public supplier sell water to individual customers outside the County boundary?

   3.1. If yes, how much? 2008 quantity _____ 2005 quantity _____

4. Does the public supplier have significant industrial or other non-residential customers?

   4.1. If yes, how much? 2008 quantity _____ 2005 quantity _____

   4.2. If yes, and industrial, what type of industry is it?

   4.3. Are there any known plans for future expansion?