

Appendix B

“Population Projections and Economic Forecasts for Water Use Planning”

This appendix contains the above titled report produced by the Center for Business and Economic Research in the University of Alabama’s Culverhouse College of Commerce through a grant by the Office of Water Resources (OWR).

The report provides population projections and economic forecasts for Alabama and the state’s 67 counties in five-year intervals from 2010 to 2040. Population is also forecasted by county for the state’s 1,181 census tracts as defined in the 2010 Census. These forecasts furnish data to OWR that support long-term water supply planning and in projecting water use demands through 2040 for the state.

Both the population and economic forecasts are produced by models developed and maintained by the Center for Business and Economic Research. The methodology for these projections is detailed in the report.

POPULATION PROJECTIONS AND ECONOMIC FORECASTS FOR WATER USE PLANNING



For:
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Alabama Department of Economic and Community Affairs

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Population Projections and Economic Forecasts for Water Use Planning

This project provides population projections and economic forecasts for Alabama and the state's 67 counties in five-year intervals from 2010 to 2040. Population is also forecasted by county for the state's 1,181 tracts as defined in the 2010 Census. These forecasts furnish data to the Office of Water Resources for projecting water use demands through 2040 in the context of long-term water supply planning for the state.

Both the population and economic forecasts are produced by models developed and maintained by the Center for Business and Economic Research in The University of Alabama's Culverhouse College of Commerce. The methodology for these projections is detailed in this report.

Population Projections Summary

The Center for Business and Economic Research has projected population for all counties and census tracts in Alabama for 2015 to 2040 in five-year increments. The projections are based on the available demographic and socioeconomic information and reflect current expectations of future economic conditions.

Overall, Alabama's population is expected to increase by 804,955 people (16.8 percent) over the 2010 to 2040 period, rising from 4,779,736 in 2010 to 5,584,691 in 2040. Projected population growth varies by county and census tract. Counties with the highest number of projected new residents are Madison, Baldwin, Shelby, Lee, Tuscaloosa, Limestone, St. Clair, Houston, Marshall, and Mobile.

Top 10 Increasing County Populations in Alabama

County	2010 Census	2040 Projection	Change 2010-2040	
			Number	Percent
Madison	334,811	470,624	135,813	40.6
Baldwin	182,265	300,466	118,201	64.9
Shelby	195,085	295,029	99,944	51.2
Lee	140,247	211,575	71,328	50.9
Tuscaloosa	194,656	248,921	54,265	27.9
Limestone	82,782	131,174	48,392	58.5
St. Clair	83,593	125,720	42,127	50.4
Houston	101,547	131,211	29,664	29.2
Marshall	93,019	121,698	28,679	30.8
Mobile	412,992	438,667	25,675	6.2

Source: U.S. Census Bureau and Center for Business and Economic Research,
The University of Alabama, September 2014.

Thirty-one of Alabama's 67 counties have projected population declines from 2010 to 2040, with percentage losses ranging from -0.1 to -22.7 percent. Among these counties, Macon, Monroe, Dallas, Lawrence, Marengo, Clarke, Marion, Choctaw, Fayette, and Washington counties are the bottom 10 counties in terms of the number of residents lost.

Bottom 10 Declining County Populations in Alabama

County	2010 Census	2040 Projection	Change 2010-2040	
			Number	Percent
Macon	21,452	16,590	-4,862	-22.7
Monroe	23,068	19,105	-3,963	-17.2
Dallas	43,820	39,858	-3,962	-9.0
Lawrence	34,339	30,477	-3,862	-11.2
Marengo	21,027	17,626	-3,401	-16.2
Clarke	25,833	22,555	-3,278	-12.7
Marion	30,776	27,696	-3,080	-10.0
Choctaw	13,859	10,867	-2,992	-21.6
Fayette	17,241	14,542	-2,699	-15.7
Washington	17,581	14,883	-2,698	-15.3

Source: U.S. Census Bureau and Center for Business and Economic Research,
The University of Alabama, September 2014.

Methodology

Economic Forecasts

CBER has prepared baseline economic forecasts for the state's manufacturing sector and the two-digit sectors of the economy for all 67 counties in Alabama. Economic output and employment forecasts for counties are made to 2040 using the two-digit NAICS industry classifications. Appropriate versions of the Alabama Econometric Model (AEM) were developed and used to calculate the economic forecasts. The AEM is developed and maintained by CBER.

The Alabama Econometric Model is a simultaneous equation model with over 200 stochastic equations and identities. This simultaneous equation structure captures the interrelationships and feedback among economic variables and provides consistent measures of economic activity across all sectors of the state's economy, including the gross domestic product (GDP), employment, wage rates, and income. GDP is defined as the total value of goods and services produced in the nation, the state, or a county. Consistency in estimating the models is achieved because all of the equations included in the model are solved simultaneously. Simultaneous equation econometric models are based on sound statistical methodology that enables the testing of estimated structural relationships. These models are powerful tools for regional economic forecasting and economic impact analysis. AEM comprises five major components or blocks, each consisting of a set of equations for every major sector and industry in the state's economy.

Output Block. This block models gross output in 2005 dollars (real gross output) for the major sectors. In general, the component of GDP originating from a state sector is influenced by the national counterpart, aggregate state demand as represented by total real personal income, and competitive factors such as the relative tax burden and the relative wage rate. U.S. output and state total personal income are positively related to output. Typically, a negative relationship exists with the relative tax burden variable as higher state and local taxes reduce output. A lower relative wage rate tends to increase investment and production. Total GDP is obtained through the use of an identity that sums up each sector's output. The general functional form of the output equation is:

State sector real output = F(U.S. same sector output, relative sector wage rate, relative tax burden, ...)

For sectors such as trade and finance, insurance, and real estate, and some of the services providing sectors, the state and/or national real personal income could be a better driving force of the output variable because internal demand tends to play a stronger role. The final selection of independent variables for the output equation depends on model fitness and is therefore determined empirically. Use of state real

personal income as the driving variable introduces more feedback effects in the model through the output-employment-income relationship.

Employment Block. This block models demand for labor. Each sector's wage and salary employment is derived from its real gross output and real wage rate. Theoretically, real gross output should be positively related to employment, while the real wage rate has a negative relationship. The total state wage and salary employment is obtained as the sum of the employment for each sector. The general functional form of the employment equation is:

State sector wage and salary employment = F(Same state sector real output, real sector wage rate, ...)

Unemployment Rate. State unemployment rate is typically a function of the U.S. unemployment rate and total state employment or the change in total state employment. The state unemployment rate is positively related to the U.S. unemployment rate and negatively related to the level of state employment or the change in total state employment, as rising employment creates additional aggregate demand generating downward pressure on unemployment. The general functional form of the unemployment rate equation is:

State unemployment rate = F(U.S. unemployment rate, change in or actual state total employment, ...)

Wage Rates. Each sector's wage rate is explained by the corresponding U.S. sector wage rate and the state unemployment rate. While the state wage rate has a tendency to move together with the U.S. wage rate, its rise can be tempered by a high state unemployment rate. The general functional form of the wage rate equation is:

State sector wage rate = F(Corresponding U.S. sector wage rate, state unemployment rate,...)

Income Block. Wage and salary income is obtained by multiplying wage and salary employment by the wage rate for each sector and then summing up across the sectors. Other income categories such as dividends, interest, and rent; transfer payments; other labor income; proprietors' income; and adjustment for residence are driven by their national level counterparts. The general functional form of the income equations are:

State income category = F(Corresponding U.S. income category, ...).

Total personal income is the sum of total wage and salary income and the other income categories. Very often total personal income, deflated by the GNP price deflator, is used to drive the output variables of such sectors as construction; transportation, communication, and public utilities (TCPU); finance, insurance, and real estate (FIRE); and services.

National Economy Assumptions for Economic Forecast

The following exogenous assumptions from IHS Global Insight were used for the forecasts in this study:

- Real GDP growth will average 2.5 percent per year for 2014 through 2040.
- The outlook for inflation remains moderate. Consumer price index (CPI) inflation will average 2.0 percent per year over the forecast period. Core inflation will average 2.0 percent.
- Nonfarm business productivity growth averages 1.9 percent over the forecast period.
- The current-account deficit is negative through 2024. At present, the current-account deficit is approximately \$509 billion, but it is expected to improve over the forecast period.
- Oil prices as measured by the West Texas Intermediate crude will continue to rise over the forecast period.
- The labor market improves over the forecast period, with the unemployment rate averaging 5.3 percent.
- The federal budget continues to run a deficit throughout the forecast period, currently at \$413 billion. It is expected to improve slightly over the forecast period.

Alabama forecasts were made for the manufacturing sector of the state, including these industries:

Industry	NAICS
Manufacturing	3110-3399
-Nondurable Goods	
Food Products	3110
Textiles and Products Mills	3130-3140
Apparel	3150
Paper	3220
Printing and Related Activities	3230
Petroleum and Coal Products	3240
Chemicals	3250
Rubber, Plastics	3260
-Durable Goods	
Wood Products	3210
Nonmetallic Mineral Products	3270
Primary Metals	3310
Fabricated Metals	3320
Machinery	3330
Computer and Electronic Products	3340
Electrical Equipment and Appliances	3350
Motor Vehicle Body, Trailers and Parts	3361-3363
Other Transportation Equipment	3364-3369
Furniture and Related Products	3370
Miscellaneous	

Baseline economic forecasts for each of the 67 counties are provided in the tables included in the Excel workbook. GDP at the county level is also calculated in constant 2005 dollars. County level forecasts are driven by both historical trends and recent developments. The GDP for each county was forecasted first, with most county employment forecasts based on the county level GDP forecasts. The economic forecasts take into account IHS Global Insight forecasts of annual national economic indicators, such as GDP, consumer spending, and industrial production indices through 2040, and the state level forecasts.

The county level econometric models provide baseline projections under certain key assumptions, primarily based on historic trends and economic growth. County level economic forecasts (both for GDP and payroll employment) were made for the following two-digit sectors of the economy and are provided in the tables included in the workbook.

NAICS	Total GDP and Employment
11	Agriculture
21	Mining
22	Utilities
23	Construction
31-33	Manufacturing
42	Wholesale trade
44-45	Retail trade
48-49	Transportation and warehousing
51	Information
52	Finance and insurance
53	Real estate and rental and leasing
54	Professional, scientific, and technical services
55	Management of companies and enterprises
56	Administrative and waste management services
61	Educational services
62	Health care and social assistance
71	Arts, entertainment, and recreation
72	Accommodation and food services
81	Other services, except public administration
	Government and government enterprises

Population Projections

County Population Projections

Population projections at the county level are generated using an in-house cohort-component model developed by the Center for Business and Economic Research (CBER). The model is driven by measured demographic change including population growth (or decline) between 2000 and 2010 as well as recent population estimates and birth and death rates. Any remaining population change is assumed to be due to migration. Net migration is calculated as the residual between the county's 2010 Census count and its 2000 tally after adding births between 2000 and 2010 and subtracting deaths. Announced changes in group quarters population and permitted and ongoing real estate developments are also taken into consideration.

Assumptions about future migration trends are key factors in the projections process. Age groups which have been experiencing strong in-migration are unlikely to see in-migration continue at the same rate, so migration expectations for these cohorts are generally dampened during each five-year projection period. Similarly, age groups having more residents move out than in will likely not experience the same level of out-migration in the future. The demographics of aging will naturally come into play to dampen population growth, with the number and percent of population 65 and over increasing rapidly as the baby boom generation enter this age group from 2011 through 2029.

Since recent population estimates data are available, population projections have been modified to account for the trend between April 1, 2010 and July 1, 2013 using Census Bureau estimates. Annual rates of change at the county level were examined for this time period. Since these rates were quite variable over the three years for many counties, the average of the two highest rates of annual growth (or lowest rates of decline) was used in the projections model, which works in five-year increments.

Census Tract Population Projections

Population projections were then developed for the 1,181 census tracts in the state. In order to account for changes in tract geographies between the 2000 and 2010 censuses, population data from the Longitudinal Tract Data Base (LTDB), developed at Brown University, were used. This project calculated data equivalencies for prior Census periods in terms of the 2010 tract boundaries. Hence, matching population and household data for 2000 and 2010 can be obtained to drive the tract-level projections.

Two separate series of projections were initially produced for each tract. Each forecasts total population in five-year intervals from 2015 to 2040. The constant proportion

method assumes that the non-group quarters¹ population of a tract grows at the same rate as the previously projected non-group quarters population of the county. Thus, an area keeps almost the same proportion of the county's total population through 2040. The group quarters population of each census tract is assumed to remain constant at the number of group quarters residents counted in the 2010 census (except for significant known changes between 2010 and 2013). A second, or growth rate factor, method is based on the census tracts' growth rate from 2000 to 2010. This growth factor is multiplied by the previously projected county growth rate for each five-year interval to yield a projected growth rate for the tract in that interval.

Studying the results of the two series of projections developed above revealed that the constant proportion method ignored recent growth trends, which often vary widely among census tracts in a given county. On the other hand, the growth rate factor method sometimes resulted in rapidly escalating growth or decline. Consequently, for most areas, the projections from the two methods were averaged for each five-year interval to yield the preliminary projections. The averaging process helped pull in extreme rates while incorporating both recent subcounty and county growth rates and the county total population projections.

These preliminary results were then modified to dampen trends of very rapid growth or decline and to take into account recent socioeconomic data and developments. In order to fine tune the preliminary projections, extensive data was compiled for the Census tracts. The following variables were included in this analysis:

Census Bureau Data

1. Change in the population between 2000 and 2010.
2. Age of the housing stock from the 2008-2012 American Community Survey (ACS), looking for indications of recent construction.
3. Size of the tract land area in square miles and persons per square mile in 2010.
4. Median household income in 2008-2012 from the ACS.
5. Civilian labor force, employment, and unemployment for 2008-2012 from the ACS.
6. Population living in group quarters for 2010 and, whenever relevant, for 2000.
7. Building permits by place for 2010-2013.

Non-Census Data

8. Location of residential subdivisions with available building lots.
9. Approved development where construction is anticipated.

Finally, the tract-level projections for each county were controlled to sum to the previously-projected county total population in each five-year interval from 2015 to 2040.

¹ Group quarters include institutional populations such as correctional facilities, nursing homes, and mental hospitals as well as non-institutional dwellings such as college dormitories, military barracks, group homes, and shelters.