Appendix D

“Forecast of Water Withdrawals for Self-Supplied Industrial Users: 2010-2040”

This appendix contains the above titled report produced by the Troy University Center for Water Resource Economics (CWRE) through a grant by the Office of Water Resources (OWR).

The report provides county and HUC8 (subbasin) level forecasts for self-supplied industrial water use in Alabama in five-year increments from 2010-2040. The foundational data for this forecast is annual water withdrawal amounts for industrial users from 1993-2013 and the University of Alabama CBER report included as Appendix B. Using that information, CWRE analyzed five different estimation methods to project future water withdrawals for industrial users. Of these, the forecast methodology selected was based on the deflated GDP data from an international forecasting service.

Forecast of Water Withdrawals for Self-Supplied Industrial Users: 2010-2040

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Executive Summary

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The purpose of this research is to forecast the water withdrawals for self-supplied industrial water users in Alabama from 2010-2040. The foundational data for this forecast is annual water withdrawal amounts for industrial users from 1993-2013 and the results of the University of Alabama Study forecasting employment and GDP for 2010-2040 as provided by the Alabama Office of Water Resources (OWR). A literature review was conducted to compare methodologies for projections. After review of these numerous methods, the key limitation is the application of two-digit NAICS codes for creating the water use coefficient.

From the user reported data, five estimation methods were utilized to forecast water withdrawals for industrial users for 2010-2040. The five methods were based on employment data from the University of Alabama Study, employment data from EMSI, GDP data from the University of Alabama Study, GDP data from an international forecasting service, and deflated GDP data from an international forecasting service. Although there are limitations for all five methods, with particular concern with aggregated two-digit NAICS data, the method that provides the most reasonable forecast is the one based on the deflated GDP data from an international forecasting service. This method incorporates the anticipated growth in real GDP that is expected for several industries over the 31-year period of the forecast. Further, it does not ignore labor productivity gains, which are not included in the results from the two methods based on employment data, the University of Alabama Study using employment data and EMSI. Labor productivity gains have averaged approximately two percent per year since the 1960's. Both employment-based methodologies indicate that the labor force will decrease, which will lead to a reduction in water withdrawals at the same time that GDP is increasing.

The final forecasts for the five methods are provided below in MGD

Method	2010	2015	2020	2025	2030	2035	2040
University of Alabama GDP	8,822.1737	9,886.7494	7,790.5695	8,239.2185	8,722.2159	9,219.6964	9,719.7223
University of Alabama Employment	8,822.1737	9,556.8897	7,471.5386	7,564.6645	7,660.6424	7,586.1047	7,450.4210
EMSI Employment	8,822.1737	8,708.6472	6,134.6432	6,133.1072	6,131.9149	6,165.6098	6,233.7028
International Forecasting Service GDP	8,822.1737	8,789.7909	7,447.2792	8,041.1587	8,814.0827	9,859.4526	11,334.6346
International Forecasting Service Deflated GDP	8,822.1737	8,789.7909	7,450.4679	7,738.3500	8,065.7086	8,441.3060	8,876.5018

Introduction

The purpose of this research is to forecast the water withdrawals for self-supplied industrial water users in Alabama from 2010-2040. The foundational data for this forecast is water withdrawal rates for industrial users from 1993-2013 and the results of the University of Alabama Study forecasting employment and Gross Domestic Product (GDP) for 2010-2040 as provided by the Alabama Office of Water Resources (OWR), Division of the Alabama Department of Economic and Community Affairs (ADECA). From the user reported data, five estimation methods were utilized to forecast water withdrawals for industrial users for 2010-2040. The five methods were based on employment data from the University of Alabama Study, employment data from EMSI, GDP data from the University of Alabama Study, GDP data from an international forecasting service, and deflated GDP data from an international forecasting service. Although there are limitations for all five methods, the method that provides the most reasonable forecast is the one based on the deflated GDP data from an international forecasting service. Improved data collection in the annual survey may provide an opportunity to improve the accuracy of the forecasting process.

Summary Review of State Water Forecast Methodologies

Based on the review of water forecasting methodologies utilized by other states in the US, the variation of approaches examined follows a pattern of similar foundational data collected. Out of the numerous research articles and reports reviewed for methodologies which could be used as a model for the Alabama forecast, research conducted in the states of Oklahoma and Idaho were selected as "best fit" based on their economic assumptions and similar foundational data as provided by the Alabama Office of Water Resources to the CWRE. In addition to the identified similarities, these "best fit" models are used also as a source for what additional data could be collected in the future through new survey instruments to improve the accuracy of forecasted industrial use in Alabama.

The State of Oklahoma Comprehensive Water Plan 2012 Update of the Water Forecast Demand (Oklahoma Water Resource Board (OWRB 2011) provided a comprehensive look at water demand forecasting for municipal, agriculture and self-supplied industrial users. Based on this report, industrial/commercial use for both public-supply nonresidential and self-supplied industrial forecasts relied on several data points. These data points included employment by group and county, water use per employee by group, employment projections for Oklahoma, survey data specific to oil and gas and thermoelectric outputs and population projections.

The estimation of Oklahoma county-level nonresidential water use was derived by multiplying county employment by water use per employee—with the assumption of holding constant the water use per employee as employment changes in the future. Both employment and water use per employee were available at the two-digit North American Industrial Classification System (NAICS) level. As a forecast foundation for self-supplied users, the OWRB used data from their annual surface and groundwater reports. Two core pieces of information needed to forecast this sector was annual average water use and employment. Due to lack of information on future growth for various self-supplied industrial users, they were forecasted into the future using the growth rates of the employment projections developed for the public supply nonresidential forecast as described earlier.

This Idaho Department of Water Resources (2002) published the report *Domestic, Commercial, Municipal, and Industrial (DCMI) Water Demand Assessment and Forecast in Ada and Canyon Counties, Idaho*. This research forecasted the water needed in order to supply users within the high growth areas of Ada and Canyon Counties with limited ground water availability. The forecast for domestic, commercial, municipal, and industrial (DCMI) demand came forth through a cooperative effort between the Community Planning Association of Ada and Canyon Counties (COMPASS), the United States Geological Survey (USGS), and the Idaho Department of Water Resources (IDWR).

For municipal, commercial, and industrial users (MCI), establishments were grouped by Standard Industrial Code (SIC)—the precursor to the current NAICS system. For this study, a water demand coefficient was calculated for all SIC groups at the two-digit level of aggregation. The resulting water demand coefficients were ratios of water use to the numbers of employees in a SIC group. Hence, the coefficients represented the amount of water demanded per employee within an SIC group to produce products or supply services. This approach proves nearly identical to the methodology used by the Oklahoma study in 2011. The authors of the Idaho study note that "data deficiencies may necessitate the need for caution about the commercial results. Most important is the lack of data on groundwater and surface water use by commercial users. This gap may lead to an underestimation of baseline and forecasted commercial water demand. (Idaho Department of Water Resources, 2002)

After review of these numerous methods, the key limitation in the approach used by both Oklahoma and Idaho is the application of two-digit NAICS codes for creating the water use coefficient. Yet, their application is understandable based on the fact that it is the most readily available employment data from the Bureau of Labor Statistics (BLS). The BLS data typically does not dive into further industrial classification specificity at the county level (three to six-digit NAICS) because of data confidentiality issues. This problem was specifically identified in both studies. A simple example of how this can distort the calculated water coefficient would be the percentage employment growth in manufacturing (two-digit NAICS codes 31-33) for the coming decade within Montgomery County, Alabama. The large manufacturing employment percentage growth does not occur in the manufacturing sectors represented in the self-supplied industrial users within the county. Under closer inspection, the overwhelming percentage of the industrial growth took place in Auto Manufacturing Industry (NAICS: 336111), which is served by municipal water. Thus, using a two-digit NAICS proxy can inflate or deflate the anticipated water use with no direct relationship to water consumption for self-supplied users.

The studies also provided greater insight into the types of data needs for better projections. Though this will be discussed at

the conclusion of the report, the key data collection piece should be annual full-time equivalent employment for all industrial and commercial enterprises— served by both municipal and self-supplied sources. It will also be important to collect or verify six-digit NAICS codes for all responding to the annual survey.

Water Withdrawal Estimation Methodology

The Alabama Office of Water Resources Division provided water withdrawal data for industrial Certificates of Use (COUs) for 1993-2013 and the results of the University of Alabama Study forecasting employment and GDP through 2040. The process of estimating water withdrawals for 2010-2040 was accomplished by utilizing five different approaches and by estimating usage at the specific COU location for enterprises with a NAICS Code beginning with a two, three, or four. This resulted in the removal of some of the industrial COUs from the forecast because the COUs were associated with irrigation or agricultural use. The water withdrawal associated with these COUs should be included in the agricultural and irrigation forecasts. The original baseline for estimating water withdrawals for 2011-2040 was the actual withdrawal for 2010 for each specific COU location. However, some of the COU locations did not withdraw water in 2010 but did withdraw water in 2011, 2012, and/or 2013. Since these water withdrawals could have potential impact on the total water withdrawn during the forecast period, these actual water withdrawals were included in the baseline data. Since 2010, some COUs have been terminated. Therefore, no estimates for water withdrawal were calculated after the date of the COU termination. In addition, the Tennessee Valley Authority (TVA) has announced that two large thermo-electric facilities, Widows Creek Steam Plant and Colbert Steam Plant, will be permanently closed in 2015 and 2016, respectively. Therefore, no future water withdrawals were forecast for these two facilities after their respective closing dates. Since thermo-electric users account for most of the water withdrawals, these estimates of water withdrawals after 2016 do not include potential significant water withdrawals.

University of Alabama Employment Data Methodology

The literature review indicated that Oklahoma and Utah utilize employment data as the method for estimating water withdrawals for industrial users. For purposes of this forecast, the initial estimates were based on the employment data provided by the University of Alabama Study. The following formula was used to calculate the annual water withdrawal for each industrial COU:

$$WW_{j,t} = WW_{j,t-1} * (UAEMP_{i,k,t} / UAEMP_{i,k,t-1})$$

WW represents the water withdrawal for industrial COU *j* for time period *t*, where *t* ranges from 2011 to 2040. UAEMP is the employment data from the University of Alabama Study for industry *i* in county *k* for time periods *t* and *t-1*. The University of Alabama Study employment data was provided for the state and county level for thirteen industry groups. If sufficient county level data for the industry group were available, then county level data were used to calculate the year-to-year change in employment. However, if insufficient county level data were available, then the state level data were used to calculate the year-to-year change in employment. The primary assumptions of this methodology are that there is a cause and effect relationship between employment data and water withdrawal, aggregated employment data for industry groups are representative of all entities in the industry group, and that state level employment data are representative of employment data for counties where county level data are not available.

The University of Alabama Study employment data consisted of aggregated data for thirteen industry groups: Natural Resources; Construction; Manufacturing; Wholesale Trade; Retail Trade; Transportation, Warehousing, and Utilities; Information; Financial Activities; Professional and Business Services; Educational and Health Services; Leisure and Hospitality; Other Services; and Government. The enterprises within these groups represent multiple NAICS Codes. There is evidence that the industry growth rates are significantly different among the various NAICS Codes within an industry group. Therefore, a major concern regarding the accuracy of the water withdrawal estimates based on the employment data from the University of Alabama Study was the aggregation of data across several NAICS Codes, which might have vastly different employment projections. Some industries within the University of Alabama industry group may experience a decline in employment, while other industries within the industry group may experience a significant increase in employment. Further, there were several counties that did not

provide sufficient employment data. This required the use of State of Alabama data to calculate the estimated water withdrawal for specific industrial COUs. There is the possibility that the state level data may not be representative of the county level data for an industry group. This use of aggregated data further compromises the estimates based on the employment data from the University of Alabama Study. Therefore, the following method was deployed with the expectation that a more accurate forecast could be prepared.

EMSI Employment Data Methodology

To address these two concerns about the aggregation of data across NAICS Codes and counties, employment data from EMSI was utilized to provide for a second set of estimates. EMSI provides county level, state level and national level data by three-digit NAICS Codes. The usage of this data has the potential to improve the accuracy of the water withdrawal forecasts since the year-to-year changes in employment can be significantly different for NAICS Codes. The following formula was used to calculate the annual water withdrawal for each industrial COU:

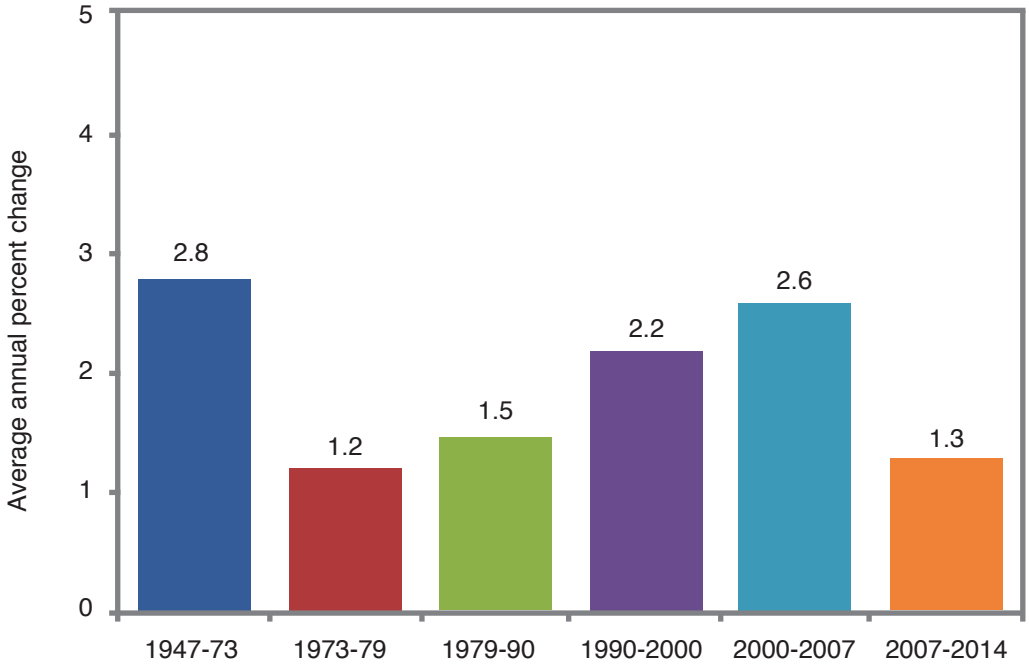
$$WW_{j,t} = WW_{j,t-1} * (EMSIEMP_{i,k,t} / EMSIEMP_{i,k,t-1})$$

WW represents the water withdrawal for industrial COU *j* for time period *t*, where *t* ranges from 2011 to 2040. EMSIEMP is the employment data from the EMSI for three-digit NAICS Code *i* county *k* for time periods *t* and *t-1*. However, EMSI only provides estimated employment data through 2025. If sufficient county level data were not available, then state level data were used, and if sufficient state level data were not available, then national level data were used. The EMSI data provides estimates of employment through 2025. Since the forecast period for water withdrawals is through 2040, the ten-year (2016-2025) average employment change was used as an estimate of the year-to-year change in employment for 2026-2040. The primary assumptions of this methodology are that there is a cause and effect relationship between employment data and water withdrawal, the ten-year average employment change is representative of the employment change expected for the 2026-2040, that state level employment data are representative of employment data for counties where county level data are not available, and national level data are representative of county level data where state level data are not available. The utilization of EMSI employment data reduced the number of estimates based on state level data. The forecasts of the EMSI Employment method were similar to the forecasts using the University of Alabama Employment Study data.

University of Alabama GDP Data Methodology

The following Bureau of Labor Statistic bar chart of productivity change from 1947-2014 provides one of the primary deficiencies of using employment data to estimate water withdrawal for a 31-year period. The annual average productivity gain for the 46-year period since 1979 has been between 1.3 and 2.6 percent, with an annual average of approximately two percent. If similar productivity gains are experienced during the 31-year period for this study, then by 2040, the labor force necessary to generate current output could be realized with approximately one-half of the current labor force. This would produce estimated water withdrawal that would be approximately one-half of current withdrawals, yet output would not have declined by a similar rate. This is plausible if there is a nominal relationship between water withdrawal and output. However for many industrial COUs, water is an integral component of the industrial process, and frequently, is an integral component of the output. If either of these conditions is representative of water withdrawal for the industrial user, then the usage of the employment data from the University of Alabama and EMSI may not provide accurate estimates for water withdrawal during this thirty-one year period. Since GDP is more closely related to output, the following GDP-based methodology was deployed.

Productivity change in the nonfarm business sector, 1947–2014



Source: U.S. Bureau of Labor Statistics

To address this concern that employment data might not be a good metric for estimating water withdrawal, GDP data from the University of Alabama Study were used to estimate water withdrawal. The following formula was used to calculate the annual water withdrawal for each industrial COU:

$$WW_{j,t} = WW_{j,k,t-1} * (UAGDP_{i,k,t} / UAGDP_{i,k,t-1})$$

WW represents the water withdrawal for industrial COU *j* for time period *t*, where *t* ranges from 2011 to 2040. UAGDP is the GDP data from the University of Alabama Study for industry *i* in county *k* for time periods *t* and *t-1*. The University of Alabama Study GDP data was provided for the state and county level for thirteen industry groups. If sufficient county level data for the industry group were available, then county level data were used to calculate the year-to-year change in GDP. However, if insufficient county level data were available, then the state level data were used to calculate the year-to-year change in GDP. The primary assumptions of this methodology are that there is a cause and effect relationship between GDP data and water withdrawal, aggregated GDP data for industry groups are representative of all entities in the industry group, and that state level GDP data are representative of GDP data for counties where county level data are not available.

The University of Alabama Study GDP data consisted of aggregated data for thirteen industry groups: Natural Resources; Construction; Manufacturing; Wholesale Trade; Retail Trade; Transportation, Warehousing, and Utilities; Information; Financial Activities; Professional and Business Services; Educational and Health Services; Leisure and Hospitality; Other Services; and Government. The enterprises within these groups represent multiple NAICS Codes. There is evidence that the industry growth rates are significantly different among the various NAICS Codes within an industry group. Therefore, a major concern regarding the accuracy of the water withdrawal estimates based on the GDP data from the University of Alabama Study was the aggregation of data across several NAICS Codes, which might have vastly different GDP projections. Some industries within the University of Alabama industry group may experience

a decline in GDP, while other industries within the industry group may experience a significant increase in GDP. This use of aggregated data compromises the estimates based on the GDP data from the University of Alabama Study. Therefore, the following method was deployed with the expectation that a more accurate forecast could be prepared.

International Forecasting Service GDP Data Methodology

To address the differences between the forecasts based on the aggregation of GDP data across several NAICS codes in the University of Alabama Study, the GDP forecasts of an international forecasting service were used to calculate additional water withdrawal forecasts. The international forecasting service provides forecasts for most five-digit NAICS Codes, which has the potential to improve the accuracy of the water withdrawal forecasts since the year-to-year changes in GDP can be significantly different for NAICS Codes. The following formula was used to calculate the annual water withdrawal for each industrial COU:

$$WW_{j,t} = WW_{j,t-1} * (IFSGDP_{i,t} / IFSGDP_{i,t-1})$$

WW represents the water withdrawal for industrial COU *j* for time period *t*, where *t* ranges from 2011 to 2040. IFSGDP is the GDP data from the International Forecasting Service for five-digit NAICS Code *i* for time periods *t* and *t-1*. The international forecasting service provides data only at the national level and provides a forecast of GDP through 2019 or 2020. Since the forecast period for water withdrawals is through 2040, the ten-year average change in GDP was used as an estimate of the year-to-year change in GDP for the remaining years of the forecast. The primary assumptions of this methodology are that there is a cause and effect relationship between GDP data and water withdrawal, national level data for GDP change is representative of the GDP change for industrial users in Alabama, and that the ten-year average GDP change through 2019 or 2020 is representative of the GDP change for the remaining years of the forecast. The forecasts of the international forecasting service method using GDP data were higher but also similar to the forecasts using the University of Alabama GDP Study data.

International Forecasting Service Deflated GDP Data Methodology

The international forecasting service indicated that for the ten-year period ending in 2019 or 2020 some industries would experience significant growth in GDP. The likelihood that that same rate of growth could be sustained for approximately 30 years is highly unlikely. Therefore, the ten-year average change in GDP was deflated by 50 percent to provide for a more realistic long-term growth rate. The following formula was used to calculate the annual water withdrawal for each industrial COU:

$$WW_{j,t} = WW_{j,t-1} * (IFSGDP_{i,t} / IFSGDP_{i,t-1})$$

WW represents the water withdrawal for industrial COU *j* for time period *t*, where *t* ranges from 2011 to 2040. IFSGDP is the GDP data from the International Forecasting Service for five-digit NAICS Code i for time periods *t* and *t-1*. The international forecasting service provides data only at the national level and provides a forecast of GDP through 2019 or 2020. Since the forecast period for water withdrawals is through 2040, the ten-year average change in GDP deflated by 50 percent was used as an estimate of the year-to-year change in GDP for the remaining years of the forecast. The primary assumptions of this methodology are that there is a cause and effect relationship between GDP data and water withdrawal, national level data for GDP change is representative of the GDP change for industrial users in Alabama, and that the ten-year average GDP change through 2019 or 2020 deflated by 50 percent is representative of the GDP change for the remaining years of the forecast. The forecasts of the international forecasting service method using deflated GDP were lower than the other two GDP-based methods and produced a result that was approximately equal to the average of the four other methods.

The International Forecasting Service Deflated GDP was selected as the method for estimating water withdrawal forecasts because it appears to be the most accurate of the five methodologies. This method incorporates the anticipated growth in real GDP that is expected for several industries over the 31-year period of the forecast. However, it does not produce results that are possibly too optimistic, as does the University of Alabama Study using GDP data and the International Forecasting Service using GDP data. Further, it does not ignore labor productivity gains, which are not included in the results from the two methods based on employment data, the University of Alabama Study using employment data and EMSI. Labor productivity gains have averaged approximately two percent per year since the 1960's. Both employment-based methodologies

Table 1: Ground Water Withdrawals (in MGD)

	YEAR						
Method	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
University of Alabama GDP	33.20	53.34	64.97	75.29	89.02	104.04	119.86
University of Alabama Employment	33.20	44.12	46.44	47.45	48.24	49.20	50.34
EMSI Employment	33.20	45.69	45.37	46.62	47.72	49.26	51.26
International Forecasting Service GDP	33.20	45.64	50.97	58.29	67.57	79.39	94.56
International Forecasting Service Deflated GDP	33.20	45.64	50.81	54.10	57.79	61.92	66.56

indicate that the labor force will decrease, which will lead to a reduction in water withdrawals at the same time that GDP is increasing. This does not seem to be a reasonable representation of water withdrawals.

Analysis of Forecasts

The analysis of the five forecasts will evaluate the withdrawal of water at the state, county, and HUC level. Although there are forecasts for every well for the 31-year period, the state level analysis will focus on the annual withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040. The state level analysis will address the withdrawal of ground water, surface water, and the total water withdrawn. This analysis will also address the type of industrial user, based on the three-digit NAICS Code. Six industry groups were identified for this analysis: mining, thermo-electric, pulp and paper, petrochemical, other manufacturing, and wholesale. The county level analysis will address total water withdrawn for 2010, 2015, 2020, 2025, 2030, 2035, and 2040. The HUC level analysis will address total water withdrawn for those same years.

The main report will address the results based on the International Forecasting Service Deflated GDP. The analysis of the other four forecasting methods is contained in the Appendices.

State Level Analysis

Ground Water Withdrawals

The five forecasts of ground water withdrawal produce significantly different results for water withdrawn during the 31-year period and a significant difference in the primary industries withdrawing the water. Table 1 provides an overview of the forecasts for the five methods. The forecast based on the University of Alabama Study using GDP data produces the largest amount of ground water withdrawal, with an estimated 119.86 million gallons per day for 2040. This forecast estimates that ground water withdrawals will increase by 261 percent during the 31-year period. The forecast based on the University of Alabama Study using employment data produces the least amount of ground water withdrawal, with an estimated 50.34 million gallons per day in 2040. This forecast estimates that ground water withdrawals will increase by only 51 percent during the 31-year period. The forecast based on the EMSI employment data produces similar results to the University of Alabama Study based on employment data. The only major difference between these two employment-based forecasts is that the forecast based on the University of Alabama Study has ground water withdrawal growing at a small rate for the entire 31-year period. Whereas, the forecast based on the EMSI employment data projects that ground water withdrawals for 2015-2018 will be less than the prior year withdrawals. Beginning in 2019 ground water withdrawals begin to increase, but the ground water withdrawals

Table 2: Ground Water Withdrawal Data (in MGD) - International Forecasting Service Deflated GDP

	YEAR						
Type of Industrial User	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Mining	0.24	0.25	0.28	0.30	0.32	0.34	0.36
Thermo-electric	0.20	0.31	0.34	0.34	0.34	0.34	0.34
Pulp and Paper	11.78	11.76	12.16	12.27	12.38	12.49	12.61
Petrochemical	10.96	18.00	21.03	23.35	25.98	28.96	32.35
Other Manufacturing	10.01	15.29	16.98	17.81	18.73	19.74	20.85
Wholesale	0.02	0.02	0.03	0.03	0.04	0.04	0.04
Total	33.20	45.64	50.81	54.10	57.79	61.92	66.56

do not match the 2014 ground water withdrawals until 2025. The forecast based on the International Forecasting Service estimates for GDP produces a result that is comparable to the University of Alabama Study based on GDP. The estimated ground water withdrawal in 2040 is 94.56, which represents a 185 percent increase during the 31-year period. The forecast based on the International Forecasting Service estimates for GDP deflated by 50 percent produces a result more similar to the employment-based forecasts. The estimated ground water withdrawal in 2040 is 66.56, which is a 100 percent increase during the 31-year period.

Table 2 provides a breakdown of ground water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the type of industrial user based on the International Forecasting Service Deflated GDP data. The forecasts indicate that Mining, Thermo-electric, Petrochemical, and Other Manufacturing will experience significant increases in ground water withdrawal, with increases of 53 percent, 73 percent, 195 percent, and 108 percent, respectively. Pulp and Paper and Wholesale will experience modest increases of seven percent and 40 percent increase, respectively. Total ground water withdrawals are forecast to increase by 100 percent.

The following charts, Chart 1.1 – Chart 1.4, provide the breakdown of ground water withdrawals by the type of industrial user based on the International Forecasting Service Deflated GDP data for 2010, 2020, 2030, and 2040. An analysis of these charts indicates that during the 31-year period, the proportion of ground water withdrawn by Pulp and Paper industrial users declines, while the proportion of ground water withdrawn by Petrochemical and Other Manufacturing industrial users increases. This is consistent with the long-term projections for these three industrial users, since Pulp and Paper is expected to have nominal growth, but Petrochemical and Other Manufacturing are expected to have significant growth.

Chart 1.1: Self-Supplied Ground Water Withdrawals (in MGD) 2010: International Forecasting Service Deflated GDP

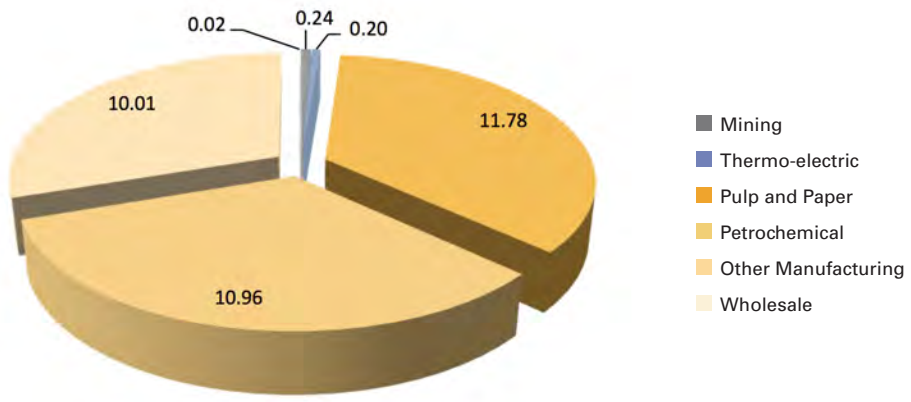


Chart 1.2: Self-Supplied Ground Water Withdrawals (in MGD) 2020: International Forecasting Service Deflated GDP

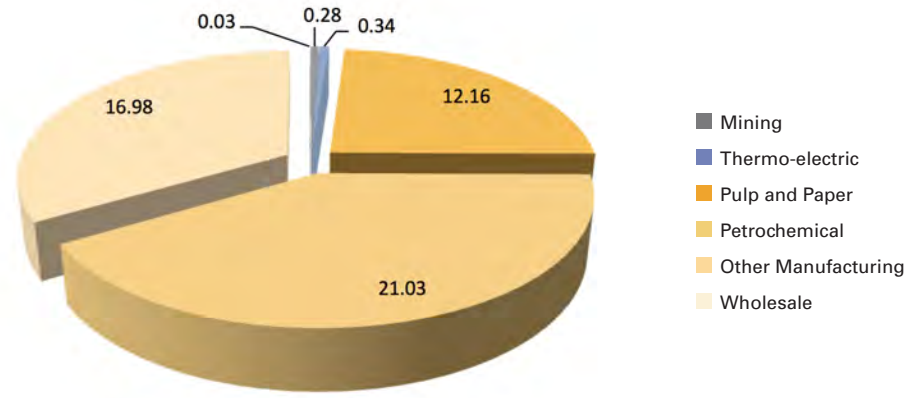


Chart 1.3: Self-Supplied Ground Water Withdrawals (in MGD) 2030: International Forecasting Service Deflated GDP

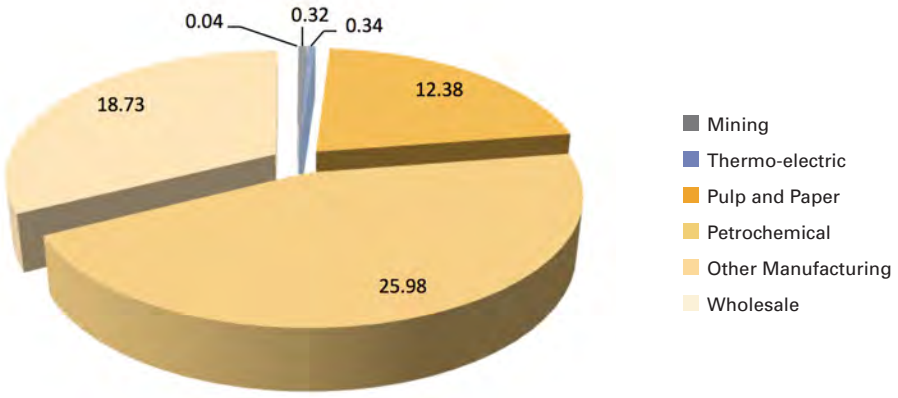


Chart 1.4: Self-Supplied Ground Water Withdrawals (in MGD) 2040: International Forecasting Service Deflated GDP

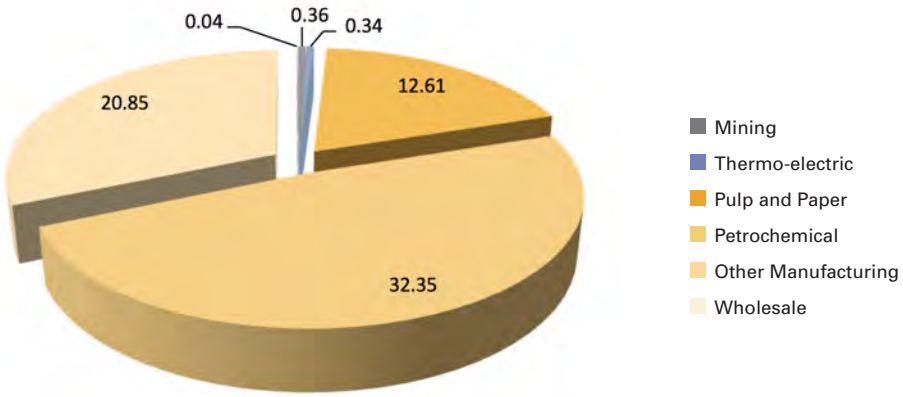


Table 3: Surface Water Withdrawals (in MGD)

	YEAR						
Method	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
University of Alabama GDP	8,788.97	9,833.41	7,725.60	8,163.93	8,633.19	9,115.66	9,599.86
University of Alabama Employment	8,788.97	9,512.77	7,425.10	7,517.21	7,612.40	7,536.90	7,400.09
EMSI Employment	8,788.97	8,662.95	6,089.28	6,086.49	6,084.19	6,116.35	6,182.44
International Forecasting Service GDP	8,788.97	8,744.16	7,396.31	7,982.86	8,746.51	9,780.06	11,240.07
International Forecasting Service Deflated GDP	8,788.97	8,744.16	7,399.66	7,684.25	8,007.92	8,379.39	8,809.94

Surface Water Withdrawals

The five forecasts of surface water withdrawal produce significantly different results for water withdrawn during the 31-year period and a significant difference in the primary industries withdrawing the water. Table 3 provides an overview of the forecasts for the five methods. The forecast based on the International Forecasting Service for GDP produces the largest amount of surface water withdrawal, with an estimated 11,240.0724 million gallons per day for 2040. This forecast estimates that surface water withdrawals will increase by 28 percent during the 31-year period. The forecast based on the EMSI employment data produces the least amount of surface water withdrawal, with an estimated 6,182.44 million gallons per day in 2040. This forecast estimates that surface water withdrawals will decrease by 30 percent during the 31-year period. The forecast based on the University of Alabama Study using employment data projects that surface water withdrawals will be 7,400.09 million gallons per day in 2040, which is a 16 percent decline during the 31-year period. These results are similar results to the EMSI employment data method. The major reason that these two methods forecast a decline in surface water withdrawal is the closing of two TVA thermo-electric plants in 2015 and 2016. The forecast based on the University of Alabama Study using GDP data projects that surface water withdrawals will be 9,599.86 million gallons per day in 2040, which is an increase of nine percent during the 31-year period. The forecast based on the International Forecasting Service Deflated GDP estimates projects that surface water withdrawals will be 8,809.94 million gallons per day in 2040, which is a one percent increase during the 31-year period. The results of these two methods produce very similar results, with the major difference being the rate at which surface water withdrawals increase after the closing of the two TVA thermo-electric plants.

Table 4: Surface Water Withdrawal Data (in MGD) - International Forecasting Service Deflated GDP

	YEAR						
Type of Industrial User	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Mining	3.30	3.04	3.86	4.04	4.24	4.46	4.70
Thermo-electric	8,251.64	8,076.08	6,705.51	6,903.33	7,113.62	7,337.06	7,574.38
Pulp and Paper	369.99	357.41	346.16	344.81	344.27	344.53	345.60
Petrochemical	140.28	277.64	311.18	396.23	506.80	650.86	838.94
Other Manufacturing	23.77	29.94	32.91	35.79	38.95	42.43	46.26
Wholesale	-	0.03	0.03	0.04	0.04	0.04	0.05
Total	8,788.97	8,744.16	7,399.66	7,684.25	8,007.92	8,379.39	8,809.94

Table 4 provides a breakdown of surface water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the type of industrial user based on the International Forecasting Service Deflated GDP data. The forecasts indicate that Mining, Petrochemical, and Other Manufacturing will experience significant increases in surface water withdrawal, with increases of 43 percent, 498 percent, and 95 percent, respectively. Thermo-electric and Pulp and Paper will experience decreases of eight percent and seven percent, respectively. Total surface water withdrawals are forecast to increase by less than one percent.

The following charts, Chart 2.1 – Chart 2.4, provide the breakdown of surface water withdrawals by the type of industrial user based on the International Forecasting Service Deflated GDP data for 2010, 2020, 2030, and 2040. An analysis of these charts indicates that during the 31-year period, the proportion of surface water withdrawn by Thermo-electric industrial users declines, while the proportion of surface water withdrawn by Petrochemical, Other Manufacturing, and Pulp and Paper industrial users increases. This is consistent with closing of two TVA thermo-electric plants and the long-term projections for these three industrial users, since Pulp and Paper is expected to have nominal growth, but Petrochemical and Other Manufacturing are expected to have significant growth.

Chart 2.1: Self-Supplied Surface Water Withdrawals (in MGD) 2010: International Forecasting Service Deflated GDP

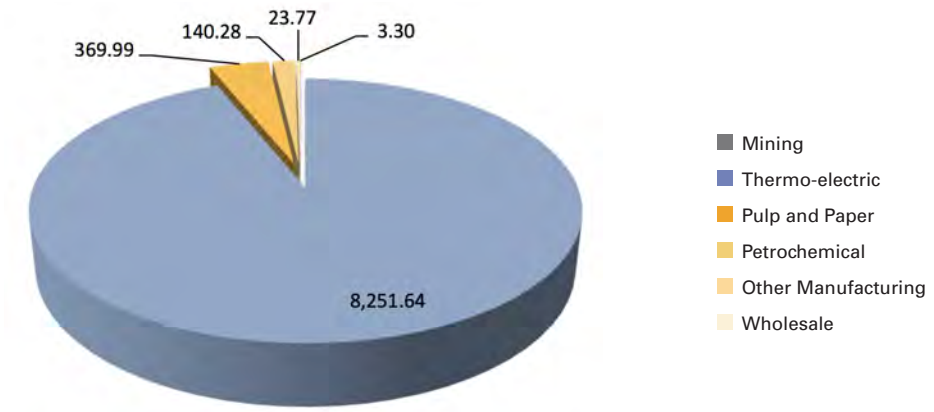


Chart 2.2: Self-Supplied Ground Water Withdrawals (in MGD) 2020: International Forecasting Service Deflated GDP

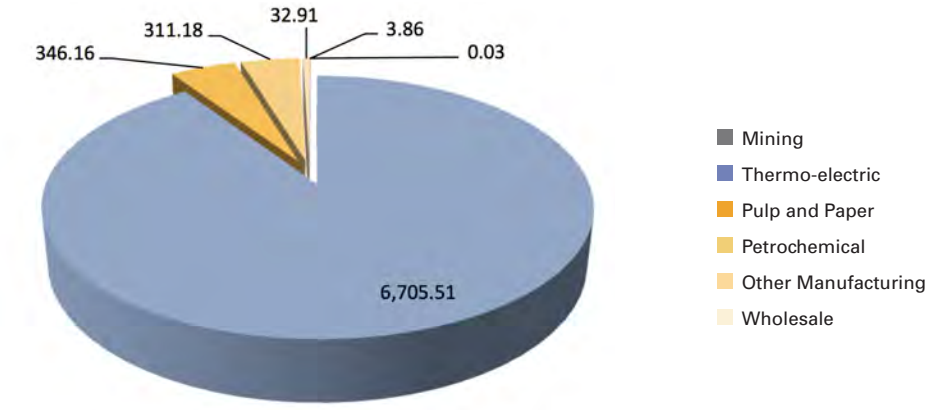


Chart 2.3: Self-Supplied Ground Water Withdrawals (in MGD) 2030: International Forecasting Service Deflated GDP

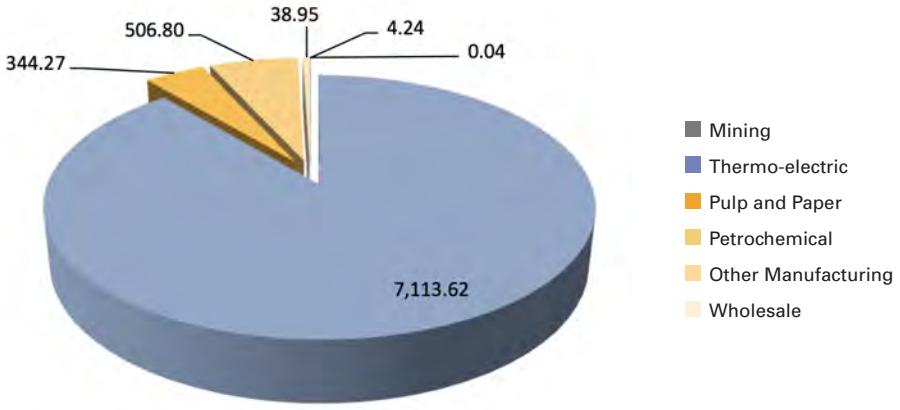


Chart 2.4: Self-Supplied Ground Water Withdrawals (in MGD) 2040: International Forecasting Service Deflated GDP

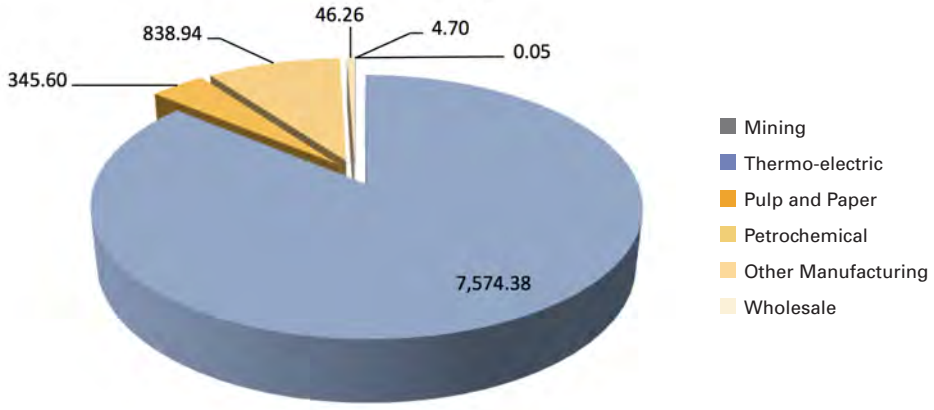


Table 5: Total Water Withdrawals (in MGD)

	YEAR						
Method	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
University of Alabama GDP	8,822.17	9,886.75	7,790.57	8,239.22	8,722.22	9,219.70	9,719.72
University of Alabama Employment	8,822.17	9,556.89	7,471.54	7,564.66	7,660.64	7,586.10	7,450.42
EMSI Employment	8,822.17	8,708.65	6,134.64	6,133.11	6,131.91	6,165.61	6,233.70
International Forecasting Service GDP	8,822.17	8,789.79	7,447.28	8,041.16	8,814.08	9,859.45	11,334.63
International Forecasting Service Deflated GDP	8,822.17	8,789.79	7,450.47	7,738.35	8,065.71	8,441.31	8,876.50

Total Water Withdrawals

The five forecasts of total water withdrawals produce significantly different results for total water withdrawn during the 31-year period and a significant difference in the primary industries withdrawing the water. Table 5 provides an overview of the forecasts for the five methods. The forecast based on the International Forecasting Service GDP data produces the largest amount of total water withdrawal, with an estimated 11,334.63 million gallons per day for 2040. This forecast estimates that total water withdrawals will increase by 28 percent during the 31-year period. The forecast based on the EMSI employment data produces the least amount of total water withdrawal, with an estimated 6,233.70 million gallons per day in 2040. This forecast estimates that total water withdrawals will decrease by 29 percent during the 31-year period. The forecast based on the University of Alabama Study using employment data produces similar results and projects that total water withdrawn will be 7,450.42 million gallons per day in 2040, which is a 16 percent decline during the 31-year period. The forecast based on the University of Alabama Study using GDP data projects that total water withdrawn will be 9,719.72 million gallons per day in 2040, which is a 10 percent increase during the 31-year period. The forecast based on the International Forecasting Service Deflated GDP estimates that total water withdrawn will be 8,876.50 million gallons per day in 2040, which is an increase of one percent during the 31-year period.

Table 6: Total Water Withdrawal Data (in MGD) - International Forecasting Service Deflated GDP

	YEAR						
Type of Industrial User	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Mining	3.53	3.29	4.15	4.35	4.56	4.80	5.07
Thermo-electric	8,251.84	8,076.40	6,705.85	6,903.68	7,113.96	7,337.41	7,574.73
Pulp and Paper	381.77	369.17	358.32	357.08	356.64	357.02	358.21
Petrochemical	151.24	295.64	332.20	419.58	532.78	679.82	871.29
Other Manufacturing	33.78	45.23	49.89	53.60	57.68	62.17	67.11
Wholesale	0.02	0.05	0.06	0.07	0.07	0.08	0.09
Total	8,822.17	8,789.79	7,450.47	7,738.35	8,065.71	8,441.31	8,876.50

Table 6 provides a breakdown of total water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the type of industrial user based on the International Forecasting Service Deflated GDP data. The forecasts indicate that Mining, Petrochemical, Other Manufacturing, and Wholesale will experience significant increases in total water withdrawal, with increases of 43 percent, 476 percent, 99 percent, and 308 percent, respectively. Thermo-electric and Pulp and Paper will experience declines of eight and six percent, respectively.

The following charts, Chart 3.1 – Chart 3.4, provide the breakdown of total water withdrawals by the type of industrial user based on the International Forecasting Service Deflated GDP data for 2010, 2020, 2030, and 2040. An analysis of these charts indicates that the during the 31-year period, the proportion of total water withdrawn by Thermo-electric industrial users declines, while the proportion of total water withdrawn by Petrochemical, Pulp and Paper, and Other Manufacturing industrial users increases. This is consistent with the closing of two TVA thermo-electric plants and the long-term projections for these three industrial users, since Pulp and Paper is expected to have nominal growth, but Petrochemical and Other Manufacturing are expected to have significant growth.

Chart 3.1: Self-Supplied Total Water Withdrawals (in MGD) 2010: International Forecasting Service Deflated GDP

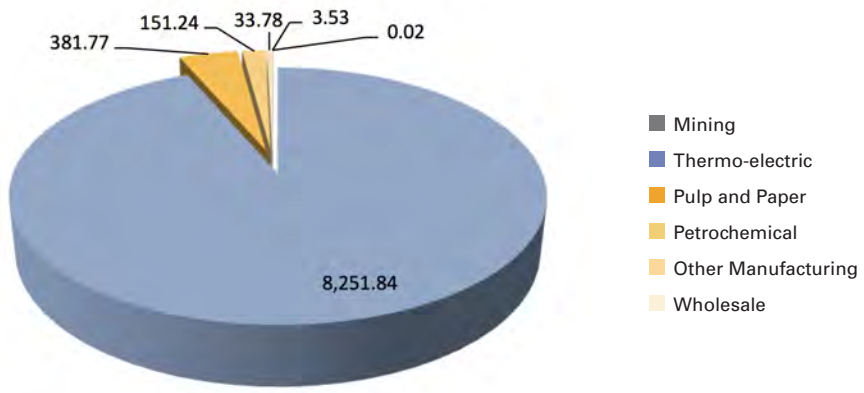


Chart 3.2: Self-Supplied Total Water Withdrawals (in MGD) 2020: International Forecasting Service Deflated GDP

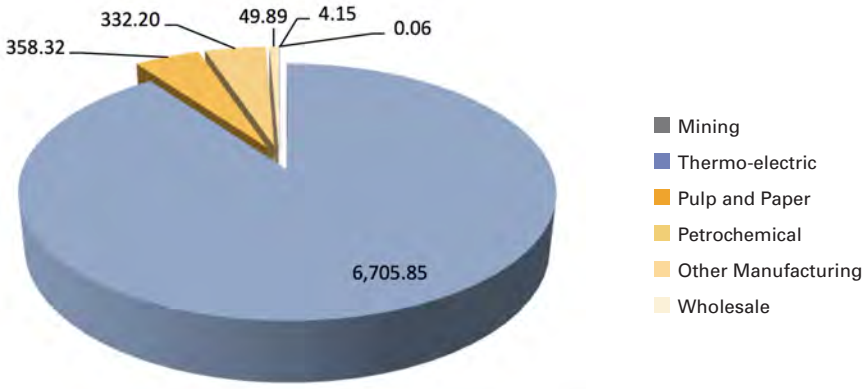


Chart 3.3: Self-Supplied Total Water Withdrawals (in MGD) 2030: International Forecasting Service Deflated GDP

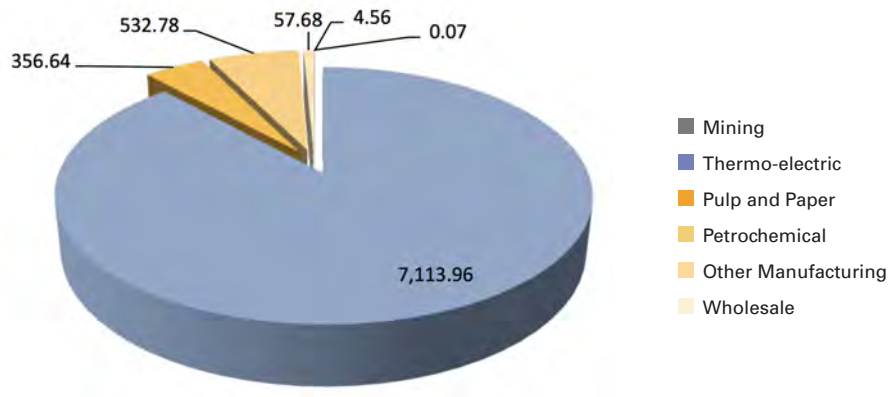


Chart 3.4: Self-Supplied Total Water Withdrawals (in MGD) 2040: International Forecasting Service Deflated GDP

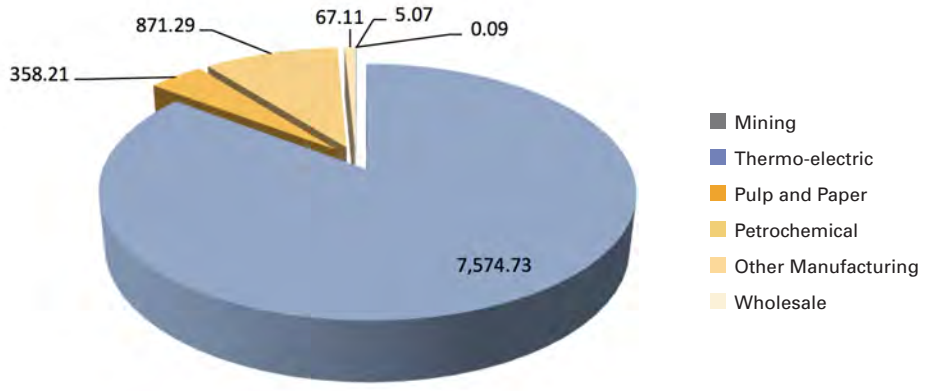


Table 7: Total Water Withdrawal Data (in MGD) - International Forecasting Service Deflated GDP

	YEAR						
Water Source	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Ground	33.20	45.64	50.81	54.10	57.79	61.92	66.56
Surface	8,788.97	8,744.16	7,399.66	7,684.25	8,007.92	8,379.39	8,809.94
Total	8,822.17	8,789.79	7,450.47	7,738.35	8,065.71	8,441.31	8,876.50

Chart 4: Self-Supplied Total Water Withdrawal (in MGD) 2010-2040: International Forecasting Service Deflated GDP-

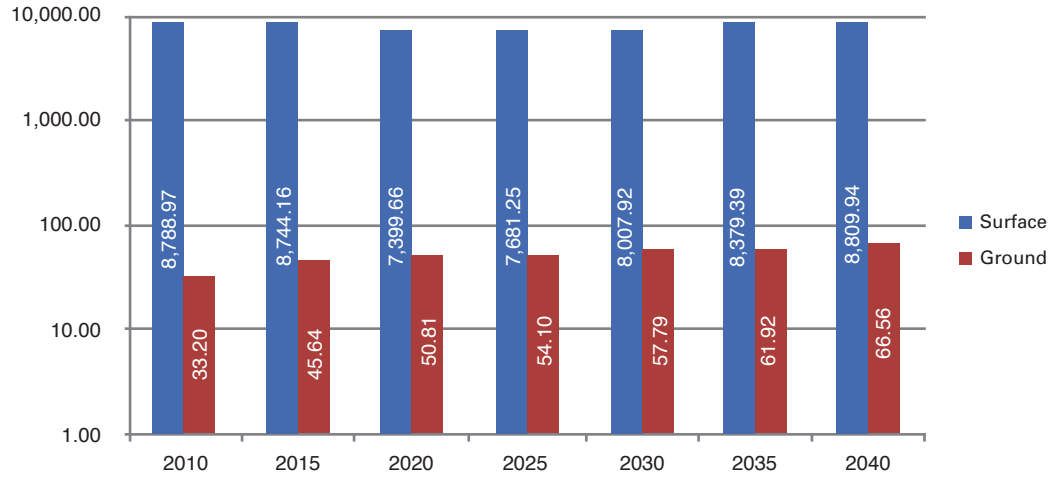


Table 7 and Chart 4 provide a breakdown of total water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the water source based on the International Forecasting Service Deflated GDP data. The forecast indicates that approximately 99 percent of water withdrawn is surface water. Ground water is projected to increase by 100 percent during the 31-year period; whereas, surface water is expected to increase by less than one percent. Thermo-electric is the largest user of surface water, and the closing of the two TVA plants significantly impacts the surface water withdrawn.

County Level Analysis

The county level analysis addresses the total water withdrawn by industrial users in each county during the 31-year period. Table 8 provides a breakdown of total water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 for each county in the State of Alabama based on the International Forecasting Service Deflated GDP data. The results indicate that two counties, Colbert and Jackson, experience significant declines in the amount of water withdrawn. This is because TVA is closing a steam plant in each county. However, some counties experience significant increases in water withdrawn during the 31-year period, e.g., Etowah, Greene, Mobile, Morgan, Shelby, Walker, and Washington, with increases of 56 percent, 55 percent, 55 percent, 751 percent, 55 percent, 55 percent, and 58 percent. The counties with the largest water withdrawals are Limestone, Walker, Mobile, Shelby, and Morgan, with each county having water withdrawals in excess of 690 million gallons per day by 2040. In 2040, the water withdrawal for these five counties accounts for 83 percent of all water withdrawn.

Table 8: Water Withdrawal (in MGD) by County - International Forecasting Service Deflated GDP

	2010			2015			2020			2025			2030			2035			2040		
COUNTY	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**
AUTAUGA	32.42	9.84	**42.26**	32.43	9.84	**42.28**	33.89	10.21	**44.11**	34.31	10.31	**44.62**	34.73	10.42	**45.15**	35.16	10.52	**45.68**	35.60	10.63	**46.23**
BALDWIN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BARBOUR	-	1.58	**1.58**	-	1.32	**1.32**	-	1.46	**1.46**	-	1.43	**1.43**	-	1.40	**1.40**	-	1.37	**1.37**	-	1.34	**1.34**
BIBB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BLOUNT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BULLOCK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BUTLER	-	0.30	**0.30**	-	0.27	**0.27**	-	0.25	**0.25**	-	0.24	**0.24**	-	0.22	**0.22**	-	0.21	**0.21**	-	0.20	**0.20**
CALHOUN	-	0.97	**0.97**	-	0.98	**0.98**	-	1.04	**1.04**	-	1.06	**1.06**	-	1.09	**1.09**	-	1.11	**1.11**	-	1.13	**1.13**
CHAMBERS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHEROKEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHILTON	-	0.35	**0.35**	-	0.38	**0.38**	-	0.43	**0.43**	-	0.45	**0.45**	-	0.48	**0.48**	-	0.50	**0.50**	-	0.53	**0.53**
CHOCTAW	40.80	-	**40.80**	36.57	-	**36.57**	33.35	-	**33.35**	31.71	-	**31.71**	30.16	-	**30.16**	28.68	-	**28.68**	27.27	-	**27.27**
CLARKE	20.21	-	**20.21**	18.11	-	**18.11**	16.52	-	**16.52**	15.71	-	**15.71**	14.94	-	**14.94**	14.21	-	**14.21**	13.51	-	**13.51**
CLAY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLEBURNE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COFFEE	-	1.13	**1.13**	-	2.06	**2.06**	-	2.26	**2.26**	-	2.22	**2.22**	-	2.17	**2.17**	-	2.13	**2.13**	-	2.09	**2.09**
COLBERT	1,331.41	0.31	**1,331.72**	1,353.63	0.35	**1,353.98**	93.19	0.36	**93.55**	106.29	0.38	**106.68**	121.60	0.40	**122.00**	139.48	0.42	**139.91**	160.40	0.45	**160.85**
CONECUH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COOSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COVINGTON	1.74	-	**1.74**	1.76	-	**1.76**	2.16	-	**2.16**	2.28	-	**2.28**	2.41	-	**2.41**	2.54	-	**2.54**	2.69	-	**2.69**
CRENSHAW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CULLMAN	1.83	0.43	**2.26**	2.79	0.76	**3.55**	3.11	0.88	**3.99**	3.25	0.99	**4.24**	3.41	1.11	**4.52**	3.60	1.24	**4.85**	3.82	1.40	**5.22**
DALE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DALLAS	32.20	0.14	**32.34**	28.86	0.12	**28.99**	26.32	0.11	**26.43**	25.03	0.11	**25.13**	23.80	0.10	**23.90**	22.64	0.10	**22.73**	21.53	0.09	**21.62**
DEKALB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ELMORE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ESCAMBIA	33.61	1.47	**35.08**	40.92	1.66	**42.58**	44.17	1.87	**46.04**	47.35	1.99	**49.34**	50.76	2.12	**52.88**	54.41	2.25	**56.67**	58.33	2.40	**60.73**
ETOWAH	123.78	-	**123.78**	127.22	-	**127.22**	154.59	-	**154.59**	163.53	-	**163.53**	173.00	-	**173.00**	183.02	-	**183.02**	193.63	-	**193.63**
FAYETTE	1.10	-	**1.10**	0.85	-	**0.85**	1.12	-	**1.12**	1.12	-	**1.12**	1.13	-	**1.13**	1.14	-	**1.14**	1.14	-	**1.14**
FRANKLIN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GENEVA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GREENE	354.43	0.03	**354.46**	358.44	0.03	**358.47**	440.84	0.04	**440.88**	465.62	0.04	**465.66**	491.80	0.04	**491.84**	519.45	0.05	**519.50**	548.66	0.05	**548.71**
HALE	-	0.02	**0.02**	-	0.02	**0.02**	-	0.03	**0.03**	-	0.03	**0.03**	-	0.04	**0.04**	-	0.04	**0.04**	-	0.04	**0.04**
HENRY	-	0.54	**0.54**	-	0.58	**0.58**	-	0.63	**0.63**	-	0.66	**0.66**	-	0.69	**0.69**	-	0.72	**0.72**	-	0.74	**0.74**
HOUSTON	89.20	0.17	**89.37**	81.69	0.28	**81.96**	89.13	0.31	**89.44**	88.47	0.30	**88.77**	87.81	0.30	**88.11**	87.15	0.30	**87.45**	86.50	0.30	**86.79**
JACKSON	1,054.12	-	**1,054.12**	1,065.94	-	**1,065.94**	9.23	-	**9.23**	9.33	-	**9.33**	9.42	-	**9.42**	9.52	-	**9.52**	9.61	-	**9.61**
JEFFERSON	-	0.50	**0.50**	0.03	0.55	**0.58**	0.03	0.60	**0.64**	0.04	0.64	**0.67**	0.04	0.67	**0.71**	0.04	0.71	**0.75**	0.05	0.75	**0.80**
LAMAR	-	0.11	**0.11**	-	0.12	**0.12**	-	0.13	**0.13**	-	0.14	**0.14**	-	0.15	**0.15**	-	0.16	**0.16**	-	0.16	**0.16**
LAUDERDALE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LAWRENCE	60.09	-	**60.09**	53.86	-	**53.86**	49.11	-	**49.11**	46.70	-	**46.70**	44.42	-	**44.42**	42.24	-	**42.24**	40.17	-	**40.17**
LEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LIMESTONE	2,725.63	-	**2,725.63**	2,496.09	-	**2,496.09**	2,723.72	-	**2,723.72**	2,703.35	-	**2,703.35**	2,683.14	-	**2,683.14**	2,663.08	-	**2,663.08**	2,643.16	-	**2,643.16**
LOWNDES	-	-	-	-	4.56	**4.56**	-	4.61	**4.61**	-	5.02	**5.02**	-	5.48	**5.48**	-	5.98	**5.98**	-	6.52	**6.52**
MACON	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MADISON	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MARENGO	17.78	-	**17.78**	17.78	-	**17.78**	18.45	-	**18.45**	18.63	-	**18.63**	18.82	-	**18.82**	19.01	-	**19.01**	19.20	-	**19.20**
MARION	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MARSHALL	-	0.08	**0.08**	-	0.09	**0.09**	-	0.12	**0.12**	-	0.13	**0.13**	-	0.13	**0.13**	-	0.14	**0.14**	-	0.15	**0.15**
MOBILE	991.17	7.03	**998.20**	1,002.53	9.65	**1,012.17**	1,232.89	10.90	**1,243.79**	1,302.23	12.16	**1,314.40**	1,375.47	13.63	**1,389.11**	1,452.84	15.34	**1,468.18**	1,534.55	17.33	**1,551.88**
MONROE	46.31	0.39	**46.70**	47.54	0.69	**48.23**	46.02	0.79	**46.81**	48.74	0.89	**49.63**	51.62	1.00	**52.62**	54.67	1.12	**55.80**	57.91	1.26	**59.17**
MONTGOMERY	-	-	-	0.14	2.88	**3.03**	0.13	3.33	**3.46**	0.12	3.55	**3.67**	0.12	3.79	**3.91**	0.11	4.05	**4.16**	0.11	4.32	**4.43**
MORGAN	81.43	0.00	**81.44**	211.28	0.00	**211.28**	229.50	0.01	**229.50**	301.95	0.01	**301.95**	397.80	0.01	**397.81**	524.66	0.01	**524.67**	692.62	0.01	**692.63**
PERRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PICKENS	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**
PIKE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RANDOLPH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUSSELL	27.64	0.92	**28.56**	27.64	0.92	**28.56**	28.67	0.96	**29.62**	28.96	0.97	**29.92**	29.25	0.98	**30.22**	29.54	0.99	**30.53**	29.84	1.00	**30.83**
SHELBY	665.45	-	**665.45**	672.98	-	**672.98**	827.68	-	**827.68**	874.21	-	**874.21**	923.37	-	**923.37**	975.28	-	**975.28**	1,030.11	-	**1,030.11**
STCLAIR	4.46	-	**4.46**	5.71	-	**5.71**	6.75	-	**6.75**	7.49	-	**7.49**	8.31	-	**8.31**	9.22	-	**9.22**	10.23	-	**10.23**
SUMTER	2.03	-	**2.03**	2.28	-	**2.28**	2.55	-	**2.55**	2.77	-	**2.77**	3.02	-	**3.02**	3.28	-	**3.28**	3.58	-	**3.58**
TALLADEGA	24.67	-	**24.67**	22.12	-	**22.12**	20.17	-	**20.17**	19.18	-	**19.18**	18.24	-	**18.24**	17.34	-	**17.34**	16.49	-	**16.49**
TALLAPOOSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TUSCALOOSA	2.12	0.74	**2.86**	2.00	0.76	**2.76**	2.36	0.82	**3.18**	2.52	0.91	**3.43**	2.71	1.01	**3.72**	2.91	1.13	**4.04**	3.15	1.26	**4.41**
WALKER	922.82	-	**922.82**	933.26	-	**933.26**	1,147.79	-	**1,147.79**	1,212.32	-	**1,212.32**	1,280.48	-	**1,280.48**	1,352.47	-	**1,352.47**	1,428.52	-	**1,428.52**
WASHINGTON	80.39	6.15	**86.55**	81.66	6.73	**88.39**	99.78	8.66	**108.44**	105.37	9.47	**114.84**	111.28	10.36	**121.64**	117.52	11.33	**128.85**	124.11	12.40	**136.51**
WILCOX	20.13	-	**20.13**	18.05	-	**18.05**	16.46	-	**16.46**	15.65	-	**15.65**	14.88	-	**14.88**	14.15	-	**14.15**	13.46	-	**13.46**
WINSTON	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	8,788.97	33.20	**8,822.17**	8,744.16	45.64	**8,789.79**	7,399.66	50.81	**7,450.47**	7,684.25	54.10	**7,738.35**	8,007.92	57.79	**8,065.71**	8,379.39	61.92	**8,441.31**	8,809.94	66.56	**8,876.50**

HUC Level Analysis

The HUC level analysis addresses the total water withdrawn by industrial users in each HUC during the 31-year period. Table 9 provides a breakdown of total water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 for each HUC in the State of Alabama based on the International Forecasting Service Deflated GDP data. The results indicate that two HUCs, 06030001 and 06030005, experience significant declines in the amount of water withdrawn. This is because TVA is closing a steam plant in each HUC. However, some HUCs experience significant increases in water withdrawn during the 31-year period, e.g., 03140304, 0350106, 03150107, 3160109, 3160113, 03160203, and 03160204, with increases of 73 percent, 44 percent, 55 percent, 55 percent, 55 percent, 41 percent, and 55 percent, respectively. The HUCs with the largest water withdrawals are 03150107, 03160109, 03160204, and 06030002, with each HUC having water withdrawals in excess of one billion gallons per day by 2040. In 2040, the water withdrawal for these four HUCs accounts for 83 percent of all water withdrawn.

Table 9: Water Withdrawal (in MGD) by HUC - International Forecasting Service Deflated GDP

	2010			2015			2020			2025			2030			2035			2040		
HUC	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**
03130002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03130003	27.64	2.50	**30.14**	27.64	2.25	**29.88**	28.67	2.41	**31.08**	28.96	2.39	**31.35**	29.25	2.37	**31.62**	29.54	2.36	**31.90**	29.84	2.34	**32.18**
03130004	89.20	0.44	**89.64**	81.69	0.57	**82.25**	89.13	0.62	**89.76**	88.47	0.63	**89.10**	87.81	0.64	**88.45**	87.15	0.66	**87.81**	86.50	0.67	**87.17**
03130012	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140103	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140106	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140107	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140201	-	0.27	**0.27**	-	1.40	**1.40**	-	1.53	**1.53**	-	1.52	**1.52**	-	1.51	**1.51**	-	1.50	**1.50**	-	1.49	**1.49**
03140202	-	1.13	**1.13**	-	0.95	**0.95**	-	1.04	**1.04**	-	1.02	**1.02**	-	1.00	**1.00**	-	0.98	**0.98**	-	0.96	**0.96**
03140203	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140301	1.74	-	**1.74**	1.76	-	**1.76**	2.16	-	**2.16**	2.28	-	**2.28**	2.41	-	**2.41**	2.54	-	**2.54**	2.69	-	**2.69**
03140302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140303	-	0.30	**0.30**	-	0.27	**0.27**	-	0.25	**0.25**	-	0.24	**0.24**	-	0.22	**0.22**	-	0.21	**0.21**	-	0.20	**0.20**
03140304	33.61	1.38	**34.99**	40.92	1.57	**42.48**	44.17	1.76	**45.94**	47.35	1.87	**49.23**	50.76	1.99	**52.75**	54.41	2.12	**56.53**	58.33	2.25	**60.59**
03140305	-	0.09	**0.09**	-	0.09	**0.09**	-	0.10	**0.10**	-	0.11	**0.11**	-	0.12	**0.12**	-	0.13	**0.13**	-	0.14	**0.14**
03150105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150106	152.91	0.97	**153.88**	155.04	0.98	**156.02**	181.50	1.04	**182.55**	190.20	1.06	**191.26**	199.55	1.09	**200.63**	209.59	1.11	**210.69**	220.35	1.13	**221.48**
03150107	665.45	-	**665.45**	672.98	-	**672.98**	827.68	-	**827.68**	874.21	-	**874.21**	923.37	-	**923.37**	975.28	-	**975.28**	1,030.11	-	**1,030.11**
03150108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150109	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150201	64.62	10.33	**74.95**	61.44	17.79	**79.23**	60.34	18.68	**79.03**	59.46	19.45	**78.91**	58.65	20.26	**78.91**	57.91	21.14	**79.05**	57.24	22.09	**79.32**
03150202	-	0.16	**0.16**	0.03	0.20	**0.23**	0.03	0.24	**0.27**	0.04	0.26	**0.30**	0.04	0.29	**0.33**	0.04	0.32	**0.37**	0.05	0.36	**0.41**
03150203	20.13	-	**20.13**	18.05	-	**18.05**	16.46	-	**16.46**	15.65	-	**15.65**	14.88	-	**14.88**	14.15	-	**14.15**	13.46	-	**13.46**
03150204	46.31	0.39	**46.70**	47.54	0.69	**48.23**	46.02	0.79	**46.81**	48.74	0.89	**49.63**	51.62	1.00	**52.62**	54.67	1.12	**55.80**	57.91	1.26	**59.17**
03160101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160103	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160105	-	0.11	**0.11**	-	0.12	**0.12**	-	0.13	**0.13**	-	0.14	**0.14**	-	0.15	**0.15**	-	0.16	**0.16**	-	0.16	**0.16**
03160106	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**
03160107	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160109	924.65	0.43	**925.08**	936.04	0.76	**936.81**	1,150.90	0.88	**1,151.77**	1,215.57	0.99	**1,216.56**	1,283.90	1.11	**1,285.00**	1,356.08	1.24	**1,357.32**	1,432.34	1.40	**1,433.73**
03160110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160111	-	0.34	**0.34**	-	0.35	**0.35**	-	0.37	**0.37**	-	0.38	**0.38**	-	0.38	**0.38**	-	0.39	**0.39**	-	0.40	**0.40**
03160112	2.19	0.20	**2.39**	1.70	0.18	**1.88**	2.22	0.18	**2.41**	2.23	0.19	**2.42**	2.25	0.19	**2.44**	2.26	0.20	**2.45**	2.27	0.20	**2.47**
03160113	355.47	0.58	**356.05**	359.59	0.64	**360.23**	442.09	0.70	**442.79**	467.03	0.79	**467.83**	493.39	0.90	**494.29**	521.24	1.02	**522.26**	550.68	1.15	**551.83**
03160201	59.50	-	**59.50**	55.29	-	**55.29**	52.70	-	**52.70**	51.30	-	**51.30**	49.99	-	**49.99**	48.76	-	**48.76**	47.61	-	**47.61**
03160202	1.11	-	**1.11**	1.34	-	**1.34**	1.64	-	**1.64**	1.81	-	**1.81**	2.00	-	**2.00**	2.21	-	**2.21**	2.44	-	**2.44**
03160203	100.60	7.08	**107.68**	99.78	7.86	**107.63**	116.30	9.93	**126.22**	121.08	10.84	**131.92**	126.22	11.84	**138.06**	131.73	12.93	**144.66**	137.62	14.14	**151.76**
03160204	991.17	4.94	**996.11**	1,002.53	6.63	**1,009.16**	1,232.89	7.43	**1,240.31**	1,302.23	8.19	**1,310.42**	1,375.47	9.06	**1,384.54**	1,452.84	10.08	**1,462.92**	1,534.55	11.26	**1,545.81**
03160205	-	1.16	**1.16**	-	1.88	**1.88**	-	2.21	**2.21**	-	2.61	**2.61**	-	3.09	**3.09**	-	3.66	**3.66**	-	4.34	**4.34**
03170002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03170003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03170008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03170009	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**
06020001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06030001	1,054.12	0.08	**1,054.20**	1,065.94	0.09	**1,066.03**	9.23	0.12	**9.36**	9.33	0.13	**9.46**	9.42	0.13	**9.56**	9.52	0.14	**9.66**	9.61	0.15	**9.76**
06030002	2,867.15	0.00	**2,867.15**	2,761.23	0.00	**2,761.24**	3,002.33	0.01	**3,002.34**	3,052.00	0.01	**3,052.01**	3,125.35	0.01	**3,125.36**	3,229.98	0.01	**3,229.99**	3,375.95	0.01	**3,375.96**
06030003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06030004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06030005	1,331.41	0.31	**1,331.72**	1,353.63	0.35	**1,353.98**	93.19	0.36	**93.55**	106.29	0.38	**106.68**	121.60	0.40	**122.00**	139.48	0.42	**139.91**	160.40	0.45	**160.85**
06030006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	8,788.97	33.20	**8,822.17**	8,744.16	45.64	**8,789.79**	7,399.66	50.81	**7,450.47**	7,684.25	54.10	**7,738.35**	8,007.92	57.79	**8,065.71**	8,379.39	61.92	**8,441.31**	8,809.94	66.56	**8,876.50**

Limitations of This Study

Data Limitations

This study has several limitations that are caused by data limitations. The first major limitation resulting from data limitations is the accuracy of the water withdrawal estimates provided by the self-supplied users. If these data are not accurate, then all of the forecasts are compromised. The second major limitation is that the intended usage of water withdrawals by the self-supplied user is unknown. The current survey of self-supplied users does not request that information. Knowledge about the intended usage of the water withdrawal may have a significant impact on the estimation of future water withdrawal and the appropriate metric for estimating future withdrawals. Some water withdrawals are directly related to output because they are integral components of the output, e.g., ice manufacturing enterprise. Other water withdrawals would not be an integral component of the output, e.g., water used by lumber mills to prevent timber from drying prior to processing. A third limitation is the aggregation of the employment and GDP data that are used to calculate the forecasts. Some of the data are aggregated at the national level, and some are aggregated across multiple industries. This aggregation creates potential problems with developing accurate forecasts.

Estimation Methods

The first major limitation that is associated with the estimation methods is that it is highly likely that a singular approach to estimating water withdrawals may not be the most accurate because of the fundamental difference in the nature of water withdrawals. A model that estimates water withdrawal using specific models for NAICS codes may be the most appropriate. A second major limitation is that it is assumed that there will be no changes in the number of self-supplied users. This means that there will be no new COUs after 2013 and no additional terminations after 2016. This has the potential to significantly alter the forecasts because two industrial users that withdraw large amounts of water, TVA Widows Creek Fossil Plant and TVA Colbert Fossil Plant, are being closed during the estimation period. TVA will be replacing these thermo-electric plants, but the exact type of replacement has not been determined. Therefore, the forecasts for water withdrawal underestimate water withdrawals for all time periods after the closure of these two plants. A fourth major limitation is that it is assumed that the current rate of water withdrawal will remain constant for the next 31 years. This is highly unlikely given the innovations and process changes that may occur during that time period. If the rate of usage changes because of technological changes, then the accuracy of the forecasts will be compromised. A fifth major limitation of this study is that it does not address water returns. Most industrial users that withdraw large amounts of water also return large amounts of water. In some cases, this results in negative water usage.

Recommended Areas for Additional Study

There are three areas recommended for additional study. The first is to address the impact of water returns. The current study does not address this, and water returns is an important aspect of water withdrawals for several industries, especially thermo-electric. The second is to address the accuracy of all five methods based on historical data. The assessment of the accuracy of each method has been subjective and based upon logical reasoning. However, sufficient data exists to evaluate the accuracy of the five methods. The third is to identify the water withdrawal driver for industries. The identification of a water withdrawal driver may increase the accuracy of water withdrawal forecasts. The current study has raw data on water withdrawals, but there is no information regarding how the water is used. Knowledge regarding the use of the water, e.g., an integral component of the output versus an item used to clean or cool the finished output.

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Biographical Information of Authors

Dr. Bill Hamby is the Director of Accreditation for the Sorrell College of Business and an Associate Professor of Accounting at Troy University. He earned his Ph.D. in Accounting with a minor in Statistics from the University of Alabama in 1992. He has a B.S. in Accounting and MIS from the University of North Alabama. He has 26 years of full-time teaching experience and has taught at the following institutions: Indiana Wesleyan University, Lincoln Memorial University, Thomas University, Saint Mary's University (Nova Scotia), University of West Georgia, and University of South Alabama. He has served nine years in administration as a Dean, Division Chair, Department Chair, and Director of Accreditation. His primary teaching responsibilities and research interests relate to accounting information systems and managerial accounting. He has published in *Academy of Business Research Journal, The Journal of American Academy of Business (Cambridge), Advances in Accounting Information Systems, Employee Benefits Journal*, and CPA Journal. Dr. Hamby has been active in consulting and currently is a Marketing Executive with Ivy Software.

Dr. Hamby is a native of Alabama but has also lived in Georgia, Tennessee, Indiana, and Nova Scotia. He is married and has three children.

Dr. Judson Edwards is Dean of the Sorrell College of Business at Troy University, Troy, Alabama. Prior to his appointment as Dean, he served as a tenured Associate Professor of Economics and Director of the Center for International Business and Economic Development at Troy University. Dr. Edwards created the vision and established within the college the Center for Water Resource Economics on the Phenix City Campus. In addition to his accomplishments as Dean, he is the author of numerous peer-reviewed publications, including his book *Digital Deliverance: Dragging Rural America, Kicking and Screaming, Into the Information Economy*. He received a B.S. in Economics from Troy University and M.S. and Ph.D. in International Economic Development from The University of Southern Mississippi. Before returning to his alma mater, Dr. Edwards served as Director of the Economic Development Master's Program and tenure-track faculty at The University of Southern Mississippi. He also served as tenure-track faculty at the University of North Dakota. Before assuming administrative duties as Dean, he held the positions of Senior Editorial Advisor to *Applied Research in Economic Development: Journal of the Council of Community and Economic Research*, Managing Editor of *The Economic Development Review: Journal of the American Economic Development Council* and Editorial Board Member of Community Development: *Journal of the Community Development Society*. Dr. Edwards is a former member of the Agriculture Advisory Board of the Federal Reserve Bank of Atlanta and previously served on the Special Advisory Committee of the Alabama Rural Action Commission and the Alabama Rural Broadband Initiative under former Governor Bob Riley.

He and wife Stacy are from Phenix City, Alabama and have two children, Carter and Maggie.

Appendix A

Water Withdrawal Forecasts based on University of Alabama Employment Data

State Level Analysis

Ground Water Withdrawals

Table A-1 provides a breakdown of ground water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the type of industrial user based on the University of Alabama Study using employment data. The forecasts indicate that Thermo-electric, Petrochemical, and Other Manufacturing will experience significant increases in ground water withdrawal, with increases of 89 percent, 74 percent, and 75 percent, respectively. Mining, Pulp and Paper, and Wholesale will experience modest increases of 15 percent, 11 percent, and four percent, respectively. Total ground water withdrawals are forecast to increase by 52 percent.

Table A-1: Ground Water Withdrawals (in MGD)

	YEAR						
Type of Industrial User	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Mining	0.24	0.26	0.27	0.27	0.27	0.27	0.27
Thermo-electric	0.20	0.36	0.38	0.38	0.39	0.38	0.38
Pulp and Paper	11.78	12.45	12.91	12.99	12.99	13.04	13.13
Petrochemical	10.96	16.30	17.24	17.70	18.08	18.53	19.04
Other Manufacturing	10.01	14.73	15.63	16.09	16.49	16.96	17.50
Wholesale	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Total	33.20	44.12	46.44	47.45	48.24	49.20	50.34

Chart A-1.1: Self-Supplied Ground Water Withdrawals (in MGD) 2010: University of Alabama Employment

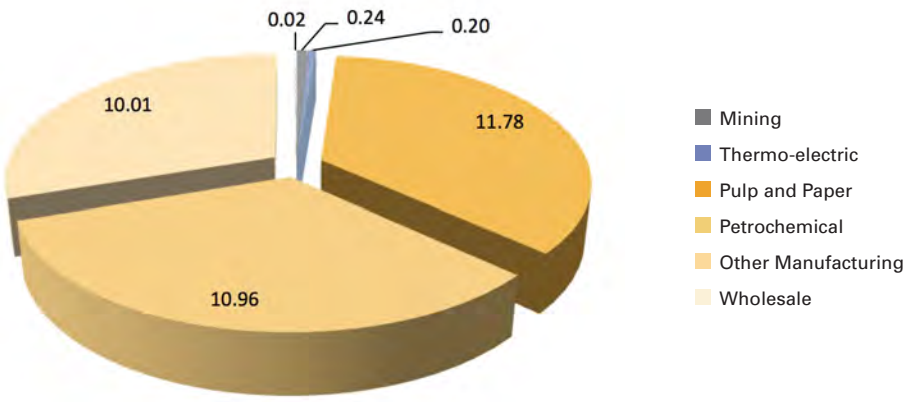
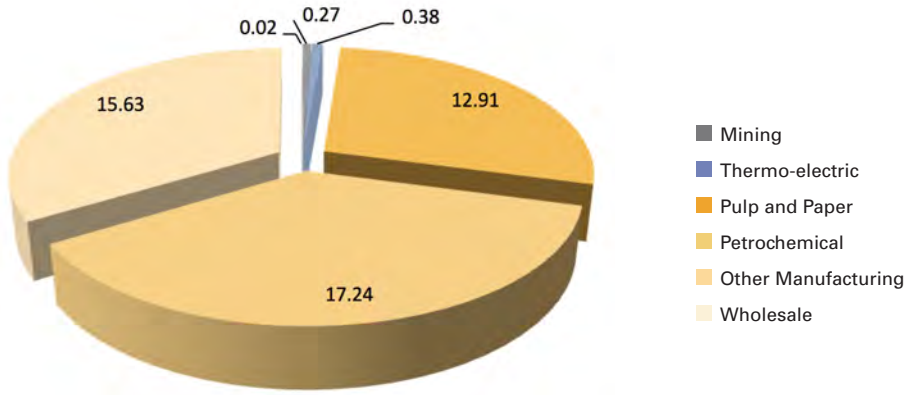


Chart A-1.2: Self-Supplied Ground Water Withdrawals (in MGD) 2020: University of Alabama Employment



The following charts, Chart A-1.1 – Chart A-1.4, provide the breakdown of ground water withdrawals by the type of industrial user based on the University of Alabama Study using employment data for 2010, 2020, 2030, and 2040. An analysis of these charts indicates that during the 31-year period, the proportion of ground water withdrawn by Pulp and Paper industrial users declines, while the proportion of ground water withdrawn by Petrochemical and Other Manufacturing industrial users increases. This is consistent with the long-term projections for these three industrial users, since Pulp and Paper is expected to have nominal growth, but Petrochemical and Other Manufacturing are expected to have significant growth.

Chart A-1.3: Self-Supplied Ground Water Withdrawals (in MGD) 2030: University of Alabama Employment

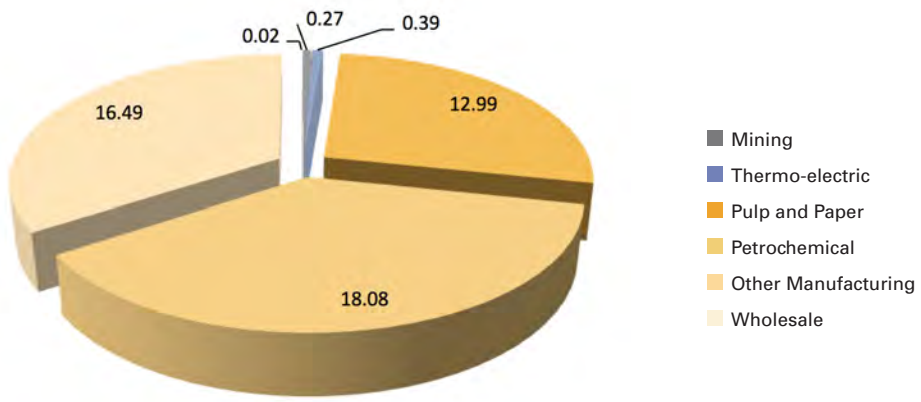
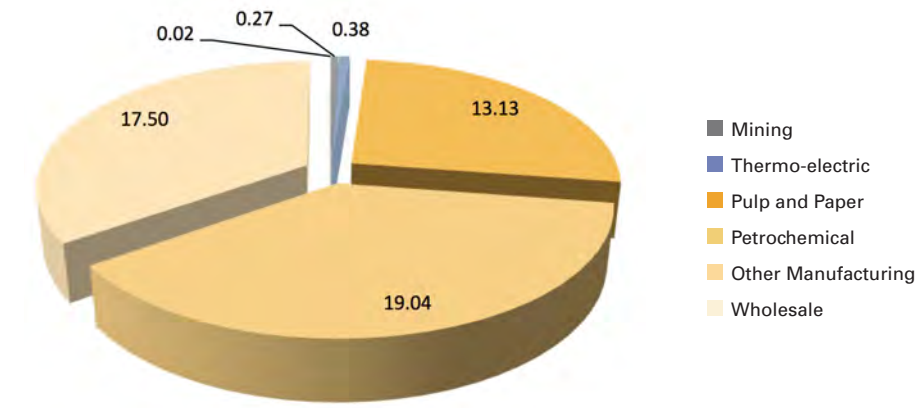


Chart A-1.4: Self-Supplied Ground Water Withdrawals (in MGD) 2040: University of Alabama Employment



Surface Water Withdrawals

Table A-2 provides a breakdown of surface water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the type of industrial user based on the University of Alabama Study using employment data. The forecasts indicate that Mining, Pulp and Paper, Petrochemical, and Other Manufacturing will experience moderate increases in surface water withdrawal, with increases of five percent, 14 percent, 16 percent, and 34 percent, respectively. Thermo-electric will experience an 18 percent decline. Total surface water withdrawals are forecast to decrease by 16 percent.

Table A-2: Surface Water Withdrawal Data (in MGD) - University of Alabama Employment

	YEAR						
Type of Industrial User	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Mining	3.30	3.29	3.41	3.44	3.44	3.45	3.46
Thermo-electric	8,251.64	8,937.56	6,826.03	6,912.00	7,004.59	6,924.01	6,780.41
Pulp and Paper	369.99	387.53	404.34	409.40	412.01	416.44	422.10
Petrochemical	140.28	155.57	161.12	161.70	161.37	161.57	162.13
Other Manufacturing	23.77	28.79	30.16	30.64	30.97	31.40	31.95
Wholesale	-	0.03	0.03	0.03	0.03	0.03	0.03
Total	8,788.97	9,512.77	7,425.10	7,517.21	7,612.40	7,536.90	7,400.09

The following charts, Chart A-2.1 – Chart A-2.4, provide the breakdown of surface water withdrawals by the type of industrial user based on the University of Alabama Study using employment data for 2010, 2020, 2030, and 2040. An analysis of these charts indicates that during the 31-year period, the proportion of surface water withdrawn by Thermo-electric industrial users declines, while the proportion of surface water withdrawn by Petrochemical, Other Manufacturing, and Pulp and Paper industrial users increases. This is consistent with closing of two TVA thermo-electric plants and the long-term projections for these three industrial users, since Pulp and Paper is expected to have nominal growth, but Petrochemical and Other Manufacturing are expected to have significant growth.

Chart A-2.1: Self-Supplied Surface Water Withdrawals (in MGD) 2010: University of Alabama Employment

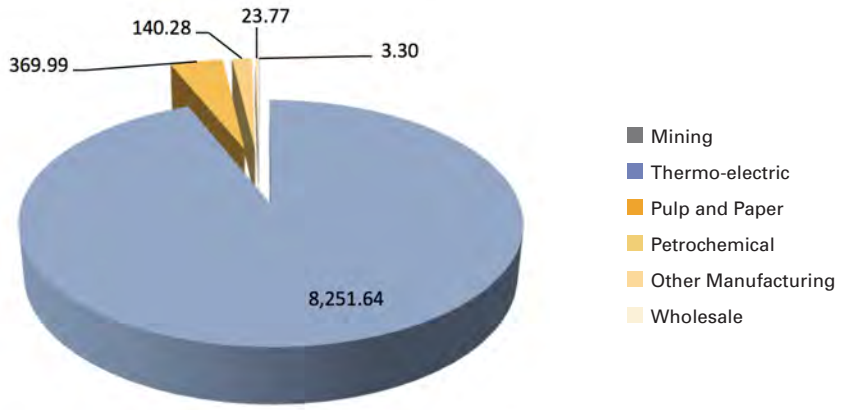


Chart A-2.2: Self-Supplied Surface Water Withdrawals (in MGD) 2020: University of Alabama Employment

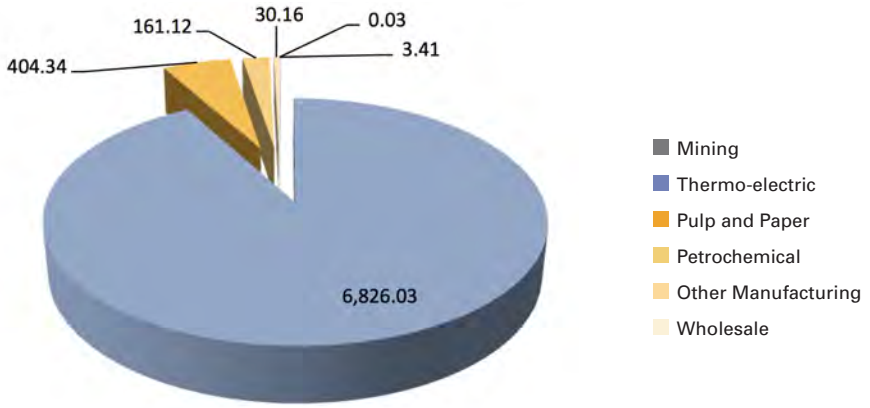


Chart A-2.3: Self-Supplied Surface Water Withdrawals (in MGD) 2030: University of Alabama Employment

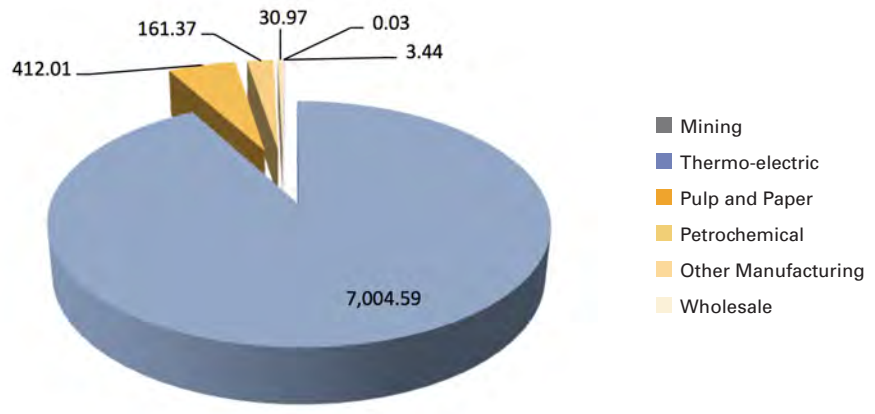
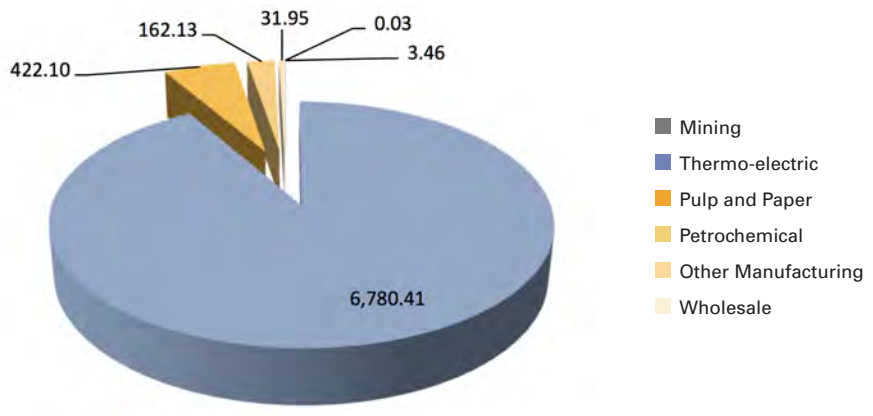


Chart A-2.4: Self-Supplied Surface Water Withdrawals (in MGD) 2040: University of Alabama Employment



Total Water Withdrawals

Table A-3 provides a breakdown of total water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the type of industrial user based on the University of Alabama Study using employment data. The forecasts indicate that Mining, Pulp and Paper, Petrochemical, and Other Manufacturing will experience moderate increases in total water withdrawal, with increases of six percent, 14 percent, 20 percent, and 46 percent, respectively. Thermo-electric will experience an 18 percent decline, and Wholesale will experience a 161 percent increase.

Table A-3: Total Water Withdrawal Data (in MGD) - University of Alabama Employment

	YEAR						
Type of Industrial User	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Mining	3.53	3.55	3.68	3.71	3.71	3.72	3.73
Thermo-electric	8,251.84	8,937.92	6,826.41	6,912.39	7,004.97	6,924.39	6,780.79
Pulp and Paper	381.77	399.98	417.25	422.39	425.00	429.48	435.23
Petrochemical	151.24	171.88	178.36	179.39	179.45	180.11	181.17
Other Manufacturing	33.78	43.52	45.79	46.74	47.46	48.36	49.45
Wholesale	0.02	0.04	0.05	0.05	0.05	0.05	0.05
Total	8,822.17	9,556.89	7,471.54	7,564.66	7,660.64	7,586.10	7,450.42

Chart A-3.1: Self-Supplied Total Water Withdrawals (in MGD) 2010: University of Alabama Employment

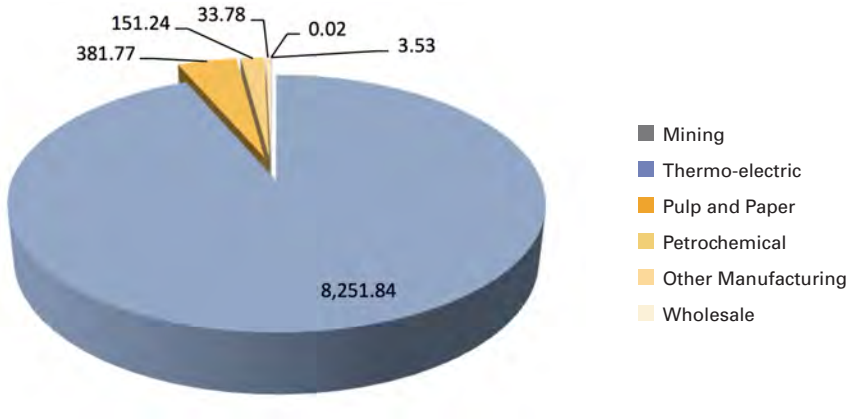
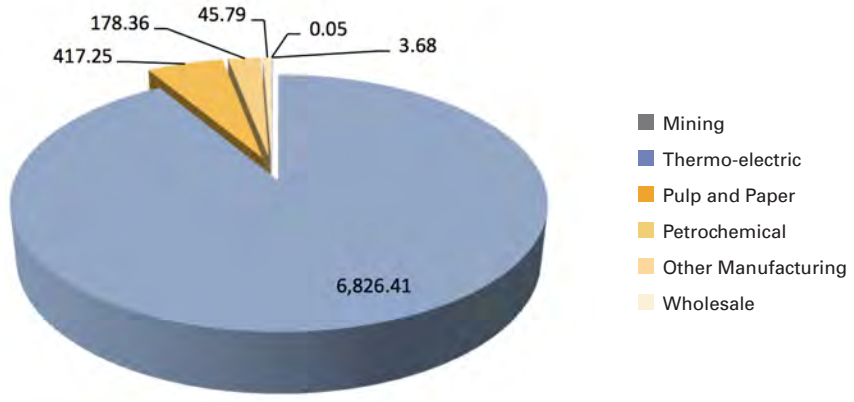


Chart A-3.2: Self-Supplied Total Water Withdrawals (in MGD) 2020: University of Alabama Employment



The following charts, Chart A-3.1 – Chart A-3.4, provide the breakdown of total water withdrawals by the type of industrial user based on the University of Alabama Study using employment data for 2010, 2020, 2030, and 2040. An analysis of these charts indicates that during the 31-year period, the proportion of total water withdrawn by Thermo-electric industrial users declines, while the proportion of total water withdrawn by Petrochemical, Pulp and Paper, and Other Manufacturing industrial users increases. This is consistent with the closing of two TVA thermo-electric plants and the long-term projections for these three industrial users, since Pulp and Paper is expected to have nominal growth, but Petrochemical and Other Manufacturing are expected to have significant growth.

Chart A-3.3: Self-Supplied Total Water Withdrawals (in MGD) 2030: University of Alabama Employment

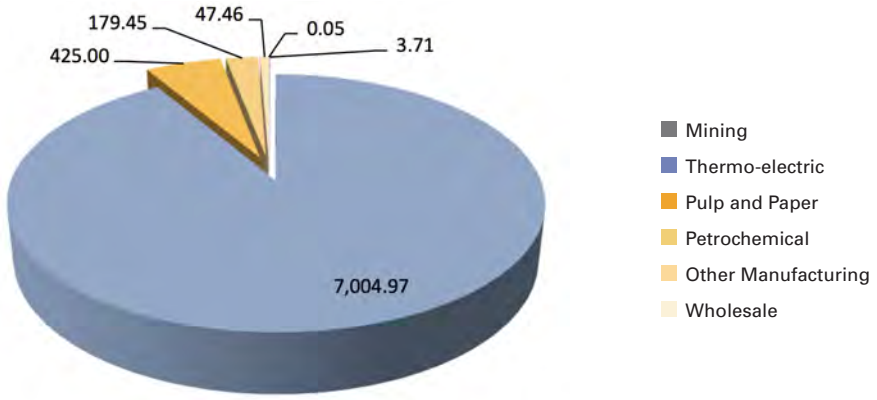


Chart A-3.4: Self-Supplied Total Water Withdrawals (in MGD) 2040: University of Alabama Employment

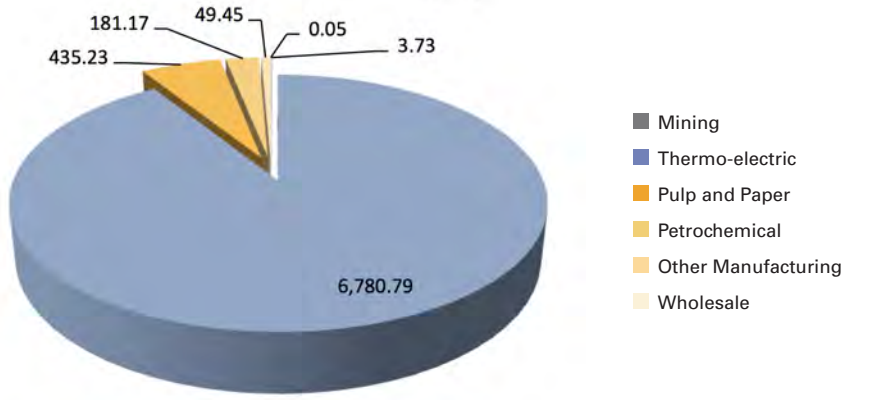
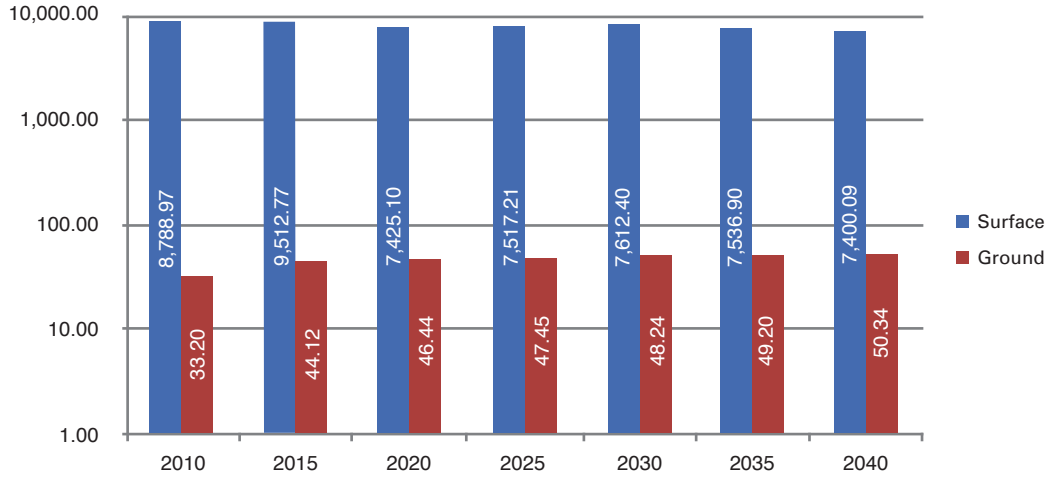


Table A-4 and Chart A-4 provide a breakdown of total water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the water source based on the University of Alabama Study using Employment data. The forecast indicates that approximately 99 percent of water withdrawn is surface water. Ground water is projected to increase by 52 percent during the 31-year period; whereas, surface water is expected to decrease by 16 percent. Thermo-electric is the largest user of surface water, and the closing of the two TVA plants significantly impacts the surface water withdrawn.

Table A-4: Total Water Withdrawal Data (in MGD) - University of Alabama Employment

	YEAR						
Water Source	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Ground	33.20	44.12	46.44	47.45	48.24	49.20	50.34
Surface	8,788.97	9,512.77	7,425.10	7,517.21	7,612.40	7,536.90	7,400.09
Total	8,822.17	9,556.89	7,471.54	7,564.66	7,660.64	7,586.10	7,450.42

Chart A-4: Self-Supplied Total Water Withdrawal (in MGD) 2010-2040: University of Alabama Employment



County Level Analysis

The county-level analysis addresses the total water withdrawn by industrial users in each county during the 31-year period. Table A-5 provides the forecasts for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 for each county in the State of Alabama based on the University of Alabama Study using Employment data. The results indicate that two counties, Colbert and Jackson, experience significant declines in the amount of water withdrawn. This is because TVA is closing a steam plant in each county. However, some counties experience significant increases in water withdrawn during the 31-year period, e.g., Shelby, with an increase of 41 percent. The counties with the largest water withdrawals are Limestone, Walker, Mobile, and Shelby, with each county having water withdrawals in excess of 900 million gallons per day by 2040. In 2040, the water withdrawal for these four counties accounts for 82 percent of all water withdrawn.

HUC Level Analysis

The HUC level analysis addresses the total water withdrawn by industrial users in each HUC during the 31-year period. Table A-6 provides the forecasts for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 for each HUC in the State of Alabama based on the University of Alabama Study using employment data. The results indicate that two HUCs, 06030001 and 06030005, experience significant declines in the amount of water withdrawn. This is because TVA is closing a steam plant in each HUC. However, some HUCs experience significant increases in water withdrawn during the 31-year period, e.g., 03150107, with an increase of 41 percent. The HUCs with the largest water withdrawals are 03150107, 03160109, 03160204, and 06030002, with each HUC having water withdrawals in excess of 930 million gallons per day by 2040. In 2040, the water withdrawal for these four HUCs accounts for 84 percent of all water withdrawn.

Table A-5: Water Withdrawal (in MGD) by County - University of Alabama Employment

	2010			2015			2020			2025			2030			2035			2040		
COUNTY	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**
AUTAUGA	32.42	9.84	**42.26**	33.87	10.27	**44.14**	35.10	10.64	**45.74**	35.29	10.69	**45.98**	35.26	10.67	**45.93**	35.28	10.69	**45.97**	35.41	10.74	**46.15**
BALDWIN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BARBOUR	-	1.58	**1.58**	-	1.47	**1.47**	-	1.53	**1.53**	-	1.54	**1.54**	-	1.55	**1.55**	-	1.56	**1.56**	-	1.57	**1.57**
BIBB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BLOUNT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BULLOCK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BUTLER	-	0.30	**0.30**	-	0.36	**0.36**	-	0.39	**0.39**	-	0.40	**0.40**	-	0.41	**0.41**	-	0.42	**0.42**	-	0.43	**0.43**
CALHOUN	-	0.97	**0.97**	-	0.99	**0.99**	-	1.04	**1.04**	-	1.06	**1.06**	-	1.07	**1.07**	-	1.08	**1.08**	-	1.10	**1.10**
CHAMBERS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHEROKEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHILTON	-	0.35	**0.35**	-	0.40	**0.40**	-	0.42	**0.42**	-	0.43	**0.43**	-	0.43	**0.43**	-	0.44	**0.44**	-	0.45	**0.45**
CHOCTAW	40.80	-	**40.80**	41.68	-	**41.68**	42.93	-	**42.93**	42.88	-	**42.88**	42.58	-	**42.58**	42.44	-	**42.44**	42.38	-	**42.38**
CLARKE	20.21	-	**20.21**	20.27	-	**20.27**	21.46	-	**21.46**	22.03	-	**22.03**	22.52	-	**22.52**	23.08	-	**23.08**	23.73	-	**23.73**
CLAY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLEBURNE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COFFEE	-	1.13	**1.13**	-	2.35	**2.35**	-	2.50	**2.50**	-	2.59	**2.59**	-	2.66	**2.66**	-	2.75	**2.75**	-	2.85	**2.85**
COLBERT	1,331.41	0.31	**1,331.72**	1,434.10	0.36	**1,434.46**	84.02	0.37	**84.39**	84.11	0.37	**84.48**	83.67	0.37	**84.04**	83.49	0.37	**83.86**	83.44	0.37	**83.81**
CONECUH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COOSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COVINGTON	1.74	-	**1.74**	1.86	-	**1.86**	1.97	-	**1.97**	2.00	-	**2.00**	2.03	-	**2.03**	2.01	-	**2.01**	1.97	-	**1.97**
CRENSHAW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CULLMAN	1.83	0.43	**2.26**	2.97	0.47	**3.44**	3.10	0.49	**3.59**	3.14	0.49	**3.64**	3.18	0.50	**3.68**	3.24	0.51	**3.75**	3.31	0.52	**3.84**
DALE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DALLAS	32.20	0.14	**32.34**	33.15	0.14	**33.29**	34.53	0.15	**34.68**	34.98	0.15	**35.13**	35.30	0.15	**35.45**	35.82	0.15	**35.97**	36.47	0.15	**36.62**
DEKALB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ELMORE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ESCAMBIA	33.61	1.47	**35.08**	37.98	1.65	**39.63**	39.95	1.74	**41.69**	40.74	1.77	**42.51**	41.29	1.79	**43.09**	41.94	1.82	**43.76**	42.75	1.86	**44.60**
ETOWAH	123.78	-	**123.78**	124.88	-	**124.88**	131.38	-	**131.38**	132.64	-	**132.64**	134.52	-	**134.52**	133.36	-	**133.36**	131.17	-	**131.17**
FAYETTE	1.10	-	**1.10**	1.02	-	**1.02**	1.04	-	**1.04**	1.03	-	**1.03**	1.01	-	**1.01**	1.00	-	**1.00**	0.98	-	**0.98**
FRANKLIN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GENEVA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GREENE	354.43	0.03	**354.46**	379.98	0.03	**380.01**	402.20	0.03	**402.24**	408.20	0.04	**408.24**	414.60	0.04	**414.63**	410.39	0.04	**410.42**	402.56	0.04	**402.60**
HALE	-	0.02	**0.02**	-	0.02	**0.02**	-	0.02	**0.02**	-	0.02	**0.02**	-	0.02	**0.02**	-	0.02	**0.02**	-	0.02	**0.02**
HENRY	-	0.54	**0.54**	-	0.55	**0.55**	-	0.58	**0.58**	-	0.60	**0.60**	-	0.61	**0.61**	-	0.63	**0.63**	-	0.64	**0.64**
HOUSTON	89.20	0.17	**89.37**	95.63	0.32	**95.95**	101.22	0.34	**101.56**	102.73	0.35	**103.07**	104.34	0.35	**104.69**	103.28	0.35	**103.63**	101.31	0.34	**101.65**
JACKSON	1,054.12	-	**1,054.12**	1,129.85	-	**1,129.85**	9.68	-	**9.68**	9.78	-	**9.78**	9.85	-	**9.85**	9.96	-	**9.96**	10.11	-	**10.11**
JEFFERSON	-	0.50	**0.50**	0.03	0.52	**0.54**	0.03	0.54	**0.57**	0.03	0.54	**0.57**	0.03	0.54	**0.57**	0.03	0.55	**0.58**	0.03	0.55	**0.58**
LAMAR	-	0.11	**0.11**	-	0.13	**0.13**	-	0.13	**0.13**	-	0.13	**0.13**	-	0.14	**0.14**	-	0.14	**0.14**	-	0.14	**0.14**
LAUDERDALE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LAWRENCE	60.09	-	**60.09**	63.64	-	**63.64**	66.59	-	**66.59**	67.64	-	**67.64**	67.93	-	**67.93**	68.57	-	**68.57**	69.55	-	**69.55**
LEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LIMESTONE	2,725.63	-	**2,725.63**	2,922.09	-	**2,922.09**	3,093.00	-	**3,093.00**	3,139.14	-	**3,139.14**	3,188.32	-	**3,188.32**	3,155.94	-	**3,155.94**	3,095.75	-	**3,095.75**
LOWNDES	-	-	-	-	4.29	**4.29**	-	4.50	**4.50**	-	4.59	**4.59**	-	4.66	**4.66**	-	4.75	**4.75**	-	4.83	**4.83**
MACON	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MADISON	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MARENGO	17.78	-	**17.78**	17.23	-	**17.23**	17.91	-	**17.91**	18.05	-	**18.05**	18.11	-	**18.11**	18.20	-	**18.20**	18.33	-	**18.33**
MARION	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MARSHALL	-	0.08	**0.08**	-	0.08	**0.08**	-	0.09	**0.09**	-	0.09	**0.09**	-	0.09	**0.09**	-	0.09	**0.09**	-	0.09	**0.09**
MOBILE	991.17	7.03	**998.20**	1,020.10	8.69	**1,028.79**	1,056.58	9.40	**1,065.98**	1,050.23	9.87	**1,060.10**	1,046.43	10.29	**1,056.72**	1,017.98	10.75	**1,028.74**	982.07	11.27	**993.34**
MONROE	46.31	0.39	**46.70**	43.61	0.36	**43.97**	45.64	0.38	**46.02**	46.28	0.39	**46.67**	46.69	0.39	**47.08**	47.36	0.40	**47.76**	47.96	0.40	**48.36**
MONTGOMERY	-	-	-	0.16	2.40	**2.56**	0.17	2.56	**2.72**	0.17	2.64	**2.81**	0.18	2.72	**2.89**	0.18	2.81	**2.99**	0.19	2.91	**3.10**
MORGAN	81.43	0.00	**81.44**	87.43	0.00	**87.44**	90.70	0.00	**90.70**	91.21	0.00	**91.22**	91.31	0.00	**91.31**	91.59	0.00	**91.60**	92.07	0.00	**92.08**
PERRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PICKENS	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**
PIKE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RANDOLPH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUSSELL	27.64	0.92	**28.56**	32.24	1.07	**33.31**	33.28	1.11	**34.39**	33.43	1.11	**34.54**	33.48	1.12	**34.60**	33.76	1.12	**34.88**	34.16	1.14	**35.30**
SHELBY	665.45	-	**665.45**	855.49	-	**855.49**	913.28	-	**913.28**	933.95	-	**933.95**	953.34	-	**953.34**	952.17	-	**952.17**	939.12	-	**939.12**
STCLAIR	4.46	-	**4.46**	5.35	-	**5.35**	5.62	-	**5.62**	5.72	-	**5.72**	5.79	-	**5.79**	5.88	-	**5.88**	5.98	-	**5.98**
SUMTER	2.03	-	**2.03**	1.93	-	**1.93**	1.99	-	**1.99**	1.99	-	**1.99**	1.97	-	**1.97**	1.97	-	**1.97**	1.96	-	**1.96**
TALLADEGA	24.67	-	**24.67**	27.45	-	**27.45**	29.09	-	**29.09**	29.93	-	**29.93**	30.63	-	**30.63**	31.42	-	**31.42**	32.28	-	**32.28**
TALLAPOOSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TUSCALOOSA	2.12	0.74	**2.86**	2.19	0.76	**2.95**	2.32	0.81	**3.14**	2.40	0.85	**3.25**	2.47	0.88	**3.35**	2.55	0.92	**3.47**	2.64	0.96	**3.60**
WALKER	922.82	-	**922.82**	989.34	-	**989.34**	1,047.20	-	**1,047.20**	1,062.82	-	**1,062.82**	1,079.47	-	**1,079.47**	1,068.51	-	**1,068.51**	1,048.13	-	**1,048.13**
WASHINGTON	80.39	6.15	**86.55**	86.04	6.41	**92.45**	90.99	6.67	**97.66**	92.32	6.75	**99.07**	93.72	6.79	**100.51**	92.88	6.86	**99.74**	91.28	6.95	**98.24**
WILCOX	20.13	-	**20.13**	21.24	-	**21.24**	22.12	-	**22.12**	22.32	-	**22.32**	22.40	-	**22.40**	22.64	-	**22.64**	22.98	-	**22.98**
WINSTON	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	8,788.97	33.20	**8,822.17**	9,512.77	44.12	**9,556.89**	7,425.10	46.44	**7,471.54**	7,517.21	47.45	**7,564.66**	7,612.40	48.24	**7,660.64**	7,536.90	49.20	**7,586.10**	7,400.09	50.34	**7,450.42**

Table A-6: Water Withdrawal (in MGD) by HUC - University of Alabama Employment

	2010			2015			2020			2025			2030			2035			2040		
HUC	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**
03130002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03130003	27.64	2.50	**30.14**	32.24	2.55	**34.79**	33.28	2.64	**35.92**	33.43	2.66	**36.09**	33.48	2.66	**36.15**	33.76	2.68	**36.44**	34.16	2.71	**36.87**
03130004	89.20	0.44	**89.64**	95.63	0.60	**96.22**	101.22	0.63	**101.85**	102.73	0.65	**103.37**	104.34	0.66	**105.00**	103.28	0.66	**103.94**	101.31	0.66	**101.97**
03130012	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140103	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140106	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140107	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140201	-	0.27	**0.27**	-	1.42	**1.42**	-	1.51	**1.51**	-	1.56	**1.56**	-	1.60	**1.60**	-	1.65	**1.65**	-	1.71	**1.71**
03140202	-	1.13	**1.13**	-	1.21	**1.21**	-	1.28	**1.28**	-	1.33	**1.33**	-	1.37	**1.37**	-	1.41	**1.41**	-	1.46	**1.46**
03140203	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140301	1.74	-	**1.74**	1.86	-	**1.86**	1.97	-	**1.97**	2.00	-	**2.00**	2.03	-	**2.03**	2.01	-	**2.01**	1.97	-	**1.97**
03140302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140303	-	0.30	**0.30**	-	0.36	**0.36**	-	0.39	**0.39**	-	0.40	**0.40**	-	0.41	**0.41**	-	0.42	**0.42**	-	0.43	**0.43**
03140304	33.61	1.38	**34.99**	37.98	1.56	**39.53**	39.95	1.64	**41.59**	40.74	1.67	**42.41**	41.29	1.69	**42.98**	41.94	1.72	**43.66**	42.75	1.75	**44.50**
03140305	-	0.09	**0.09**	-	0.10	**0.10**	-	0.10	**0.10**	-	0.10	**0.10**	-	0.10	**0.10**	-	0.10	**0.10**	-	0.10	**0.10**
03150105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150106	152.91	0.97	**153.88**	157.68	0.99	**158.67**	166.09	1.04	**167.13**	168.29	1.06	**169.34**	170.94	1.07	**172.00**	170.65	1.08	**171.73**	169.43	1.10	**170.53**
03150107	665.45	-	**665.45**	855.49	-	**855.49**	913.28	-	**913.28**	933.95	-	**933.95**	953.34	-	**953.34**	952.17	-	**952.17**	939.12	-	**939.12**
03150108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150109	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150201	64.62	10.33	**74.95**	67.17	17.51	**84.68**	69.80	18.26	**88.06**	70.44	18.49	**88.94**	70.73	18.63	**89.37**	71.29	18.83	**90.12**	72.07	19.07	**91.15**
03150202	-	0.16	**0.16**	0.03	0.16	**0.19**	0.03	0.17	**0.20**	0.03	0.17	**0.20**	0.03	0.17	**0.20**	0.03	0.17	**0.20**	0.03	0.17	**0.20**
03150203	20.13	-	**20.13**	21.24	-	**21.24**	22.12	-	**22.12**	22.32	-	**22.32**	22.40	-	**22.40**	22.64	-	**22.64**	22.98	-	**22.98**
03150204	46.31	0.39	**46.70**	43.61	0.36	**43.97**	45.64	0.38	**46.02**	46.28	0.39	**46.67**	46.69	0.39	**47.08**	47.36	0.40	**47.76**	47.96	0.40	**48.36**
03160101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160103	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160105	-	0.11	**0.11**	-	0.13	**0.13**	-	0.13	**0.13**	-	0.13	**0.13**	-	0.14	**0.14**	-	0.14	**0.14**	-	0.14	**0.14**
03160106	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**
03160107	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160109	924.65	0.43	**925.08**	992.31	0.47	**992.77**	1,050.30	0.49	**1,050.79**	1,065.97	0.49	**1,066.46**	1,082.65	0.50	**1,083.15**	1,071.75	0.51	**1,072.26**	1,051.45	0.52	**1,051.97**
03160110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160111	-	0.34	**0.34**	-	0.35	**0.35**	-	0.37	**0.37**	-	0.37	**0.37**	-	0.37	**0.37**	-	0.38	**0.38**	-	0.38	**0.38**
03160112	2.19	0.20	**2.39**	2.13	0.21	**2.34**	2.21	0.22	**2.44**	2.24	0.23	**2.47**	2.24	0.24	**2.48**	2.26	0.25	**2.51**	2.27	0.26	**2.53**
03160113	355.47	0.58	**356.05**	381.05	0.60	**381.66**	403.35	0.65	**404.00**	409.40	0.67	**410.07**	415.84	0.70	**416.53**	411.68	0.72	**412.40**	403.92	0.75	**404.67**
03160201	59.50	-	**59.50**	59.68	-	**59.68**	61.63	-	**61.63**	61.72	-	**61.72**	61.46	-	**61.46**	61.41	-	**61.41**	61.48	-	**61.48**
03160202	1.11	-	**1.11**	1.16	-	**1.16**	1.20	-	**1.20**	1.20	-	**1.20**	1.19	-	**1.19**	1.19	-	**1.19**	1.19	-	**1.19**
03160203	100.60	7.08	**107.68**	106.31	7.49	**113.80**	112.45	7.84	**120.29**	114.36	7.97	**122.33**	116.24	8.07	**124.31**	115.96	8.19	**124.15**	115.01	8.35	**123.37**
03160204	991.17	4.94	**996.11**	1,020.10	6.26	**1,026.37**	1,056.58	6.79	**1,063.37**	1,050.23	7.13	**1,057.36**	1,046.43	7.44	**1,053.87**	1,017.98	7.78	**1,025.76**	982.07	8.16	**990.23**
03160205	-	1.16	**1.16**	-	1.34	**1.34**	-	1.45	**1.45**	-	1.52	**1.52**	-	1.57	**1.57**	-	1.64	**1.64**	-	1.71	**1.71**
03170002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03170003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03170008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03170009	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**
06020001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06030001	1,054.12	0.08	**1,054.20**	1,129.85	0.08	**1,129.94**	9.68	0.09	**9.77**	9.78	0.09	**9.86**	9.85	0.09	**9.94**	9.96	0.09	**10.05**	10.11	0.09	**10.20**
06030002	2,867.15	0.00	**2,867.15**	3,073.17	0.00	**3,073.17**	3,250.29	0.00	**3,250.30**	3,297.99	0.00	**3,298.00**	3,347.56	0.00	**3,347.56**	3,316.11	0.00	**3,316.11**	3,257.38	0.00	**3,257.38**
06030003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06030004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06030005	1,331.41	0.31	**1,331.72**	1,434.10	0.36	**1,434.46**	84.02	0.37	**84.39**	84.11	0.37	**84.48**	83.67	0.37	**84.04**	83.49	0.37	**83.86**	83.44	0.37	**83.81**
06030006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	8,788.97	33.20	**8,822.17**	9,512.77	44.12	**9,556.89**	7,425.10	46.44	**7,471.54**	7,517.21	47.45	**7,564.66**	7,612.40	48.24	**7,660.64**	7,536.90	49.20	**7,586.10**	7,400.09	50.34	**7,450.42**

Appendix B

Water Withdrawal Forecasts based on EMSI Employment Data

State Level Analysis

Ground Water Withdrawals

Table B-1 provides a breakdown of ground water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the type of industrial user based on the EMSI employment data. The forecasts indicate that Mining and Other Manufacturing will experience significant increases in ground water withdrawal, with increases of 585 percent and 103 percent, respectively. Thermo-electric, Pulp and Paper, and Petrochemical will experience modest increases of seven percent, 38 percent, and 17 percent, respectively. Wholesale does not experience a change. Total ground water withdrawals are forecast to increase by 54 percent.

Table B-1: Ground Water Withdrawal Data (in MGD) - EMSI Employment

	YEAR						
Type of Industrial User	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Mining	0.24	0.63	0.81	0.91	1.10	1.34	1.63
Thermo-electric	0.20	0.19	0.20	0.20	0.20	0.21	0.21
Pulp and Paper	11.78	14.31	14.76	14.97	15.36	15.79	16.25
Petrochemical	10.96	15.46	14.13	14.16	13.65	13.22	12.87
Other Manufacturing	10.01	15.09	15.45	16.37	17.39	18.69	20.29
Wholesale	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Total	33.20	45.69	45.37	46.62	47.72	49.26	51.26

Chart B-1.1: Self-Supplied Ground Water Withdrawals (in MGD) 2010: EMSI Employment

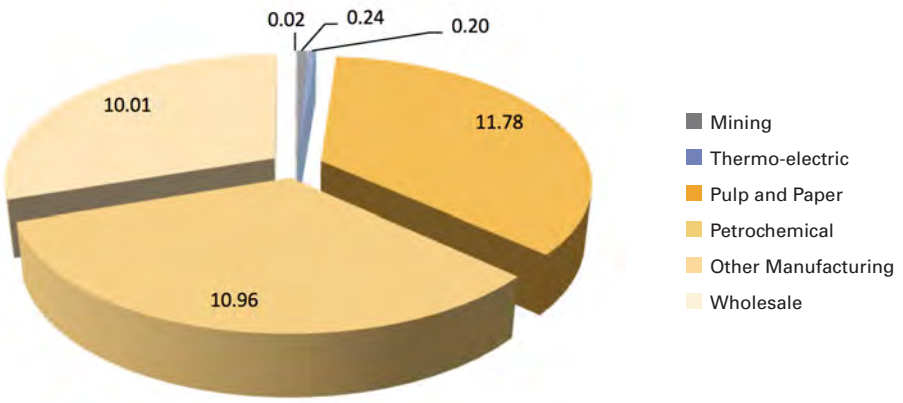
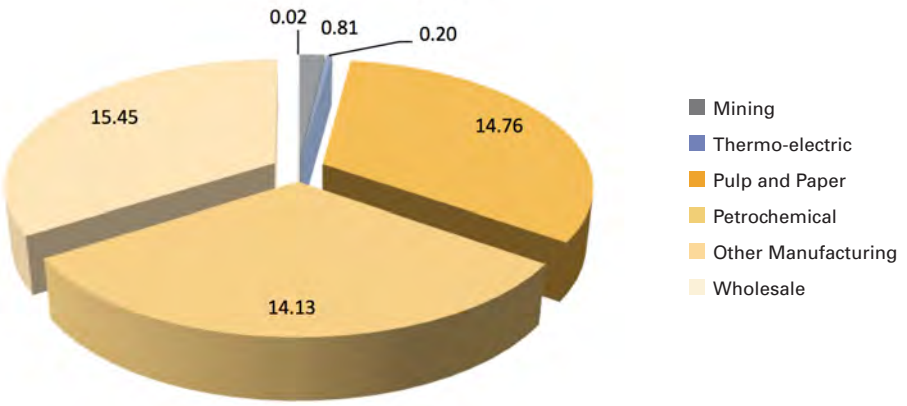


Chart B-1.2: Self-Supplied Ground Water Withdrawals (in MGD) 2020: EMSI Employment



The following charts, Chart B-1.1 – Chart B-1.4, provide the breakdown of ground water withdrawals by the type of industrial user based on the EMSI employment data for 2010, 2020, 2030, and 2040. An analysis of these charts indicates that the during the 31-year period, the proportion of ground water withdrawn by Petrochemical and Pulp and Paper industrial users declines, while the proportion of ground water withdrawn by Other Manufacturing industrial users increases. This is partially consistent with the long-term projections for these three industrial users, since Pulp and Paper is expected to have nominal growth, but Petrochemical and Other Manufacturing are expected to have significant growth.

Chart B-1.3: Self-Supplied Ground Water Withdrawals (in MGD) 2030: EMSI Employment

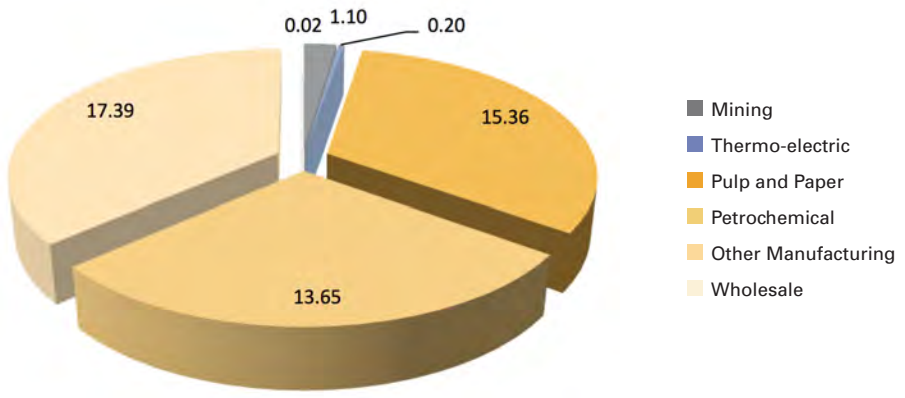
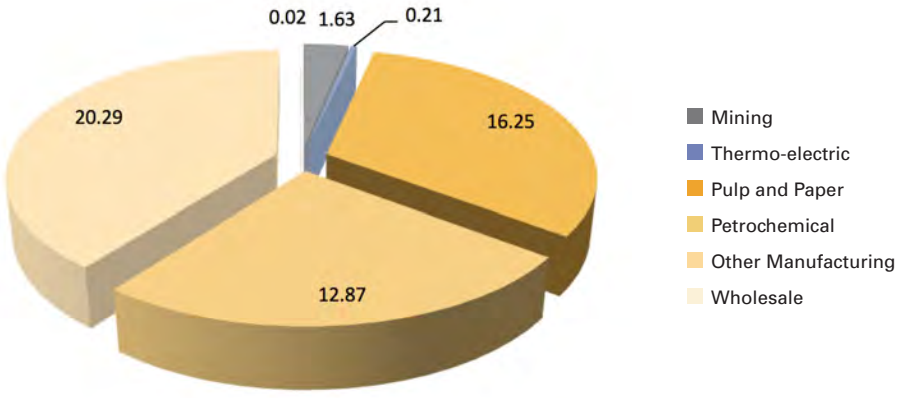


Chart B-1.4: Self-Supplied Ground Water Withdrawals (in MGD) 2040: EMSI Employment



Surface Water Withdrawals

Table B-2 provides a breakdown of surface water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the type of industrial user based on the EMSI employment data. The forecasts indicate that Thermo-electric, Pulp and Paper, and Petrochemical will experience significant decreases in surface water withdrawal, with decreases of 30 percent, 28 percent, and 18 percent, respectively. Mining will experience a 15 percent increase, and Other Manufacturing and Wholesale will experience a 109 percent increase. Total surface water withdrawals are forecast to decrease by 30 percent.

Table B-2: Surface Water Withdrawal Data (in MGD) - EMSI Employment

	YEAR						
Type of Industrial User	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Mining	3.30	3.03	3.23	3.30	3.45	3.62	3.80
Thermo-electric	8,251.64	8,158.41	5,623.71	5,638.74	5,646.84	5,682.42	5,746.45
Pulp and Paper	369.99	319.55	294.24	277.66	270.26	267.45	268.01
Petrochemical	140.28	148.86	133.75	128.79	122.42	117.80	114.54
Other Manufacturing	23.77	33.07	34.31	37.96	41.19	45.04	49.61
Wholesale	-	0.03	0.03	0.03	0.03	0.03	0.03
Total	8,788.97	8,662.95	6,089.28	6,086.49	6,084.19	6,116.35	6,182.44

The following charts, Chart B-2.1 – Chart B-2.4, provide the breakdown of surface water withdrawals by the type of industrial user based on the EMSI employment data for 2010, 2020, 2030, and 2040. An analysis of these charts indicates that during the 31-year period, the proportion of surface water withdrawn by Thermo-electric industrial users declines, while the proportion of surface water withdrawn by Petrochemical, Other Manufacturing, and Pulp and Paper industrial users increases. This is consistent with closing of two TVA thermo-electric plants and the long-term projections for these three industrial users, since Pulp and Paper is expected to have nominal growth, but Petrochemical and Other Manufacturing are expected to have significant growth.

Chart B-2.1: Self-Supplied Surface Water Withdrawals (in MGD) 2010: EMSI Employment

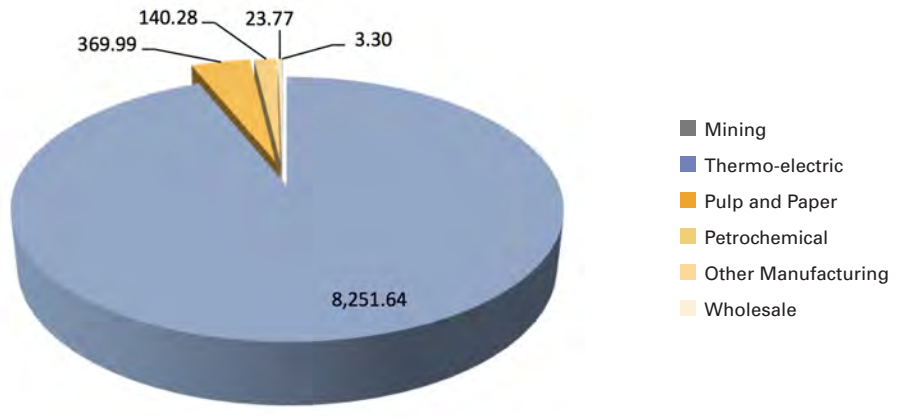


Chart B-2.2: Self-Supplied Surface Water Withdrawals (in MGD) 2020: EMSI Employment

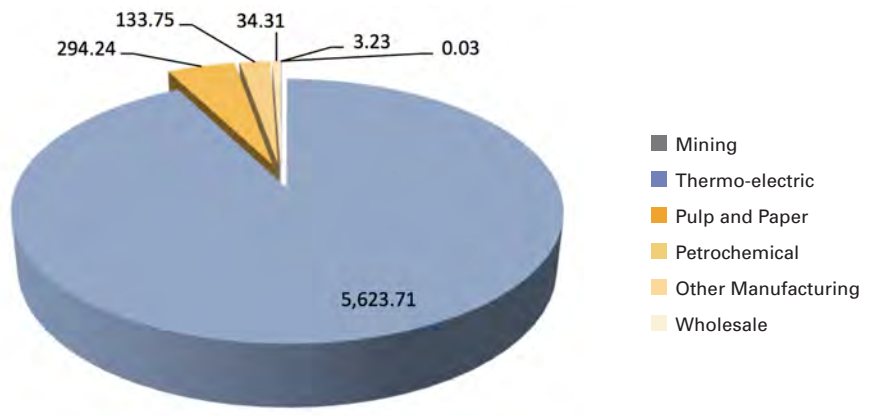


Chart B-2.3: Self-Supplied Surface Water Withdrawals (in MGD) 2030: EMSI Employment

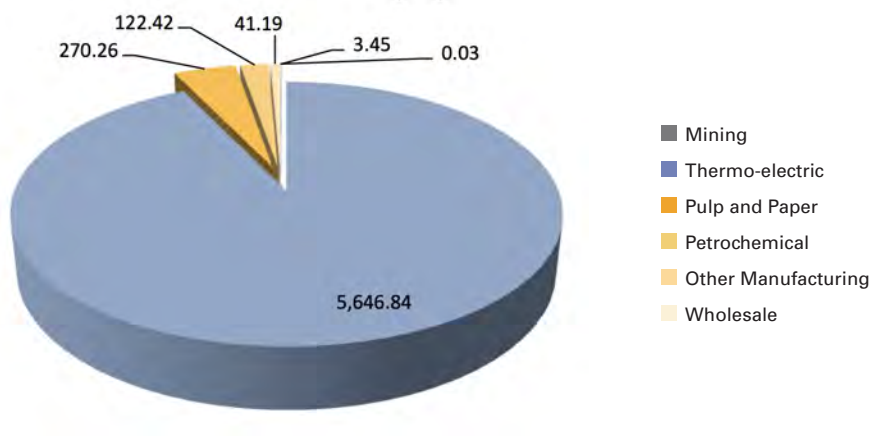
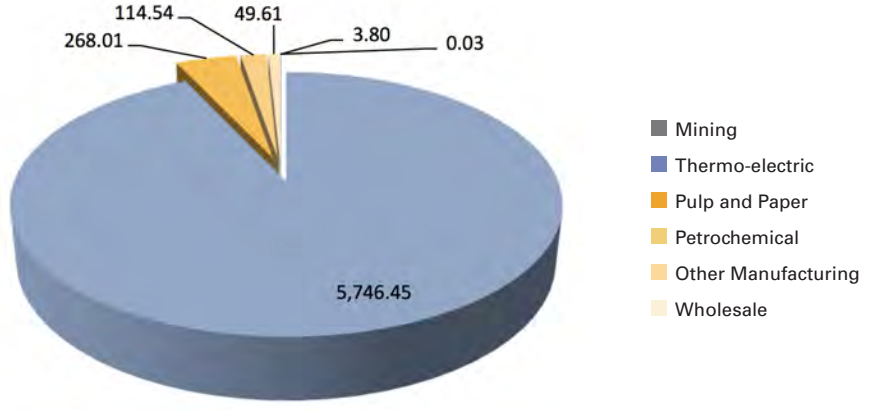


Chart B-2.4: Self-Supplied Surface Water Withdrawals (in MGD) 2040: EMSI Employment



Total Water Withdrawals

Table B-3 provides a breakdown of total water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the type of industrial user based on the EMSI employment data. The forecasts indicate that Mining, Other Manufacturing and Wholesale will experience significant increases in total water withdrawal, with increases of 53 percent, 107 percent, and 163 percent, respectively. Thermo-electric, Pulp and Paper, and Petrochemical will experience decreases of 30 percent, 26 percent, and 16 percent, respectively.

Table B-3: Total Water Withdrawal Data (in MGD) - EMSI Employment

	YEAR						
Type of Industrial User	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Mining	3.53	3.67	4.05	4.21	4.56	4.96	5.42
Thermo-electric	8,251.84	8,158.60	5,623.91	5,638.94	5,647.04	5,682.63	5,746.66
Pulp and Paper	381.77	333.86	309.00	292.63	285.62	283.23	284.26
Petrochemical	151.24	164.32	147.89	142.95	136.07	131.02	127.41
Other Manufacturing	33.78	48.16	49.76	54.33	58.58	63.73	69.91
Wholesale	0.02	0.04	0.05	0.05	0.05	0.05	0.05
Total	8,822.17	8,708.65	6,134.64	6,133.11	6,131.91	6,165.61	6,233.70

Chart B-3.1: Self-Supplied Total Water Withdrawals (in MGD) 2010: EMSI Employment

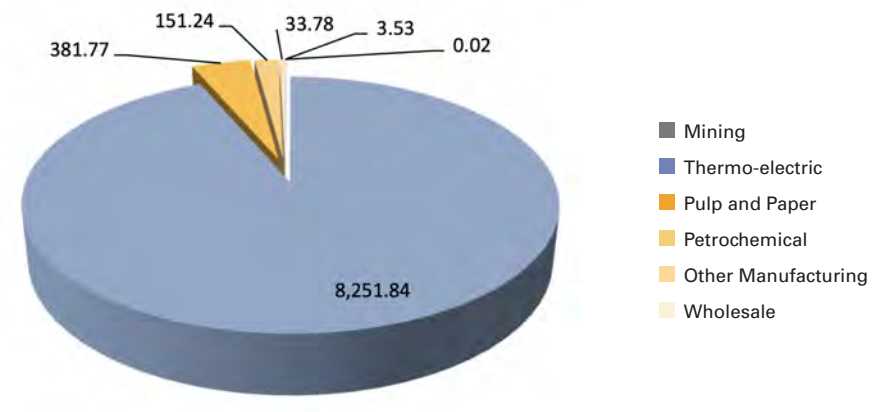
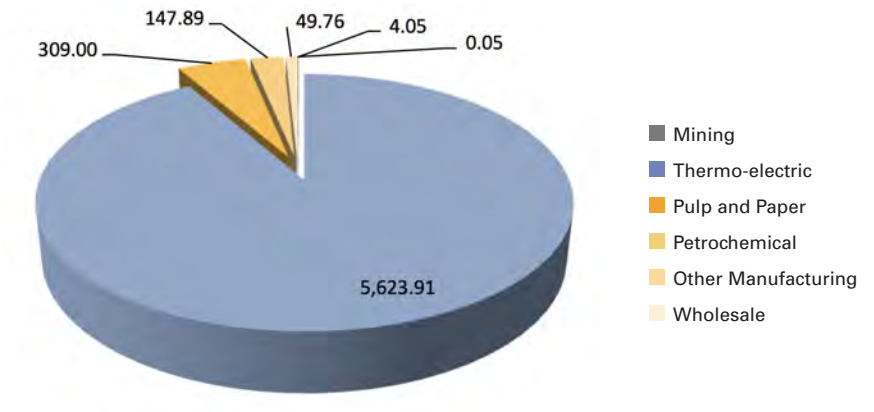


Chart B-3.2: Self-Supplied Total Water Withdrawals (in MGD) 2020: EMSI Employment



The following charts, Chart B-3.1 – Chart B-3.4, provide the breakdown of total water withdrawals by the type of industrial user based on the EMSI employment data for 2010, 2020, 2030, and 2040. An analysis of these charts indicates that during the 31-year period, the proportion of total water withdrawn by Thermo-electric industrial users declines, while the proportion of total water withdrawn by Petrochemical, Pulp and Paper, and Other Manufacturing industrial users increases. This is consistent with the closing of two TVA thermo-electric plants and the long-term projections for these three industrial users, since Pulp and Paper is expected to have nominal growth, but Petrochemical and Other Manufacturing are expected to have significant growth.

Chart B-3.3: Self-Supplied Total Water Withdrawals (in MGD) 2030: EMSI Employment

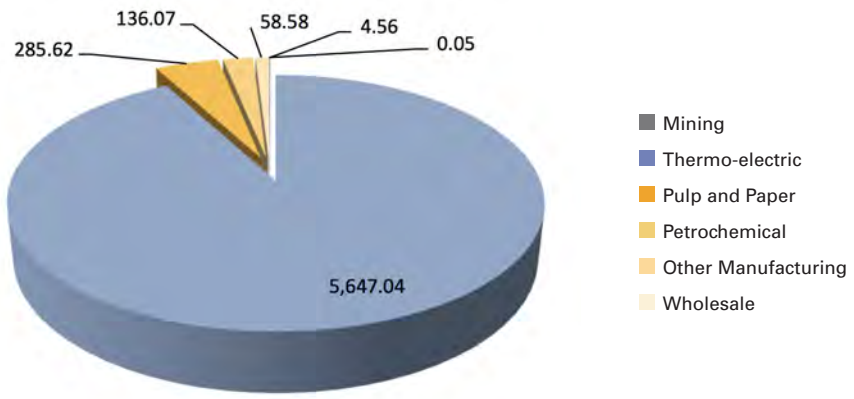


Chart B-3.4: Self-Supplied Total Water Withdrawals (in MGD) 2040: EMSI Employment

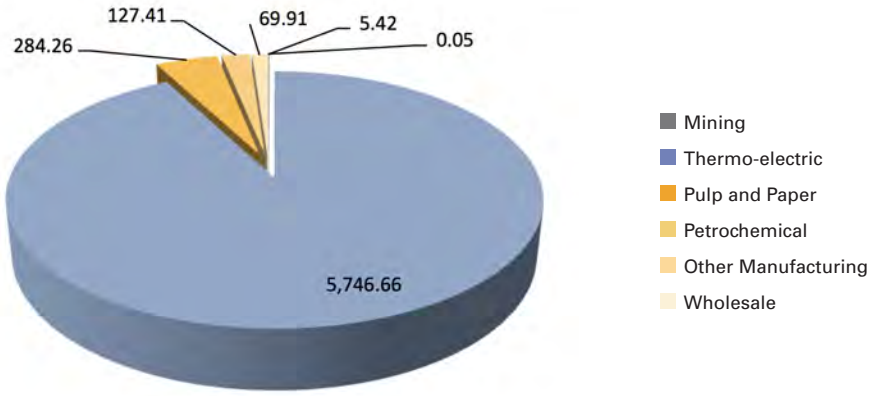
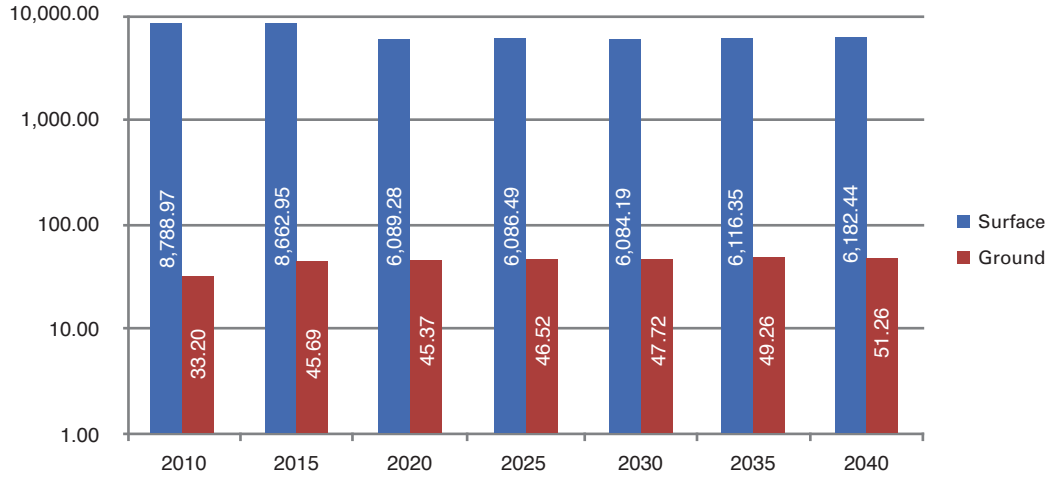


Table B-4 and Chart B-4 provide a breakdown of total water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the water source based on the EMSI Employment data. The forecast indicates that approximately 99 percent of water withdrawn is surface water. Ground water is projected to increase by 54 percent during the 31-year period; whereas, surface water is expected to decrease by 30 percent. Thermo-electric is the largest user of surface water, and the closing of the two TVA plants significantly impacts the surface water withdrawn.

Table B-4: Total Water Withdrawal Data (in MGD) - EMSI Employment

	YEAR						
Water Source	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Ground	33.20	45.69	45.37	46.62	47.72	49.26	51.26
Surface	8,788.97	8,662.95	6,089.28	6,086.49	6,084.19	6,116.35	6,182.44
Total	8,822.17	8,708.65	6,134.64	6,133.11	6,131.91	6,165.61	6,233.70

Chart B-4: Self-Supplied Total Water Withdrawal (in MGD) 2010-2040: EMSI Employment



County Level Analysis

The county level analysis addresses the total water withdrawn by industrial users in each county during the 31-year period. Table B-5 provides the forecasts for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 for each county in the State of Alabama based on the EMSI Employment data. The results indicate that two counties, Colbert and Jackson, experience significant declines in the amount of water withdrawn. This is because TVA is closing a steam plant in each county. However, some counties experience significant increases in water withdrawn during the 31-year period, e.g., Autauga, Morgan, and Shelby, with increases of 46 percent, 42 percent, and 67 percent. The counties with the largest water withdrawals are Limestone, Walker, Mobile, and Shelby, with each county having water withdrawals in excess of 450 million gallons per day by 2040. In 2040, the water withdrawal for these four counties accounts for 87 percent of all water withdrawn.

HUC Level Analysis

The HUC level analysis addresses the total water withdrawn by industrial users in each HUC during the 31-year period. Table B-6 provides the forecasts for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 for each HUC in the State of Alabama based on the EMSI employment data. The results indicate that two HUCs, 06030001 and 06030005, experience significant declines in the amount of water withdrawn. This is because TVA is closing a steam plant in each HUC. However, some HUCs experience significant increases in water withdrawn during the 31-year period, e.g., 03150107 and 03150201, with increases of 67 percent and 46 percent, respectively. The HUCs with the largest water withdrawals are 03150107, 03160204, and 06030002, with each HUC having water withdrawals in excess of 740 million gallons per day by 2040. In 2040, the water withdrawal for these three HUCs accounts for 81 percent of all water withdrawn.

Table B-5: Water Withdrawal (in MGD) by County - EMSI Employment

	2010			2015			2020			2025			2030			2035			2040		
COUNTY	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**
AUTAUGA	32.42	9.84	**42.26**	40.26	12.30	**52.56**	42.08	12.91	**54.99**	42.86	13.19	**56.05**	44.25	13.66	**57.91**	45.70	14.15	**59.85**	47.21	14.65	**61.86**
BALDWIN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BARBOUR	-	1.58	**1.58**	-	1.41	**1.41**	-	1.43	**1.43**	-	1.46	**1.46**	-	1.40	**1.40**	-	1.35	**1.35**	-	1.31	**1.31**
BIBB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BLOUNT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BULLOCK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BUTLER	-	0.30	**0.30**	-	0.26	**0.26**	-	0.25	**0.25**	-	0.24	**0.24**	-	0.23	**0.23**	-	0.22	**0.22**	-	0.20	**0.20**
CALHOUN	-	0.97	**0.97**	-	1.81	**1.81**	-	1.88	**1.88**	-	1.98	**1.98**	-	2.09	**2.09**	-	2.20	**2.20**	-	2.33	**2.33**
CHAMBERS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHEROKEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHILTON	-	0.35	**0.35**	-	0.39	**0.39**	-	0.43	**0.43**	-	0.52	**0.52**	-	0.59	**0.59**	-	0.68	**0.68**	-	0.78	**0.78**
CHOCTAW	40.80	-	**40.80**	35.19	-	**35.19**	31.57	-	**31.57**	29.26	-	**29.26**	26.68	-	**26.68**	24.34	-	**24.34**	22.19	-	**22.19**
CLARKE	20.21	-	**20.21**	20.92	-	**20.92**	21.84	-	**21.84**	22.80	-	**22.80**	23.80	-	**23.80**	24.84	-	**24.84**	25.93	-	**25.93**
CLAY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLEBURNE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COFFEE	-	1.13	**1.13**	-	1.95	**1.95**	-	2.13	**2.13**	-	2.23	**2.23**	-	2.40	**2.40**	-	2.59	**2.59**	-	2.79	**2.79**
COLBERT	1,331.41	0.31	**1,331.72**	1,326.16	0.32	**1,326.48**	53.10	0.37	**53.47**	45.04	0.39	**45.43**	39.41	0.44	**39.85**	35.82	0.49	**36.30**	33.97	0.54	**34.51**
CONECUH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COOSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COVINGTON	1.74	-	**1.74**	1.82	-	**1.82**	2.30	-	**2.30**	2.49	-	**2.49**	2.92	-	**2.92**	3.43	-	**3.43**	4.02	-	**4.02**
CRENSHAW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CULLMAN	1.83	0.43	**2.26**	2.90	0.59	**3.49**	3.12	0.72	**3.84**	3.51	0.90	**4.41**	3.93	1.11	**5.04**	4.44	1.37	**5.82**	5.08	1.69	**6.78**
DALE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DALLAS	32.20	0.14	**32.34**	32.51	0.14	**32.65**	34.72	0.15	**34.87**	35.08	0.15	**35.23**	36.44	0.15	**36.60**	37.86	0.16	**38.02**	39.33	0.17	**39.49**
DEKALB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ELMORE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ESCAMBIA	33.61	1.47	**35.08**	31.74	1.92	**33.66**	35.48	2.09	**37.57**	35.48	2.27	**37.75**	37.55	2.50	**40.05**	39.75	2.77	**42.52**	42.07	3.10	**45.17**
ETOWAH	123.78	-	**123.78**	116.20	-	**116.20**	97.29	-	**97.29**	93.33	-	**93.33**	83.77	-	**83.77**	75.24	-	**75.24**	67.61	-	**67.61**
FAYETTE	1.10	-	**1.10**	1.10	-	**1.10**	1.10	-	**1.10**	1.10	-	**1.10**	1.10	-	**1.10**	1.10	-	**1.10**	1.10	-	**1.10**
FRANKLIN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GENEVA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GREENE	354.43	0.03	**354.46**	29.05	0.00	**29.05**	43.58	0.00	**43.58**	52.29	0.00	**52.30**	70.63	0.01	**70.64**	95.40	0.01	**95.41**	128.86	0.01	**128.87**
HALE	-	0.02	**0.02**	-	0.02	**0.02**	-	0.02	**0.02**	-	0.02	**0.02**	-	0.02	**0.02**	-	0.02	**0.02**	-	0.02	**0.02**
HENRY	-	0.54	**0.54**	-	0.41	**0.41**	-	0.16	**0.16**	-	0.08	**0.08**	-	0.04	**0.04**	-	0.02	**0.02**	-	0.01	**0.01**
HOUSTON	89.20	0.17	**89.37**	97.36	0.18	**97.55**	101.69	0.19	**101.88**	101.05	0.19	**101.24**	102.95	0.19	**103.15**	104.89	0.20	**105.09**	106.87	0.20	**107.07**
JACKSON	1,054.12	-	**1,054.12**	1,198.41	-	**1,198.41**	11.13	-	**11.13**	11.94	-	**11.94**	13.74	-	**13.74**	15.82	-	**15.82**	18.21	-	**18.21**
JEFFERSON	-	0.50	**0.50**	0.03	0.48	**0.51**	0.03	0.46	**0.49**	0.03	0.49	**0.52**	0.03	0.49	**0.52**	0.03	0.49	**0.52**	0.03	0.50	**0.53**
LAMAR	-	0.11	**0.11**	-	0.11	**0.11**	-	0.09	**0.09**	-	0.09	**0.09**	-	0.08	**0.08**	-	0.08	**0.08**	-	0.07	**0.07**
LAUDERDALE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LAWRENCE	60.09	-	**60.09**	24.89	-	**24.89**	13.71	-	**13.71**	4.85	-	**4.85**	2.15	-	**2.15**	0.96	-	**0.96**	0.42	-	**0.42**
LEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LIMESTONE	2,725.63	-	**2,725.63**	2,748.44	-	**2,748.44**	2,816.31	-	**2,816.31**	2,869.68	-	**2,869.68**	2,932.29	-	**2,932.29**	2,996.27	-	**2,996.27**	3,061.64	-	**3,061.64**
LOWNDES	-	-	-	-	4.37	**4.37**	-	4.04	**4.04**	-	3.99	**3.99**	-	3.81	**3.81**	-	3.64	**3.64**	-	3.48	**3.48**
MACON	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MADISON	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MARENGO	17.78	-	**17.78**	18.77	-	**18.77**	15.97	-	**15.97**	15.07	-	**15.07**	13.50	-	**13.50**	12.10	-	**12.10**	10.85	-	**10.85**
MARION	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MARSHALL	-	0.08	**0.08**	-	0.07	**0.07**	-	0.08	**0.08**	-	0.08	**0.08**	-	0.08	**0.08**	-	0.08	**0.08**	-	0.08	**0.08**
MOBILE	991.17	7.03	**998.20**	934.12	9.19	**943.30**	855.16	9.30	**864.47**	847.75	9.87	**857.62**	807.98	10.39	**818.37**	770.18	11.04	**781.22**	734.27	11.84	**746.11**
MONROE	46.31	0.39	**46.70**	39.69	0.44	**40.13**	35.34	0.40	**35.74**	33.80	0.47	**34.27**	31.21	0.48	**31.69**	28.81	0.50	**29.30**	26.59	0.51	**27.10**
MONTGOMERY	-	-	-	0.19	2.47	**2.66**	0.17	2.67	**2.84**	0.17	2.81	**2.97**	0.15	3.01	**3.16**	0.14	3.24	**3.38**	0.14	3.50	**3.64**
MORGAN	81.43	0.00	**81.44**	99.09	0.00	**99.09**	99.37	0.00	**99.37**	104.97	0.00	**104.98**	108.30	0.00	**108.31**	111.94	0.00	**111.94**	115.93	0.00	**115.93**
PERRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PICKENS	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**
PERRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RANDOLPH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUSSELL	27.64	0.92	**28.56**	17.97	0.60	**18.57**	13.99	0.47	**14.46**	11.17	0.37	**11.54**	8.81	0.29	**9.10**	6.94	0.23	**7.18**	5.48	0.18	**5.66**
SHELBY	665.45	-	**665.45**	777.21	-	**777.21**	860.44	-	**860.44**	897.17	-	**897.17**	964.04	-	**964.04**	1,035.89	-	**1,035.89**	1,113.10	-	**1,113.10**
STCLAIR	4.46	-	**4.46**	5.98	-	**5.98**	6.33	-	**6.33**	7.37	-	**7.37**	8.19	-	**8.19**	9.10	-	**9.10**	10.11	-	**10.11**
SUMTER	2.03	-	**2.03**	1.75	-	**1.75**	1.77	-	**1.77**	1.77	-	**1.77**	1.78	-	**1.78**	1.79	-	**1.79**	1.80	-	**1.80**
TALLADEGA	24.67	-	**24.67**	19.76	-	**19.76**	11.57	-	**11.57**	8.53	-	**8.53**	5.61	-	**5.61**	3.69	-	**3.69**	2.43	-	**2.43**
TALLAPOOSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TUSCALOOSA	2.12	0.74	**2.86**	2.06	0.71	**2.77**	2.07	0.61	**2.68**	2.11	0.58	**2.69**	2.16	0.53	**2.69**	2.23	0.48	**2.71**	2.31	0.44	**2.75**
WALKER	922.82	-	**922.82**	934.74	-	**934.74**	779.75	-	**779.75**	710.59	-	**710.59**	619.78	-	**619.78**	540.57	-	**540.57**	471.48	-	**471.48**
WASHINGTON	80.39	6.15	**86.55**	79.90	5.53	**85.43**	77.38	4.52	**81.89**	74.74	4.23	**78.97**	72.34	3.71	**76.04**	70.04	3.24	**73.29**	67.85	2.84	**70.69**
WILCOX	20.13	-	**20.13**	24.74	-	**24.74**	20.91	-	**20.91**	20.52	-	**20.52**	18.71	-	**18.71**	17.05	-	**17.05**	15.54	-	**15.54**
WINSTON	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	8,788.97	33.20	**8,822.17**	8,662.95	45.69	**8,708.65**	6,089.28	45.37	**6,134.64**	6,086.49	46.62	**6,133.11**	6,084.19	47.72	**6,131.91**	6,116.35	49.26	**6,165.61**	6,182.44	51.26	**6,233.70**

TableB-6: Water Withdrawal (in MGD) by HUC - EMSI Employment

	2010			2015			2020			2025			2030			2035			2040		
HUC	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**
03130002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03130003	27.64	2.50	**30.14**	17.97	2.01	**19.98**	13.99	1.90	**15.89**	11.17	1.83	**12.99**	8.81	1.70	**10.50**	6.94	1.59	**8.53**	5.48	1.49	**6.96**
03130004	89.20	0.44	**89.64**	97.36	0.39	**97.75**	101.69	0.27	**101.96**	101.05	0.23	**101.28**	102.95	0.21	**103.16**	104.89	0.21	**105.10**	106.87	0.21	**107.07**
03130012	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140103	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140106	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140107	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140201	-	0.27	**0.27**	-	1.20	**1.20**	-	1.09	**1.09**	-	1.07	**1.07**	-	1.06	**1.06**	-	1.07	**1.07**	-	1.08	**1.08**
03140202	-	1.13	**1.13**	-	0.95	**0.95**	-	1.12	**1.12**	-	1.21	**1.21**	-	1.36	**1.36**	-	1.52	**1.52**	-	1.71	**1.71**
03140203	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140301	1.74	-	**1.74**	1.82	-	**1.82**	2.30	-	**2.30**	2.49	-	**2.49**	2.92	-	**2.92**	3.43	-	**3.43**	4.02	-	**4.02**
03140302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140303	-	0.30	**0.30**	-	0.26	**0.26**	-	0.25	**0.25**	-	0.24	**0.24**	-	0.23	**0.23**	-	0.22	**0.22**	-	0.20	**0.20**
03140304	33.61	1.38	**34.99**	31.74	1.44	**33.18**	35.48	1.45	**36.92**	35.48	1.53	**37.01**	37.55	1.58	**39.13**	39.75	1.63	**41.38**	42.07	1.69	**43.76**
03140305	-	0.09	**0.09**	-	0.48	**0.48**	-	0.64	**0.64**	-	0.74	**0.74**	-	0.92	**0.92**	-	1.14	**1.14**	-	1.41	**1.41**
03150105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150106	152.91	0.97	**153.88**	141.94	1.81	**143.75**	115.20	1.88	**117.08**	109.23	1.98	**111.22**	97.58	2.09	**99.66**	88.03	2.20	**90.23**	80.15	2.33	**82.48**
03150107	665.45	-	**665.45**	777.21	-	**777.21**	860.44	-	**860.44**	897.17	-	**897.17**	964.04	-	**964.04**	1,035.89	-	**1,035.89**	1,113.10	-	**1,113.10**
03150108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150109	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150201	64.62	10.33	**74.95**	72.96	19.67	**92.63**	76.97	20.20	**97.17**	78.10	20.65	**98.76**	80.84	21.23	**102.07**	83.70	21.87	**105.57**	86.67	22.59	**109.26**
03150202	-	0.16	**0.16**	0.03	0.13	**0.16**	0.03	0.12	**0.14**	0.03	0.12	**0.15**	0.03	0.12	**0.15**	0.03	0.12	**0.14**	0.03	0.11	**0.14**
03150203	20.13	-	**20.13**	24.74	-	**24.74**	20.91	-	**20.91**	20.52	-	**20.52**	18.71	-	**18.71**	17.05	-	**17.05**	15.54	-	**15.54**
03150204	46.31	0.39	**46.70**	39.69	0.44	**40.13**	35.34	0.40	**35.74**	33.80	0.47	**34.27**	31.21	0.48	**31.69**	28.81	0.50	**29.30**	26.59	0.51	**27.10**
03160101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160103	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160105	-	0.11	**0.11**	-	0.11	**0.11**	-	0.09	**0.09**	-	0.09	**0.09**	-	0.08	**0.08**	-	0.08	**0.08**	-	0.07	**0.07**
03160106	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**
03160107	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160109	924.65	0.43	**925.08**	937.64	0.59	**938.24**	782.87	0.72	**783.58**	714.10	0.90	**715.01**	623.70	1.11	**624.82**	545.01	1.37	**546.38**	476.56	1.69	**478.26**
03160110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160111	-	0.34	**0.34**	-	0.35	**0.35**	-	0.34	**0.34**	-	0.37	**0.37**	-	0.37	**0.37**	-	0.38	**0.38**	-	0.39	**0.39**
03160112	2.19	0.20	**2.39**	2.05	0.19	**2.24**	2.20	0.17	**2.36**	2.25	0.16	**2.41**	2.36	0.15	**2.51**	2.49	0.13	**2.62**	2.63	0.12	**2.75**
03160113	355.47	0.58	**356.05**	30.16	0.54	**30.70**	44.55	0.46	**45.01**	53.25	0.45	**53.70**	71.53	0.41	**71.93**	96.24	0.37	**96.61**	129.64	0.35	**129.99**
03160201	59.50	-	**59.50**	54.73	-	**54.73**	48.28	-	**48.28**	45.03	-	**45.03**	40.87	-	**40.87**	37.10	-	**37.10**	33.68	-	**33.68**
03160202	1.11	-	**1.11**	0.99	-	**0.99**	1.04	-	**1.04**	1.06	-	**1.06**	1.09	-	**1.09**	1.13	-	**1.13**	1.17	-	**1.17**
03160203	100.60	7.08	**107.68**	100.82	7.12	**107.95**	99.22	6.55	**105.77**	97.53	6.51	**104.04**	96.13	6.43	**102.57**	94.89	6.51	**101.39**	93.78	6.75	**100.53**
03160204	991.17	4.94	**996.11**	934.12	6.26	**940.37**	855.16	5.92	**861.08**	847.75	6.16	**853.91**	807.98	6.18	**814.16**	770.18	6.24	**776.42**	734.27	6.34	**740.60**
03160205	-	1.16	**1.16**	-	1.34	**1.34**	-	1.35	**1.35**	-	1.43	**1.43**	-	1.49	**1.49**	-	1.54	**1.54**	-	1.60	**1.60**
03170002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03170003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03170008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03170009	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**
06020001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06030001	1,054.12	0.08	**1,054.20**	1,198.41	0.07	**1,198.48**	11.13	0.08	**11.20**	11.94	0.08	**12.01**	13.74	0.08	**13.82**	15.82	0.08	**15.90**	18.21	0.08	**18.29**
06030002	2,867.15	0.00	**2,867.15**	2,872.42	0.00	**2,872.43**	2,929.39	0.00	**2,929.40**	2,979.50	0.00	**2,979.50**	3,042.75	0.00	**3,042.75**	3,109.16	0.00	**3,109.17**	3,178.00	0.00	**3,178.00**
06030003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06030004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06030005	1,331.41	0.31	**1,331.72**	1,326.16	0.32	**1,326.48**	53.10	0.37	**53.47**	45.04	0.39	**45.43**	39.41	0.44	**39.85**	35.82	0.49	**36.30**	33.97	0.54	**34.51**
06030006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	8,788.97	33.20	**8,822.17**	8,662.95	45.69	**8,708.65**	6,089.28	45.37	**6,134.64**	6,086.49	46.62	**6,133.11**	6,084.19	47.72	**6,131.91**	6,116.35	49.26	**6,165.61**	6,182.44	51.26	**6,233.70**

Appendix C

Water Withdrawal Forecasts based on University of Alabama GDP Data

State Level Analysis

Ground Water Withdrawals

Table C-1 provides a breakdown of ground water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the type of industrial user based on the University of Alabama Study using GDP data. The forecasts indicate that Thermo-electric, Pulp and Paper, Petrochemical, and Other Manufacturing will experience significant increases in ground water withdrawal, with increases of 125 percent, 177 percent, 311 percent, and 315 percent, respectively. Mining will experience a nine percent decline, and Wholesale will experience an 8 percent increase. Total ground water withdrawals are forecast to increase by 261 percent.

Table C-1: Ground Water Withdrawal Data (in MGD) - University of Alabama GDP

	YEAR						
Type of Industrial User	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Mining	0.24	0.21	0.23	0.22	0.21	0.22	0.22
Thermo-electric	0.20	0.36	0.38	0.40	0.42	0.43	0.45
Pulp and Paper	11.78	14.95	18.13	20.88	24.54	28.51	32.60
Petrochemical	10.96	20.01	24.37	28.26	33.43	39.06	45.01
Other Manufacturing	10.01	17.78	21.83	25.51	30.39	35.77	41.53
Wholesale	0.02	0.02	0.02	0.03	0.04	0.05	0.06
Total	33.20	53.34	64.97	75.29	89.02	104.04	119.86

Chart C-1.1: Self-Supplied Ground Water Withdrawals (in MGD) 2010: University of Alabama GDP

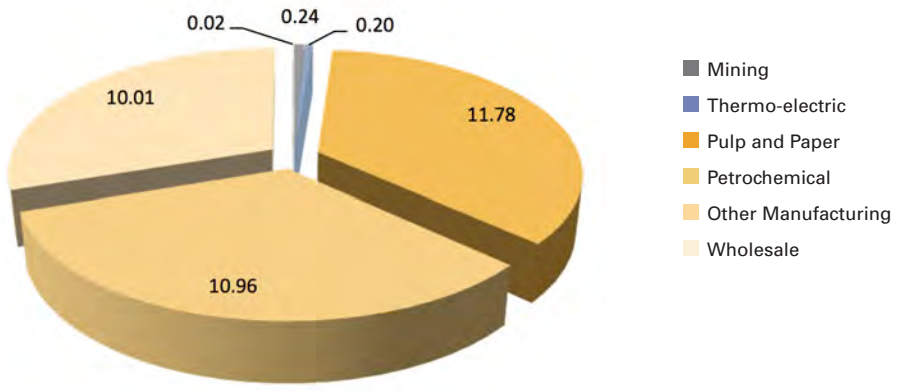
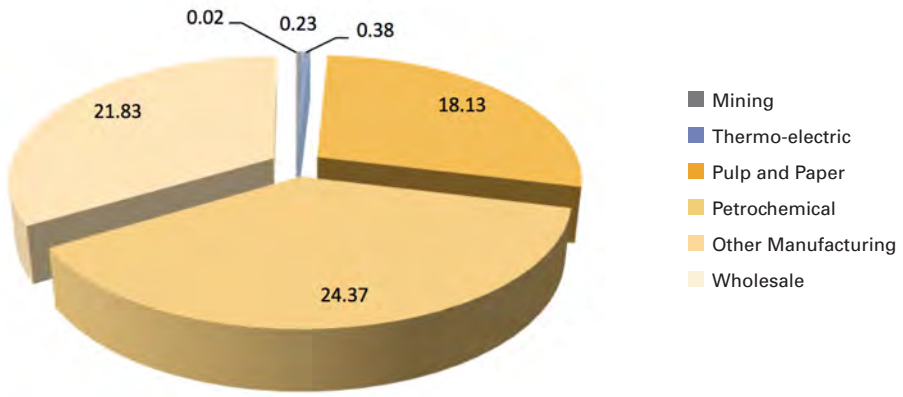


Chart C-1.2: Self-Supplied Ground Water Withdrawals (in MGD) 2020: University of Alabama GDP



The following charts, Chart C-1.1 – Chart C-1.4, provide the breakdown of ground water withdrawals by the type of industrial user based on the University of Alabama Study using GDP data for 2010, 2020, 2030, and 2040. An analysis of these charts indicates that during the 31-year period, the proportion of ground water withdrawn by Pulp and Paper industrial users declines, while the proportion of ground water withdrawn by Petrochemical and Other Manufacturing industrial users increases. This is consistent with the long-term projections for these three industrial users, since Pulp and Paper is expected to have nominal growth, but Petrochemical and Other Manufacturing are expected to have significant growth.

Chart C-1.3: Self-Supplied Ground Water Withdrawals (in MGD) 2030: University of Alabama GDP

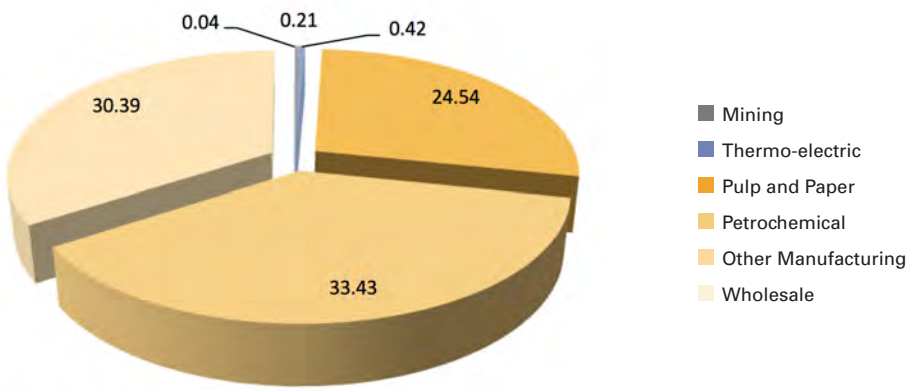
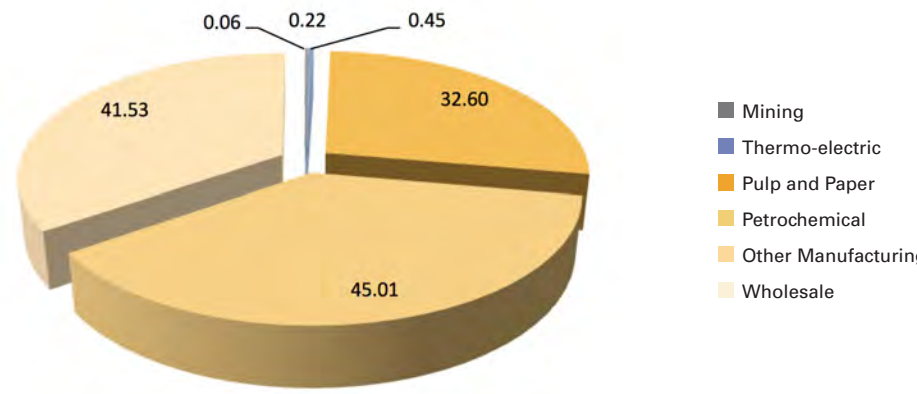


Chart C-1.4: Self-Supplied Ground Water Withdrawals (in MGD) 2040: University of Alabama GDP



Surface Water Withdrawals

Table C-2 provides a breakdown of surface water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the type of industrial user based on the University of Alabama Study using GDP data. The forecasts indicate that Pulp and Paper, Petrochemical, and Other Manufacturing will experience significant increases in surface water withdrawal, with increases of 140 percent, 173 percent, and 202 percent, respectively. Mining will experience a 14 percent decline, and Thermo-electric will remain unchanged. Total surface water withdrawals are forecast to increase by nine percent.

Table C-2: Surface Water Withdrawal Data (in MGD) - University of Alabama GDP

	YEAR						
Type of Industrial User	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Mining	3.30	2.69	2.95	2.79	2.74	2.80	2.84
Thermo-electric	8,251.64	9,151.34	6,914.97	7,248.50	7,580.09	7,918.29	8,257.48
Pulp and Paper	369.99	454.32	538.81	607.48	697.28	791.15	885.06
Petrochemical	140.28	191.05	227.75	258.08	298.10	340.04	382.51
Other Manufacturing	23.77	33.97	41.08	47.05	54.93	63.31	71.89
Wholesale	-	0.03	0.03	0.04	0.05	0.07	0.09
Total	8,788.97	9,833.41	7,725.60	8,163.93	8,633.19	9,115.66	9,599.86

The following charts, Chart C-2.1 – Chart C-2.4, provide the breakdown of surface water withdrawals by the type of industrial user based on the University of Alabama Study using GDP data for 2010, 2020, 2030, and 2040. An analysis of these charts indicates that during the 31-year period, the proportion of surface water withdrawn by Thermo-electric industrial users declines, while the proportion of surface water withdrawn by Petrochemical, Other Manufacturing, and Pulp and Paper industrial users increases. This is consistent with closing of two TVA thermo-electric plants and the long-term projections for these three industrial users, since Pulp and Paper is expected to have nominal growth, but Petrochemical and Other Manufacturing are expected to have significant growth.

Chart C-2.1: Self-Supplied Surface Water Withdrawals (in MGD) 2010: University of Alabama GDP

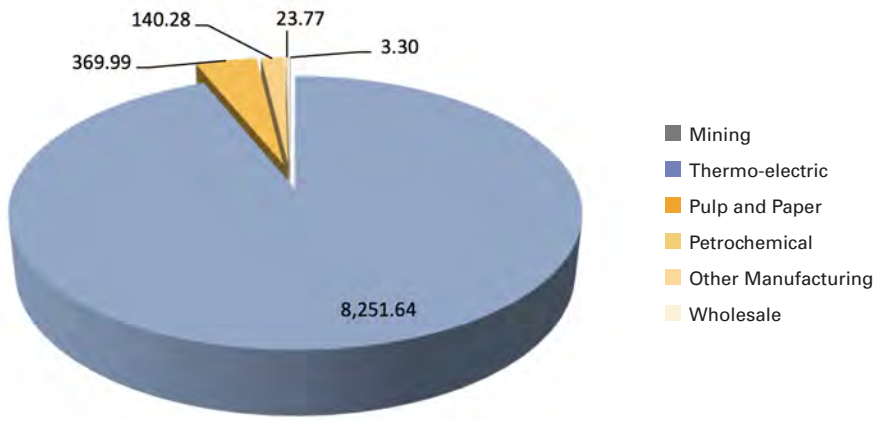


Chart C-2.2: Self-Supplied Surface Water Withdrawals (in MGD) 2020: University of Alabama GDP

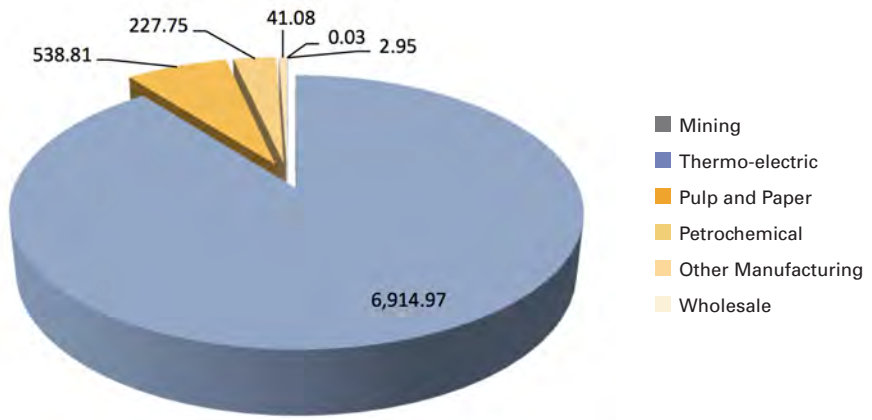


Chart C-2.3: Self-Supplied Surface Water Withdrawals (in MGD) 2030: University of Alabama GDP

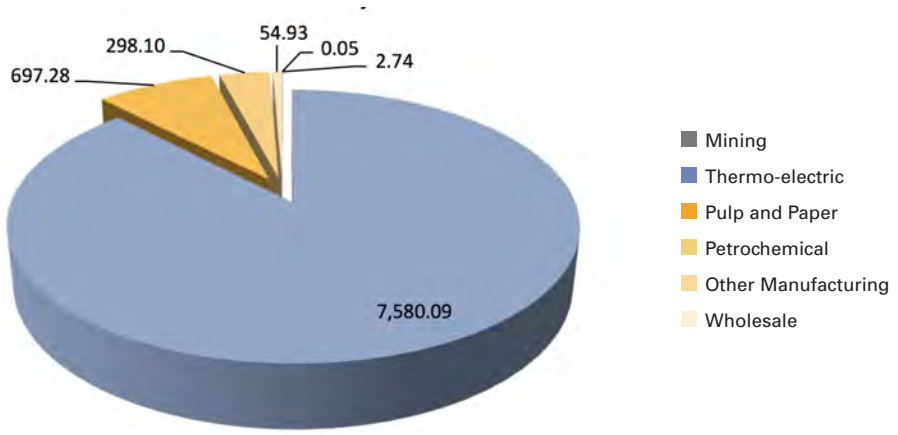
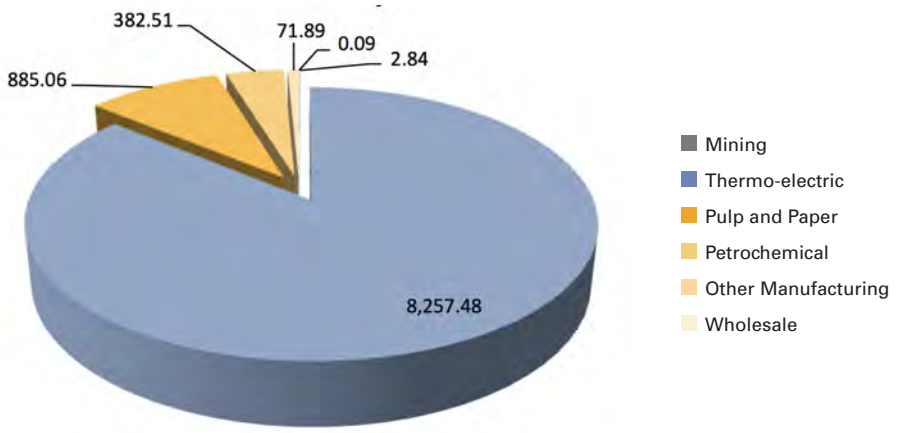


Chart C-2.4: Self-Supplied Surface Water Withdrawals (in MGD) 2040: University of Alabama GDP



Total Water Withdrawals

Table C-3 provides a breakdown of total water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the type of industrial user based on the University of Alabama Study using GDP data. The forecasts indicate that Pulp and Paper, Petrochemical, Other Manufacturing, and Wholesale will experience significant increases in total water withdrawal, with increases of 140 percent, 183 percent, 236 percent, and 511 percent, respectively. Mining will experience a 14 percent decline, and Thermo-electric will experience an increase of less than one percent.

Table C-3: Surface Water Withdrawal Data (in MGD) - University of Alabama GDP

	YEAR						
Type of Industrial User	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Mining	3.53	2.91	3.19	3.00	2.96	3.02	3.05
Thermo-electric	8,251.84	9,151.71	6,915.35	7,248.89	7,580.51	7,918.72	8,257.93
Pulp and Paper	381.77	469.27	556.95	628.35	721.82	819.66	917.66
Petrochemical	151.24	211.07	252.12	286.34	331.53	379.10	427.52
Other Manufacturing	33.78	51.76	62.90	72.56	85.32	99.08	113.42
Wholesale	0.02	0.05	0.06	0.07	0.09	0.12	0.15
Total	8,822.17	9,886.75	7,790.57	8,239.22	8,722.22	9,219.70	9,719.72

Chart C-3.1: Self-Supplied Total Water Withdrawals (in MGD) 2010: University of Alabama GDP

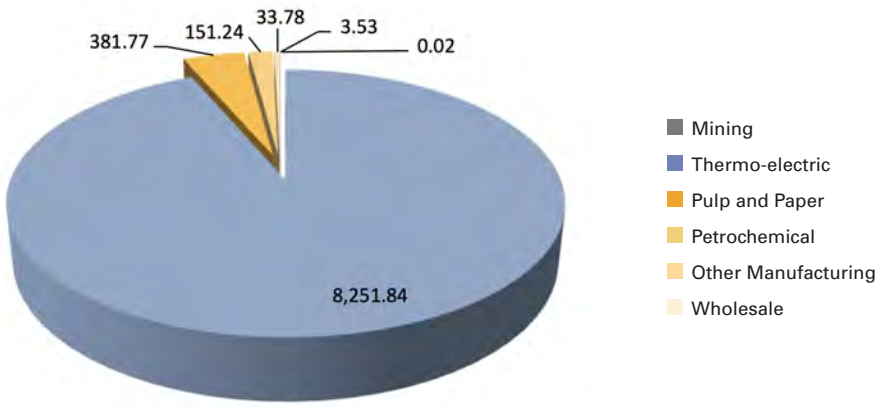
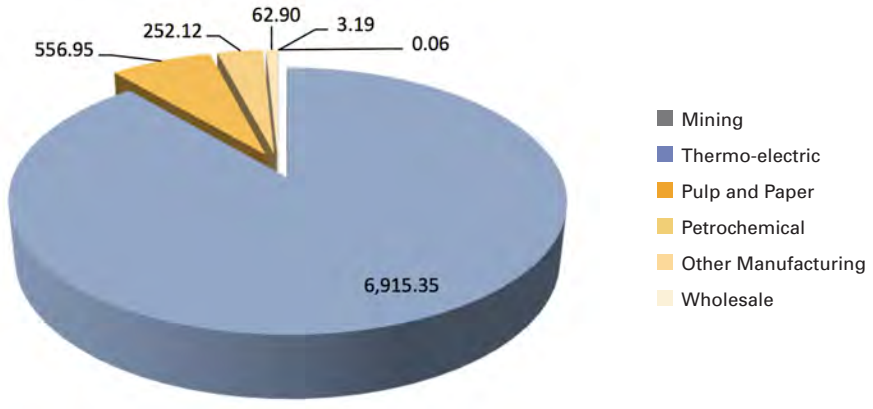


Chart C-3.2: Self-Supplied Total Water Withdrawals (in MGD) 2020: University of Alabama GDP



The following charts, Chart C-3.1 – Chart C-3.4, provide the breakdown of total water withdrawals by the type of industrial user based on the University of Alabama Study using GDP data for 2010, 2020, 2030, and 2040. An analysis of these charts indicates that during the 31-year period, the proportion of total water withdrawn by Thermo-electric industrial users declines, while the proportion of total water withdrawn by Petrochemical, Pulp and Paper, and Other Manufacturing industrial users increases. This is consistent with the closing of two TVA thermo-electric plants and the long-term projections for these three industrial users, since Pulp and Paper is expected to have nominal growth, but Petrochemical and Other Manufacturing are expected to have significant growth.

Chart C-3.3: Self-Supplied Total Water Withdrawals (in MGD) 2030: University of Alabama GDP

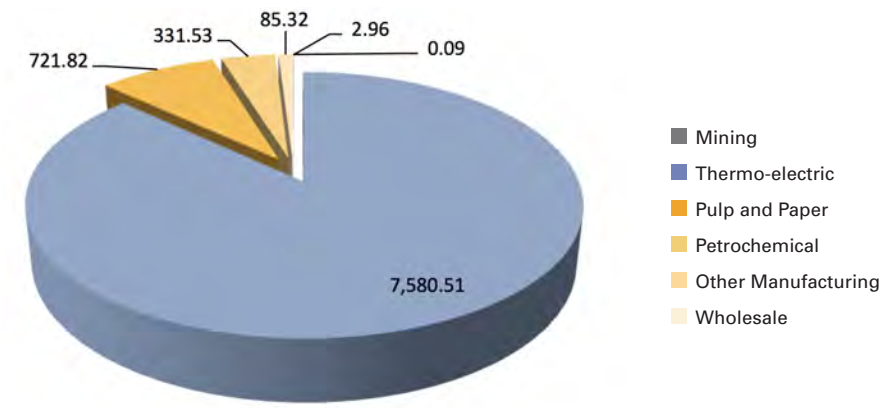


Chart C-3.4: Self-Supplied Total Water Withdrawals (in MGD) 2040: University of Alabama GDP

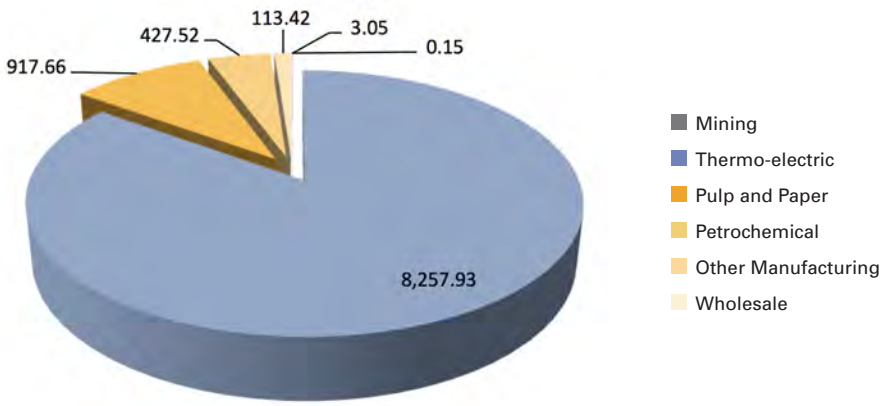
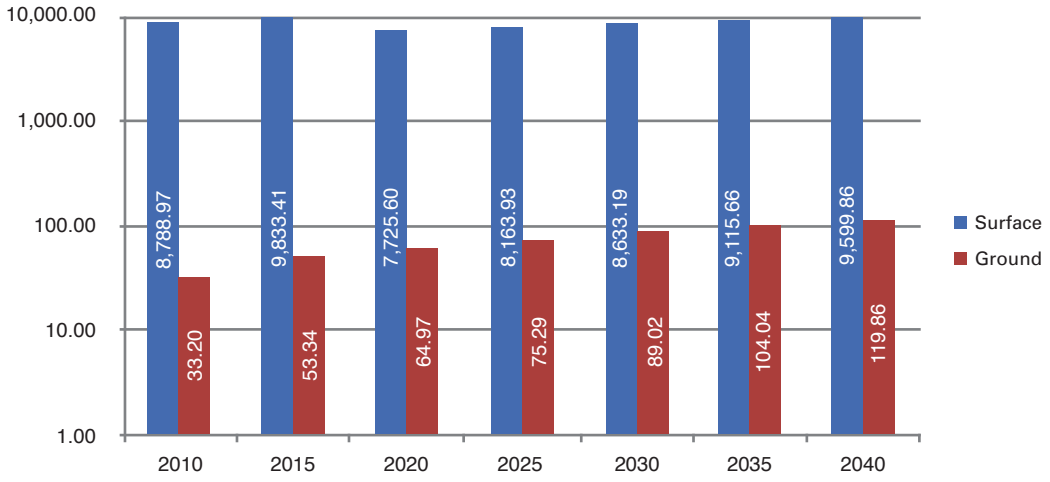


Table C-4 and Chart C-4 provide a breakdown of total water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the water source based on the University of Alabama Study using GDP data. The forecast indicates that approximately 99 percent of water withdrawn is surface water. Ground water is projected to increase by 261 percent during the 31-year period; whereas, surface water is expected to increase by only nine percent. Thermo-electric is the largest user of surface water, and the closing of the two TVA plants significantly impacts the surface water withdrawn.

Table C-4: Total Water Withdrawal Data (in MGD) - University of Alabama GDP

	YEAR						
Water Source	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Ground	33.20	53.34	64.97	75.29	89.02	104.04	119.86
Surface	8,788.97	9,833.41	7,725.60	8,163.93	8,633.19	9,115.66	9,599.86
Total	8,822.17	9,886.75	7,790.57	8,239.22	8,722.22	9,219.70	9,719.72

Chart C-4: Self-Supplied Water Withdrawal Data (in MGD) 2010-2040 - University of Alabama GDP



County Level Analysis

The county level analysis addresses the total water withdrawn by industrial users in each county during the 31-year period. Table C-5 provides the forecasts for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 for each county in the State of Alabama based on the University of Alabama Study using GDP data. The results indicate that two counties, Colbert and Jackson, experience significant declines in the amount of water withdrawn. This is because TVA is closing a steam plant in each county. However, some counties experience significant increases in water withdrawn during the 31-year period, e.g., Autauga, Choctaw, Lawrence, Monroe, Morgan, and Shelby, with increases of 176 percent, 116 percent, 141 percent, 86 percent, 150 percent, and 83 percent. The counties with the largest water withdrawals are Limestone, Walker, Mobile, and Shelby, with each county having water withdrawals in excess of one billion gallons per day by 2040. In 2040, the water withdrawal for these four counties accounts for 77 percent of all water withdrawn.

HUC Level Analysis

The HUC level analysis addresses the total water withdrawn by industrial users in each HUC during the 31-year period. Table C-6 provides the forecasts for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 for each HUC in the State of Alabama based on the University of Alabama Study using GDP data. The results indicate that two HUCs, 06030001 and 06030005, experience significant declines in the amount of water withdrawn. This is because TVA is closing a steam plant in each HUC. However, some HUCs experience significant increases in water withdrawn during the 31-year period, e.g., 03130003, 03140304, 03150107, 03150201, 03150204, 03160201 and 06030002, with increases of 152 percent, 159 percent, 83 percent, 179 percent, 86 percent, 121 percent, 74 percent and 43 percent, respectively. The HUCs with the largest water withdrawals are 03150107, 03160109, 03160203, 03160204, and 06030002, with each HUC having water withdrawals in excess of one billion gallons per day by 2040. In 2040, the water withdrawal for these four HUCs accounts for 81 percent of all water withdrawn.

Table C-5: Water Withdrawal (in MGD) by County - University of Alabama GDP

	2010			2015			2020			2025			2030			2035			2040		
COUNTY	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**
AUTAUGA	32.42	9.84	**42.26**	40.73	12.43	**53.16**	49.35	15.14	**64.48**	56.83	17.49	**74.32**	66.82	20.64	**87.46**	77.71	24.07	**101.78**	88.98	27.62	**116.60**
BALDWIN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BARBOUR	-	1.58	**1.58**	-	1.57	**1.57**	-	1.84	**1.84**	-	2.05	**2.05**	-	2.33	**2.33**	-	2.61	**2.61**	-	2.89	**2.89**
BIBB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BULLOCK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BUTLER	-	0.30	**0.30**	-	0.43	**0.43**	-	0.52	**0.52**	-	0.58	**0.58**	-	0.67	**0.67**	-	0.76	**0.76**	-	0.86	**0.86**
CALHOUN	-	0.97	**0.97**	-	1.18	**1.18**	-	1.41	**1.41**	-	1.60	**1.60**	-	1.85	**1.85**	-	2.12	**2.12**	-	2.40	**2.40**
CHAMBERS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHEROKEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHILTON	-	0.35	**0.35**	-	0.56	**0.56**	-	0.69	**0.69**	-	0.79	**0.79**	-	0.94	**0.94**	-	1.10	**1.10**	-	1.26	**1.26**
CHOCTAW	40.80	-	**40.80**	46.75	-	**46.75**	55.11	-	**55.11**	61.76	-	**61.76**	70.49	-	**70.49**	79.51	-	**79.51**	88.32	-	**88.32**
CLARKE	20.21	-	**20.21**	26.81	-	**26.81**	31.74	-	**31.74**	35.70	-	**35.70**	40.97	-	**40.97**	46.43	-	**46.43**	51.90	-	**51.90**
CLAY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLEBURNE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COFFEE	-	1.13	**1.13**	-	2.71	**2.71**	-	3.31	**3.31**	-	3.84	**3.84**	-	4.53	**4.53**	-	5.29	**5.29**	-	6.08	**6.08**
COLBERT	1,331.41	0.31	**1,331.72**	1,509.23	0.46	**1,509.69**	124.87	0.55	**125.42**	141.14	0.62	**141.77**	162.49	0.72	**163.20**	184.90	0.82	**185.71**	207.72	0.92	**208.63**
CONECUH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COOSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COVINGTON	1.74	-	**1.74**	1.85	-	**1.85**	1.93	-	**1.93**	2.02	-	**2.02**	2.10	-	**2.10**	2.19	-	**2.19**	2.28	-	**2.28**
CRENSHAW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CULLMAN	1.83	0.43	**2.26**	3.52	0.56	**4.08**	4.19	0.67	**4.87**	4.75	0.76	**5.51**	5.47	0.88	**6.35**	6.24	1.00	**7.24**	7.01	1.12	**8.13**
DALE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DALLAS	32.20	0.14	**32.34**	40.00	0.17	**40.16**	47.08	0.20	**47.28**	52.72	0.22	**52.94**	60.16	0.26	**60.42**	67.84	0.29	**68.13**	75.34	0.32	**75.66**
DEKALB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ELMORE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ESCAMBIA	33.61	1.47	**35.08**	46.11	1.97	**48.08**	54.35	2.32	**56.67**	60.89	2.58	**63.46**	69.51	2.93	**72.44**	78.30	3.29	**81.59**	87.03	3.64	**90.67**
ETOWAH	123.78	-	**123.78**	121.07	-	**121.07**	124.31	-	**124.31**	125.56	-	**125.56**	127.21	-	**127.21**	128.85	-	**128.85**	130.11	-	**130.11**
FAYETTE	1.10	-	**1.10**	0.73	-	**0.73**	0.77	-	**0.77**	0.70	-	**0.70**	0.66	-	**0.66**	0.65	-	**0.65**	0.63	-	**0.63**
FRANKLIN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GENEVA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GREENE	354.43	0.03	**354.46**	394.39	0.03	**394.43**	412.83	0.04	**412.87**	431.27	0.04	**431.31**	449.71	0.04	**449.75**	468.15	0.04	**468.19**	486.58	0.04	**486.63**
HALE	-	0.02	**0.02**	-	0.02	**0.02**	-	0.02	**0.02**	-	0.03	**0.03**	-	0.04	**0.04**	-	0.05	**0.05**	-	0.06	**0.06**
HENRY	-	0.54	**0.54**	-	0.71	**0.71**	-	0.84	**0.84**	-	0.96	**0.96**	-	1.10	**1.10**	-	1.25	**1.25**	-	1.41	**1.41**
HOUSTON	89.20	0.17	**89.37**	99.25	0.33	**99.58**	103.89	0.35	**104.24**	108.53	0.36	**108.89**	113.17	0.38	**113.55**	117.81	0.39	**118.21**	122.45	0.41	**122.86**
JACKSON	1,054.12	-	**1,054.12**	1,173.32	-	**1,173.32**	12.09	-	**12.09**	13.54	-	**13.54**	15.46	-	**15.46**	17.43	-	**17.43**	19.36	-	**19.36**
JEFFERSON	-	0.50	**0.50**	0.03	0.71	**0.74**	0.03	0.90	**0.93**	0.04	1.08	**1.12**	0.05	1.32	**1.38**	0.07	1.60	**1.67**	0.09	1.90	**1.99**
LAMAR	-	0.11	**0.11**	-	0.15	**0.15**	-	0.18	**0.18**	-	0.20	**0.20**	-	0.23	**0.23**	-	0.26	**0.26**	-	0.29	**0.29**
LAUDERDALE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LAWRENCE	60.09	-	**60.09**	76.24	-	**76.24**	90.11	-	**90.11**	101.39	-	**101.39**	115.41	-	**115.41**	130.05	-	**130.05**	144.90	-	**144.90**
LEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LIMESTONE	2,725.63	-	**2,725.63**	3,032.93	-	**3,032.93**	3,174.72	-	**3,174.72**	3,316.52	-	**3,316.52**	3,458.31	-	**3,458.31**	3,600.10	-	**3,600.10**	3,741.89	-	**3,741.89**
LOWNDES	-	-	-	-	4.35	**4.35**	-	5.18	**5.18**	-	5.86	**5.86**	-	6.76	**6.76**	-	7.70	**7.70**	-	8.63	**8.63**
MACON	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MADISON	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MARENGO	17.78	-	**17.78**	21.81	-	**21.81**	25.71	-	**25.71**	28.79	-	**28.79**	32.87	-	**32.87**	37.05	-	**37.05**	41.19	-	**41.19**
MARION	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MARSHALL	-	0.08	**0.08**	-	0.10	0.10	-	0.12	**0.12**	-	0.14	**0.14**	-	0.17	**0.17**	-	0.19	**0.19**	-	0.22	**0.22**
MOBILE	991.17	7.03	**998.20**	974.34	11.45	**985.79**	1,021.01	14.63	**1,035.64**	1,067.29	17.78	**1,085.07**	1,112.45	22.00	**1,134.45**	1,159.22	26.81	**1,186.03**	1,205.17	32.17	**1,237.34**
MONROE	46.31	0.39	**46.70**	45.54	0.38	**45.92**	53.65	0.45	**54.10**	60.13	0.50	**60.64**	68.64	0.57	**69.22**	77.41	0.65	**78.06**	86.00	0.72	**86.72**
MONTGOMERY	-	-	-	0.18	2.69	**2.86**	0.22	3.31	**3.53**	0.25	3.88	**4.14**	0.30	4.64	**4.94**	0.36	5.47	**5.83**	0.42	6.36	**6.77**
MORGAN	81.43	0.00	**81.44**	101.42	0.00	**101.42**	120.77	0.00	**120.77**	136.94	0.00	**136.94**	158.33	0.01	**158.34**	180.73	0.01	**180.74**	203.35	0.01	**203.36**
PERRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PICKENS	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.02	**0.02**	-	0.02	**0.02**	-	0.02	**0.02**
PIKE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RANDOLPH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUSSELL	27.64	0.92	**28.56**	35.85	1.19	**37.04**	42.61	1.42	**44.03**	48.17	1.61	**49.78**	55.50	1.85	**57.35**	63.19	2.11	**65.30**	70.82	2.36	**73.18**
SHELBY	665.45	-	**665.45**	856.32	-	**856.32**	922.71	-	**922.71**	993.64	-	**993.64**	1,064.04	-	**1,064.04**	1,139.61	-	**1,139.61**	1,217.41	-	**1,217.41**
STCLAIR	4.46	-	**4.46**	7.09	-	**7.09**	8.70	-	**8.70**	10.12	-	**10.12**	11.98	-	**11.98**	13.95	-	**13.95**	15.98	-	**15.98**
SUMTER	2.03	-	**2.03**	2.03	-	**2.03**	2.31	-	**2.31**	2.38	-	**2.38**	2.55	-	**2.55**	2.77	-	**2.77**	2.97	-	**2.97**
TALLADEGA	24.67	-	**24.67**	32.08	-	**32.08**	38.77	-	**38.77**	44.49	-	**44.49**	52.01	-	**52.01**	60.18	-	**60.18**	68.55	-	**68.55**
TALLAPOOSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TUSCALOOSA	2.12	0.74	**2.86**	2.27	0.96	**3.23**	2.76	1.23	**3.99**	3.10	1.49	**4.59**	3.61	1.85	**5.45**	4.23	2.25	**6.48**	4.91	2.71	**7.63**
WALKER	922.82	-	**922.82**	1,026.86	-	**1,026.86**	1,074.87	-	**1,074.87**	1,122.88	-	**1,122.88**	1,170.88	-	**1,170.88**	1,218.89	-	**1,218.89**	1,266.90	-	**1,266.90**
WASHINGTON	80.39	6.15	**86.55**	90.52	8.18	**98.70**	95.59	9.64	**105.23**	100.44	10.80	**111.24**	105.58	12.33	**117.91**	110.75	13.89	**124.65**	115.90	15.44	**131.34**
WILCOX	20.13	-	**20.13**	24.19	-	**24.19**	28.53	-	**28.53**	31.95	-	**31.95**	36.44	-	**36.44**	41.11	-	**41.11**	45.70	-	**45.70**
WINSTON	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	8,788.97	33.20	**8,822.17**	9,833.41	53.34	**9,886.75**	7,725.60	64.97	**7,790.57**	8,163.93	75.29	**8,239.22**	8,633.19	89.02	**8,722.22**	9,115.66	104.04	**9,219.70**	9,599.86	119.86	**9,719.72**

Table C-6: Water Withdrawal (in MGD) by HUC - University of Alabama GDP

	2010			2015			2020			2025			2030			2035			2040		
HUC	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**
03130002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03130003	27.64	2.50	**30.14**	35.85	2.76	**38.61**	42.61	3.26	**45.87**	48.17	3.66	**51.83**	55.50	4.18	**59.68**	63.19	4.72	**67.91**	70.82	5.25	**76.07**
03130004	89.20	0.44	**89.64**	99.25	0.68	**99.94**	103.89	0.77	**104.66**	108.53	0.84	**109.37**	113.17	0.93	**114.10**	117.81	1.02	**118.83**	122.45	1.11	**123.57**
03130012	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140103	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140106	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140107	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140201	-	0.27	**0.27**	-	1.60	**1.60**	-	1.95	**1.95**	-	2.24	**2.24**	-	2.64	**2.64**	-	3.06	**3.06**	-	3.51	**3.51**
03140202	-	1.13	**1.13**	-	1.46	**1.46**	-	1.79	**1.79**	-	2.07	**2.07**	-	2.45	**2.45**	-	2.85	**2.85**	-	3.28	**3.28**
03140203	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140301	1.74	-	**1.74**	1.85	-	**1.85**	1.93	-	**1.93**	2.02	-	**2.02**	2.10	-	**2.10**	2.19	-	**2.19**	2.28	-	**2.28**
03140302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140303	-	0.30	**0.30**	-	0.43	**0.43**	-	0.52	**0.52**	-	0.58	**0.58**	-	0.67	**0.67**	-	0.76	**0.76**	-	0.86	**0.86**
03140304	33.61	1.38	**34.99**	46.11	1.89	**48.00**	54.35	2.23	**56.58**	60.89	2.50	**63.38**	69.51	2.85	**72.36**	78.30	3.21	**81.51**	87.03	3.57	**90.60**
03140305	-	0.09	**0.09**	-	0.08	**0.08**	-	0.09	**0.09**	-	0.08	**0.08**	-	0.08	**0.08**	-	0.07	**0.07**	-	0.07	**0.07**
03150105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150106	152.91	0.97	**153.88**	160.24	1.18	**161.41**	171.78	1.41	**173.19**	180.17	1.60	**181.77**	191.20	1.85	**193.06**	202.97	2.12	**205.09**	214.65	2.40	**217.04**
03150107	665.45	-	**665.45**	856.32	-	**856.32**	922.71	-	**922.71**	993.64	-	**993.64**	1,064.04	-	**1,064.04**	1,139.61	-	**1,139.61**	1,217.41	-	**1,217.41**
03150108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150109	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150201	64.62	10.33	**74.95**	80.90	20.19	**101.09**	96.65	24.51	**121.16**	109.80	28.25	**138.05**	127.29	33.22	**160.51**	145.91	38.62	**184.53**	164.74	44.19	**208.93**
03150202	-	0.16	**0.16**	0.03	0.22	**0.25**	0.03	0.28	**0.32**	0.04	0.34	**0.38**	0.05	0.41	**0.47**	0.07	0.50	**0.57**	0.09	0.59	**0.68**
03150203	20.13	-	**20.13**	24.19	-	**24.19**	28.53	-	**28.53**	31.95	-	**31.95**	36.44	-	**36.44**	41.11	-	**41.11**	45.70	-	**45.70**
03150204	46.31	0.39	**46.70**	45.54	0.38	**45.92**	53.65	0.45	**54.10**	60.13	0.50	**60.64**	68.64	0.57	**69.22**	77.41	0.65	**78.06**	86.00	0.72	**86.72**
03160101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160103	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160105	-	0.11	**0.11**	-	0.15	**0.15**	-	0.18	**0.18**	-	0.20	**0.20**	-	0.23	**0.23**	-	0.26	**0.26**	-	0.29	**0.29**
03160106	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.02	**0.02**	-	0.02	**0.02**	-	0.02	**0.02**
03160107	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160109	924.65	0.43	**925.08**	1,030.38	0.56	**1,030.95**	1,079.06	0.67	**1,079.74**	1,127.62	0.76	**1,128.38**	1,176.36	0.88	**1,177.23**	1,225.13	1.00	**1,226.13**	1,273.90	1.12	**1,275.03**
03160110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160111	-	0.34	**0.34**	-	0.49	**0.49**	-	0.62	**0.62**	-	0.74	**0.74**	-	0.91	**0.91**	-	1.10	**1.10**	-	1.31	**1.31**
03160112	2.19	0.20	**2.39**	1.65	0.26	**1.91**	1.80	0.34	**2.14**	1.70	0.41	**2.11**	1.67	0.51	**2.18**	1.71	0.62	**2.32**	1.73	0.74	**2.47**
03160113	355.47	0.58	**356.05**	395.74	0.75	**396.49**	414.56	0.95	**415.51**	433.37	1.15	**434.51**	452.30	1.42	**453.72**	471.32	1.73	**473.04**	490.40	2.07	**492.47**
03160201	59.50	-	**59.50**	69.54	-	**69.54**	81.98	-	**81.98**	91.85	-	**91.85**	104.85	-	**104.85**	118.23	-	**118.23**	131.37	-	**131.37**
03160202	1.11	-	**1.11**	1.04	-	**1.04**	1.15	-	**1.15**	1.09	-	**1.09**	1.07	-	**1.07**	1.09	-	**1.09**	1.11	-	**1.11**
03160203	100.60	7.08	**107.68**	117.33	9.63	**126.95**	127.33	11.48	**138.81**	136.14	13.05	**149.18**	146.55	15.11	**161.67**	157.18	17.29	**174.48**	167.80	19.52	**187.32**
03160204	991.17	4.94	**996.11**	974.34	8.29	**982.63**	1,021.01	10.61	**1,031.62**	1,067.29	12.92	**1,080.21**	1,112.45	16.01	**1,128.45**	1,159.22	19.53	**1,178.75**	1,205.17	23.45	**1,228.62**
03160205	-	1.16	**1.16**	-	1.72	**1.72**	-	2.18	**2.18**	-	2.61	**2.61**	-	3.20	**3.20**	-	3.88	**3.88**	-	4.64	**4.64**
03170002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03170003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03170008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03170009	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**
06020001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06030001	1,054.12	0.08	**1,054.20**	1,173.32	0.10	**1,173.42**	12.09	0.12	**12.22**	13.54	0.14	**13.68**	15.46	0.17	**15.62**	17.43	0.19	**17.62**	19.36	0.22	**19.58**
06030002	2,867.15	0.00	**2,867.15**	3,210.58	0.00	**3,210.59**	3,385.60	0.00	**3,385.60**	3,554.84	0.00	**3,554.85**	3,732.05	0.01	**3,732.05**	3,910.88	0.01	**3,910.89**	4,090.13	0.01	**4,090.14**
06030003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06030004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06030005	1,331.41	0.31	**1,331.72**	1,509.23	0.46	**1,509.69**	124.87	0.55	**125.42**	141.14	0.62	**141.77**	162.49	0.72	**163.20**	184.90	0.82	**185.71**	207.72	0.92	**208.63**
06030006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	8,788.97	33.20	**8,822.17**	9,833.41	53.34	**9,886.75**	7,725.60	64.97	**7,790.57**	8,163.93	75.29	**8,239.22**	8,633.19	89.02	**8,722.22**	9,115.66	104.04	**9,219.70**	9,599.86	119.86	**9,719.72**

Appendix D

Water Withdrawal Forecasts based on International Forecasting Service GDP Data

State Level Analysis

Ground Water Withdrawals

Table D-1 provides a breakdown of ground water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the type of industrial user based on the International Forecasting Service GDP data. The forecasts indicate that Mining, Thermo-electric, Petrochemical, and Other Manufacturing will experience significant increases in ground water withdrawal, with increases of 97 percent, 74 percent, 365 percent, and 196 percent, respectively. Pulp and Paper and Wholesale will experience modest increases of 11 percent and 40 percent increase, respectively. Total ground water withdrawals are forecast to increase by 185 percent.

Table D-1: Ground Water Withdrawal Data (in MGD) - International Forecasting Service GDP

	YEAR						
Type of Industrial User	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Mining	0.24	0.25	0.28	0.32	0.36	0.41	0.47
Thermo-electric	0.20	0.31	0.34	0.34	0.34	0.34	0.35
Pulp and Paper	11.78	11.76	12.16	12.38	12.61	12.86	13.11
Petrochemical	10.96	18.00	21.11	26.01	32.29	40.38	50.89
Other Manufacturing	10.01	15.29	17.05	19.20	21.92	25.34	29.68
Wholesale	0.02	0.02	0.03	0.04	0.04	0.06	0.07
Total	33.20	45.64	50.97	58.29	67.57	79.39	94.56

Chart D-1.1: Self-Supplied Ground Water Withdrawals (in MGD) 2010: International Forecasting Service GDP

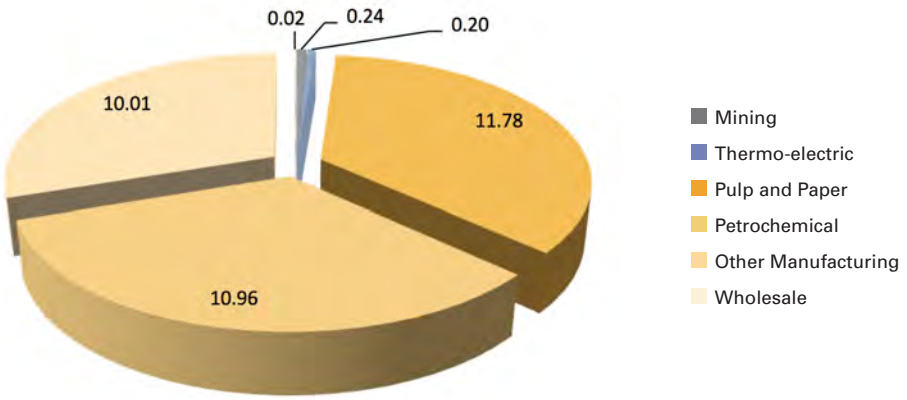
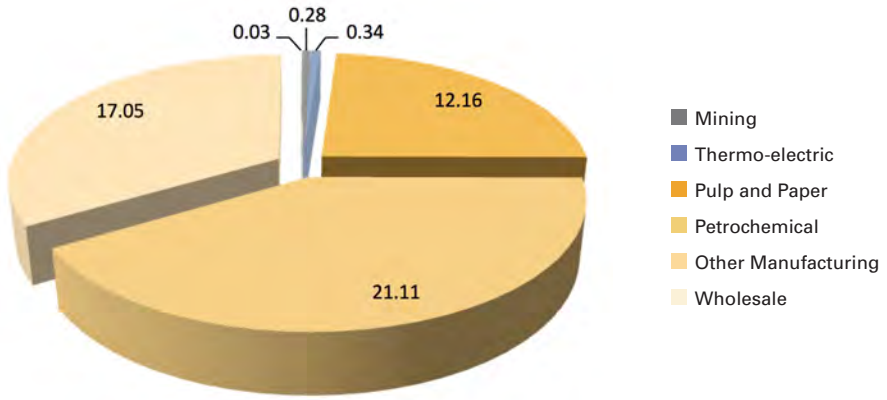


Chart D-1.2: Self-Supplied Ground Water Withdrawals (in MGD) 2020: International Forecasting Service GDP



The following charts, Chart D-1.1 – Chart D-1.4, provide the breakdown of ground water withdrawals by the type of industrial user based on the International Forecasting Service GDP data for 2010, 2020, 2030, and 2040. An analysis of these charts indicates that during the 31-year period, the proportion of ground water withdrawn by Pulp and Paper industrial users declines, while the proportion of ground water withdrawn by Petrochemical and Other Manufacturing industrial users increases. This is consistent with the long-term projections for these three industrial users, since Pulp and Paper is expected to have nominal growth, but Petrochemical and Other Manufacturing are expected to have significant growth.

Chart D-1.3: Self-Supplied Ground Water Withdrawals (in MGD) 2030: International Forecasting Service GDP

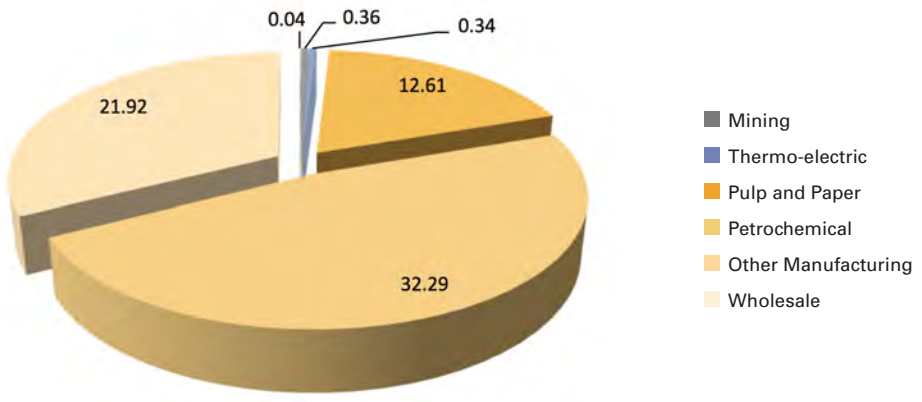
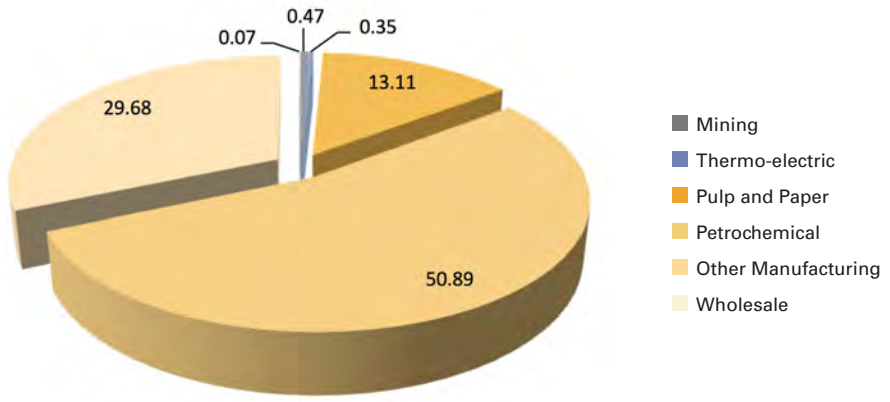


Chart D-1.4: Self-Supplied Ground Water Withdrawals (in MGD) 2040: International Forecasting Service GDP



Surface Water Withdrawals

Table D-2 provides a breakdown of surface water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the type of industrial user based on the International Forecasting Service GDP data. The forecasts indicate that Mining, Petrochemical, and Other Manufacturing will experience significant increases in surface water withdrawal, with increases of 79 percent, 1432 percent, and 178 percent, respectively. Thermo-electric will experience a five percent increase, and Pulp and Paper will experience a three percent decrease. Total surface water withdrawals are forecast to increase by 28 percent.

Table D-2: Surface Water Withdrawal Data (in MGD) - International Forecasting Service GDP

	YEAR						
Type of Industrial User	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Mining	3.30	3.04	3.86	4.24	4.70	5.24	5.91
Thermo-electric	8,251.64	8,076.08	6,701.28	7,106.86	7,564.49	8,080.08	8,660.22
Pulp and Paper	369.99	357.41	346.69	344.70	345.94	350.48	358.45
Petrochemical	140.28	277.64	311.24	487.79	784.83	1,288.88	2,149.45
Other Manufacturing	23.77	29.94	33.20	39.24	46.52	55.32	65.98
Wholesale	-	0.03	0.03	0.04	0.05	0.06	0.07
Total	8,788.97	8,744.16	7,396.31	7,982.86	8,746.51	9,780.06	11,240.07

The following charts, Chart D-2.1 – Chart D-2.4, provide the breakdown of surface water withdrawals by the type of industrial user based on the International Forecasting Service GDP data for 2010, 2020, 2030, and 2040. An analysis of these charts indicates that during the 31-year period, the proportion of surface water withdrawn by Thermo-electric industrial users declines, while the proportion of surface water withdrawn by Petrochemical, Other Manufacturing, and Pulp and Paper industrial users increases. This is consistent with closing of two TVA thermo-electric plants and the long-term projections for these three industrial users, since Pulp and Paper is expected to have nominal growth, but Petrochemical and Other Manufacturing are expected to have significant growth.

Chart D-2.1: Self-Supplied Surface Water Withdrawals (in MGD) 2010: International Forecasting Service GDP

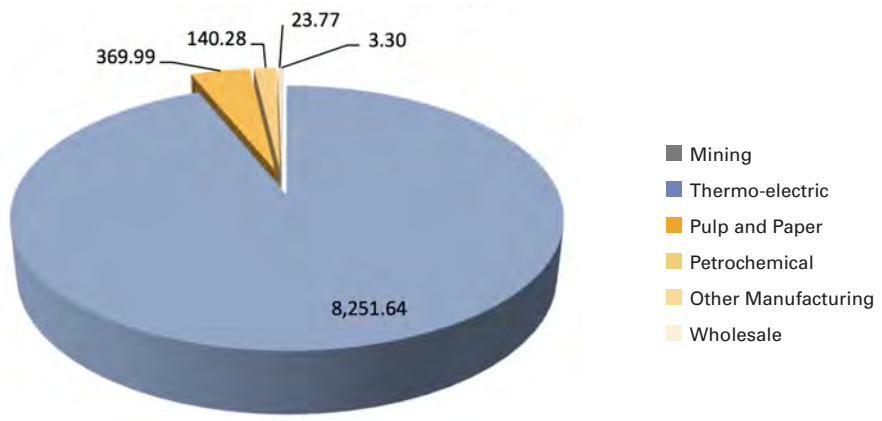


Chart D-2.2: Self-Supplied Surface Water Withdrawals (in MGD) 2020: International Forecasting Service GDP

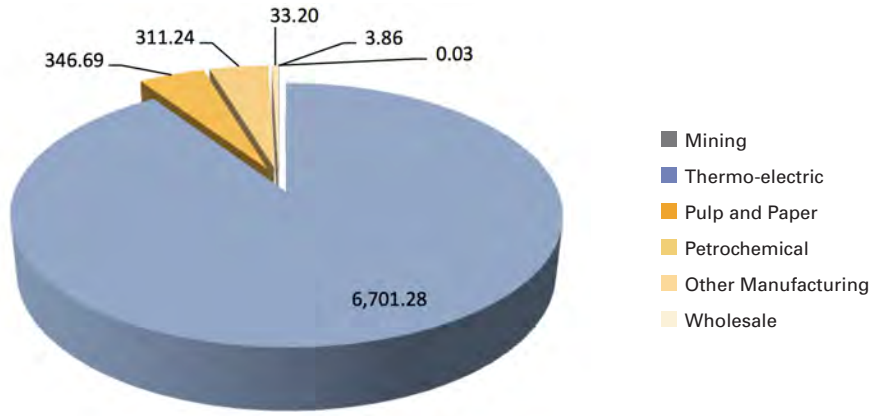


Chart D-2.3: Self-Supplied Surface Water Withdrawals (in MGD) 2030: International Forecasting Service GDP

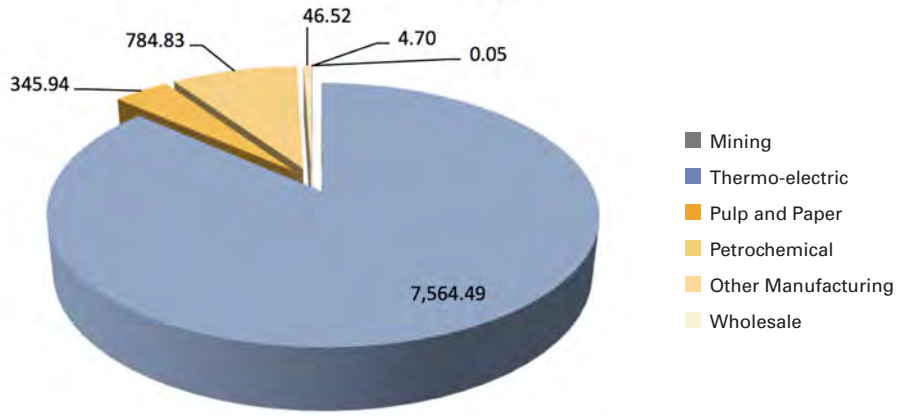
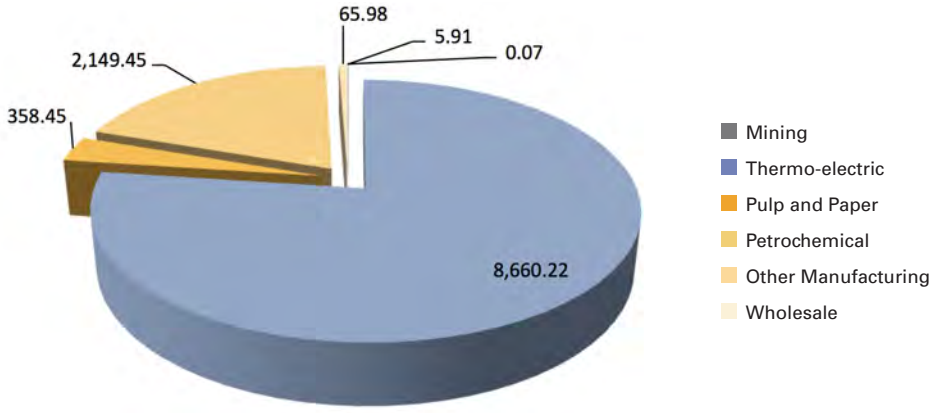


Chart D-2.4: Self-Supplied Surface Water Withdrawals (in MGD) 2040: International Forecasting Service GDP



Total Water Withdrawals

Table D-3 provides a breakdown of total water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the type of industrial user based on the International Forecasting Service GDP data. The forecasts indicate that Mining, Petrochemical, Other Manufacturing, and Wholesale will experience significant increases in total water withdrawal, with increases of 80 percent, 1355 percent, 183 percent, and 421 percent, respectively. Pulp and Paper will experience a three percent decline, and Thermo-electric will experience a five percent increase.

Table D-3: Total Water Withdrawal Data (in MGD) - International Forecasting Service GDP

	YEAR						
Type of Industrial User	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Mining	3.53	3.29	4.15	4.56	5.06	5.66	6.37
Thermo-electric	8,251.84	8,076.40	6,701.63	7,107.20	7,564.83	8,080.43	8,660.57
Pulp and Paper	381.77	369.17	358.85	357.08	358.55	363.34	371.57
Petrochemical	151.24	295.64	332.35	513.80	817.11	1,329.25	2,200.34
Other Manufacturing	33.78	45.23	50.25	58.44	68.44	80.67	95.65
Wholesale	0.02	0.05	0.06	0.07	0.09	0.11	0.14
Total	8,822.17	8,789.79	7,447.28	8,041.16	8,814.08	9,859.45	11,334.63

Chart D-3.1: Self-Supplied Total Water Withdrawals (in MGD) 2010: International Forecasting Service GDP

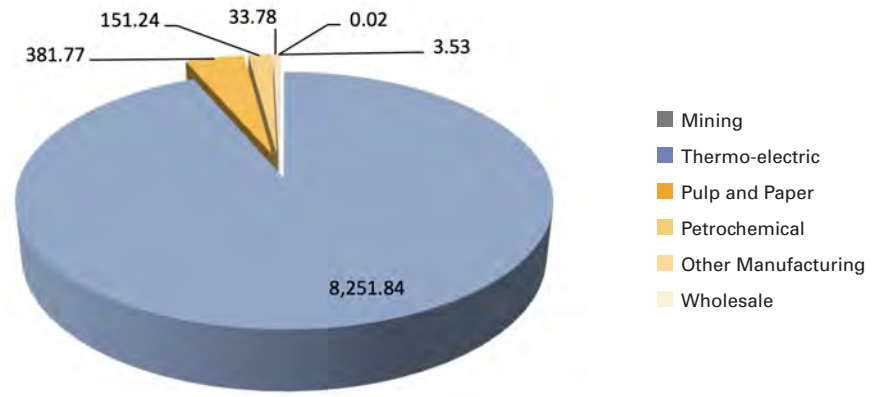
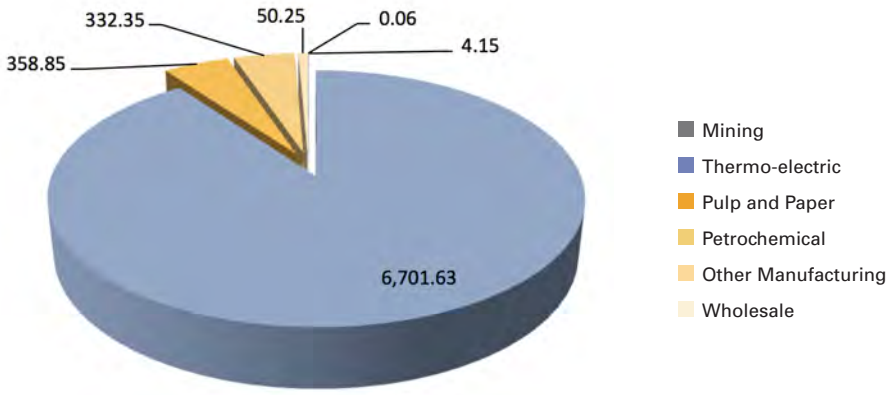


Chart D-3.2: Self-Supplied Total Water Withdrawals (in MGD) 2020: International Forecasting Service GDP



The following charts, Chart D-3.1 – Chart D-3.4, provide the breakdown of total water withdrawals by the type of industrial user based on the International Forecasting Service GDP data for 2010, 2020, 2030, and 2040. An analysis of these charts indicates that during the 31-year period, the proportion of total water withdrawn by Thermo-electric industrial users declines, while the proportion of total water withdrawn by Petrochemical, Pulp and Paper, and Other Manufacturing industrial users increases. This is consistent with the closing of two TVA thermo-electric plants and the long-term projections for these three industrial users, since Pulp and Paper is expected to have nominal growth, but Petrochemical and Other Manufacturing are expected to have significant growth.

Chart D-3.3: Self-Supplied Total Water Withdrawals (in MGD) 2010: International Forecasting Service GDP

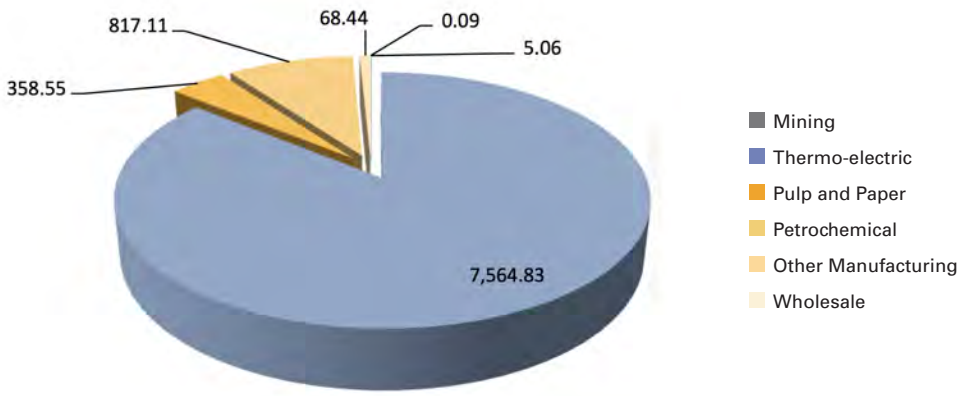


Chart D-3.4: Self-Supplied Total Water Withdrawals (in MGD) 2010: International Forecasting Service GDP

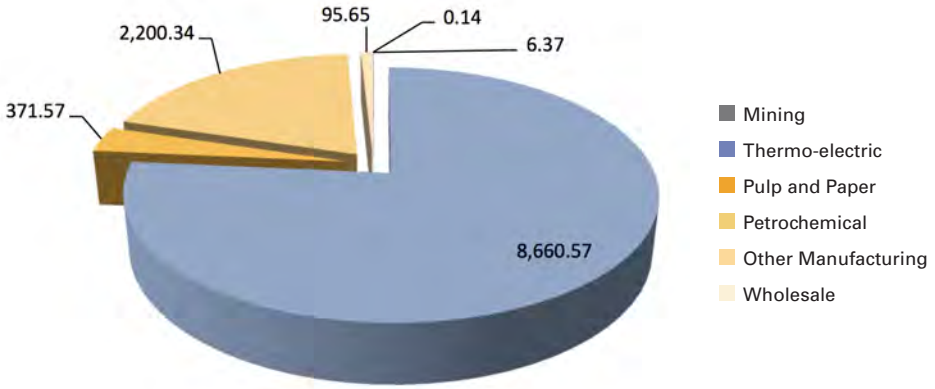
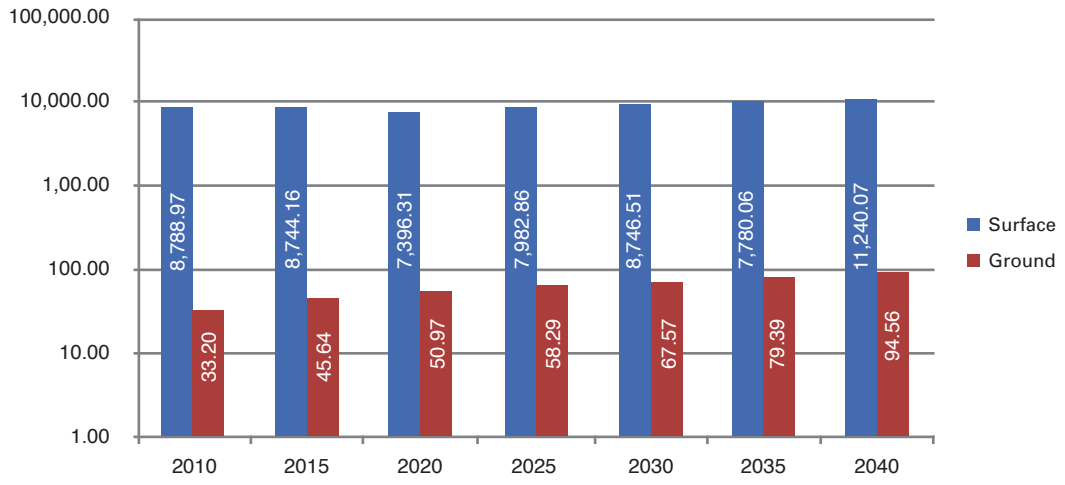


Table D-4 and Chart D-4 provide a breakdown of total water withdrawal for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 by the water source based on the International Forecasting Service GDP data. The forecast indicates that approximately 99 percent of water withdrawn is surface water. Ground water is projected to increase by 185 percent during the 31-year period; whereas, surface water is expected to increase by 28 percent. Thermo-electric is the largest user of surface water, and the closing of the two TVA plants significantly impacts the surface water withdrawn.

Table D-4: Total Water Withdrawal Data (in MGD) - International Forecasting Service GDP

	YEAR						
Water Source	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Ground	33.20	45.64	50.97	58.29	67.57	79.39	94.56
Surface	8,788.97	8,744.16	7,396.31	7,982.86	8,746.51	9,780.06	11,240.07
Total	8,822.17	8,789.79	7,447.28	8,041.16	8,814.08	9,859.45	11,334.63

Chart D-4: Self-Supplied Total Water Withdrawal (in MGD) 2010-2040: - International Forecasting Service GDP



County Level Analysis

The county level analysis addresses the total water withdrawn by industrial users in each county during the 31-year period. Table D-5 provides the forecasts for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 for each county in the State of Alabama based on the International Forecasting Service GDP data. The results indicate that two counties, Colbert and Jackson, experience significant declines in the amount of water withdrawn. This is because TVA is closing a steam plant in each county. However, some counties experience significant increases in water withdrawn during the 31-year period, e.g., Etowah, Greene, Mobile, Morgan, Shelby, and Walker, with increases of 96 percent, 92 percent, 94 percent, 2349 percent, 92 percent, and 99 percent. The counties with the largest water withdrawals are Limestone, Walker, Mobile, Morgan, and Shelby, with each county having water withdrawals in excess of one billion gallons per day by 2040. In 2040, the water withdrawal for these five counties accounts for 84 percent of all water withdrawn.

HUC Level Analysis

The HUC level analysis addresses the total water withdrawn by industrial users in each HUC during the 31-year period. Table D-6 provides the forecasts for 2010, 2015, 2020, 2025, 2030, 2035, and 2040 for each HUC in the State of Alabama based on the International Forecasting Service GDP data. The results indicate that two HUCs, 06030001 and 06030005, experience significant declines in the amount of water withdrawn. This is because TVA is closing a steam plant in each HUC. However, some HUCs experience significant increases in water withdrawn during the 31-year period, e.g., 03140304, 03150106, 03150107, 03150204, 03160109, 03160113, 03160203 and 06030002, with increases of 128 percent, 77 percent, 92 percent, 62 percent, 93 percent, 93 percent, 93 percent, and 60 percent, respectively. The HUCs with the largest water withdrawals are 03150107, 03160109, 03160204, and 06030002, with each HUC having water withdrawals in excess of one billion gallons per day by 2040. In 2040, the water withdrawal for these four HUCs accounts for 84 percent of all water withdrawn.

Table D-5: Water Withdrawal (in MGD) by County - International Forecasting Service GDP

	2010			2015			2020			2025			2030			2035			2040		
COUNTY	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**
AUTAUGA	32.42	9.84	**42.26**	32.43	9.84	**42.28**	33.89	10.21	**44.11**	34.73	10.42	**45.15**	35.60	10.63	**46.23**	36.51	10.84	**47.35**	37.45	11.06	**48.51**
BALDWIN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BARBOUR	-	1.58	**1.58**	-	1.32	**1.32**	-	1.46	**1.46**	-	1.40	**1.40**	-	1.34	**1.34**	-	1.29	**1.29**	-	1.24	**1.24**
BIBB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BLOUNT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BULLOCK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BUTLER	-	0.30	**0.30**	-	0.27	**0.27**	-	0.25	**0.25**	-	0.22	**0.22**	-	0.20	**0.20**	-	0.18	**0.18**	-	0.17	**0.17**
CALHOUN	-	0.97	**0.97**	-	0.98	**0.98**	-	1.04	**1.04**	-	1.09	**1.09**	-	1.13	**1.13**	-	1.18	**1.18**	-	1.22	**1.22**
CHAMBERS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHEROKEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHILTON	-	0.35	**0.35**	-	0.38	**0.38**	-	0.43	**0.43**	-	0.47	**0.47**	-	0.53	**0.53**	-	0.58	**0.58**	-	0.65	**0.65**
CHOCTAW	40.80	-	**40.80**	36.57	-	**36.57**	33.35	-	**33.35**	30.14	-	**30.14**	27.25	-	**27.25**	24.63	-	**24.63**	22.26	-	**22.26**
CLARKE	20.21	-	**20.21**	18.11	-	**18.11**	16.52	-	**16.52**	14.93	-	**14.93**	13.50	-	**13.50**	12.20	-	**12.20**	11.03	-	**11.03**
CLAY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLEBURNE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COFFEE	-	1.13	**1.13**	-	2.06	**2.06**	-	2.26	**2.26**	-	2.17	**2.17**	-	2.09	**2.09**	-	2.00	**2.00**	-	1.93	**1.93**
COLBERT	1,331.41	0.31	**1,331.72**	1,353.63	0.35	**1,353.98**	93.23	0.37	**93.60**	108.35	0.41	**108.76**	126.42	0.45	**126.87**	148.00	0.50	**148.50**	173.78	0.55	**174.34**
CONECUH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COOSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COVINGTON	1.74	-	**1.74**	1.76	-	**1.76**	2.16	-	**2.16**	2.41	-	**2.41**	2.68	-	**2.68**	2.99	-	**2.99**	3.34	-	**3.34**
CRENSHAW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CULLMAN	1.83	0.43	**2.26**	2.79	0.76	**3.55**	3.14	0.90	**4.04**	3.45	1.13	**4.58**	3.86	1.42	**5.28**	4.39	1.79	**6.18**	5.08	2.25	**7.33**
DALE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DALLAS	32.20	0.14	**32.34**	28.86	0.12	**28.99**	26.32	0.11	**26.43**	23.79	0.10	**23.89**	21.50	0.09	**21.60**	19.44	0.08	**19.52**	17.57	0.07	**17.64**
DEKALB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ELMORE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ESCAMBIA	33.61	1.47	**35.08**	40.92	1.66	**42.58**	44.17	1.87	**46.05**	50.71	2.12	**52.83**	58.22	2.40	**60.63**	66.84	2.73	**69.57**	76.74	3.10	**79.84**
ETOWAH	123.78	-	**123.78**	127.22	-	**127.22**	154.77	-	**154.77**	173.10	-	**173.10**	193.63	-	**193.63**	216.61	-	**216.61**	242.36	-	**242.36**
FAYETTE	1.10	-	**1.10**	0.85	-	**0.85**	1.12	-	**1.12**	1.13	-	**1.13**	1.14	-	**1.14**	1.15	-	**1.15**	1.16	-	**1.16**
FRANKLIN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GENEVA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GREENE	354.43	0.03	**354.46**	358.44	0.03	**358.47**	440.84	0.04	**440.88**	491.51	0.04	**491.55**	548.01	0.05	**548.06**	611.00	0.05	**611.05**	681.23	0.06	**681.29**
HALE	-	0.02	**0.02**	-	0.02	**0.02**	-	0.03	**0.03**	-	0.04	**0.04**	-	0.04	**0.04**	-	0.06	**0.06**	-	0.07	**0.07**
HENRY	-	0.54	**0.54**	-	0.58	**0.58**	-	0.63	**0.63**	-	0.69	**0.69**	-	0.74	**0.74**	-	0.81	**0.81**	-	0.87	**0.87**
HOUSTON	89.20	0.17	**89.37**	81.69	0.28	**81.96**	89.00	0.30	**89.31**	87.67	0.30	**87.97**	86.37	0.30	**86.66**	85.08	0.29	**85.37**	83.81	0.29	**84.10**
JACKSON	1,054.12	-	**1,054.12**	1,065.94	-	**1,065.94**	9.23	-	**9.23**	9.42	-	**9.42**	9.61	-	**9.61**	9.80	-	**9.80**	10.00	-	**10.00**
JEFFERSON	-	0.50	**0.50**	0.03	0.55	**0.58**	0.03	0.60	**0.64**	0.04	0.67	**0.71**	0.05	0.75	**0.80**	0.06	0.85	**0.90**	0.07	0.96	**1.03**
LAMAR	-	0.11	**0.11**	-	0.12	**0.12**	-	0.13	**0.13**	-	0.15	**0.15**	-	0.16	**0.16**	-	0.18	**0.18**	-	0.20	**0.20**
LAUDERDALE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LAWRENCE	60.09	-	**60.09**	53.86	-	**53.86**	49.11	-	**49.11**	44.39	-	**44.39**	40.13	-	**40.13**	36.27	-	**36.27**	32.79	-	**32.79**
LEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LIMESTONE	2,725.63	-	**2,725.63**	2,496.09	-	**2,496.09**	2,719.63	-	**2,719.63**	2,679.08	-	**2,679.08**	2,639.13	-	**2,639.13**	2,599.78	-	**2,599.78**	2,561.02	-	**2,561.02**
LOWNDES	-	-	-	-	4.56	**4.56**	-	4.61	**4.61**	-	5.47	**5.47**	-	6.50	**6.50**	-	7.72	**7.72**	-	9.17	**9.17**
MACON	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MADISON	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MARENGO	17.78	-	**17.78**	17.78	-	**17.78**	18.45	-	**18.45**	18.82	-	**18.82**	19.20	-	**19.20**	19.59	-	**19.59**	19.98	-	**19.98**
MARION	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MARSHALL	-	0.08	**0.08**	-	0.09	**0.09**	-	0.12	**0.12**	-	0.14	**0.14**	-	0.15	**0.15**	-	0.16	**0.16**	-	0.18	**0.18**
MOBILE	991.17	7.03	**998.20**	1,002.53	9.65	**1,012.17**	1,232.89	10.96	**1,243.85**	1,374.66	13.67	**1,388.33**	1,532.74	17.30	**1,550.04**	1,708.99	22.22	**1,731.22**	1,905.52	28.92	**1,934.45**
MONROE	46.31	0.39	**46.70**	47.54	0.69	**48.23**	46.54	0.81	**47.35**	52.18	1.02	**53.20**	58.49	1.29	**59.78**	65.58	1.62	**67.20**	73.53	2.03	**75.57**
MONTGOMERY	-	-	-	0.14	2.88	**3.03**	0.13	3.33	**3.46**	0.12	4.19	**4.31**	0.11	5.31	**5.42**	0.10	6.77	**6.87**	0.09	8.69	**8.78**
MORGAN	81.43	0.00	**81.44**	211.28	0.00	**211.28**	229.50	0.01	**229.50**	392.01	0.01	**392.02**	672.43	0.01	**672.44**	1,156.81	0.02	**1,156.83**	1,994.06	0.02	**1,994.08**
PERRY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PICKENS	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**
PIKE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RANDOLPH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUSSELL	27.64	0.92	**28.56**	27.64	0.92	**28.56**	28.67	0.96	**29.62**	29.25	0.98	**30.22**	29.84	1.00	**30.83**	30.44	1.02	**31.45**	31.05	1.04	**32.09**
SHELBY	665.45	-	**665.45**	672.98	-	**672.98**	827.68	-	**827.68**	922.82	-	**922.82**	1,028.90	-	**1,028.90**	1,147.16	-	**1,147.16**	1,279.03	-	**1,279.03**
STCLAIR	4.46	-	**4.46**	5.71	-	**5.71**	6.75	-	**6.75**	8.29	-	**8.29**	10.18	-	**10.18**	12.51	-	**12.51**	15.37	-	**15.37**
SUMTER	2.03	-	**2.03**	2.28	-	**2.28**	2.56	-	**2.56**	3.02	-	**3.02**	3.58	-	**3.58**	4.24	-	**4.24**	5.04	-	**5.04**
TALLADEGA	24.67	-	**24.67**	22.12	-	**22.12**	20.17	-	**20.17**	18.23	-	**18.23**	16.48	-	**16.48**	14.89	-	**14.89**	13.46	-	**13.46**
TALLAPOOSA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TUSCALOOSA	2.12	0.74	**2.86**	2.00	0.76	**2.76**	2.39	0.84	**3.23**	2.74	1.03	**3.77**	3.18	1.28	**4.46**	3.75	1.60	**5.35**	4.46	2.01	**6.47**
WALKER	922.82	-	**922.82**	933.26	-	**933.26**	1,147.79	-	**1,147.79**	1,279.72	-	**1,279.72**	1,426.83	-	**1,426.83**	1,590.84	-	**1,590.84**	1,773.70	-	**1,773.70**
WASHINGTON	80.39	6.15	**86.55**	81.66	6.73	**88.39**	99.84	8.69	**108.53**	111.28	10.37	**121.65**	124.04	12.39	**136.43**	138.26	14.84	**153.09**	154.11	17.79	**171.90**
WILCOX	20.13	-	**20.13**	18.05	-	**18.05**	16.46	-	**16.46**	14.87	-	**14.87**	13.45	-	**13.45**	12.15	-	**12.15**	10.99	-	**10.99**
WINSTON	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	8,788.97	33.20	**8,822.17**	8,744.16	45.64	**8,789.79**	7,396.31	50.97	**7,447.28**	7,982.86	58.29	**8,041.16**	8,746.51	67.57	**8,814.08**	9,780.06	79.39	**9,859.45**	11,240.07	94.56	**11,334.63**

Table D-6: Water Withdrawal (in MGD) by HUC - International Forecasting Service GDP

	2010			2015			2020			2025			2030			2035			2040		
HUC	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**	**Surface**	**Ground**	**Total**
03130002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03130003	27.64	2.50	**30.14**	27.64	2.25	**29.88**	28.67	2.41	**31.08**	29.25	2.37	**31.62**	29.84	2.34	**32.17**	30.44	2.31	**32.74**	31.05	2.28	**33.33**
03130004	89.20	0.44	**89.64**	81.69	0.57	**82.25**	89.00	0.62	**89.62**	87.67	0.64	**88.32**	86.37	0.67	**87.03**	85.08	0.69	**85.77**	83.81	0.72	**84.53**
03130012	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140103	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140106	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140107	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140201	-	0.27	**0.27**	-	1.40	**1.40**	-	1.53	**1.53**	-	1.51	**1.51**	-	1.49	**1.49**	-	1.48	**1.48**	-	1.47	**1.47**
03140202	-	1.13	**1.13**	-	0.95	**0.95**	-	1.04	**1.04**	-	1.00	**1.00**	-	0.96	**0.96**	-	0.93	**0.93**	-	0.89	**0.89**
03140203	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140301	1.74	-	**1.74**	1.76	-	**1.76**	2.16	-	**2.16**	2.41	-	**2.41**	2.68	-	**2.68**	2.99	-	**2.99**	3.34	-	**3.34**
03140302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03140303	-	0.30	**0.30**	-	0.27	**0.27**	-	0.25	**0.25**	-	0.22	**0.22**	-	0.20	**0.20**	-	0.18	**0.18**	-	0.17	**0.17**
03140304	33.61	1.38	**34.99**	40.92	1.57	**42.48**	44.17	1.77	**45.94**	50.71	2.00	**52.71**	58.22	2.26	**60.48**	66.84	2.56	**69.40**	76.74	2.90	**79.63**
03140305	-	0.09	**0.09**	-	0.09	**0.09**	-	0.11	**0.11**	-	0.12	**0.12**	-	0.15	**0.15**	-	0.17	**0.17**	-	0.20	**0.20**
03150105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150106	152.91	0.97	**153.88**	155.04	0.98	**156.02**	181.68	1.04	**182.73**	199.62	1.09	**200.71**	220.29	1.13	**221.42**	244.02	1.18	**245.19**	271.19	1.22	**272.41**
03150107	665.45	-	**665.45**	672.98	-	**672.98**	827.68	-	**827.68**	922.82	-	**922.82**	1,028.90	-	**1,028.90**	1,147.16	-	**1,147.16**	1,279.03	-	**1,279.03**
03150108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150109	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03150201	64.62	10.33	**74.95**	61.44	17.79	**79.23**	60.34	18.68	**79.03**	58.64	20.65	**79.29**	57.21	23.06	**80.26**	56.04	26.00	**82.04**	55.11	29.64	**84.75**
03150202	-	0.16	**0.16**	0.03	0.20	**0.23**	0.03	0.24	**0.27**	0.04	0.29	**0.33**	0.05	0.36	**0.40**	0.06	0.44	**0.49**	0.07	0.54	**0.61**
03150203	20.13	-	**20.13**	18.05	-	**18.05**	16.46	-	**16.46**	14.87	-	**14.87**	13.45	-	**13.45**	12.15	-	**12.15**	10.99	-	**10.99**
03150204	46.31	0.39	**46.70**	47.54	0.69	**48.23**	46.54	0.81	**47.35**	52.18	1.02	**53.20**	58.49	1.29	**59.78**	65.58	1.62	**67.20**	73.53	2.03	**75.57**
03160101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160103	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160105	-	0.11	**0.11**	-	0.12	**0.12**	-	0.13	**0.13**	-	0.15	**0.15**	-	0.16	**0.16**	-	0.18	**0.18**	-	0.20	**0.20**
03160106	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**	-	0.01	**0.01**
03160107	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160109	924.65	0.43	**925.08**	936.04	0.76	**936.81**	1,150.93	0.90	**1,151.83**	1,283.17	1.13	**1,284.30**	1,430.68	1.42	**1,432.10**	1,595.23	1.79	**1,597.01**	1,778.78	2.25	**1,781.03**
03160110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03160111	-	0.34	**0.34**	-	0.35	**0.35**	-	0.37	**0.37**	-	0.38	**0.38**	-	0.40	**0.40**	-	0.41	**0.41**	-	0.42	**0.42**
03160112	2.19	0.20	**2.39**	1.70	0.18	**1.88**	2.22	0.19	**2.41**	2.25	0.19	**2.44**	2.27	0.20	**2.47**	2.29	0.21	**2.50**	2.31	0.22	**2.53**
03160113	355.47	0.58	**356.05**	359.59	0.64	**360.23**	442.12	0.72	**442.84**	493.13	0.92	**494.05**	550.06	1.17	**551.24**	613.61	1.50	**615.11**	684.54	1.93	**686.47**
03160201	59.50	-	**59.50**	55.29	-	**55.29**	52.71	-	**52.71**	49.99	-	**49.99**	47.60	-	**47.60**	45.50	-	**45.50**	43.69	-	**43.69**
03160202	1.11	-	**1.11**	1.34	-	**1.34**	1.64	-	**1.64**	1.99	-	**1.99**	2.43	-	**2.43**	2.95	-	**2.95**	3.59	-	**3.59**
03160203	100.60	7.08	**107.68**	99.78	7.86	**107.63**	116.36	9.95	**126.30**	126.21	11.84	**138.06**	137.53	14.12	**151.65**	150.46	16.86	**167.32**	165.13	20.16	**185.29**
03160204	991.17	4.94	**996.11**	1,002.53	6.63	**1,009.16**	1,232.89	7.49	**1,240.38**	1,374.66	9.12	**1,383.78**	1,532.74	11.28	**1,544.02**	1,708.99	14.20	**1,723.19**	1,905.52	18.13	**1,923.65**
03160205	-	1.16	**1.16**	-	1.88	**1.88**	-	2.21	**2.21**	-	3.07	**3.07**	-	4.29	**4.29**	-	6.00	**6.00**	-	8.43	**8.43**
03170002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03170003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03170008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03170009	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**	-	0.00	**0.00**
06020001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06030001	1,054.12	0.08	**1,054.20**	1,065.94	0.09	**1,066.03**	9.23	0.12	**9.36**	9.42	0.14	**9.56**	9.61	0.15	**9.76**	9.80	0.16	**9.97**	10.00	0.18	**10.18**
06030002	2,867.15	0.00	**2,867.15**	2,761.23	0.00	**2,761.24**	2,998.24	0.01	**2,998.24**	3,115.48	0.01	**3,115.49**	3,351.69	0.01	**3,351.70**	3,792.87	0.02	**3,792.88**	4,587.86	0.02	**4,587.89**
06030003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06030004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06030005	1,331.41	0.31	**1,331.72**	1,353.63	0.35	**1,353.98**	93.23	0.37	**93.60**	108.35	0.41	**108.76**	126.42	0.45	**126.87**	148.00	0.50	**148.50**	173.78	0.55	**174.34**
06030006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	8,788.97	33.20	**8,822.17**	8,744.16	45.64	**8,789.79**	7,396.31	50.97	**7,447.28**	7,982.86	58.29	**8,041.16**	8,746.51	67.57	**8,814.08**	9,780.06	79.39	**9,859.45**	11,240.07	94.56	**11,334.63**

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