Georgia's State Water Plan

Population and Employment Projections Summary

Long-range population and employment projections are necessary inputs in order to forecast demand for regional municipal and industrial water and wastewater. In addition to their application in water resource planning, population and employment projections are the foundation for other planning and budgeting activities in which the state is involved. These include economic and community development, transportation, health care, and education. The Governor's Office of Planning and Budget (OPB) is responsible for preparing demographic data for the state, and therefore has significant interest in creating the technical capability - at the Carl Vinson Institute of Government (CVIOG) at the University of Georgia (UGA) - to produce a definitive and consistent set of population and employment projections for use by all agencies of state government.

In July of 2008 OPB and EPD executed an interagency agreement whereby EPD would provide the initial funding for the establishment of a demographics program at CVIOG. Subsequently, OPB and the Board of Regents entered into an agreement to have CVIOG - through this newly created demographics program - produce regional population and employment projections (in five year increments) for the period 2010 through 2050. The parties to the agreement also established an advisory board to guide the initiation of CVIOG's population and employment projections work. This advisory board consists of the following entities:

- Governor's Office of Planning and Budget
- Georgia Environmental Protection Division
- Georgia Department of Community Affairs
- Georgia Department of Transportation
- Association County Commissioners of Georgia
- Georgia Municipal Association
- Council of Regional Commissions
- Atlanta Regional Commission
- The State Economist

The **Population** projections cohort component model for this project is based on one used by demographers at the University of Texas-San Antonio (UTSA) to produce the official projections for Texas. The preliminary projections have been modified by CVIOG's Applied Demography Program based on input from its Advisory Board and staff from Georgia's 16 Regional Development Centers. CVIOG's Applied Demography Program is under the direction of Dr. Warren Brown. Before joining CVIOG in 2009, Dr. Brown directed Cornell University's Program on Applied Demographics, producing population estimates and projections for New York State. Dr. Brown has worked closely with the U.S. Census Bureau; he is a past chair of the Census Bureau's Federal State Cooperative for Population Estimates. He was also the research director of Cornell's Census Research Data Center, one of nine centers in the country providing approved projects with access to internal files of the Census Bureau.

The **Workforce** projections econometric time series model has been developed by Dr. Jeffrey Dorfman, Professor of Agricultural and Applied Economics, University of Georgia. Dr. Dorfman is Co-Director of UGA's Land Use Studies Initiative and is an expert on the economics of growth, sprawl, land use decisions, and methods of forecasting.

The two methods combined in this project are widely used by federal and state governments, academic researchers, and private firms to project population and employment. They are both based on the momentum of past trends and combine what is referred to as a bottom up and top down approach. That is, trends in detailed components of population and employment drive the bottom up approach, while trends in overall change for larger geographic areas serve to constrain the detailed change and serve as a top□down control. By bringing the population and employment projections into balance with each other, a consistent and more realistic picture of change is developed.

Local Government Advisory Board

The State Water Plan (SWP) contains a provision for an advisory body of local elected officials to provide recommendations and input on regional population, economic and employment forecasts. Between Council meetings 1 and 2, EPD - in cooperation with both ACCG and GMA - shared the population and employment projections and methodologies with locally elected officials, and solicited their input for CVIOG's consideration prior to finalizing the projections. The projections and background information on methodologies, assumptions, and data sources were presented to local government officials via a digital video disc (DVD) that was mailed to each chief elected official in county and municipal government in Georgia. The DVDs included short video modules (done by CVIOG principal staff) and links to more detailed information on www.georgiawaterplanning.org/pe that explained the methodologies, assumptions, and data sources used to produce the projections, as well as a presentation of the projections themselves. The elected officials were asked to have their professional staff submit pertinent comments on the methodologies and projections to the planning contractor for the subject regional water planning council; the planning contractor will in turn assemble these comments and transmit to CVIOG for further consideration. A summary of comments received from locally elected officials within the planning region will be shared with council members at Council meeting 2.

Regional Water Planning Council Members

Regional Water Planning Council Members also received the DVD and were invited to submit comments. In addition, a discussion of the population and employment forecasts will take place during Council Meeting 2.

1. Overview

The projections of population and workforce have been prepared in three major processes. First population projections were prepared initially using only demographic methods and rates of change. Second were the workforce projections which in similar manner were initially prepared using econometric/time series methods, without reference to the population projections. The third step was an iterative process in which the workforce projections were adjusted using information from the population projections; and then the population projections were adjusted using information from the adjusted workforce projections.

Population

The preliminary population projections have been produced by Dr. Nazrul Hoque, a consultant to the Vinson Institute. Dr. Hoque is an Assistant Professor in the Demography and Organization Studies Department, University of Texas at San Antonio. He is responsible for producing the official population projections for the State of Texas. These projections should be used only with full awareness of the inherent limitations of population projections in general and with particular and detailed knowledge of the procedures and assumptions delineated in the detailed report on Methodology.

A cohort-component model was used to project the population for the State of Georgia, and for each of the counties. The regional populations are the sum of their component counties. Four alternative scenarios of net migration were used to prepare the preliminary projections. These scenarios assume the same set of mortality and fertility assumptions in each scenario but differ in their assumptions relative to net migration.

The net migration assumptions made for three scenarios are derived from 1990-2000 patterns which have been altered relative to expected future population trends. This is done by systematically and uniformly altering the adjusted 1990-2000 net migration rates by age, sex and race/ethnicity. The scenarios so produced are referred to as the zero migration (0.0) scenario, the one-half 1990-2000 (0.5) scenario, and the 1990-2000 (1.0) scenario. The fourth scenario uses 2000 to 2007 estimates of net migration with the 2007 population values being taken from the Georgia age, sex and race/ethnicity estimates.

The projections of total population were examined with three review principals in mind. The first being that the projected population should be reasonably consistent with the historical pattern of change. Secondly, extremes of population increase or decrease should be modified to more reasonable levels. Third, that the impact of one-time events such as natural disasters or major employment change, not be used to drive future changes. The pattern of migration that seemed most reasonable for the preliminary population projections were to gradually shift from the migration rate of the high growth period of 1990-2000 to a rate by 2040 which was half that of the 1990s. As the population base in the state grows rapidly it becomes increasingly difficult to continue growing at the same rate of change.

Workforce

The preliminary population projections have been produced by Professor Jeffrey H. Dorfman, Professor in the Department of Agricultural and Applied Economics, University of Georgia. Prof. Dorfman is an expert in the economics of growth and land use, and quantitative analysis for forecasting. These

projections should be used with awareness of the limitations of employment projections in general and with knowledge of the procedures and assumptions delineated in the detailed report on Methodology.

The basic forecasting methodology used in generating projections of future employment by industry and by region in Georgia is a time series model. These models are then calibrated to adjust the growth rate in employment in each industry and region in a way that moves the growth rate toward the projected employment growth in the state, in that region, and for that industry's statewide employment growth rate.

Population and Workforce are Balanced

The projections of population and workforce were adjusted to bring them in line with each other. The only industry where the original projections for employment seemed too low for the projected population growth was the retail sector. Retail employment is fairly closely tied to population, so this is an important industry to synchronize employment and population projections. Retail employment projections were adjusted upwards to project 8% growth in each five year period from 2010 to 2030 (1.55% per year) and to project 6% growth in each five year period from 2030 to 2050 (1.17% per year).

The next step was to adjust on a regional basis the ratio of population to employment, with the effect of reducing total population, especially for the out years between 2030 and 2050. The ratio of population to employment varied between regions, as some regions draw from a laborshed that extends beyond their boundaries, others are more balanced, and yet others supply workers to jobs outside their boundaries. We have assumed that these regional difference will continue throughout the projections period.

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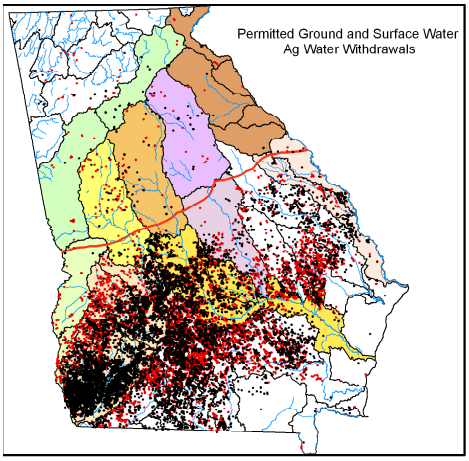
Georgia Agriculture and Water Use Summary

Agriculture is one of the largest economic sectors in Georgia. The direct and indirect economic impacts of food and fiber production total more than $55 billion. Food Processing output alone totaled $16.8 billion in 2005 and employed 64,000 Georgians. Total direct and indirect employment from food and fiber production in Georgia employs 366,000 Georgians.

Most farming occurs south of the Fall Line, where water is abundant and the soil is more suitable for farming. The most widely grown commodities are row and forage crops such as cotton, corn, peanuts, and soybeans. These account for more than 70% of the crops grown in Georgia. Indeed, in 2005 Georgia ranked first nationally in the production of peanuts, third in sweet corn, and fourth in cotton.

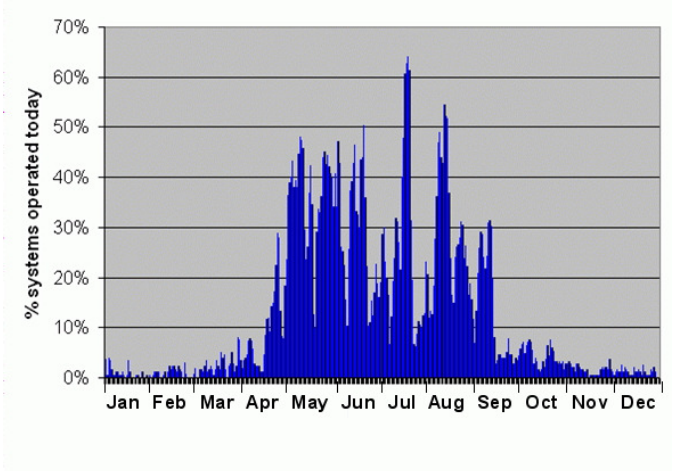
The vast majority of food, feed, and fiber production in Georgia depends heavily on supplemental irrigation. Irrigation was uncommon in Georgia before 1975, but it has become much more widely used since then. In Georgia, there are slightly more than 1.4 million acres of irrigated farmland. This number changes somewhat from year to year depending on farm commodity prices, land prices, and production costs (such as diesel fuel).

Because most farming occurs below the Fall Line, most farm irrigation also occurs there. Farmers withdraw water from streams and ponds on or flowing by their property, but rarely from major river channels. Thus, the vast majority of surface water used for farm irrigation does not come from rivers supplying north Georgia or Fall Line cities like Atlanta, Columbus, Macon, etc. Farmers also use groundwater for irrigation. The use of groundwater for irrigation has increased over the years because groundwater is a more reliable source than surface water, which may become unavailable in drought years or late summer when it is needed the most. In Georgia, most groundwater for irrigation comes from the Floridan aquifer, a limestone formation that underlies most of the Coastal Plain. On the map below, each red dot represents the location of a permitted surface water irrigation withdrawal, and each black dot represents a groundwater withdrawal.



Most farm irrigation systems are center pivots, which are usually hundreds of feet in length, and deliver as much as 1500 gallons of water per minute (gpm). A typical center pivot irrigation system can supply water to fields ranging from 100 to 250 acres in size. Center pivots are the most common system used because they are cost effective and have low labor costs. Other irrigation systems commonly used in Georgia are "traveler" systems, drip irrigation and solid set sprinklers (typically used on orchard crops and ornamentals). The choice of irrigation system may depend on the crop, field size, topography, and the amount of water needed, but center pivots have become more common as other systems are replaced.

Although some irrigation takes place year round in Georgia, most of it happens between April and September, which is when the major row and forage crops are planted. Depending upon rainfall, crop yield goals, and water supplies, an individual field may be irrigated from 3 to 10 times in the growing season. A large field may require 2-3 days of irrigation to water the entire crop. The rest of the year, the irrigation system and pumps may be idle. The following graph shows the percentage of irrigation systems operating on any given day in south Georgia during a one-year period.



The amount of water farmers use to irrigate crops varies widely, and depends on the needs of a particular crop, the stage of its development, temperature and rainfall, soil type, irrigation system type, the availability of water, and farmer preference. In dry years, farmers use more water than in wet or normal years. Irrigation usage typically is highest in June, July, and August, when the major forage and row crops are at a critical stage of development and the weather is the hottest.

Averaged across the State, each crop type uses a certain amount of water each year, depending on whether the year was wet, normal, or dry. The following table shows the major crops and the amount of water applied to them, in inches per acre, for 2008, a severe drought year. Recall that cotton, corn, peanuts, soybeans, and pecans are the most widely grown crops in Georgia, and thus volumetrically use the most irrigation water.

Irrigation amounts in 2008	
Crop	**Inches of water per acre**
Cotton	10.0
Corn	14.0
Peanuts	9.9
Soybean	6.7
Pecan (drip)	11.7
Sod production	17.9

According to State law, a person or entity wishing to withdraw more than 100,000 gallons per day on a monthly average needs to obtain a withdrawal permit from EPD, including water withdrawals for farm irrigation. Most irrigation systems can use more than 1,000,000 gallons per day. In Georgia, there are more than 21,500 withdrawal permits for farm use. EPD has an Agricultural Permitting Unit that manages all these permits, and permit applications. The Unit is housed in Tifton, GA.

Until 2003, farm use permittees were not required to measure or report their water use. In 2003, the Georgia General Assembly amended the statutes governing water use to require meters on all permitted irrigation withdrawals. The Georgia Soil and Water Conservation Commission was charged with locating and installing meters on all permitted wells and pumps by June 2009.

The Georgia Comprehensive State-wide Water Management Plan requires EPD to develop long-range forecasts of agricultural water use for 10, 20, 30, and 40-year horizons. These forecasts are being done by researchers in the University of Georgia's National Environmentally Sound Production Agriculture Laboratory; Department of Biological and Agricultural Engineering; and Department of Agricultural and Applied Economics. The approach, like all forecasting, will look to trends from the past and consider foreseeable changes. The questions that will be addressed are:

–Which crops will be grown; how many acres of each will need to be irrigated?
–How much water is needed for each crop, how is that affected by weather?
–What is the total of acres to be irrigated, and where will those be located?
–Which water sources will be used?
–How much water will be withdrawn and applied?

UNDERSTANDING MODELS

- A model is a tool used to evaluate the relationships between components of a system
  - > Physical systems
  - > Chemical systems
  - > Biological systems
  - > Economic systems
  - > Social systems

- Models document current conditions in order to be able to predict future conditions based on certain assumptions.

- Examples of models
  - > Conceptual business plan
  - > Architectural (physical) models of buildings and landscapes
  - > Wind tunnel models of cars and airplanes
  - > Mathematical models of traffic flow
  - > Actuarial models for making loans and writing insurance
  - > Economic stress tests of bank strength

- Mathematical models used during water resource assessments and forecasts.
  - > Models of the flow of water in rivers under varying circumstances
  - > Models of the changes in surface water quality and assimilative capacity under varying circumstances
  - > Models of aquifer sustainable yields
  - > Models that produce projections of future population and employment under varying circumstances
  - > Models that produce projections of agricultural water uses under varying circumstances

- A general description of resource assessment models
  - > Mathematical models that incorporate governing equations, system geometries, boundary conditions, and input data
  - > Constrained by physical and chemical measurements of system components such as stream flows, water quality, and groundwater levels
  - > Used to quantify relationships between physical and chemical components of systems
  - > Predict future outcomes of changes in physical and chemical components such as surface water withdrawals, groundwater withdrawals, waste discharges to streams, and climate change
  - > Primarily using the dry-year conditions because that is the critical condition, but with the ability to evaluate other conditions as well.

Georgia's
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Water Resource Assessments Summary

State Water Plan

The Georgia Comprehensive State-wide Water Management Plan (State Water Plan) was adopted by the General Assembly in 2008. The State Water Plan provides for:

- **Water Resource Assessments**
  The Georgia Environmental Protection Division (EPD) will conduct water resource assessments to: 1) determine a sound scientific understanding of the condition of the water resources, in terms of the quantity of surface water and groundwater available to support current and future instream and offstream uses, and; 2) to measure the capacity of Georgia's surface waters to absorb pollutants without unacceptable degradation of water quality.

- **Forecasts**
  Forecasts of future population expectations, water demands, wastewater returns, land surface types and distribution and employment characteristics will be developed. Water use forecasts will be developed for: 1) domestic/ commercial water use; 2) industrial water use; 3) energy water use; and 4) agricultural water use.

- **Regional Water Planning**
  Regional Water Planning Councils will prepare recommended Water Development and Conservation Plans. These regional plans will promote the sustainable use of Georgia's waters, through the selection of an array of management practices, to support the state's economy, to protect public health and natural systems, and to enhance the quality of life for all citizens. The plans will identify steps to be taken to ensure that the forecasted needs can be met. Implementation of the State Water Plan requires that EPD provide the Regional Water Planning Councils with technical assistance, such as contractor support, resource assessments, forecasts and guidance. After the Water Development and Conservation Plans are adopted, EPD permits and Georgia Environmental Facilities Authority (GEFA) grants and loans for water projects will be guided by the Plan.

Water Resource Assessments

EPD with the assistance of other state agencies, the University System of Georgia and other research institutions, the U.S. Geological Survey and contractors, will conduct water resource assessments to determine Surface Water Availability, Groundwater Availability, and Surface Water Quality. The assessments will include modeling, monitoring, and the compilation and management of data. Assessments will be provided to each regional water planning council as a starting point for the development of a recommended Water Development and Conservation Plan.

Surface Water Availability

The Surface Water Availability assessment will help determine the amount of water that can be consumed from the rivers and lakes of Georgia without altering the desired flow regime and the opportunities for use of water supported by that flow regime. EPD and its contractors will use the "River Basin Planning Tool", developed by the Georgia Water Resources Institute at Georgia Tech, to analyze flows in Georgia's river systems. The 14 river basins in Georgia will be delineated into smaller hydrologically connected areas, or sub-basins. The River Basin Planning Tool will allow EPD to determine the quantity of water available for consumptive use in each sub-basin. Consumptive use refers to the amount of water taken from but not returned to, without undue delay, surface water sources. Critical constraints for the technical analysis include: unimpaired flow data of all river basins, the desired flow regime of the river system, the amount of storage for water supply purpose, the desired quantity of water supply, the desired reliability of water supply, and expected quantity of return of treated wastewater to the system.

Groundwater Availability

The Groundwater Availability assessment will provide information on the ability of water from aquifers in Georgia to meet current and future needs. Together with the Surface Water Availability Assessment, they form the "consumptive use assessment" described in the State Water Plan. EPD will prioritize the aquifers for Groundwater Availability assessment based on the current condition of an aquifer and expected future demands on that aquifer.

For the prioritized aquifers, EPD, with contractor support, will develop groundwater budget models, essentially input and output balances, to determine sustainable yields (the amount of water that can be withdrawn without creating an unacceptable impact such as dropping aquifer level, salt-water intrusion, or significantly lowered surface water). For the other aquifers, benchmarks will be established to indicate the potential for unacceptable impacts from future withdrawals. Management of these aquifers will focus on monitoring of aquifer response, and the response of other connected water resources, to future increases in withdrawal.

Groundwater withdrawals may need to be limited so as not to impair groundwater quality Examples include: limiting withdrawals from Atlantic Coastal Plain aquifers to manage salt water intrusion, and limiting withdrawals from crystalline and Paleozoic rock aquifers in areas of man-made pollutant plumes (e.g. landfill leachate, dry cleaner plumes, underground storage tank (UST) plumes).

Surface Water Quality

Surface Water Quality refers to the amount of pollution waterways can handle and still meet water quality standards. The Assimilative Capacity assessment will measure the capacity of Georgia's surface waters to absorb pollutants without unacceptable degradation of water quality. This process includes basic modeling of all of Georgia's 52 watersheds. More complex models will be developed for watersheds where the assimilative capacity may not be adequate to support projected needs for wastewater discharge. The water quality models will be used to evaluate the impacts of forecasted flows, proposed discharge locations, and future land use patterns.

Monitoring and Information Management

For ongoing assessment of the state's water resources, EPD will develop a comprehensive monitoring program and a well-coordinated, computer/web based system for information management. To develop the comprehensive monitoring program, EPD and its contractors will compile existing data, coordinate and integrate governmental and voluntary water monitoring programs, identify information gaps and develop a program to fill those gaps. This information management system will be accessible to a variety of users.

For More Information

For more information on the State Water Plan visit www.georgiawaterplanning.org or contact Arnettia Murphy, arnettia_murphy@dnr.state.ga.us, 404-656-4157.