

## GULF INTRACOASTAL WATERWAY ECONOMIC IMPACT ASSESSMENT

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## **Executive Summary**

The Delta Regional Authority contracted with the South Alabama Center for Business Analytics, Real Estate, and Economic Development to assess the economic importance of the Gulf Intracoastal Waterway within the Alabama Black Belt region. Our analysis included four methodologies. Economic Impact Assessment examined industries linked to the waterway and the movement of people and freight and people. Additionally, it assessed new recreation and tourism economic development opportunities. Environmental Housing Impact Assessment examined the impact of housing proximity to Black Belt waterways and waterbodies. Wastewater and Infrastructure Assessment examined utility systems and capacities and their relationship to future Black Belt economic growth. Watershed and Ecosystem Assessment examined existing Black Belt land uses and water quality of the Black Belt's waterways and waterbodies. We supplemented data reporting by creating a regional Digital Atlas and through multiple dynamic, user-interactive electronic Dashboards.

The Black Belt regional economy is small relative to Alabama, comprising only 5.2% of the state's gross regional product. Of the 993 industries within the Black Belt, we included 31 in an industry cluster focused on waterway maintenance and operations, and related warehousing, distribution, logistics, and transportation functions. We also included 43 industries in an industry cluster focused on recreation and tourism. We identified multiple Import Gaps within each cluster that could reasonably be filled. We conducted economic impact analyses of a range of Import Gap scenarios at both the regional and individual county levels for both clusters. We reported total potential economic impacts from filling Import Gaps that support 725 jobs, add \$25.3 million in wages, create \$34.5 million in new value, produce \$86.4 million in new revenues, and generate \$11.1 million in new state and local taxes.

People living in the Black Belt consider tributaries to the Black Belt's waterways and waterbodies as an amenity. We reported empirical results of a counterfactual analysis that properties in census tracts crossed or adjacent to the Alabama or Tombigbee Rivers could depreciate by approximately 22% compared to the counterfactual, or alternate, case if the same properties were located in areas with only minor tributaries. Most importantly, we found that properties located in areas with only minor tributaries could depreciate by almost 34% if they were counterfactually situated in the proximity of the two major waterways. Results suggest that Black Belt residents perceive the proximity to minor tributaries as an economic-financial benefit, equating to approximately \$29,000 per household, and that average aggregate economicfinancial benefits are potentially as high as \$722,512. We also found that the potential social cost of water quality degradation is \$5,065 per mile of impaired waterway per household.

We collected data on the availabilities of multiple types of utility infrastructure services that impact the quality of life of Black Belt residents and the ability of the region to support new and expanding businesses. The availability of drinking water, wastewater systems, natural gas and propane, broadband, and cellular wireless service were examined for all counties in the region. Data indicate that drinking water and natural gas or propane are accessible throughout the area. Gaps in cellular data services are confined to relatively small areas. While affordable and reliable cable and DSL broadband services are generally only available in the region's few urban areas, broadband internet service is available only to other areas via far less reliable satellite services. The region would benefit from expanding broadband services, which are critical to education, business, and industry. Municipally managed wastewater service is limited to the few small towns in the region. We reported that only 50% of Black Belt residents have access to municipal managed wastewater services, indicating a need for municipal system expansions or upgrades and decentralized wastewater cluster systems of individual onsite wastewater treatment systems.

Clean and unpolluted surface waters are essential resources that support economic development and supply the water needed for personal consumption, crop irrigation, industrial processes, thermoelectric cooling, domestic water, and recreational and tourism growth. We prioritized counties that provide maximum opportunities for economic growth based on watershed and ecosystem health by assessing three county-level metrics: land use and land cover, Alabama Department of Environmental Management designated uses for surface waters and the federal government's Section 303(d) listings of impaired waters. We ranked counties according to the quality of each metric and compared aggregate data between counties to reveal environmental strengths relative to one another. We reported that all Black Belt counties offer desirable environmental qualities regarding land use and land cover, designated uses, and degrees of water quality impairment. Results indicate that Wilcox, Choctaw, Greene, and Clarke Counties offer several miles of unimpaired surface waters with high designated use tiers and little land disturbance. These counties and others throughout the Black Belt region could provide enhanced economic development leveraging the region's many high-quality surface waters.

## **1. Introduction**

## **1.1 DELTA REGIONAL AUTHORITY**

The U.S. Congress established the Delta Regional Authority (DRA) in 2000 as a regional economic development entity. Functioning as a partnership between federal, state, and local governments, the DRA oversees federal infrastructure investments in Alabama, Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee. Each state's Governor serves on the DRA's Board of Directors. Community participation throughout the region is coordinated through 45 development districts, which serves 252 counties and approximately 10 million people. **Moving the Delta Forward,** the DRA's strategic plan (DRA, 2016), identifies three investment goals that underscore its mission:

- 1. **Improved Workforce Competitiveness:** Advance the productivity and economic competitiveness of the Delta workforce.
- 2. **Strengthened Infrastructure:** Strengthen the Delta's physical, digital, and capital connections to the global economy.
- 3. <u>Increased Community Capacity</u>: Facilitate local capacity building within Delta communities, organizations, businesses, and individuals.

## **1.2. PROJECT**

Recognizing economic decline in many of Alabama's rural communities located on highly trafficked, commercially navigable waterways within the 20-county Alabama Black Belt region,<sup>1</sup> DRA leadership seeks ways to steer federal investment into projects that strengthen the region's connections to the global economy. In March 2021, the DRA issued a Request for Proposals (RFP) to provide input and recommendations into how to leverage the commercially navigable waterways connecting to the Gulf Intracoastal Waterway (GIWW) system to stimulate economic development within the region and improve the overall quality of life for the 388,520 Black Belt residents. The RFP calls explicitly for investigating "the economic impact that commercially navigable waterways and tributaries connecting to the Gulf Intracoastal Waterway have on the Alabama Black Belt's economic competitiveness and their ability to facilitate sustainable job growth through viable commercial use and continuous, reliable navigation."<sup>2</sup>

## **1.3. METHODOLOGIES**

To complete the Project, the South Alabama Center for Business Analytics, Real Estate, and Economic Development (SABRE), housed within the Mitchell College of Business at the University of South Alabama (USA), combined six methodologies, as follows:

- Economic Impact Assessment: Evaluates how changes in spending move through an economy, revealing information about local industries operating within it. An economic impact assessment examines the spending of industries that supply goods and services necessary for operation or production. This spending results in increased personal earnings, which in turn spurs increased personal spending. The economic impact cannot be reduced to a single number. Instead, jobs, wages, new value creation, revenues, and taxes must be considered.
- 2. <u>Environmental Housing Impact Assessment</u>: Evaluates the environmental quality of waterways based on a housing hedonic model, a revealed preferences method that uses the housing market as a surrogate market where the property is assumed to be a bundle of goods purchased by homebuyers

<sup>&</sup>lt;sup>1</sup> Alabama Black Belt counties include Barbour, Bullock, Butler, Choctaw, Clarke, Conecuh, Dallas, Escambia, Greene, Hale, Lowndes, Macon, Marengo, Monroe, Perry, Pickens, Russell, Sumter, Washington, and Wilcox.

that include housing, neighborhood, and environmental attributes. The analysis provides a quantitative measure, in monetary value, of the external costs associated with the current state of the study area's waterways and waterbodies for households and the region.

- 3. <u>Wastewater and Utility Infrastructure Assessment</u>: Evaluates those areas with inadequate or non-existent wastewater management systems and utility infrastructure. Because economic growth depends on an area's ability to provide critical infrastructure, improper or inadequate wastewater management poses dangerous public health and environmental risks to a community. It also serves as a deterrent for retaining and attracting industry and commerce. For waterway-dependent communities, inadequate or worse, untreated wastewater will increase economic decline and public health and environmental risks, reducing the overall quality of life and diminishing economic development opportunities.
- 4. <u>Watershed and Ecosystem Assessment</u>: Evaluates and ranks watersheds and ecosystems and their abilities to support robust ecosystem services and ecotourism activities, as well as efforts to stimulate economic development. This process is critical to initiatives designed to promote the use of waterways as recreational outlets for activities such as fishing, swimming, boating, canoeing, kayaking, and the like, all of which are wholly dependent upon the quality of the water itself.
- 5. <u>Geographic Information Systems Mapping</u>: GIS mapping creates, combines, analyzes, and incorpo rates complex data layers to develop comprehensive, multi-layered graphical interface maps to serve as a sort of regional atlas containing physical and human features, waterways and tributary systems, ports, land uses and transportation routes, recreation and tourism outlets, soil conditions, and demographic, environmental, and climatological data.
- 6. Data Visualization: Presents complex data analysis in ways that are easy for non-researchers to under stand. SABRE is highly skilled at converting large, complex datasets and analysis into dynamic, visually appealing, electronic, interactive dashboards using the Tableau data visualization platform.<sup>3</sup> Dashboards allow users to move through data over time and at different levels of granularity. End users can easily integrate dashboards into future policy initiative documents, funding proposals, and stakeholder presentations.

## **1.4. BLACK BELT REGION AND WATERWAYS**

"Depending on the criteria employed to characterize the area, the Black Belt of Alabama, named for its dark, rich soils, contains roughly between 12 and 21 counties in the central part of the state" (Winemiller, 2009). For the Project, we include the twenty DRA-specified counties: Barbour, Bullock, Butler, Choctaw, Clarke, Conecuh, Dallas, Escambia, Greene, Hale, Lowndes, Macon, Marengo, Monroe, Perry, Pickens, Russell, Sumter, Washington, and Wil-cox. Alabama's Black Belt is part of a much larger crescent-shaped area known as the Southern Black Belt stretching from Maryland to Texas. Rivers and streams from five large river basins run through the Black Belt—the Sipsey-Warrior, Coosa-Tallapoosa, Alabama-Cahaba, Tombigbee, and Chattahoochee. The Claiborne, Miller's Ferry, and Robert F. Henry locks and dams lie on the Alabama River within the Black Belt. The Alabama and the Tombigbee Rivers are both navigable, commercially viable waterways. At Demopolis, the Tombigbee River joins the Black Warrior River. It runs to Clarke County, where it joins the Alabama River to form the Mobile River, which flows to the Gulf of Mexico. The Alabama River flows west until connecting with the Cahaba River, the state's longest river (Figure 1).

Figure 1 Alabama Rivers



## **1.5. BLACK BELT ECONOMY**

Of the 388,520 people living in the Black Belt, 52% are female, 48% are male, 51% are black, 43% are white, and 40% are aged 50-plus (Table 1). Population growth has trended down in recent years, and forecasts expect a continued near-term decline of 3.8% by 2026. Gross Regional Product (GRP) totaled \$12.5 billion in 2020.

Region	2020 Рор	2021- 2026 Pop% +/-	Median Household Income	Labor Force	Jobs	GRP \$Millions	%Male	%Female	%Black	%White
Black Belt	388,520	-3.23%	\$50,800	152,669	127,532	\$12,500.0	47.98%	52.02%	50.90%	42.87%
Barbour	24,589	-1.30%	\$32,500	8,580	8,850	\$773.3	52.66%	47.35%	47.84%	44.98%
Bullock	9,976	-0.89%	\$37,800	4,939	3,760	\$308.1	54.77%	45.23%	68.44%	20.84%
Butler	19,504	-3.29%	\$40,700	8,923	7,214	\$659.4	46.54%	53.46%	44.72%	50.59%
Choctaw	12,418	-3.20%	\$35,900	4,753	4,129	\$628.8	47.28%	52.72%	41.01%	56.32%
Clarke	23,291	-3.24%	\$37,400	7,776	8,965	\$838.8	47.33%	52.67%	45.04%	51.49%
Conecuh	11,851	-3.75%	\$37,800	4,501	3,862	\$338.6	47.83%	52.17%	45.21%	49.95%
Dallas	36,098	-10.54%	\$33,800	14,377	13,206	\$1,200.0	46.24%	53.76%	70.39%	26.55%
Escambia	36,281	-2.19%	\$36,300	14,353	13,786	\$1,300.0	49.96%	50.04%	31.03%	60.01%
Greene	7,990	-2.90%	\$24,100	2,940	2,201	\$192.0	46.48%	53.52%	79.09%	17.31%
Hale	14,670	-0.54%	\$34,000	6,007	3,258	\$298.8	47.25%	52.75%	57.47%	39.42%
Lowndes	9,641	-4.36%	\$30,000	3,596	2,608	\$320.0	46.56%	53.44%	71.63%	24.62%
Macon	17,895	-4.25%	\$33,400	8,004	6,958	\$520.2	45.25%	54.75%	78.85%	16.74%
Marengo	18,733	-3.11%	\$33,200	7,763	7,711	\$843.2	46.96%	53.04%	51.40%	44.04%
Monroe	20,459	-4.38%	\$30,400	7,439	7,050	\$731.0	47.39%	52.61%	40.88%	53.77%
Perry	8,687	-3.17%	\$23,400	3,415	2,389	\$200.0	46.39%	53.61%	66.53%	29.54%
Pickens	19,793	2.68%	\$39,800	7,627	4,537	\$401.4	50.29%	49.71%	39.33%	52.90%
Russell	58,237	-1.78%	\$42,400	23,368	15,955	\$1,400.0	47.43%	52.57%	45.36%	44.69%
Sumter	12,225	-1.13%	\$24,300	4,785	3,773	\$322.6	45.83%	54.17%	69.75%	25.62%
Washington	15,976	-1.06%	\$41,400	6,697	4,118	\$776.5	48.82%	51.18%	22.97%	65.12%
Wilcox	10,206	-3.39%	\$31,000	2,826	3,201	\$423.8	46.94%	53.06%	69.47%	26.91%

Table 1 Black Belt Economy Summary Statistics

The most populous county in the Black Belt is Russell County, home to Phenix City, with 58,237 residents. The least populous county is Greene County, with a population of 7,990. Over the next five years, the most significant population decline is projected to occur in Dallas County, home to Selma, down 10.54%. Only Pickens County, home to Pickensville, the northernmost Alabama town on the Tombigbee River, is expected to see an increased population, growing by 2.68%. Median incomes within the Black Belt range from a low of \$23,400 in Perry County to a high of \$42,400 in Russell County. The region's most prominent labor force is in Russell County, with 23,368 labor force participants; the smallest is in Wilcox County, with 2,826. The top three counties ranked by the number of jobs are Russell County, with 15,955, Escambia County, and Dallas County. Education appears valued in the Black Belt, with 39% high school attainment, 43% with some college or higher, and 15% with undergraduate or graduate degrees. The Black Belt's civilian workforce is 152,669, which is 67% of the population (Table 2) and the unemployment rate is 5.3%. Black Belt workforce participation fell immediately after the Covid-19 pandemic began, but in recent months has shown improvement (Figure 2).

Black Belt Regional Workforce	
Total Population	388,520
Civilian non-institutionalized population 15-64	227,051
Not in Labor Force	74,382
Work Force	152,669
Employed	144,573
Unemployed	8,096
Military, institutionalized, under 15, and over 65	161,469

#### Figure 2 Black Belt Workforce Participation and Covid-19



## **1.6. BLACK BELT INDUSTRIES AND OCCUPATIONS**

The top five 2020 Black Belt industries ranked by jobs per industry were government, manufacturing, retail trade, health care, and accommodation and food services (Table 3). The top five industries ranked by forecasted new jobs created from 2016-2021 were services for the elderly and persons with disabilities, newsprint mills, elementary and secondary schools, commercial and industrial machinery repair, and industrial truck, tractor, trailer, and stacker machinery manufacturing (Table 4). Within those industries, the top five occupations ranked by the number of new jobs created from 2016-2021 were retail salespersons, food preparation workers, paper goods machine setters and operators, middle school teachers, and restaurant cooks (Table 5).

Industry	2020 Jobs	2020 Earnings Per Worker	2020 GRP
Government	28,877	\$54,607	\$1,779,806,993
Manufacturing	22,746	\$74,531	\$3,662,668,585
Retail Trade	13,688	\$31,861	\$769,376,331
Health Care and Social Assistance	12,498	\$47,474	\$711,841,651
Accommodation and Food Services	7,987	\$18,367	\$271,480,577
Other Services (except Public Administration)	7,162	\$23,994	\$255,791,295
Construction	5,361	\$54,094	\$443,436,288
Agriculture, Forestry, Fishing and Hunting	5,223	\$51,712	\$413,528,646
Admin Waste Management Remediation	4,930	\$36,071	\$262,147,605
Transportation and Warehousing	4,425	\$65,835	\$433,529,186
Finance and Insurance	3,094	\$60,890	\$457,587,285
Educational Services	2,844	\$32,281	\$115,428,114
Wholesale Trade	2,415	\$58,869	\$432,909,315
Professional, Scientific, and Technical Services	1,890	\$50,203	\$174,365,092
Utilities	1,157	\$121,094	\$514,045,077
Real Estate and Rental and Leasing	927	\$45,113	\$205,884,909
Arts, Entertainment, and Recreation	880	\$28,053	\$53,520,598
Information	617	\$62,944	\$131,731,699
Mining, Quarrying, and Oil and Gas Extraction	492	\$79,165	\$143,972,938
Management of Companies and Enterprises	319	\$88,771	\$70,312,815

Table 3 Top 25 Industries: Ranked by Total Jobs

Industry	2016 Jobs	2021 Jobs	Jobs +/-	Jobs% +/-	Earnings
Services for the Elderly and Persons with Disabilities	248	710	462	186%	\$19,079
Newsprint Mills	77	392	315	409%	\$83,030
Elementary and Secondary Schools	1,220	1,488	268	22%	\$28,879
Commercial and Industrial Machinery Repair	177	443	267	151%	\$55,819
Industrial Truck, Tractor, Trailer, Machinery Manuf	72	331	259	362%	\$66,805
Landscaping Services	1,187	1,443	255	22%	\$38,728
General Medical and Surgical Hospitals	2,985	3,234	249	8%	\$56,411
All Other General Merchandise Stores	1,286	1,505	218	17%	\$21,520
Offices of All Other Miscellaneous Health Practitioners	149	360	212	142%	\$55,369
Machine Shops	143	338	196	137%	\$49,384
Telemarketing Bureaus and Other Contact Centers	19	182	163	856%	\$36,356
Industrial Building Construction	473	630	158	33%	\$72,202
General Freight Trucking, Local	294	443	149	51%	\$66,975
Facilities Support Services	177	325	148	84%	\$41,997
Nursery, Garden Center, and Farm Supply Stores	240	384	144	60%	\$33,910
Federal Government, Civilian, Except Postal Service	1,512	1,653	141	9%	\$97,321
Motor Vehicle Electrical and Electronic Manuf	0	124	124	No Data	\$69,251
Commercial Bakeries	29	150	121	419%	\$37,547
Janitorial Services	812	933	121	15%	\$25,497
Other Animal Food Manufacturing	31	149	117	376%	\$56,830
Animal (except Poultry) Slaughtering	47	163	116	249%	\$43,645
Softwood Veneer and Plywood Manufacturing	691	804	113	16%	\$68,582
Recyclable Material Merchant Wholesalers	155	268	113	73%	\$54,057
Crop Production	1,004	1,113	109	11%	\$45,277
Solid Waste Collection	179	286	107	60%	\$55,021

## Table 4 Top 25 Industries: Ranked by # of New Jobs, 2016-2021

Description	2016 Jobs	2021 Jobs	Jobs +/-	Jobs% +/-	Hourly
Retail Salespersons	2,513	3,389	876	35%	\$13.15
Food Preparation Workers	634	1,272	638	101%	\$9.63
Paper Goods Machine Setters, Operators	1,083	1,591	508	47%	\$24.60
Middle School Teachers	648	993	345	53%	\$24.07
Cooks, Restaurant	629	930	300	48%	\$12.44
HelpersProduction Workers	926	1,216	290	31%	\$14.16
First-Line Supervisors of Office and Admin Support	920	1,173	253	27%	\$24.57
Industrial Machinery Mechanics	1,120	1,318	198	18%	\$29.42
Customer Service Representatives	1,113	1,292	179	16%	\$14.55
Stockers and Order Fillers	1,103	1,275	172	16%	\$13.75
Construction Laborers	817	987	170	21%	\$14.96
Bus Drivers, Transit and Intercity	82	249	167	204%	\$16.47
Chief Executives	120	285	165	138%	\$62.89
Inspectors, Testers, Sorters, Samplers, and Weighers	676	839	163	24%	\$18.13
Police and Sheriffs Patrol Officers	781	944	163	21%	\$18.85
Butchers and Meat Cutters	90	249	159	177%	\$14.11
Refuse and Recyclable Material Collectors	133	279	146	110%	\$13.90
Receptionists and Information Clerks	566	709	143	25%	\$11.56
Tire Repairers and Changers	227	353	126	56%	\$12.54
Teaching Assistants, Except Postsecondary	651	776	126	19%	\$9.73
Medical Assistants	252	377	125	50%	\$13.61
Tutors and Teachers and Instructors, All Other	281	402	120	43%	\$24.75
Civil Engineers	164	283	119	73%	\$39.80
Mobile Heavy Equipment Mechanics, Except Engines	168	287	118	70%	\$22.82
Medical Records Specialists, and Health Techs	171	288	117	68%	\$15.49

## Table 5 Top 25 Occupations: Ranked by # of New Jobs, 2016-2021

## 2. Economic Impact Assessment

## **2.1. INTRODUCTION**

Economic impact assessment refers to processes that trace how changes in spending, such as business expansions or closures, industrial or infrastructural developments, natural and manufactured disasters, sporting events, conventions, and many other economic events move through an economy. Economic impact studies generate large amounts of information about local industry employment, wages, value creation, revenues, and taxes.

An economic impact analysis looks at the industries that supply it with the goods and services necessary for its operation or production, which in turn spurs spending by the firms supplying those goods and services. Increases in labor dollars also have economic effects because increased labor dollars typically translate into increased personal earnings and, as a result, spur increased personal spending. Economic impact analysis provides a measurement of the impacts of employee spending within the study area employed by the impacted industries.

It is impossible to track the accumulation of business-to-business and labor purchases until the complete removal from the economy of the resultant spending of the original sale by imports, savings, taxes, and profits. Correctly structured economic impact analysis studies reveal significant clues that economic development officials and policymakers can use to frame strategies and develop arguments that advocate for the reallocation of capital to new economic development projects.

## 2.2. FLOW OF ECONOMIC IMPACTS

Economic activity contributes to the local and state economy by generating business revenue for the local and state firms that provide goods and services. In turn, these firms provide employment and income to individuals and pay taxes to various governments. Studying the diagram (Figure 3) shows how the impact of economic activity flows through local and state economies and makes it quickly understood that the economic impact could not be reduced to a single number, but instead, must be considered in terms of multiple impacts, namely, the impacts of jobs, wages, value-added, revenues, and taxes.



Economic impact analysis is a complex undertaking, and the terminology used can be confusing. Input-output (I-O) models attempt to describe an array of economic transactions between various sectors in a defined economy for a given period, typically a year. These models provide researchers with estimates of the economic multipliers involved and support a detailed decomposition of those multipliers. I-O models are functions of final industry production demands. As one industry's economic activity spurs demand for production by another industry, multipliers determine how the affected industries respond to each other's demand and production functions. The multiplier effect is the additional economic impact created because of the organization's direct economic impact.

Value added is expressed in dollars and refers to the difference between total revenues generated by economic activity and the costs of goods and services necessary for economic activity to occur. The direct effect includes all direct effects the organization has on the regional area due to its operations. These items include direct organizational and employee spending. The indirect effect captures the impact of local industries buying goods and services from other local industries. The cycle of spending works its way through the supply chain until all money leaks from the local economy. The impacts are calculated by applying direct effects to the multipliers. The induced effect is the response by an economy to an initial change that occurs through re-spending of income received by components of value-added, recognizing that labor income, which includes employee-compensation and proprietor components of value-added, may result in leakage from the local economy (because workers employed in one area may live and spend their earnings in another area), as money is recirculated through household spending patterns.

Since its introduction (Stone, 1948), social accounting aggregation has morphed into the Social Accounting Matrix. This national accounting matrix considers the interrelationships of income and transfer flows between firms in industries amongst all economic sectors. It treats the distribution of income identically to patterns of interindustry production transactions.

## 2.3. LITERATURE

The Gulf Intracoastal Waterway (GIWW) is a 1,100 mile commercially navigable inland waterway system running from St. Marks, Florida, through the Alabama Black Belt to Brownsville, Texas (Grossardt, Bray, and Burton, 2014). The GIWW is part of the national inland waterway system that includes over 12,000 miles of navigable waterways, operated and maintained by the U.S. Army Corps of Engineers (USACE). Due to its strategic coastal location, the GIWW is a vital element of the national inland water system. Because the U.S. Gulf Coast hosts 45% of U.S. oil refining and 51% of natural gas processing capacities, the GIWW's location along the energy-rich Gulf of Mexico offers a clear competitive advantage. The nation's third-busiest inland waterway system, nearly 285,000 vessels each year move more than 110 million tons of cargo along the GIWW (Texas DOT, 2019).

There are numerous studies of ports and port systems, some of which include ports within the GIWW system. However, because our focus is on economic development opportunities for all rural communities within the Black Belt, most of which have no ports, we exclude port studies from our review. Instead, we limit our review to previous studies examining the economic importance of the GIWW. The primary purpose of our literature review is to inform methodology wherever possible and to support our adaptations and exceptions as necessary depending on data availability.

Moving large freight cargoes by water is cost-effective. Likewise, constructing and maintaining navigable waterways is a less expensive alternative to the development of road and rail systems (Lambert, 2010). Researchers suggest four critical benefits to water-based freight movement: less highway congestion, lower costs of moving cargo, lower environmental costs, and increased overall safety (Griffin, James, and Basilotto, 1997). A primary result should be viewed as a combination of improved fuel efficiency and lower environmental impacts. For perspective, consider that the capacity of a 1,500-ton barge is equivalent to 58 commercial 18-wheel trucks and 14 rail hoppers (USACE, 2000) and that joining multiple barges together increases exponentially overall efficiencies.

The GIWW is a significant economic driver within the five states it spans—Florida, Alabama, Mississippi, Louisiana, and Texas. Although we found no recent studies of the overall impact of the GIWW, an older study provided important literature context and modeling framework (Hardebeck et al., 1999). The Texas A&M University Transportation Institute reported heavy dependence on the waterway system in Texas alone, with energy and chemical industries generating \$137 billion in sales, producing \$20 billion in payrolls, supporting 900,000 jobs, and providing \$200 million

in sales tax revenues. As impressive as these numbers are, note they were reported for 1993 nearly 30 years ago!

A large body of work on inland waterways economic impact analysis methods comprises five barge movement models (Clark, 1983); one measures the impact on road-based transportation systems due to waterway system impairments or closures<sup>4</sup> (Roop et al., 1993). We reviewed various valuation methods to value inland waterway systems. We found no research preference for cost-benefit versus economic impact analyses. Notably, we did find one study that used industry analysis to examine how marine industries contribute to local economies (Hodges et al., 2013).

Dredging is a crucial driver of waterways-related economic prosperity and supports meaningful linkages to the global economy (Wetta and Hanson, 2011). Nearly 80% of global trade by volume and more than 70% of global trade by value moves by water (IADC, 2018). Globally, the ocean-based economy is estimated at \$3 trillion annually, accounting for 5% of global GDP (Mining World, 2015). Without dredging, many waterways, ports, and harbors would become impassable to commercial and recreational vessels (USACE, 2021). It is critically important to maintain inland waterways to ensure continued commercial use and reliable navigation. Failing to do so can result in economic decline for the many regions, cities, and towns situated along the waterways.

As crucial as dredging and the global economy are, there is limited research on the links between dredging of inland waterway systems and the global economy, and even less on local economies. Most studies focus on environmental, geographical, and political issues. The limited economic research typically includes impacts as a component of a more extensive study of a particular waterway project, not as part of an overall waterway system. Data limitations may be the reason. The U.S. Corps of Engineers (USACE) oversees all inland waterway system development, operation, and maintenance. Because accessing their dredging contract funding data, parsible at county levels, is not possible, researchers must rely on economic activity databases for dredging-related data.

In addition to waterway system sustainability as a driver of the commercially related economy, its recreational use will also impact the effort. Increasing recreational use of the waterway system may also offer significant opportunities to contribute to the local economy through added recreation, hospitality, and tourism. The outdoor recreation economy in America is vast. Activities include wildlife viewing, hiking, camping, fishing, hunting, motorcycling, off-roading, and snow, trail, water, and wheel sports. American recreational enthusiasts spend money on gear and travel. Gear purchases include apparel and footwear, bicycles and all-terrain vehicles, boats and kayaks, fishing poles and tackle, tents and backpacks, rifles and bows, and anything else needed to have fun in the great outdoors. Trip purchases include airfares, rental cars, lodging, campgrounds, restaurants, groceries, gasoline, and souvenirs, and all the people providing services along the way such as river guides, instructors, rangers, outfitters, and more.

Long after the proverbial boats are cleaned and the fish are in the freezer, economies continue to benefit from recreational expenditures from businesses restocking their shelves, expanding their workforces, adding additional locations, and from local employee spending. The outdoor recreation economy numbers are staggering. A recent study reported annual expenditures of \$887 billion, support for 7.6 million jobs, and \$125 billion in annual federal, state, and local tax revenues (OIA, 2018).

Nevertheless, as important as the outdoor recreational economy is, it is equally important to recognize that efforts must be made to sustain and grow it. It is essential therefore, to ensure that future generations have the same recreational opportunities and that communities benefit economically. Everyone, from users to policymakers, must recognize the importance of sustainability and work to promote ecological, climatological, and environmental best practices. The Outdoor Industry Association promotes three policy goals as foundational to ensuring that Americans can continue to enjoy outdoor recreation for generations to come: protect the environment, invest in local and federal recreation infrastructure and programs, and promote outdoor recreation as a community health asset.

Tourism is often a key component of local economic development initiatives (Frederick, 1993). There are several reasons for its widespread inclusion. Most jobs are filled locally, often by workers at the lower end of the pay scale. Tourism can spur local investment by outsiders attracted to an area for some reason, such as the weather, a

university, or historical interest, and who stay and invest and promote new economic activity doing so. Tourism as an economic development strategy is relatively risk-free. Even though it is necessary to invest in marketing and promotion, and efforts to spur and sustain exciting attractions is necessary, costs pale to the money needed to attract something such as a manufacturing or distribution center. Because amenity, accommodation, and entertainment facilities are often privately funded, they are somewhat risk-free to policymakers as an economic segment. However, tourism sometimes gets a black eye amidst criticisms about low wages, adverse local environmental effects, and local culture disruptions.

We reviewed existing outdoor recreation and tourism and entertainment opportunities within the Alabama Black Belt. We summarized available categories of primary venues and outlets related to hospitality and entertainment offerings for each county, such as hotels, restaurants, museums, tours, and music and theatrical productions and events (Appendix A).

In sum, the literature review produces some clear takeaways. Examining commodity trade flow data is a commonly preferred method. However, use is often limited because necessary data are reported typically per span, meaning a distance from point-to-point along some portion of the waterway rather than per county. Using trade flow data is also limited by reporting frequency.<sup>5</sup> However, even if the data were available, this method does not lend itself to the Project because it will not capture the required value of the economic impact of the commercially navigable waterway itself; the value of the freight moved through the GIWW has no relevance. Second, the literature offers a path for examining potential economic development opportunities by identifying Import Gaps that enumerate the import dollar components of the present economy. Third, IMPLAN, a sophisticated, comprehensive input-output economic modeling tool using economic base theory, is the preferred platform for economic impact analysis. Finally, evaluating a region's economic development opportunities must also include outdoor recreation and related tourism, hospitality, and entertainment industries.

## 2.4. DATA AND METHODOLOGY

#### 2.4.1. Cluster Analysis

Consistent with the literature, we use cluster analysis to identify and evaluate industries specific to the Project. Cluster analysis is a statistical technique used in many different fields. It includes a wide-ranging assortment of methods, practices, and procedures used to outline and categorize various economic sectors or industries into related groups, or clusters. At the core of cluster analysis is the process of delineating an assembly of objects into similar groups that have more similarities than those in other clusters. Promoting industry clusters and targeting industries within clusters for expansion is an effective and vital tool for economic developers and policymakers because both industry retention and expansion are critical for the long-term health of any economy (Porter, 1998).

We varied our application slightly by combining two clusters, two separate times. In one case, we included an additional industry category. We did so because in both instances, the clusters we combined are closely related and because of inherent data granularity concerns given a total Black Belt population below 400,000. We combined the Harvard clusters Water Transportation and Transportation & Logistics with the industry category related to dredging activity to Form the Waterway & Logistics Cluster (WTC) (Table 6). We combined the Harvard<sup>6</sup> clusters Hospitality and Tourism and Local Hospitality Establishments to form the Recreation & Tourism Cluster (RTC) (Table 7). We then assessed each cluster's industry distribution for the Black Belt region and each of the twenty counties in the Black Belt. Some included industries do not apply to the area, such as Coastal and Great Lakes Passenger Transportation. We include and report them rather than exclude them even if the number of jobs equals zero. We do this to illustrate and underscore the extent of economic activity generated by each industry within each cluster and highlight any lack of activity as an opportunity. Because the Project requires current and county-level analyses, data availability and granularity were critical.

<sup>&</sup>lt;sup>5</sup> The U.S. Bureau of Transportation Statistics produces national commodity trade flow data reports in years that end with "2" or "7." The most recent report was for 2017.

## Table 6 Black Belt Waterway & Logistics Cluster

Waterway & Logistics Cluster					
Cluster	NAICS	Industry			
	237990	Other Heavy and Civil Engineering Construction			
	336611	Ship Building and Repairing			
	336612	Boat Building			
	483111	Deep-Sea Freight Transportation			
	483112	Deep-Sea Passenger Transportation			
	483113	Coastal and Great Lakes Freight Transportation			
Water Transportation Cluster	483114	Coastal and Great Lakes Passenger Transportation			
	483211	Inland Water Freight Transportation			
	483212	Inland Water Passenger Transportation			
	488310	Port and Harbor Operations			
	488320	Marine Cargo Handling			
	488330	Navigational Services to Shipping			
	488390	Other Support Activities for Water Transportation			
	481111	Scheduled Passenger Air Transportation			
	481112	Scheduled Freight Air Transportation			
	481211	Chartered Passenger Air Transportation			
	481212	Chartered Freight Air Transportation			
	481219	Other Nonscheduled Air Transportation			
	482110	Rail transportation			
	484121	General Freight Trucking, Long-Distance, Truckload			
	484230	Specialized Freight Trucking, Long-Distance			
_	485210	Interurban and Rural Bus Transportation			
Transportation & Logistics Cluster	485510	Charter Bus Industry			
	488111	Air Traffic Control			
	488119	Other Airport Operations			
	488190	Other Support Activities for Air Transportation			
	488210	Support Activities for Rail Transportation			
	488490	Other Support Activities for Road Transportation			
	488510	Freight Transportation Arrangement			
	488991	Packing and Crating			
	488999	All Other Support Activities for Transportation			
	491110	Postal Service			

Recreation & Tourism Cluster					
Cluster	NAICS	Industry			
	114210	Hunting and Trapping			
	453920	Art Dealers			
	487110	Scenic and Sightseeing Transportation, Land			
	487210	Scenic and Sightseeing Transportation, Water			
	487990	Scenic and Sightseeing Transportation, Other			
	532284	Recreational Goods Rental			
	561510	Travel Agencies			
	561520	Tour Operators			
	561591	Convention and Visitors Bureaus			
	561599	All Other Travel Arrangement and Reservation			
	711211	Sports Teams and Clubs			
	711212	Racetracks			
	711219	Other Spectator Sports			
	712110	Museums			
	712120	Historical Sites			
Cluster	712130	Zoos and Botanical Gardens			
	712190	Nature Parks and Other Similar Institutions			
	713110	Amusement and Theme Parks			
	713120	Amusement Arcades			
	713210	Casinos (except Casino Hotels)			
	713290	Other Gambling Industries			
	713920	Skiing Facilities			
	713930	Marinas			
	713990	All Other Amusement and Recreation			
	721110	Hotels (except Casino Hotels) and Motels			
	721120	Casino Hotels			
	721191	Bed-and-Breakfast Inns			
	721199	All Other Traveler Accommodation			
	721211	Recreational Vehicle Parks and Campgrounds			
	721214	Recreational and Vacation Camps			
	721310	Rooming, Boarding, Dormitories, Camps			
	453220	Gift, Novelty, and Souvenir Stores			
	611620	Sports and Recreation Instruction			
Local Hospitality	722310	Food Service Contractors			
Establishments Cluster	722320	Caterers			
	722410	Drinking Places (Alcoholic Beverages)			
	722511	Full-Service Restaurants			
	722513	Limited-Service Restaurants			
	722514	Cafeterias, Grill Buffets, and Buffets			
	722515	Snack and Nonalcoholic Beverage Bars			

#### Table 7 Black Belt Recreation & Tourism Cluster

#### 2.4.2. Total Requirements Approach

For this reason, we used the Total Requirements (TR) Approach to set up our initial analysis. The Total Requirements Approach captures the total value of all goods and services needed for production inside a region, and crucially, where they are purchased (Cummings and Epley, 2014). The TR Approach enabled us to construct a gauge of the present regional exchanges of dollars necessary for production. This gauge functions as an economic baseline of what exists today before new economic development activity is undertaken.

#### 2.4.3. Import Gaps Approach

TR's data structure enabled us to use the Import Gaps (IG) Approach to quantify total dollars spent outside a region to import goods or services needed for production inside a region (Cummings and Epley, 2015), which we then used as inputs in our economic impact modeling. We identified, ranked, and reported the top 25 industries in each cluster by 2021-2026 forecasted jobs, occupations, TR, and IG. The forecasted jobs and occupations data explain what is likely, given past trends, to occur in future occupations across all industries if existing economic development activity continues unchanged. The TR data explain how large an industry is based on the total amount of economic activity needed to support it. The IG data explain how much industries spend to import resources needed for their production.

We used identified IG to analyze economic impacts on industries most likely to be economic development targets within each cluster. We then modeled the economic impact of the IG. We demonstrated how the money could have had a more significant economic effect if spent within the region. Note that not all industries are targets for local economic development recruiting just because they have significant IG. For example, a large federal military or a petroleum refinery IG are not likely targets. Still, there are other targets, such as industries that need products and materials to run their operation or production or personnel to man a distribution or call center. This exercise is critically important because it produces results that policymakers can use to help understand the economic impact values of potential new targeted economic development activity.

#### 2.4.4. Input-Output Modeling

We analyzed the IG using IMPLAN's input-output framework,<sup>7</sup> which expands the basic I-O model by including transactions within regions and between institutions, calculating the direct, indirect, and induced economic impacts. IMPLAN calculates the indirect and induced impacts by applying a series of multipliers throughout its modeling processes using regional Social Accounting Matrices (SAM) that help explain various financial flows through the economy (Cheney, 2018). Like all I-O models, IMPLAN is based on the theory that when new money enters a community, some of it is re-spent one or more times in the local economy, creating additional economic impacts. This multiplier effect or impact is measured in terms of employment or income. The total economic effect on a region caused by a change in final demand is measured in jobs, wages, value-added, revenues, and taxes.

Our cluster-centered research design best captures the economic value of the waterway and logistics framework on a per-industry basis across multiple metrics. Using it enabled us to frame the current economic perspective of the Black Belt region and its counties, identify each cluster's preferred industries as economic development targets, and provide modeled economic benefit estimates of identified IG that pose realistic opportunities for economic development advancement.

#### 2.4.5. Black Belt Industries and Occupations, 2021 – 2026

Looking ahead five years, ranked forecasts of the top five industries for job creation in 2021-2026 are services for the elderly and persons with disabilities, elementary and secondary schools, general medical and surgical hospitals, limited-service restaurants, and offices of all other miscellaneous health practitioners (Table 8). Job occupation patterns over the 2021-2026 horizon differ from the past, with home health and personal care aides in the top position (Table 9).

<sup>&</sup>lt;sup>7</sup> IMPLAN's I-O framework is based on Nobel laureate Wassily Leontief's I-O model of equilibrium of the economy's interdependent relationships (Leontief, 1936, 1937, 1970).

Description	2021 Jobs	2026 Jobs	Jobs +/-	Jobs% +/-	Annually
Services for Elderly and Persons with Disabilities	710	1,010	300	42%	\$19,079
Elementary and Secondary Schools	1,488	1,766	278	19%	\$28,879
General Medical and Surgical Hospitals	3,234	3,434	201	6%	\$56,411
Limited-Service Restaurants	5,025	5,215	190	4%	\$16,421
Offices of Miscellaneous Health Practitioners	360	527	167	46%	\$55,369
Temporary Help Services	1,121	1,263	142	13%	\$26,284
Janitorial Services	933	1,062	129	14%	\$25,497
Landscaping Services	1,443	1,566	123	9%	\$38,728
Commercial and Industrial Machinery Repair	443	560	117	26%	\$55,819
Linen Supply	230	341	111	48%	\$51,966
Hotels (except Casino Hotels) and Motels	708	818	109	15%	\$20,491
Other Gambling Industries	241	346	105	44%	\$39,727
Wholesale Trade Agents and Brokers	297	397	100	34%	\$81,362
Industrial Building Construction	630	729	98	16%	\$72,202
Newsprint Mills	392	489	96	25%	\$83,030
Telemarketing Bureaus and Other Contact Centers	182	273	91	50%	\$36,356
Nursery, Garden Center, and Farm Supply Stores	384	465	81	21%	\$33,910
Warehouse Clubs and Supercenters	2,130	2,208	78	4%	\$33,580
All Other General Merchandise Stores	1,505	1,581	76	5%	\$21,520
General Freight Trucking, Local	443	519	75	17%	\$66,975
Other Aircraft Parts and Auxiliary Equipment Manuf	266	341	74	28%	\$67,924
Solid Waste Collection	286	357	71	25%	\$55,021
Full-Service Restaurants	1,665	1,735	69	4%	\$18,863
Department Stores	362	431	69	19%	\$36,318
Machine Shops	338	407	69	20%	\$49,384

## Table 8 Top 25 Industries: Ranked by # of New Jobs, 2021-2026

Description	2021 Jobs	2026 Jobs	Jobs +/-	Jobs% +/-	Avg. Hourly
Home Health and Personal Care Aides	1,276	1,532	256	20%	\$10.40
Retail Salespersons	3,389	3,556	166	5%	\$13.15
Fast Food and Counter Workers	2,667	2,832	165	6%	\$9.09
Cooks, Restaurant	930	1,067	137	15%	\$12.44
Janitors and Cleaners, Except Maids	1,821	1,942	121	7%	\$11.79
Laborers and Freight, Stock, and Material Movers	1,768	1,858	90	5%	\$13.74
Landscaping and Groundskeeping Workers	1,252	1,342	89	7%	\$13.98
Industrial Machinery Mechanics	1,318	1,402	84	6%	\$29.42
General and Operations Managers	1,475	1,557	82	6%	\$50.15
Sales Representatives, Wholesale and Manufacturing	846	917	71	8%	\$28.78
Customer Service Representatives	1,292	1,348	57	4%	\$14.55
First-Line Supervisors of Retail Sales Workers	1,529	1,583	54	4%	\$18.93
Personal Service, Entertain and Recreation Mgrs	536	587	51	9%	\$33.35
Waiters and Waitresses	817	866	49	6%	\$9.16
Project Management and Business Operations	412	457	44	11%	\$35.84
Construction Laborers	987	1,028	42	4%	\$14.96
Machinists	177	215	38	21%	\$23.97
Laundry and Dry-Cleaning Workers	174	211	37	21%	\$10.12
Accountants and Auditors	642	678	36	6%	\$34.19
Sales Representatives of Services	228	264	36	16%	\$28.73
Electricians	446	481	35	8%	\$21.31
Registered Nurses	1,912	1,947	35	2%	\$27.68
Stockers and Order Fillers	1,275	1,309	34	3%	\$13.75
Software Developers and Quality Assurance	131	163	32	25%	\$41.81
Refuse and Recyclable Material Collectors	279	311	32	12%	\$13.90

#### Table 9 Top 25 Occupations: Ranked by # of New Jobs, 2021-2026

## 2.5. BLACK BELT TOTAL REQUIREMENTS AND IMPORT GAPS

## 2.5.1. Total Requirements

Black Belt TR total \$14.3 billion. Note that in some cases, the dollars needed for production are for operations and manufacturing, for example, with governments and institutions. Of the Black Belt's 993 industries, the top 25 account for 42% of TR (Table 10).

Industry	<b>Total Requirements</b>
Local Government, Excluding Education and Hospitals	\$649,719,866
Elementary and Secondary Schools (Local Government)	\$557,925,596
Corporate, Subsidiary, and Regional Managing Offices	\$458,686,979
Animal Production	\$428,296,811
State Government, Excluding Education and Hospitals	\$399,865,261
Federal Government, Military	\$386,824,768
Logging	\$367,865,621
Sawmills	\$295,208,880
Petroleum Refineries	\$247,812,004
General Warehousing and Storage	\$241,351,834
Colleges, Universities, and Professional Schools (State Government)	\$187,761,534
All Other Basic Organic Chemical Manufacturing	\$159,482,438
Crude Petroleum Extraction	\$154,827,361
General Freight Trucking, Long-Distance, Truckload	\$139,974,606
Insurance Agencies and Brokerages	\$134,731,303
Electric Power Distribution	\$133,086,699
Lessors of Residential Buildings and Dwellings	\$119,760,101
Other Basic Inorganic Chemical Manufacturing	\$115,201,674
Commercial Banking	\$112,866,772
Iron and Steel Mills and Ferroalloy Manufacturing	\$107,298,753
Hospitals (Local Government)	\$107,212,384
Poultry Processing	\$106,183,481
Offices of Lawyers	\$104,826,918
Temporary Help Services	\$99,796,531
Other Animal Food Manufacturing	\$96,101,837

#### Table 10 Top 25 Industries: Ranked by Total Requirements

#### 2.5.2. Import Gaps

Black Belt IG total \$10.22 billion, which means that Black Belt industries purchase 72% of their needed production inputs from suppliers outside the region. The \$3.9 billion purchased by the top 25 industries accounts for 38% of all IG purchases. As already discussed, not all industries have IG that can be easily filled because of limitations imposed by institutional structure (e.g., government), complexity (e.g., hospital), or scale (e.g., refinery). However, industries needing goods and materials, or personnel offer significant IG opportunities for targeted economic development recruitment. (Table 11).

Industry	Import Gap
Corporate, Subsidiary, and Regional Managing Offices	\$420,079,563
Federal Government, Military	\$386,824,768
Animal Production	\$385,144,273
State Government, Excluding Education and Hospitals	\$340,447,574
General Warehousing and Storage	\$228,571,316
Elementary and Secondary Schools (Local Government)	\$220,086,111
Petroleum Refineries	\$194,810,268
All Other Basic Organic Chemical Manufacturing	\$159,482,438
Logging	\$159,254,050
Local Government, Excluding Education and Hospitals	\$137,989,110
Crude Petroleum Extraction	\$115,731,304
Colleges, Universities, and Professional Schools (State Government)	\$114,094,102
Hospitals (State Government)	\$94,343,538
Other Basic Inorganic Chemical Manufacturing	\$89,975,579
Other Animal Food Manufacturing	\$88,402,121
Iron and Steel Mills and Ferroalloy Manufacturing	\$87,917,135
Hospitals (Local Government)	\$78,014,530
Crop Production	\$77,570,309
Internet Publishing and Broadcasting and Web Search Portals	\$77,504,250
Corrugated and Solid Fiber Box Manufacturing	\$77,315,375
Data Processing, Hosting, and Related Services	\$76,451,966
Engineering Services	\$75,443,980
Offices of Lawyers	\$74,263,951
Petrochemical Manufacturing	\$73,595,565
Machine Shops	\$66,328,596

#### Table 11 Top 25 Industries: Ranked by Import Gap

## 2.6. CLUSTERS

We identified, ranked, and reported all industries in the WLC and RTC Clusters by 2021-2026 forecasted jobs, occupations, TR, and IG. Industries with highly positive expected jobs changes merit economic development consideration. The most significant number of forecasted new jobs within the WLC will be in trucking and ware-housing, which makes sense given the earlier reported TR of over \$228 billion spent on marine cargo handling, and dredging (classified as heavy civil engineering) (Table 12). Within the RTC, the most significant number of new jobs forecasted will be in food service and lodging accommodation (Table 13).

Description	2021 Jobs	2026 Jobs	2021 - 2026 Change	2021 - 2026 % Change	Avg. Earnings Per Job
Specialized Freight Trucking, Long-Distance	396	428	31	8%	\$72,331
Marine Cargo Handling	68	95	27	39%	\$63,305
Other Support Activities for Road Transp	47	66	18	39%	\$48,755
Other Heavy/Civil Engineering Construction	69	81	12	17%	\$67,344
Other Support Activities for Air Transportation	30	38	8	28%	\$79,214
Support Activities for Rail Transportation	148	155	7	5%	\$57,069
Freight Transportation Arrangement	56	62	6	12%	\$65,085
Other Airport Operations	18	23	5	30%	\$44,482
Ship Building and Repairing	0	0	0	0%	\$0
Boat Building	0	0	0	0%	\$0
Scheduled Passenger Air Transportation	0	0	0	0%	\$0
Scheduled Freight Air Transportation	0	0	0	0%	\$0
Nonscheduled Chartered Passenger Air Transp	0	0	0	0%	\$0
Other Nonscheduled Air Transportation	0	0	0	0%	\$0
Deep Sea Freight Transportation	0	0	0	0%	\$0
Deep Sea Passenger Transportation	0	0	0	0%	\$0
Coastal and Great Lakes Freight Transp	0	0	0	0%	\$0
Coastal and Great Lakes Passenger Transp	0	0	0	0%	\$0
Inland Water Freight Transportation	0	0	0	0%	\$0
Inland Water Passenger Transportation	0	0	0	0%	\$0
Air Traffic Control	0	0	0	0%	\$0
Port and Harbor Operations	0	0	0	0%	\$0
Navigational Services to Shipping	0	0	0	0%	\$0
Packing and Crating	0	0	0	0%	\$0
All Other Support Activities for Transp	0	0	0	0%	\$0
Postal Service	0	0	0	0%	\$0
Rail transportation	285	258	(27)	(9%)	\$95,523
General Freight Trucking, Long-Distance	1,692	1,505	(187)	(11%)	\$65,836
	2,818	2,722	(96)	(3%)	\$69,000

Table 12 Industry Profile: Waterway & Logistics Cluster Ranked by # of New Jobs, 2021-2026

Table 13 Industry Profile: Recreation & Tourism Cluster Ranked by # of Forecasted New Jobs, 2021-2026

Industry	Import Gap
Corporate, Subsidiary, and Regional Managing Offices	\$420,079,563
Federal Government, Military	\$386,824,768
Animal Production	\$385,144,273
State Government, Excluding Education and Hospitals	\$340,447,574
General Warehousing and Storage	\$228,571,316
Elementary and Secondary Schools (Local Government)	\$220,086,111
Petroleum Refineries	\$194,810,268
All Other Basic Organic Chemical Manufacturing	\$159,482,438
Logging	\$159,254,050
Local Government, Excluding Education and Hospitals	\$137,989,110
Crude Petroleum Extraction	\$115,731,304
Colleges, Universities, and Professional Schools (State Government)	\$114,094,102
Hospitals (State Government)	\$94,343,538
Other Basic Inorganic Chemical Manufacturing	\$89,975,579
Other Animal Food Manufacturing	\$88,402,121
Iron and Steel Mills and Ferroalloy Manufacturing	\$87,917,135
Hospitals (Local Government)	\$78,014,530
Crop Production	\$77,570,309
Internet Publishing and Broadcasting and Web Search Portals	\$77,504,250
Corrugated and Solid Fiber Box Manufacturing	\$77,315,375
Data Processing, Hosting, and Related Services	\$76,451,966
Engineering Services	\$75,443,980
Offices of Lawyers	\$74,263,951
Petrochemical Manufacturing	\$73,595,565
Machine Shops	\$66,328,596

#### 2.6.1. Cluster Total Requirements and Import Gaps

Black Belt WLC TR are \$303.9 million annually. The top 25 industries account for 57.8% of all purchases (Table 14). Black Belt RTC TR are \$221 million annually. The top 25 industries account for 58.1% of purchases (Table 15). The total Black Belt WLC IG estimate is \$221.1 million (Table 16). The total Black Belt RTC IG estimate is \$209.1 million. (Table 17).

Table 14 Top 25 Waterway & Logistics Cluster Industries Ranked by Total Requirements, 2021-2026

Purchases from:	<b>Total Purchases</b>
Petroleum Refineries	\$22,306,206
Couriers and Express Delivery Services	\$17,833,749
Freight Transportation Arrangement	\$14,689,631
General Warehousing and Storage	\$11,435,913
Corporate, Subsidiary, and Regional Offices	\$10,675,479
Temporary Help Services	\$9,815,467
Petroleum and Petroleum Wholesalers	\$8,506,526
Commercial Banking	\$7,329,683
Gasoline Stations with Convenience Stores	\$7,009,269
Direct Property and Casualty Insurance Carriers	\$6,946,165
Other Support Activities for Air Transportation	\$6,865,007
Direct Health and Medical Insurance Carriers	\$5,469,238
General Automotive Repair	\$4,662,252
Wired Telecommunications Carriers	\$4,094,928
Commercial and Industrial Machinery Rental	\$4,063,825
Marine Cargo Handling	\$4,042,191
Petroleum Bulk Stations and Terminals	\$3,988,711
Construction, Mining, Forestry Machinery Rental	\$3,906,477
General Freight Trucking, Long-Distance	\$3,806,986
Rail transportation	\$3,266,072
Real Estate Credit	\$3,199,894
US Postal Service	\$3,128,346
Local Messengers and Local Delivery	\$3,011,477
Motor Vehicle Towing	\$2,971,294
Automotive Body, Paint, Repair and Maintenance	\$2,731,673

Purchases from:	Total Purchases
Corporate, Subsidiary, and Regional Offices	\$40,928,500
Lessors of Residential Buildings and Dwellings	\$12,679,057
Offices of Real Estate Agents and Brokers	\$9,908,110
Lessors of Nonresidential Buildings	\$8,285,837
Other Activities Related to Real Estate	\$7,443,716
Electric Power Distribution	\$6,032,746
Internet Publishing and Broadcasting and Portals	\$5,654,274
Lessors of Nonfinancial Intangible Assets	\$5,013,142
Residential Property Managers	\$4,527,024
Breweries	\$4,526,607
Offices of Lawyers	\$4,061,275
Advertising Agencies	\$3,231,908
Cheese Manufacturing	\$3,154,449
Lessors of Mini warehouses and Self-Storage	\$3,085,578
Offices of Certified Public Accountants	\$2,869,801
Poultry Processing	\$2,741,357
Temporary Help Services	\$2,704,902
Nonresidential Property Managers	\$2,574,012
Animal (except Poultry) Slaughtering	\$2,571,793
Landscaping Services	\$2,545,531
Fossil Fuel Electric Power Generation	\$2,445,215
Petroleum Refineries	\$2,418,584
Janitorial Services	\$2,397,347
Management Consulting Services	\$2,383,168
Meat Processed from Carcasses	\$2,374,449

 Table 15 Top 25 Recreation & Tourism Cluster Industries Ranked by Total Requirements, 2021-2026

Industry	Import Gap
Petroleum Refineries	\$17,462,282
Couriers and Express Delivery Services	\$15,234,072
General Warehousing and Storage	\$11,121,077
Freight Transportation Arrangement	\$10,876,246
Corporate, Subsidiary, and Regional Offices	\$9,521,838
Direct Property and Casualty Insurance Carriers	\$6,874,007
Petroleum and Petroleum Products Wholesalers	\$5,698,157
Direct Health and Medical Insurance Carriers	\$5,469,238
Other Support Activities for Air Transportation	\$4,987,283
Temporary Help Services	\$4,731,502
Marine Cargo Handling	\$3,705,746
Real Estate Credit	\$3,018,930
Wired Telecommunications Carriers	\$2,850,334
Construction, Mining, Forestry Machinery Rental	\$2,790,684
Petroleum Bulk Stations and Terminals	\$2,733,990
Gasoline Stations with Convenience Stores	\$2,448,490
Other Commercial and Industrial Machinery Rental	\$2,418,699
Local Messengers and Local Delivery	\$2,380,846
Wireless Telecommunications Carriers	\$2,355,386
Commercial Banking	\$2,136,592
Other Airport Operations	\$1,971,328
Motor Vehicle Towing	\$1,893,869
New Car Dealers	\$1,847,499
Professional Employer Organizations	\$1,839,717
Portfolio Management	\$1,805,101

## Table 16 Top 25 Waterway & Logistics Raked by Import Gaps, 2021-2026

Industry	Imported Purchases
Corporate, Subsidiary, and Regional Offices	\$37,106,146
Internet Publishing and Broadcasting and Portals	\$5,407,655
Breweries	\$4,316,760
Lessors of Nonresidential Buildings	\$4,176,330
Offices of Real Estate Agents and Brokers	\$4,135,418
Cheese Manufacturing	\$3,130,899
Offices of Lawyers	\$2,722,255
Lessors of Nonfinancial Intangible Assets	\$2,681,453
Other Activities Related to Real Estate	\$2,566,057
Advertising Agencies	\$2,526,745
Offices of Certified Public Accountants	\$2,342.916

\$2,292,216

\$2,240,684

\$2,151,163

\$2,084,079

\$2,075,756

\$1,918,850

\$1,852,000

\$1,803,957

\$1,801,175

\$1,749,474

\$1,680,702

\$1,636,864

\$1,551,183 \$1,531,790

Table 17 Top 25 Recreation & Tourism Cluster Industries Ranked by Import Gaps, 2021-2025

#### 2.6.2. Import Gap Economic Development Opportunities

Animal (except Poultry) Slaughtering

Lessors of Residential Buildings and Dwellings

Meat Processed from Carcasses

Petroleum Refineries

Distilleries

Television Broadcasting

Residential Property Managers

Fossil Fuel Electric Power Generation

Offices of Other Holding Companies

Nonresidential Property Managers

Computer Systems Design Services

Polystyrene Foam Product Manufacturing

Temporary Help Services

Management Consulting Services

Using the IG Approach, we identified which industries offer potential economic development opportunities based on the dollar amounts of goods or services needed for production inside the region that are purchased from outside the region. As already shown, the IG point to significant monies being spent outside the Black Belt. Reducing IG by increasing money spent inside the region will lead to increased economic impact because of the additional spending's added indirect and induced effects.

Earlier, we outlined why it may not be possible to fill all IG within a region. However, some industries do have IG that can potentially be filled. We examined the data to identify and select industries with significant IG that were likely targets. Four industries within the Black Belt WLC have IG greater than \$2 million annually, with a combined

total IG of \$43.3 million (Table 18). Two industries within the Black Belt RTC have IG greater than \$2 million annually, with a combined total IG of \$12.1 million (Table 19). The two clusters' combined IG represent \$55.4 million worth of economic development opportunity. Recall earlier discussions that it may not be possible to fill all industry IG due to specific industries' structure, complexity, or scale. For others, though, IG can be filled. When they are filled, local regions benefit economically by the new change in resulting local economic activity. The question that must then drive the analysis is which changes to pursue. Economic impact estimation of IG offered some insights.

Purchases from	Imported Purchases	% Imported Purchases
Couriers and Express Delivery Services	\$17,614,918	88.9%
General Warehousing and Storage	\$11,121,077	97.2%
Freight Transportation Arrangement	\$10,876,246	74.0%
Marine Cargo Handling	\$3,705,746	91.7%

Table 18 Black Belt Waterway & Logistics Cluster Industries with \$2 Million+ Import Gaps

Table 19 Black Belt Recreation & Tourism Cluster Industries with \$2 Million+ Import Gaps

Industry	Imported Purchases	% Imported Purchases
Real Estate Agents, Brokers & Property Managers	\$6,701,475	41.7%
Internet Publishing and Broadcasting Search Portals	\$5,407,655	95.6%

## 2.7. IMPORT GAPS ECONOMIC IMPACT ANALYSIS

We conducted economic impact analyses of the IG of the six identified Black Belt industries offering opportunities for economic development. WLC industries included couriers and express delivery services, general warehousing and storage, freight transportation arrangement, and marine cargo handling. RTC industries included real estate agents, brokers, and property managers, and internet publishing, broadcasting, and portals from the RTC.

We reported the results of the modeled changes in economic activity in five ways (Table 20). Jobs is the number of jobs supported. Wages are employee wages. Value is the difference between revenues and production costs. Revenues are the total contribution to GRP. Taxes are the total taxes paid by businesses and individuals to state and local governments. The results suggest that if all Black Belt IG were filled, total economic impacts would support 725 jobs, add \$25.3 million in new wages, create \$34.5 million in new value, produce \$86.4 million in new revenues, and generate \$11.1 million in new state and local taxes.

Black Belt Waterway & Logistics Cluster									
Couriers & Express Delivery Services	Impact Type	Jobs	Wages	Value	Revenues	Taxes			
	Direct Impact	273	\$5,464,797	\$7,117,817	\$17,614,918	\$244,941			
	Indirect Impact	35	\$1,614,988	\$2,659,454	\$5,930,050	\$388,339			
	Induced Impact	16	\$554,903	\$1,238,845	\$2,335,557	\$157,700			
	Total Impacts	324	\$7,634,688	\$11,016,116	\$25,880,525	\$790,980			
General Warehousing & Storage	Impact Type	Jobs	Wages	Value	Revenues	Taxes			
	Direct Impact	144	\$3,678,315	\$4,168,382	\$11,121,077	\$1,738,335			
	Indirect Impact	26	\$862,275	\$1,595,545	\$4,324,469	\$698,849			
	Induced Impact	10	\$347,322	\$775,403	\$1,461,845	\$367,684			
	Total Impacts	180	\$4,887,912	\$6,539,330	\$16,907,391	\$2,804,868			
	Impact Type	Jobs	Wages	Value	Revenues	Taxes			
Freight Transportation Arrangement	Direct Impact	64	\$5,281,835	\$5,557,964	\$10,876,246	\$2,559,239			
	Indirect Impact	23	\$1,072,553	\$1,549,096	\$3,490,112	\$733,981			
	Induced Impact	16	\$549,803	\$1,229,077	\$2,316,749	\$581,990			
	Total Impacts	102	\$6,904,191	\$8,336,136	\$16,683,107	\$3,875,210			
Marine Cargo Handling	Impact Type	Jobs	Wages	Value	Revenues	Taxes			
	Direct Impact	22	\$1,799,623	\$1,893,705	\$3,705,746	\$871,982			
	Indirect Impact	8	\$365,440	\$527,807	\$1,189,148	\$250,082			
	Induced Impact	6	\$187,329	\$418,770	\$789,361	\$198,295			
	Total Impacts	35	\$2,352,391	\$2,840,282	\$5,684,255	\$1,320,359			
TOTAL CLUSTER IMPACTS		642	\$21,779,181	\$28,731,863	\$65,155,279	\$8,791,417			
	Blac	k Belt Re	creation & Tour	ism Cluster					
Real Estate Agents, Brokers & Property Managers	Impact Type	Jobs	Wages	Value	Revenues	Taxes			
	Direct Impact	40	\$411,383	\$1,686,277	\$6,701,475	\$405,273			
	Indirect Impact	21	\$627,074	\$1,142,028	\$3,128,959	\$493,019			
	Induced Impact	3	\$84,820	\$189,481	\$357,194	\$89,789			
	Total Impacts	63	\$1,123,277	\$3,017,786	\$10,187,628	\$988,081			
	Impact Type	Jobs	Wages	Value	Revenues	Taxes			
Internet Publishing & Broadcasting & Portals	Direct Impact	6	\$85,262	\$172,827	\$5,407,655	\$67,274			
	Indirect Impact	13	\$402,106	\$638,295	\$1,746,217	\$293,349			
	Induced Impact	1	\$38,611	\$86,229	\$162,557	\$40,874			
	Total Impacts	21	\$525,979	\$897,351	\$7,316,430	\$401,496			
TOTAL CLUSTER IMPACTS		84	\$3,448,879	\$5,808,842	\$21,209,803	\$2,261,559			
TOTAL IMPACTS		725	\$25,228,060	\$34,540,705	\$86,365,082	\$11,052,977			

#### Table 20 Economic Impact of Import Gaps

We conducted 34 county-level economic impact analyses of WLC industries (Table 21). The WLC IG opportunities translated to combined industry economic impacts would support 371 jobs, add \$12 million in new wages, create \$15.3 million in new value, produce \$38.5 million in new revenues, and generate \$1 million in new state and local taxes. We conducted 22 county-level economic impact analyses of RTC industries (Table 22). Impacts from the RTC IG would support 71 jobs, add \$1.4 million in new wages, create \$3.3 million in new value, produce \$14.7 million in new revenues, and generate \$232,500 in new state and local taxes.

## Table 21 County-Level Waterway & Logistics Cluster Industry Import Gap Economic Impacts

	County	Import Gap	Potential Economic Impacts						
Industry			Jobs	Earnings	Value Added	Revenues	Taxes		
	Monroe	\$1,652,539	16	\$969,935	\$1,151,470	\$2,441,836	\$72,132		
	Escambia	\$1,492,763	16	\$887,046	\$1,117,679	\$2,464,953	\$61,231		
	Conecuh	\$1,235,429	8	\$928,712	\$1,047,414	\$1,698,408	\$43,816		
	Butler	\$1,176,841	11	\$845,980	\$1,004,325	\$1,837,278	\$63,748		
Freight	Washington	\$910,057	7	\$531,546	\$602,923	\$1,199,635	\$26,965		
Transportation	Barbour	\$680,414	7	\$378,441	\$458,570	\$1,010,991	\$28,608		
Arrangement	Russell	\$602,145	7	\$306,494	\$374,569	\$884,527	\$25,153		
	Sumter	\$537,690	5	\$229,852	\$276,519	\$719,990	\$19,875		
	Dallas	\$430,100	4	\$285,317	\$336,974	\$647,381	\$23,260		
	Marengo	\$407,819	4	\$270,694	\$318,877	\$606,990	\$20,858		
	Clarke	\$401,588	4	\$223,590	\$273,778	\$592,690	\$21,446		
INDUSTRY TOTAL		\$9,527,385	88	\$5,857,607	\$6,963,097	\$14,104,680	\$407,093		
	Monroe	\$1,875,708	32	\$667,179	\$898,668	\$2,729,421	\$57,743		
	Barbour	\$1,803,254	31	\$711,593	\$982,817	\$2,838,505	\$66,975		
	Butler	\$1,423,681	28	\$428,231	\$605,966	\$2,156,325	\$45,296		
Caparal	Sumter	\$621,202	10	\$247,128	\$330,784	\$922,853	\$18,000		
Warehousing	Marengo	\$481,552	7	\$247,424	\$325,306	\$740,482	\$18,312		
and Storage	Washington	\$427,550	8	\$83,781	\$103,749	\$509,515	\$6,101		
	Dallas	\$419,434	7	\$180,429	\$237,777	\$615,827	\$14,270		
	Russell	\$410,596	6	\$221,388	\$281,380	\$592,818	\$9,414		
	Clarke	\$398,315	8	\$71,121	\$110,356	\$582,016	\$11,914		
INDUSTRY TOTAL		\$7,861,292	138	\$2,858,274	\$3,876,802	\$11,687,760	\$248,024		
	Butler	\$2,165,770	42	\$430,636	\$732,513	\$3,496,762	\$129,476		
	Conecuh	\$972,168	12	\$517,667	\$706,357	\$1,270,373	\$24,168		
	Russell	\$709,087	16	\$195,523	\$283,049	\$969,003	\$24,542		
Couriers.	Barbour	\$468,296	13	\$67,905	\$118,930	\$734,524	\$16,639		
Delivery & Messenger	Monroe	\$453,028	13	\$70,096	\$107,963	\$669,916	\$14,848		
Services	Choctaw	\$378,913	11	\$74,147	\$131,030	\$653,362	\$23,617		
	Conecuh	\$339,055	4	\$180,543	\$246,350	\$443,057	\$8,429		
	Clarke	\$338,539	4	\$192,405	\$257,990	\$462,237	\$15,363		
	Hale	\$304,153	9	\$58,960	\$75,892	\$432,536	\$9,112		
INDUSTRY TOTAL		\$6,129,010	124	\$1,787,881	\$2,660,075	\$9,131,770	\$266,194		
	Monroe	\$561,563	5	\$329,602	\$391,290	\$829,780	\$24,512		
	Barbour	\$518,259	5	\$288,252	\$349,284	\$770,054	\$21,790		
Marine Cargo Handling	Escambia	\$460,471	5	\$273,626	\$344,769	\$760,361	\$18,888		
	Butler	\$409,901	4	\$294,660	\$349,813	\$639,935	\$22,204		
	Conecuh	\$404,497	3	\$304,073	\$342,938	\$556,083	\$14,346		
INDUSTRY TOTAL		\$2,354,691	22	\$1,490,213	\$1,778,095	\$3,556,214	\$101,739		
COMBINED INDUSTRY TOTALS		\$25,872,378	371	\$11,993,975	\$15,278,069	\$38,480,424	\$1,023,051		
				Potential Economic Impacts					
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Industry	County	Import Gap	Jobs	Earnings	Value Added	Revenues	Taxes		
	Dallas	\$1,245,240	10	\$242,234	\$597,258	\$1,807,957	\$39,331		
	Escambia	\$974,759	11	\$182,785	\$444,826	\$1,658,732	\$27,041		
	Macon	\$548,231	5	\$53,491	\$207,095	\$775,363	\$10,651		
	Clarke	\$521,522	6	\$112,857	\$205,592	\$892,131	\$21,068		
	Conecuh	\$441,904	4	\$43,470	\$120,531	\$618,112	\$10,103		
	Marengo	\$406,821	4	\$89,348	\$179,727	\$660,257	\$15,167		
Real Estate Brokers, Agents & Managers	Butler	\$381,547	3	\$71,091	\$197,279	\$569,751	\$12,024		
0	Pickens	\$375,521	2	\$48,542	\$196,706	\$466,910	\$7,823		
	Bullock	\$257,971	1	\$35,513	\$156,440	\$328,303	\$5,590		
	Russell	\$243,154	2	\$34,379	\$133,233	\$341,324	\$5,672		
	Hale	\$225,982	2	\$33,310	\$61,933	\$346,029	\$6,575		
	Sumter	\$220,125	2	\$28,753	\$103,710	\$325,691	\$5,831		
	Greene	\$205,940	2	\$10,459	\$22,414	\$304,791	\$5,587		
INDUSTRY TOTAL		\$6,048,717	56	\$986,233	\$2,626,744	\$9,095,349	\$172,462		
	Russell	\$1,015,817	4	\$76,752	\$131,085	\$1,410,325	\$14,280		
	Escambia	\$620,992	2	\$98,290	\$191,248	\$807,378	\$8,323		
	Greene	\$465,747	2	\$22,798	\$34,512	\$623,606	\$5,504		
	Dallas	\$465,398	2	\$45,599	\$70,369	\$627,461	\$7,719		
General Warehousing and Storage	Clarke	\$368,748	1	\$30,973	\$55,278	\$507,400	\$6,559		
g-	Monroe	\$323,556	1	\$27,610	\$49,617	\$463,009	\$5,727		
	Marengo	\$315,529	1	\$35,079	\$53,173	\$413,722	\$5,018		
	Barbour	\$301,264	1	\$40,621	\$74,458	\$377,494	\$3,829		
	Macon	\$245,949	1	\$10,307	\$23,110	\$321,339	\$3,126		
INDUSTRY TOTAL		\$4,123,000	15	\$388,028	\$682,850	\$5,551,734	\$60,086		
COMBINED INDUSTRY TOTALS		\$10,171,717	71	\$1,374,261	\$3,309,594	\$14,647,083	\$232,548		

### Table 22 County-Level Recreation & Tourism Cluster Industry Economic Impacts

# 3. Environmental Housing Impact Assessment

# **3.1. INTRODUCTION AND LITERATURE**

A conventional method used to assess how waterbodies affect citizens' welfare living in their proximities is studying the relationship between proximity to water and property value. The hedonic pricing method (Kain and Quigley 1970; Rosen 1974) is a standard procedure used to directly assess the value of environmental disamenities based on consumers' revealed preferences. When a consumer purchases a property, he buys a bundle of goods that includes housing and neighborhood attributes, and environmental characteristics of the surrounding area. It should then be clear that clean or polluted waterbodies can affect property values. The idea behind the hedonic pricing method is to use the housing market as a surrogate to measure the aesthetic and recreational value of water and the marginal value of its environmental quality.

The location of water bodies has historically affected human settlement decisions since ancient times. There is a common consensus, based on empirical evidence, among environmental scientists and practitioners of real estate economics to consider water proximity as a positive externality on the market for residential properties (Artell, 2014; Bin, 2005; Lanford and Jones, 1995). Increased property value associated with water streams and open lakes increases local tax revenue, triggering economic growth. However, some studies have found opposite results when the quality of water bodies is impaired. Steinnes (1992) supports the thesis that consumer perceptions of degraded water quality could switch the positive externality associated with the waterbody itself into a negatively perceived disamenity because of waterbody impairment.

Affuso et al. (2010) found that properties in Anniston, Alabama, located one kilometer from a waterbody, are associated with an almost 17% loss in value. However, homebuyers are willing to pay a premium of nearly 74% to live one kilometer from potentially lead polluted water streams in the same area. This result confirms the findings of Gibbs et al. (2002), who provide empirical evidence that water quality has a significant positive effect on residential property values. Similarly, and most recently, Tuttle and Heintzelman (2015) and Bonetti et al. (2016) confirm the previous studies' findings. The first researchers argue that the presence of loons in Adirondacks lakes increases property values. In contrast, lake acidity depreciates residential properties. The latter study found that clean water bodies provide a positive externality in the residential property market in the province of Milan, Italy. In contrast, reduced water quality is perceived as a disamenity.

# 3.2. DATA

We obtained cross-sectional data on property values and attributes, and demographic and socioeconomic characteristics from the U.S. Census Bureau's American Community Survey (ACS)<sup>8</sup>. The observation unit used was the census tract within Alabama Black Belt. We merged this dataset with county-level water quality obtained from the Alabama Department of Environmental Management. The proxy for water quality is measured as miles of impaired streams per county (Table 23).

## Table 23 Descriptive Statistics

Variable	Description	Mean	Std.Dev			
D*	1 if the census tract is crossed by Tombigee or Alabama Rivers	66.00	5.81			
MEDIANVALUE	Median Property Value (2016 US\$)	84414.07	25325.93			
POPDENSITY	Inhabitants/sq. mile	257.35	647.44			
POPBLACK	Number of African American inhabitants	1592.69	1023.19			
POPWHITE	Number of Caucasian inhabitants	1368.81	1134.21			
MEDINC	Median Income (2016 US\$)	31619.24	9051.24			
HSDIPLOMA	Number of people with high school diploma	688.58	372.10			
ASSOCDEG	Number of people with associate degree	154.29	114.01			
BACHDEG	Number of people with bachelor's degree	175.58	152.18			
V9	Area covered by water (sq. Miles)	1.33	1.91			
R1	Number of housing units with 1 room	19.16	30.13			
R2	Number of housing units with 2 rooms	15.18	24.61			
R3	Number of housing units with 3 rooms	74.19	75.30			
R4	Number of housing units with 4 rooms	242.53	160.68			
R5	Number of housing units with 5 rooms	406.98	196.20			
R6PLUS	Number of housing units with 6 or more rooms	729.26	382.18			
VACHUNITS	Number of vacant housing units	333.22	170.71			
MOBHUNITS	Number of mobile homes	369.44	241.37			
HUNITSRENT	Number of rented occupied housing units	292.34	273.66			
HAGELT3Y	Number of housing units that are less than 3 years old	3.61	9.79			
HAGE4T6Y	Number of housing units between 4 and 6 years old	31.86	98.05			
HAGE7T17Y	Number of housing units between 7 and 17 years old	165.42	143.98			
HAGE18T27Y	Number of housing units between 18 and 27 years old	300.14	165.47			
HAGE28T37Y	Number of housing units between 28 and 37 years old	249.44	166.02			
HAGE38T47Y	Number of housing units between 38 and 47 years old	267.23	148.97			
HAGE48T57Y	Number of housing units between 48 and 57 years old	172.98	115.06			
HAGE58T67Y	Number of housing units between 58 and 67 years old	128.19	94.59			
HAGE68T77Y	Number of housing units between 68 and 77 years old	68.84	58.77			
HAGEGT78Y	Number of housing units older than 78 years	99.59	91.17			
IMPAIREDMILES	Impaired river miles within the county superset of census tract	97.75	70.78			
Sample Size	Number of census tracts	13	35			
Note: *Binary Variable. Mean and Standard Deviation are computed for the binomial distribution.						

Our outcome variable, the median property value of occupied housing units per census tract, estimates the house and land value, as self-reported by the survey's respondents if their properties were for sale. Because the outcome variable is an unobservable transaction, we based our analysis on a "stated preference" model rather than a "revealed preference" model. One possible drawback is self-reporting bias due to survey respondents' overvaluing their properties. However, Arrow et al. (1993) suggest that stated preferences models like contingent valuations are more than adequate tools to assess the analysis of environmental externalities if surveys have a reliable basis. Paul Portney (1994:16), writing about the contingent valuation debate of stated preferences versus revealed preferences, concludes:

"Whether the economics profession likes it or not, it seems inevitable to me that contingent valuation methods are going to play a role in public policy formulation. Both regulatory agencies and governmental offices responsible for natural resource damage assessment are making increasing use of it in their work. This has now been reinforced by the Department of the Interior and NOAA–proposed regulations sanctioning the use of the contingent valuation method. Surely, it is better for economists to be involved at all stages of the debate about the contingent valuation method than to stand by while others dictate the way this tool will be used."

Also, McLean and Mundy (1998) argue that contingent valuation analyses are widely accepted as ways to assess the values of contaminated properties when historical or recent transactions are unavailable. Therefore, since contingent valuation models are based on self-reported stated preferences, an owner's self-assessment of the value of his property is a reasonable measure of their willingness to sell. In our analysis, this measure would capture an owner's willingness to accept compensation for potential externalities, such as waterbody pollution's impacts on property value.

#### 3.3. METHODOLOGY

Our endogenous regime-switching model attempts to include a latent process (D\*) that captures a consumer's locational choice of buying a property in a census tract that is crossed or adjacent to the Tombigbee or Alabama Rivers. Therefore, if such a process exists, then

(1) 
$$D_i^* = z'_{i\gamma} + u_i \text{ with } \{D_i = 1 \text{ if } D_i^* > 0 \text{ } D_i = 0 \text{ if } D_i^* < 0 \}$$

where  $z'_{i}$  is a vector of exogenous variables that help to explain a homeowner's choice to buy the property in the census tract that is in proximity to the Alabama or Tombigbee Rivers, if  $D_i=1$  or the census tract where only minor tributaries are present if  $D_i=0^9$ . The exogenous factors include population density (POPDENSITY), size of the African American population (POPBLACK), size of the Caucasian population (POPWHITE), median household income (MED-INC), number of housing units (HUNITS), number of mobile homes (MOBHUNITS), number of vacant housing units (VACHUNITS), and area covered by water (AWATER).

The discrete choice equation (1)—a probit model—is simultaneously estimated with the following endogenous switching equations to model the median property prices that face two regimes: (D1) median price of properties located in a census tract crossed or adjacent to the main waterway; and, (D0) median price of properties located in a census tract not crossed or adjacent to the main waterway. Therefore, the hedonic model that accounts for the two regimes can be written as:

(2) 
$$\ln(y)_{1i} = \ln(x)'_{1i}\beta_1 + \varepsilon_{1i} \quad if \ D_i^* > 0 \ (D_i = 1)$$

(3) 
$$\ln(y)_{0i} = \ln(x)'_{0i}\beta_0 + \varepsilon_{0i} \text{ if } D_i^* < 0 \ (D_i = 0)$$

where y<sub>i</sub> is the median price of the property in logarithmic form in the two regimes; and,  $x'_{1i}$  and  $x'_{0i}$  are vectors of housing attributes, economic, demographic, and environmental characteristics of the census tract i that may have an impact on the median price of the property in the two regimes. Those factors (all in logarithmic form) include: size of the African American population (POPBLACK); size of the Caucasian population (POPWHITE); median household income (MEDINC); population with high school diploma (HSDIPLOMA); population with associate degree (ASSOC-DEG); population with bachelor's degree (BACHDEG); area covered by water (AWATER) that may explain the value of lake- and riverfront properties; number of housing units with 1 room (R1); number of housing units with 2 rooms (R2); number of housing units with 3 rooms (R3); number of housing units with 4 rooms (R4); number of housing units with 5 rooms (R5); number of housing units with 6 or more rooms (R6PLUS); number of vacant housing units (VACHUNITS); number of mobile homes (MOBHUNITS); number of occupied rented units (HUNITSRENT); number of properties less than three years old (HAGELT3Y); number of properties between four and six years old (HAGE4T6Y); number of properties between seven and 17 years old (HAGE7T17Y); number of properties between 18 and 27 vears old (HAGE18T27Y): number of properties between 28 and 37 years old (HAGE28T37Y): number of properties between 38 and 47 years old (HAGE38T47Y); number of properties between 48 and 57 years old (HAGE48T57Y); number of properties between 58 and 67 years old (HAGE58T67Y); number of properties between 68 and 77 years old (HAGE68T77Y); number of properties older than 78 years (HAGEGT78Y); and, miles of impaired waterway (IM-PAIREDMILES). The model is efficiently estimated using an algorithm of nonlinear unconstrained optimization that maximizes a Full Information Maximum Likelihood (FIML) function (Affuso and Lahtinen, 2018).

The endogenous switching model allowed us to conduct a counterfactual analysis that estimated the monetary value of housing in proximity to waterways (Heckman, 2001). Our analysis goal was to estimate the average median value of a property in a census tract crossed or adjacent to the main waterway. Counterfactually, we estimated the same value in an area where main waterways were not present. Similarly, we estimated the average median value of a property located in a census tract without a main waterway relative to what it would be if located in a census tract with one. The advantage of using the endogenous regime-switching model versus similar non-parametric methods (such as propensity score matching) is that it allows us to compute heterogeneity effects—meaning, the impacts of other unobservable factors influencing median property value (Winship and Morgan, 1999; Carter and Milon, 2005).<sup>10</sup>

<sup>&</sup>lt;sup>10</sup> See Affusso and Lahtinen (2018) for the statistical derivation of the heterogeneity effects, statistical properties of the endogenous switching regime model, and statistical derivation of the FIML function.

# 3.4. RESULTS

For numerical optimization, we scaled the probit equation variables by 1,000 (except for the area covered by water). Therefore, the estimates of the marginal effects for the selection equation should be interpreted as changes of the order of 1,000 units. Statistically significant results indicate an increased likelihood that people choose to live in houses and mobile homes in the census tracts crossed by the main waterways, 77%, and 59%, respectively. Other significant predictors are the Caucasian and African American populations and vacant housing units. If housing units are vacant, the probability associated with the choice to live in census tracts crossed with major waterways falls by 76% per 1,000 vacant housing units. Water surface does not influence the choice of living within a census tract crossed by the main waterways.

Because our two-regime hedonic model's variables are in logarithmic form, estimates should be interpreted as elasticities—meaning, the percentage change in the average median property value due to a one percent change in the variable (Table 24). In terms of statistical power, the number of rental units is the main predictor of median property value within the census tract with major rivers. In contrast, median income appears to be the most economical and statistically significant predictor for the median property value in the census tracts with minor tributaries. A 10% increase in median income corresponds to a 5.8% increase in the average median property value in those census tracts not adjacent to the Alabama and Tombigbee Rivers. Finally, water quality seems to affect only those properties located in areas with minor tributaries connected to the main waterways (Regime 0). There is empirical evidence that a 10% increase in pollutants (measured in impaired river miles) corresponds to a decline in median property value that is approximately 0.6% (5% a-level).

As expected, the coefficient of correlation of the selected equation and the statistical noise (error terms) associated with the equations for the two regimes,  $p_1$  and  $p_0$ , are statistically different from zero with 99% confidence. Consequently, there is evidence of a sample selection process, which justifies using our econometric modeling approach.

	Probit Selection Equation			Regime D1	Regime D0
	Estimates	Marginal Effects		Estimates	Estimates
Constant	0.24	0.082	Constant	12.357***	5.27***
	-0.431	-1.566		(7.793)	(4.351)
POPDENSITY	0.027	0.009	ln(POPBLACK)	-0.013	0.115**
	-0.143	-0.154		(-0.157)	(2.453)
POPBLACK	-0.903***	-0.308***	ln(POPWHITE)	0.189***	0.092***
	(-2.576)	(-10.267)		(3.273)	(4.178)
POPWHITE	-0.967***	-0.330***	ln(MEDINC)	-0.152	0.581***
	(-2.76)	(-9.271)		(-1.104)	(4.921)
MEDINC	-0.029**	-0.01	ln(HSDIPLOMA)	0.033	-0.256***
	(-1.958)	(-1.095)		(0.287)	(-3.115)
HUNITS	2.268***	0.773***	ln(ASSOCDEG)	-0.077	0.111**
	-2.579	-8.897		(-1.199)	(2.405)
MOBHUNITS	1.724***	0.587***	ln(BACHDEG)	0.092**	0.029
	-2.879	-4.622		(2.37)	(0.84)
VACHUNITS	-2.227*	-0.759***	ln(AWATER)	0.157***	0.056
	(-1.826)	(-12.545)		(2.934)	(1.301)
AWATER	0.062	0.021	ln(R1)	0.045***	0.029***
	-0.972	-1.001		(3.246)	(2.826)
			ln(R2)	0.006 (0.419)	0.008 (0.632)
				(0.419)	
			ln(R3)	-0.098***	-0.008
				(-3.909)	(-0.429)
			ln(R4)	-0.28***	-0.093*
				(-4.492)	(-1.746)
			ln(R5)	-0.273**	-0.115*
				(-2.492)	(-1.646)
			ln(R6PLUS)	-0.113	-0.066
				(-0.697)	(-0.537)

Table 24 Endogenous Switching Model Results (FIML Estimates)

Probit Select Equation	tion		Regime D1	Regime D0
Estimates	Marginal Effects		Estimates	Estimates
		ln(VACHUNITS)	0.063	0.060 (0.864)
			(0.59)	(0.864)
		ln(MOBHUNITS)	0.01	-0.008
			(0.206)	(-0.375)
		ln(HUNITSRENT)	0.231*** (6.057)	0.120*** (3.028)
			(6.057)	(3.028)
		ln(HAGELT3Y)	0.014 (0.602)	-0.017
			(0.602)	(-1.328)
		ln(HAGE4T6Y)	-0.006	-0.017
			(-0.426)	(-1.28)
		ln(HAGE7T17Y)	0.119***	-0.039
			(2.674)	(-1.226)
		ln(HAGE18T27Y)	-0.036	0.091
			(-0.74)	(1.55)
		ln(HAGE28T37Y)	-0.006	-0.025
			(-0.105)	(-0.526)
		ln(HAGE38T47Y)	0.001 (0.009)	0.082 (1.454)
			(0.009)	(1.454)
		ln(HAGE48T57Y)	0.147***	-0.009
			(3.419)	(-0.211)
		ln(HAGE58T67Y)	0.002 (0.065)	0.028 (0.73)
			(0.065)	(0.73)
		ln(HAGE68T77Y)	0.046*** (2.179)	0.03
			(2.179)	(1.011)
		ln(HAGEGT78Y)	-0.016	-0.069***
			(-0.579)	(-2.804)

Table 24 Endogenous Switching Model Results (FIML Estimates) cont.

	Probit Selection Equation			Regime D1	Regime D0
	Estimates	Marginal Effects		Estimates	Estimates
			ln(IMPAIREDMILES)	-0.008	-0.059**
				(-0.433)	(-2.128)
			$\sigma_1$	0.210*** (9.917)	
			$\sigma_0$		0.130*** (6.347)
			ρ1	0.993*** (202.201)	NA
			ρο	NA	0.667*** (2.633)
Loglikelihood Value					-15.97
AIC					106.1
Degrees of Freedom					66
Notes: ***99%,**9	95%,*90% con	fidence. Z-stat	s in parentheses.		

Table 24 Endogenous Switching Model Results (FIML Estimates) cont.

#### 3.5. DISCUSSION

Our analysis focused on environmental disamenity. The estimated econometric model predicts that households in areas with proximity to minor tributaries experience a 0.6% loss in property value per mile of impaired stream. This loss corresponds to a monetary value loss that is approximately \$5,065 per polluted mile of water stream per household.

We reported counterfactual analysis results (Table 25, Row 2) of the predicted average median value of a property located in a census tract that is crossed or is adjacent to the Alabama or Tombigbee Rivers in the actual case, E(PriceID=1), and the counterfactual, or alternative case, E(PriceID=0). The difference between these figures provides a potential measure of the social benefit or cost of living close to a major waterway. Alabama or Tombigbee River proximity is perceived as an external cost of approximately \$22,756 (or a 22.17% decrease in value). However, as previously mentioned, this value should be taken as a hypothetical upper boundary given that the median property value includes (house and lot) and is a self-reported value. In other words, this may be upper biased. However, the t-test of the difference between the means of the factual and counterfactual scenarios (t-value -4.352) rejects the hypothesis that living in proximity of a major river has no impact on the median value of properties located in an area that is crossed or is adjacent to a major river (99% confidence). Likewise, the t-test rejects the null hypothesis that a major river would not impact property value. Hypothetically, major river proximity would reduce median property value by an average of 34.02%.

Base and transitional heterogeneities accounted for other unobserved factors that may impact property value (Table 25, Row 3). For example, owners of properties located in a census tract in proximity to one of the two major rivers would be willing to sell their property, on average, for \$22,554 more, regardless of the potential impact of the major river. Similarly, in the counterfactual case where a property was located in an area with minor tributaries, the same households would be willing to sell their property for an additional \$15,758, on average. These disparities are potentially induced by the systematic variation across the two subsamples not fully captured by the hedonic model using available data. However, the transitional heterogeneities, which measure whether the effects of the major waterways were more significant for households located in a census tract with a major waterways or for those located in a census tract with minor tributaries, were statistically equal to those located in a census tract with minor tributaries. This means that the negative impact of the major waterway is equal across the two subsamples (census tracts with major waterways and census tracts with only minor tributaries). Our analysis suggests that people prefer living in areas crossed or adjacent to minor tributaries rather than the Alabama and Tombigbee Rivers. The counterfactual cost of a major waterway on those households' welfare could be as high as \$29,552. Since this cost is measured in a counterfactual scenario, it could also be a benefit of living in a developing area with only minor tributaries. The aggregate benefit of living in areas with only minor tributaries could be computed by summing the home price differential in the factual and counterfactual case across all the census tracts. This figure is approximately \$722.512.

The primary takeaway is that properties near minor tributaries are associated with higher median property values, and potentially higher tax revenues. However, one should not forget that there is also a cost associated with the environmental quality of these water bodies. If ecological issues are not addressed, water quality degradation could affect property values in these areas, which in turn would reduce tax revenues and shrink economies.

### Table 25 Counterfactual Analysis

	E(Price D=1)	E(Price D=0)	Major River Effect
Sample(D=1)	79,881	102,636	-22,756***
	(23,588) <sup>a</sup>	(35,330) <sup>a</sup>	(5,229) <sup>b</sup>
Sample(D=0)	57,327	86,879	-29,552***
	(19,633) <sup>a</sup>	(23,770) <sup>a</sup>	(3,711) <sup>b</sup>
Base Heterogeneity	22,554***	15,758***	6,796°
	(3,744) <sup>b</sup>	(5,206) <sup>b</sup>	(6,412) <sup>b</sup>

Notes: All values in 2016 US\$; \*\*\*99% confidence; asame standard deviation in parentheses; bstandard error t-test; cTransitional Heterogeneity.

# 4. Wastewater and Infrastructure Assessment

# **4.1. INTRODUCTION**

The facilities and systems that support the daily life of residents and businesses in an area make up the local utility infrastructure. The availability of crucial infrastructures provides the opportunity to establish new businesses and attract new residents. Policymakers and political leaders must ensure that adequate infrastructure services are available to both residents and industries. Failing to do so will restrict economic growth.

# 4.2. LITERATURE

Access to several utility infrastructures was determined for the Black Belt region:

- Drinking Water
- Wastewater
- Natural Gas/Propane
- Broadband (internet)
- Cellular Wireless (telephone)

Note that basic electricity and transportation infrastructures are available throughout the Black Belt. Each of the selected infrastructure categories has direct and indirect impacts on the potential for economic growth within this region. Direct impacts of investing in infrastructure include creating jobs infrastructure design, construction, and operation. There would also be indirect impacts related to material purchases necessary for infrastructure construction.

Addressing infrastructure gaps is an important issue for the Black Belt region. Closing the gaps would provide immense economic benefits. For example, the American Society of Civil Engineers indicates that the direct impact of closing the nation's water and wastewater infrastructure gaps would result in annual increases in employment of 500,000 jobs, wages of \$32 billion, and revenues of \$82 billion per year. Indirect and induced impacts of investing in infrastructure include increased spending in the region as a result of direct job creation; the ability for businesses to open in areas with newly established infrastructure; the economic stimulation and jobs created in the building and operation of these new businesses; and finally, the increased spending in the region due to the creation of jobs by these new businesses. According to the Value of Water Campaign, the indirect and induced impacts of closing the nation's water and wastewater infrastructure gaps would result in annual increases in employment of 760,000 jobs, wages of \$43 billion, and revenues of \$140 billion. Of course, impacts would be smaller in the Black Belt region, but just by addressing water and wastewater infrastructure needs, if roughly proportional to population, doing so would result in about 1,500 jobs, \$89 million in wages, and \$260 million of new revenues.

These economic impacts are observable in each infrastructure category targeted in this study. For example, according to the Farm Foundation, the number of jobs per billion dollars spent in infrastructure is estimated at 21,888 for natural gas infrastructure and 17,761 for drinking water and wastewater infrastructure. Additionally, the Farm Foundation estimates that for every 1 billion dollars spent, there is an economic output of \$2.88 billion from broad-band infrastructure and \$3.45 billion from water and wastewater infrastructure.

Another factor to consider is the risk of economic impact due to disruption of services because of aging and failing infrastructure in need of repair. According to the Value of Water Campaign, "an eight-day national disruption in water service would amount to a 1 percent loss in annual GDP—putting roughly 1.9 million jobs at risk." When interpreting the gathered infrastructure data for the Black Belt, one must consider the complex factors that impact the need for infrastructure investments. For example, when reviewing drinking water infrastructure, it is easy to assume that most, if not all, residents have access. It is essential to note that the data do not include information regarding the age, expected lifespan, or current condition of water infrastructure in each county. Therefore, service providers must be individually investigated to establish the exact need for drinking water infrastructure investments for each county within the region.

# 4.3. DATA

#### 4.3.1. Wastewater

Fifty-nine wastewater service providers serve homes and businesses within the Black Belt (Table 26). Each reported service area (city or town) assumes the entire geometric area is within city limits. However, by comparing the population served by the wastewater system to the service area's Census-listed population, one can determine if the actual area of service is likely to be somewhat larger or smaller than the geometric area within city limits (Tables 27 and 28 and Figure 4). Other considerations are maximum daily flow rate, annual average flow rate, the design flow rate of each system (Table 29), and the shortest distances from each service area to the nearest navigable waterway (Table 30).

County	Service Providers	Reported Service Areas	Sq. Miles	Population Served	Population of Service Areas	% Population Served
	Town of Clayton Water and Sewer Board	Clayton, Ventress Prison	6.76	3,100	3,891	79.67%
Barbour	Town of Louisville	Louisville	2.75	410	604	67.88%
	City of Clio	Clio	10.07	1,500	1,015	147.78%
	Eufaula Water Works	Eufaula	73.48	12,000	12,065	99.46%
	Town of Midway	Midway	3.31	499	683	73.06%
Bullock	City of Union Springs Utility Board	Union Springs	6.69	4,800	3,514	136.60%
Patlar	The Water Works & Sewer Board of the City of Georgiana	Georgiana	6.24	1,700	1,806	94.13%
Butler	Water Works and Sewer Board of the City of Greenville	Greenville	21.53	2,800	7,589	36.90%
	Utilities Board of the Town of Gilbertown	Gilbertown	0.78	187	256	73.05%
	Utilities Board of the Town of Butler	Butler	6.75	1,860	2,419	76.89%
Choctaw	North Choctaw Water & Sewer Authority	Lisman, Riderwood, Pushmataha, Cromwell, Yantley, Halsell, Jachin, Rock Springs, Needham, Littlehope, Mollie, Robjohn, Brightwater, Victory Grove, Shady Grove, Scotts Mountain	168.55	580	653	88.82%
	Utilities Board of the Town of Pennington	Pennington	1.96	221	321	68.85%

#### Table 26 Black Belt Region Wastewater Service Providers by County

Table 26 Black Belt Region Wastewater Service Providers by County cont.

County	Service Providers	Reported Service Areas	Sq. Miles	Population Served	Population of Service Areas	% Population Served
	Town of Coffeeville	Coffeeville	4.52	100	516	19.38%
	Jackson Water Works & Sewer Board	Jackson	15.83	5,500	4,781	115.04%
Clarke	City of Thomasville Water Works and Sewer Board	Thomasville	8.73	4,700	3,928	119.65%
	Utilities Board of the Town of Grove Hill	Grovehill	7.60	1,500	1,839	81.57%
Conecuh	City of Evergreen	Evergreen	20.01	3,300	3,646	90.51%
	Dallas County Commission Delwood HCR Lagoon	Orville	1.04	200	154	129.87%
Dallas	Dallas County Water and Sewer Authority	Selmont	3.32	5,151	1,812	284.27%
	Selma Water Works & Sewer Board	Selma	14.40	20,000	18,276	109.43%
	City of Valley Grande	Valley Grande	33.82	250	3708	6.74%
	Poarch Creek Indians Utility Authority	Poarch Creek Reservation	0.36	2,500	2,340	106.84%
	West Escambia Utilities, Inc.	Atmore, Poarch	21.94	8,150	9,495	85.83%
Escambia	Town of Flomaton	Flomaton	5.20	1,440	1,652	87.17%
	City of Brewton	Brewton	11.45	12,000	5,240	229.01%
	The Water Works Board of the Town of East Brewton	East Brewton	3.44	2,500	2,917	85.70%
Greene	Greene County Water and Sewer Authority	Eutaw	1.28	380	380	100%
	City Of Eutaw	Eutaw, Boligee	14.69	3,475	2,737	126.96%
	City of Moundville	Moundville	4.66	2,450	3,017	81.21%
Hale	Town Of Akron	Akron	0.69	356	315	113.02%
	Utilities Board of the City of Greensboro	Greensborough	2.39	3,300	3,149	104.80%

<sup>T</sup>able 26 Black Belt Region Wastewater Service Providers by County cont.

County	Service Providers	Reported Service Areas	Sq. Miles	Population Served	Population of Service Areas	% Population Served
	Mosses Water, Sewer, and Fire Protection Authority	Mosses	4.78	150	1,101	13.62%
Lowndes	Town Of Hayneville	Hayneville	1.88	700	872	80.28%
	Fort Deposit Water Works & Sewer Board	Fort Deposit	5.66	1,300	1,835	70.84%
Macon	Utilities Board of the City of Tuskegee	Tuskegee, Franklin, Shorter, part of Macon County	41.98	3,500	9,116	38.39%
	Town of Shorter	Shorter	4.57	300	356	84.27%
	Town of Notasulga	Nostaluga	13.95	475	1,011	46.98%
	Utilities Board of the City of Linden	Linden	3.61	2,424	1,794	135.12%
Watengo	Water and Sewer Board of Demopolis	Demopolis	18.06	7,700	6,807	113.12%
Monroe	Monroeville Water Works	Monroeville, Frisco City, Excel	25.05	7,235	8,443	85.69%
	City Of Marion	Marion	10.66	1,375	3,275	41.98%
Perry	The Water & Sewer Board of Uniontown	Uniontown	15.19	None listed	1,880	None listed
	City Of Reform	Reform	8.04	1,660	1,621	102.41%
	Gordo Water, Gas and Sewer Board	Gordo	3.26	1,785	1,660	107.53%
Pickens	Town Of Carrollton	Carrollton	2.08	350	1055	33.18%
	Water Works & Sewer Board of the City of Aliceville	Aliceville	4.56	6,390	2,362	270.53%

County	Service Providers	Reported Service Areas	Sq. Miles	Population Served	Population of Service Areas	% Population Served
Puscall	Water Works Board of the Town of Hurtsboro	Hurtsboro	1.03	335	535	62.62%
Kussen	Phenix City Department of Public Utilities	Phenix	28.13	36,000	36,516	98.59%
	Town Of Cuba	Cuba	4.07	600	422	142.18%
	City of York	York	6.88	1,250	2,529	49.43%
Sumter	Sumter County Commission	Bellamy	3.82	520	466	111.59%
	City of Livingston	Livingston, Sumter County	7.21	1,650	3,356	49.17%
	Industrial Development Authority of Sumter County	Epes	6.60	250	614	40.72%
	Sumter County Sewer Authority	Emelle, Geiger, Gainesville	2.89	460	497	92.56%
Washington	Chatom Utilities Board	Chatom	10.72	600	1195	50.21%
	Town Of Millry	Millry	7.51	750	697	107.60%
	Town of Pine Hill	Pine Hill	3.82	660	927	71.20%
Wilcox	City Of Camden	Camden	4.20	4,500	2,177	206.71%
Wilcox	Wilcox County Water Authority	Meadowbrook Neighborhood	0.08	500	500	100%

Table 26 Black Belt Region Wastewater Service Providers by County cont.

County	<b>County Population</b>	<b>Population Served</b>	% Population Served
Barbour	24,686	17,010	68.91%
Bullock	10,101	5,299	52.46%
Butler	19,448	4,500	23.14%
Choctaw	12,589	2,848	22.62%
Clarke	23,622	11,800	49.95%
Conecuh	12,067	3,300	27.35%
Dallas	37,196	25,601	68.83%
Escambia	36,633	26,590	72.58%
Greene	8,111	3,855	47.53%
Hale	14,651	6,106	41.68%
Lowndes	9,726	2,150	22.11%
Macon	18,068	4,275	23.66%
Marengo	18,863	10,124	53.67%
Monroe	20,733	7,235	34.90%
Perry	8,923	1,375	15.41%
Pickens	19,930	10,185	51.10%
Russell	57,961	36,335	62.69%
Sumter	12,427	4,730	38.06%
Washington	16,326	1,350	8.27%
Wilcox	10,373	5,660	54.56%

County Name	County Area (sq mi)	Area Served (sq mi)	Percent of Area Served
Barbour	905	93.06	10.28%
Bullock	625	10.00	1.60%
Butler	778	27.77	3.57%
Choctaw	921	178.04	19.33%
Clarke	1,253	36.68	2.93%
Conecuh	853	20.01	2.35%
Dallas	994	52.58	5.29%
Escambia	953	42.39	4.45%
Greene	660	15.97	2.42%
Hale	657	7.74	1.18%
Lowndes	725	12.32	1.70%
Macon	613	60.50	9.87%
Marengo	983	21.67	2.20%
Monroe	1,034	25.05	2.42%
Perry	724	25.85	3.57%
Pickens	890	17.94	2.02%
Russell	647	29.16	4.51%
Sumter	913	31.47	3.45%
Washington	1,089	18.23	1.67%
Wilcox	907	8.10	0.89%

### Figure 4 Wastewater Service Areas



Service Provider	Design Flow Rate (MGD)	Max Daily Flow Rate (MGD)	Annual Average Flow Rate (MGD)
Town of Clayton Water and Sewer Board	0.400	0.318	0.663
Town of Louisville	0.100	0.500	0.020
City of Clio	0.400	0.380	0.220
Eufaula Water Works	2.700	5.810	1.900
Town of Midway	0.150	0.224	0.047
City of Union Springs Utility Board	2.250	2.400	1.300
Water Works & Sewer Board of the City of Georgiana	0.300	0.702	0.309
Water Works & Sewer Board of the City of Greenville	2.000	2.910	1.380
Utilities Board of the Town of Gilbertown	0.060	0.055	0.023
Utilities Board of the Town of Butler	0.417	0.055	0.023
North Choctaw Water & Sewer Authority	0.096	0.070	0.050
Utilities Board of the Town of Pennington	0.095	0.110	0.035
Town of Coffeeville	0.015	0.000	0.000
Jackson Water Works & Sewer Board	0.830	1.410	0.520
City of Thomasville Water Works and Sewer Board	1.500	1.000	6.000
Utilities Board of the Town of Grove Hill	0.450	0.422	0.180
City of Evergreen	1.500	1.265	0.660
Dallas County Commission Delwood HCR Lagoon	0.060	0.286	0.263
Dallas County Water and Sewer Authority	2.000	2.381	0.605
Selma Water Works & Sewer Board	6.000	9.500	3.000
City of Valley Grande	0.070	0.012	0.003
Poarch Creek Indians Utility Authority	0.500	0.516	0.247
West Escambia Utilities, Inc.	2.500	4.467	1.251
Town of Flomaton	0.490	0.260	0.200
City of Brewton	2.000	2.543	1.309
The Water Works Board of the Town of East Brewton	0.300	0.380	0.156
Greene County Water and Sewer Authority	0.025	0.135	0.023
City Of Eutaw	0.880	0.420	0.190
City of Moundville	0.210	0.400	0.168
Town Of Akron	0.080	0.201	0.089
Utilities Board of the City of Greensboro	2.000	1.400	1.590
Mosses Water, Sewer, and Fire Protection Authority	0.110	0.070	0.040

### Table 29 Service Provider Flow Rates

Service Provider	Design Flow Rate (MGD)	Max Daily Flow Rate (MGD)	Annual Average Flow Rate (MGD)
Town Of Hayneville	0.180	0.310	0.180
Fort Deposit Water Works & Sewer Board	0.240	0.273	0.048
Utilities Board of the City of Tuskegee	3.000	6.850	4.370
Town of Shorter	0.060	0.000	0.000
Town of Notasulga	0.085	0.180	0.119
Utilities Board of the City of Linden	0.450	10.630	0.270
Water Works & Sewer Board of the City of Demopolis	2.650	9.300	2.150
Monroeville Water Works	1.350	2.352	1.047
City Of Marion	0.500	None listed	0.400
Waterworks & Sewer Board of the City of Uniontown	None listed	1.000	0.415
City Of Reform	0.490	0.754	0.330
Gordo Water, Gas and Sewer Board	0.270	0.221	0.170
Town Of Carrollton	0.140	0.148	0.131
Water Works & Sewer Board of the City of Aliceville	1.346	0.990	0.130
Water Works Board of the Town of Hurtsboro	0.260	0.150	0.060
Phenix City Department of Public Utilities	6.000	6.009	4.915
Town Of Cuba	0.060	0.060	0.029
City of York	0.600	0.770	0.360
Sumter County Commission	0.060	0.190	0.050
City of Livingston	0.800	0.820	0.270
Industrial Development Authority of Sumter County	0.020	0.063	0.008
Sumter County Sewer Authority	None listed	0.179	0.040
Chatom Utilities Board	0.400	0.170	0.130
Town Of Millry	0.085	0.064	0.051
Town of Pine Hill	0.125	0.463	0.170
City Of Camden	0.780	0.975	0.190
Wilcox County Water Authority	0.030	0.754	0.097

#### Table 29 Service Provider Flow Rates cont.

Service Provider	Distance to Nearest Waterway (mi)	Waterway Name
Town of Clayton Water and Sewer Board	16.50	Chattahoochee
Town of Louisville	22.80	Chattahoochee
City of Clio	26.60	Chattahoochee
Eufaula Water Works	0.00	Chattahoochee
Town of Midway	28.00	Tallapoosa
City of Union Springs Utility Board	22.90	Tallapoosa
The Water Works & Sewer Board of the City of Georgiana	40.00	Alabama
Water Works and Sewer Board of the City of Greenville	22.20	Alabama
Utilities Board of the Town of Gilbertown	9.00	Tombigbee
Utilities Board of the Town of Butler	4.50	Tombigbee
North Choctaw Water & Sewer Authority	6.20	Tombigbee
Utilities Board of the Town of Pennington	1.10	Tombigbee
Town of Coffeeville	0.20	Tombigbee
Jackson Water Works & Sewer Board	0.00	Tombigbee
City of Thomasville Water Works and Sewer Board	10.90	Alabama
Utilities Board of the Town of Grove Hill	11.00	Alabama
City of Evergreen	31.00	Alabama
Dallas County Commission Delwood HCR Lagoon	1.50	Alabama
Dallas County Water and Sewer Authority	0.00	Alabama
Selma Water Works & Sewer Board	0.00	Alabama
City of Valley Grande	2.90	Alabama
Poarch Creek Indians Utility Authority	18.50	Alabama
West Escambia Utilities, Inc.	18.90	Tensaw
Town of Flomaton	35.70	Tensaw
City of Brewton	32.50	Alabama
The Water Works Board of the Town of East Brewton	35.00	Alabama
Greene County Water and Sewer Authority	1.40	Black Warrior
City Of Eutaw	1.40	Black Warrior
City of Moundville	0.00	Black Warrior
Town Of Akron	0.80	Black Warrior
Utilities Board of the City of Greensboro	7.60	Black Warrior

Table 30 Shortest Distances from Wastewater Service Areas to Nearest Major Waterways

Table 30 Shortest Distances from Wastewater S	Service Areas to Nearest Major Waterways cont.
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Service Provider	Distance to Nearest Waterway	Waterway Name
Mosses Water, Sewer, and Fire Protection Authority	9.50	Alabama
Town Of Hayneville	5.10	Alabama
Fort Deposit Water Works & Sewer Board	22.00	Alabama
Utilities Board of the City of Tuskegee	2.00	Tallapoosa
Town of Shorter	1.40	Tallapoosa
Town of Notasulga	9.90	Tallapoosa
Utilities Board of the City of Linden	6.70	Tombigbee
Water and Sewer Board of the City of Demopolis	0.00	Black Warrior
Monroeville Water Works	8.70	Alabama
City Of Marion	1.70	Cahaba
The Waterworks and Sewer Board of the City of Uniontown	15.40	Black Warrior
City Of Reform	15.30	Tombigbee
Gordo Water, Gas and Sewer Board	14.00	Black Warrior
Town Of Carrollton	8.40	Tombigbee
Water Works & Sewer Board of the City of Aliceville	1.40	Tombigbee
Water Works Board of the Town of Hurtsboro	9.30	Tallapoosa
Phenix City Department of Public Utilities	0.00	Chattahoochee
Town Of Cuba	18.50	Tombigbee
City of York	13.60	Tombigbee
Sumter County Commission	0.00	Sucarnoochee
City of Livingston	0.00	Sucarnoochee
Industrial Development Authority of Sumter County	0.00	Tombigbee
Sumter County Sewer Authority	0.00	Tombigbee
Chatom Utilities Board	16.30	Tombigbee
Town Of Millry	12.40	Tombigbee
Town of Pine Hill	4.90	Alabama
City Of Camden	1.30	Alabama
Wilcox County Water Authority	5.70	Alabama

# 4.4. DRINKING WATER

One hundred nineteen drinking water service providers provide access to the entire Black Belt population (Table 31). The Alabama Department of Environmental Management (ADEM) and the U.S. Environmental Protection Agency (EPA) track and report relationships between service areas and populations served (Table 32) and the percentages of each county's population with access to drinking water service according to the EPA and the ADEM, respectively (Tables 33 and 34).

County	Service Provider	Reported Service Areas	Population Served
	Bakerhill Water Authority	Bakerhill	7,128
	Blue Springs Water Works	Clio	600
	Clayton Water Works and Sewer	Clayton	2,235
Darhour	Clio Water Works	Clio	2,730
Barbour	Cowikee Water Authority	Eufaula	1,989
	Eufaula Water Works	Eufaula	17,958
	Louisville Water Works	Louisville	1,380
	West Barbour Water Authority	Clayton	1,407
	Midway Water Works	Clayton, Midway	1,050
Bullock	South Bullock County Water Authority	Union Springs	8,601
	Union Springs Utility Board	Union Springs	5,250
	Mt Andrew Water Authority	Midway	729
	Butler County Water Authority	Greenville	14,052
Dutlor	Georgiana Water Works & Sewer Board	Georgiana	2,793
Buller	Greenville Water Works	Greenville	9,290
	McKenzie Water Board	McKenzie	1,170
	Butler Water System	Butler	6,852
	Choctaw-edna Water Authority, Inc.	Pennington	894
Choctaw	Utilities Board of the Town of Gilbertown	Gilbertown	8,157
	North Choctaw Water & Sewer Authority	Lisman	3,552
	Utilities Board of Pennington	Pennington	1,080

County	Service Provider	Reported Service Areas	Population Served
	Town of Coffeeville Water Works	Coffeeville	2,730
	Utilities Board of the Town of Fulton	Fulton	534
	Grove Hill Water Works	Grove Hill	3,750
	Jackson Water Works & Sewer Board	Jackson	11,715
	McVay Water System	Jackson	1,482
Clarke	Mid-central Water Authority	Fulton	2,331
	Mid-Clarke Water System	Grove Hill	1,500
	North Clarke Water Authority	Thomasville	975
	Old Line Water System	Jackson	5,145
	Thomasville Water Works and Sewer Board	Thomasville	6,897
	CWM Water Authority	Dickinson	1,722
	Castleberry Water System	Castleberry	1,095
	Evergreen Water Works	Evergreen	4,950
	Fairview Water System (Conecuh)	Evergreen	975
Conecuh	Hamden Ridge Water Authority	Evergreen	2,196
	Lyeffion Water and Fire Pro Authority	Evergreen	1,419
	Owassa-Brownsville Water Authority	Evergreen	3,300
	Repton Water Works	Repton	510
	Dallas County Water & Sewer Authority	Selma	4,152
	North Dallas Water Authority	Selma	8,838
Dallas	Town of Orrville Water Department	Orrville	435
Danas	Selma Water Works & Sewer Board	Selma	24,039
	South Dallas Water Authority	Sardis	3,669
	West Dallas Co Water Authority	Sardis	3,870

County	Service Provider	Reported Service Areas	Population Served
	Brewton Water Works	Brewton	9,756
	East Brewton Water & Sewer Board	East Brewton	3,120
	Escambia Community Utilities LLC	Huxford	1,500
	Flomaton Water Works	Flomaton	2,409
Escambia	Freemanville Water System	Atmore	3,414
	McCall Water System Inc	Brewton	7,500
	Pollard Water System	Pollard	216
	Riverview Water Works	East Brewton	903
	West Escambia Utilities Inc.	Atmore	12,060
	Eutaw Water Department	Eutaw	4,764
Greene	Forkland Water System	Forkland	1,137
	Greene County Water Authority	Eutaw	4,062
	Akron Water System	Akron	570
11-1-	Utilities Board of the City of Greensboro	Greensboro	4,500
Hale	Hale County Water Authority	Greensboro	9,540
	Moundville Water Works	Moundville	4,404
	Fort Deposit Water & Sewer Board	Fort Deposit	2,280
	Hayneville Water Department	Hayneville	2,958
	Lowndes County Water System	Hayneville	3,675
Lowndes	Lowndesboro Water System	Lowndesboro	840
	Mosses Water & Fire Pro Authority	Hayneville	2,008
	White Hall Water Board	White Hall	2,250
	Town of Franklin Water System	Tuskegee	150
	Macon County Water Authority	Tuskegee	7,566
Macon	Notasulga Water System	Notasulga	2,565
	Star-Mindingall Water Authority	Not Reported	1,962
	Tuskegee Utilities Board	Tuskegee	13,500

County	Service Provider	Reported Service Areas	Population Served
	Demopolis Water Works and Sewer Board	Demopolis	10,530
	Faunsdale Water Works	Faunsdale	414
	Linden Utilities Board	Linden	5,103
Marengo	Myrtlewood Water System	Myrtlewood	4,095
	South Marengo Co Water & Fire Pro Auth	Linden	5,610
	Sweetwater Water & Sewer Board	Sweet Water	465
	Thomaston Water Works & Gas Board	Thomaston	960
	Beatrice Water System	Beatrice	591
	Excel Water System	Excel	3,600
	Frisco City Water System	Frisco City	2,100
Monroe	Mexia Water System, Inc.	Mexia	2,550
	Water Works Board of the City of Monroeville	Monroeville	9,885
	Southwest Alabama Water Authority	Peterman	5,196
	Uriah Water System Inc.	Uriah	3,420
	Marion Water Department	Marion	4,323
Perry	Perry County Water Authority	Marion	2,850
	Uniontown Utilities Board	Uniontown	3,894
	Aliceville Water & Sewer Board	Aliceville	5,655
	Carrollton Water Works	Not Reported	1,404
Pickens	Gordo Water Gas & Sewer Board	Gordo	3,630
	Pickens County Water & F. P. Authority	Not Reported	14,364
	Reform Water & Sewer Board	Reform	2,376
	Ft Mitchell Water System	Not Reported	13,200
Buggell	Hurtsboro Water & Sewer Board	Hurtsboro	1,182
Russell	Phenix City Utilities	Phenix City	42,267
	Russell County Water Authority	Phenix City	16,800

County	Service Provider	Reported Service Areas	Population Served
	Cuba Water Board	Cuba	591
Country	Livingston Water Works	Livingston	4,680
Sumer	Sumter County Water Authority	Livingston	10,983
	York Water System/City of York	York	3,435
	Chatom Utilities Board	Chatom	2,037
	Deer Park-vinegar Bend Water & FPA	Deer Park	1,467
	Frankville Water & Fire Pro Authority	Frankville	945
	Fruitdale Water System	Chatom	3,057
	Hobson Water System	Chatom	621
Washington	Leroy Water Authority	Leroy	1,710
washington	McIntosh Water & Fire Pro Authority	Mcintosh	3,060
	Millry Water Works	Millry	2,217
	St Stephens Water System	Not Reported	735
	Tibbie Water & Fire Protection Authority	Tibbie	1,326
	Wagarville Water System	Wagarville	480
	Washington County Water Authority	Chatom	2,445
	Camden Water & Sewer Department	Camden	4,170
Wilcox	Millers Ferry Water Authority, Inc.	Millers Ferry	1,650
	Pine Apple Water Works	Georgiana, Pine Apple	390
	Pine Hill Water Department	Pine Hill	2,370
	Wilcox County Water Authority	Camden	6,594

County	Service Provider	Number of Connections	Persons per Household	Estimated Population Served
	Bakerhill Water Authority	2,369	2.41	5,709
	Blue Springs Water Works	222	2.41	535
	Clayton Water Works and Sewer	687	2.41	1,656
Darhour	Clio Water Works	960	2.41	2,314
Barbour	Cowikee Water Authority	672	2.41	1,620
	Eufaula Water Works	5,990	2.41	14,436
	Louisville Water Works	560	2.41	1,350
	West Barbour Water Authority	466	2.41	1,123
	Midway Water Works	267	2.79	745
Dullast	South Bullock County Water Authority	2,944	2.79	8,214
Bullock	Union Springs Utility Board	1,325	2.79	3,697
	Mt Andrew Water Authority	660	2.79	1,841
	Butler County Water Authority	4,688	3.00	14,064
Dutlon	Georgiana Water Works & Sewer Board	927	3.00	2,781
Butter	Greenville Water Works	3,150	3.00	9,450
	McKenzie Water Board	390	3.00	1,170
	Butler Water System	1,500	2.40	3,600
Choctaw	Choctaw-Edna Water Authority, Inc.	273	2.40	655
	Utilities Board of the Town of Gilbertown	2,780	2.40	6,672
	North Choctaw Water & Sewer Authority	1,240	2.40	2,976
	Utilities Board of Pennington	400	2.40	960

County	Service Provider	Number of Connections	Persons per Household	Estimated Population Served
	Town of Coffeeville Water Works	925	2.61	2,414
	Utilities Board of the Town of Fulton	170	2.61	444
	Grove Hill Water Works	1,200	2.61	3,132
	Jackson Water Works & Sewer Board	3,905	2.61	10,192
	McVay Water System	494	2.61	1,289
Clarke	Mid-central Water Authority	2,300	2.61	6,003
	Mid-Clarke Water System	510	2.61	1,331
	North Clarke Water Authority	325	2.61	848
	Old Line Water System	1,900	2.61	4,959
	Thomasville Water Works and Sewer Board	2,700	2.61	7,047
	CWM Water Authority	1,704	2.61	4,447
	Castleberry Water System	300	2.71	813
	Evergreen Water Works	1,700	2.71	4,607
	Fairview Water System (Conecuh)	315	2.71	854
Conecuh	Hamden Ridge Water Authority	760	2.71	2,060
	Lyeffion Water and Fire Authority	520	2.71	1,409
	Owassa-Brownsville Water Authority	1,085	2.71	2,940
	Repton Water Works	170	2.71	461
	Dallas County Water & Sewer Authority	1,364	2.42	3,301
	North Dallas Water Authority	2,945	2.42	7,127
Dallas	Town of Orrville Water Department	145	2.42	351
Dallas	Selma Water Works & Sewer Board	7,900	2.42	19,118
	South Dallas Water Authority	1,225	2.42	2,965
	West Dallas Co Water Authority	1,300	2.42	3,146

County	Service Provider	Number of Connections	Persons per Household	Estimated Population Served
	Brewton Water Works	3,800	2.61	9,918
	East Brewton Water & Sewer Board	1,030	2.61	2,688
	Escambia Community Utilities LLC	500	2.61	1,305
	Flomaton Water Works	794	2.61	2,072
Escambia	Freemanville Water System	1,143	2.61	2,983
	McCall Water System Inc	2,500	2.61	6,525
	Pollard Water System	75	2.61	196
	Riverview Water Works	307	2.61	801
	West Escambia Utilities Inc.	3,950	2.61	10,310
	Eutaw Water Department	1,585	2.80	4,438
Greene	Forkland Water System	370	2.80	1,036
	Greene County Water Authority	1,360	2.80	3,808
	Akron Water System	175	2.59	453
Hala	Utilities Board of the City of Greensboro	1,400	2.59	3,626
Hale	Hale County Water Authority	3,100	2.59	8,029
	Moundville Water Works	1,470	2.59	3,807
	Fort Deposit Water & Sewer Board	720	2.35	1,692
	Hayneville Water Department	980	2.35	2,303
Lorrandos	Lowndes County Water System	1,245	2.35	2,926
Lowndes	Lowndesboro Water System	376	2.35	884
	Mosses Water & Fire Pro Authority	570	2.35	1,340
	White Hall Water Board	397	2.35	933
	Town of Franklin Water System	57	2.20	125
	Macon County Water Authority	2,367	2.20	5,207
Macon	Notasulga Water System	900	2.20	1,980
	Southwest Alabama Water Authority	1,700	2.57	4,369
	Uriah Water System Inc.	1,150	2.57	2,956

County	Service Provider	Number of Connections	Persons per Household	Estimated Population Served
	Marion Water Department	1,375	2.76	3,795
Perry	Perry County Water Authority	955	2.76	2,636
	Uniontown Utilities Board	1,350	2.76	3,726
	Aliceville Water & Sewer Board	1,040	2.41	2,506
	Carrollton Water Works	465	2.41	1,121
Pickens	Gordo Water Gas & Sewer Board	1,160	2.41	2,796
	Pickens County Water & F. P. Authority	4,775	2.41	11,508
	Reform Water & Sewer Board	780	2.41	1,880
<b>D</b>	Ft Mitchell Water System	4,571	2.47	11,290
	Hurtsboro Water & Sewer Board	465	2.47	1,149
Kussell	Phenix City Utilities	14,090	2.47	34,802
	Russell County Water Authority	5,660	2.47	13,980
Sumter	Cuba Water Board	210	2.29	481
	Livingston Water Works	1,520	2.29	3,481
	Sumter County Water Authority	3,628	2.29	8,308
	York Water System/City of York	1,145	2.29	2,622

County	Service Provider	Number of Connections	Persons per Household	Estimated Population Served
	Chatom Utilities Board	680	2.74	1,863
	Deer Park-vinegar Bend Water & FPA	496	2.74	1,359
	Frankville Water & Fire Pro Authority	320	2.74	877
	Fruitdale Water System	570	2.74	1,562
	Hobson Water System	218	2.74	597
Washington	Leroy Water Authority	575	2.74	1,576
	McIntosh Water & Fire Pro Authority	1,020	2.74	2,795
	Millry Water Works	740	2.74	2,028
	St Stephens Water System	325	2.74	891
	Tibbie Water & Fire Protection Authority	489	2.74	1,340
	Wagarville Water System	175	2.74	480
	Washington County Water Authority	820	2.74	2,247
Wilcox	Camden Water & Sewer Department	1,390	2.71	3,767
	Millers Ferry Water Authority, Inc.	565	2.71	1,531
	Pine Apple Water Works	125	2.71	339
	Pine Hill Water Department	820	2.71	2,222
	Wilcox County Water Authority	2,048	2.71	5,550

County	<b>County Population</b>	Population Served	% Population Served	
Barbour	24,686	35,427	143.51%	
Bullock	10,101	15,630	154.74%	
Butler	19,448	27,305	140.40%	
Choctaw	12,589	20,535	163.12%	
Clarke	23,622	38,781	164.17%	
Conecuh	12,067	14,445	119.71%	
Dallas	37,196	45,003	120.99%	
Escambia	36,633	40,878	111.59%	
Greene	8,111	9,963	122.83%	
Hale	14,651	19,014	129.78%	
Lowndes	9,726	14,011	144.06%	
Macon	18,068	25,743	142.48%	
Marengo	18,863	27,177	144.08%	
Monroe	20,733	27,342	131.88%	
Perry	8,923	11,067	124.03%	
Pickens	19,930	27,429	137.63%	
Russell	57,961	73,449	126.72%	
Sumter	12,427	19,689	158.44%	
Washington	16,326	20,100	123.12%	
Wilcox	10,373	15,174	146.28%	

Table 33 Percentage of County Populations with Drinking Water Service (EPA data)

County Name	County Population	Service Connections	Persons Per Household	Estimated Population Served	% Population Served
Barbour	24,686	11,926	2.41	28,742	116.43%
Bullock	10,101	5,196	2.79	14,497	143.52%
Butler	19,448	9,155	3	27,465	141.22%
Choctaw	12,589	6,193	2.4	14,863	118.06%
Clarke	23,622	15,808	2.61	41,259	174.66%
Conecuh	12,067	4,850	2.71	13,144	108.92%
Dallas	37,196	14,897	2.42	36,051	96.92%
Escambia	36,633	14,099	2.61	36,798	100.45%
Greene	8,111	3,315	2.8	9,282	114.44%
Hale	14,651	6,145	2.59	15,916	108.63%
Lowndes	9,726	4,288	2.35	10,077	103.61%
Macon	18,068	8,153	2.2	17,937	99.27%
Marengo	18,863	9,161	2.59	23,727	125.79%
Monroe	20,733	9,362	2.57	24,060	116.05%
Perry	8,923	3,680	2.76	10,157	113.83%
Pickens	19,930	8,220	2.41	19,810	99.40%
Russell	57,961	24,786	2.47	61,221	105.63%
Sumter	12,427	6,503	2.29	14,892	119.83%
Washington	16,326	6,428	2.74	17,613	107.88%
Wilcox	10,373	4,948	2.71	13,409	129.27%

Table 34 Percentage of County Populations with Drinking Water Service (ADEM data)

# 4.5. NATURAL GAS AND PROPANE

The entire Black Belt population has access to either natural gas or propane (Tables 35 and 36).

	Natural Gas Service Providers									
County	South east Gas	Union Springs Utility Board	Clarke Mobile Counties Gas District	Spi re	South Alabam a Gas District	The City of Brewt on	West Escamb ia Utilities	Town of Gord o	Pickens County Natural Gas	Wilcox County Gas District
Barbour	х				_		-		-	
Bullock	х	х								
Butler	х									
Choctaw			х	х						
Clarke					х					
Conecuh					х					
Dallas				х						
Escambia			х		х	х	х			
Greene				х						
Hale				х						
Lowndes				х						
Macon				х						
Marengo				х						
Monroe					х					
Perry				х						
Pickens				х				х	х	
Russell				х						
Sumter					х					
Washington			x							
Wilcox					х					х

Table 35 Black Belt Region Natural Gas Providers by County
		Propane Service Providers																
County	Ferrell gas	Suburban Propane	Air gas	Gal a Gas	Thompson Gas	A e x	Superior Gas	Blos sman	ACME Propane Gas	AmeriGas	Southern Alabama Propane	Tombigbee Propane	South Alabama Gas	HyTemp	Casey Propane	Marengo Propane	Green's Propane Gas	Allgas
Barbour		х	х	х	х					х								
Bullock	х	х		х	х	х	х	х	х	х								
Butler	х	х							х	х	х		х	х	х			
Choctaw	х	х											х			х		
Clarke		х	х										x			х		
Conecuh		х											х	х				
Dallas	х	х	х		х			х		х			х		х	х		
Escambia	х	х	х										х	х				
Greene	х	х								х		х	х			х		
Hale	х	х								х						х		
Lowndes	х	х			х		х	х	х	х	х	х	x					х
Macon	х	х			х	х	х	х	х									
Marengo	х	х	х										х			х		
Monroe		х			х								x	х				
Perry	х	х								х						х		
Pickens	х	х								х		х						
Russell	х	х		х	x		х	х									х	
Sumter	х	х											х			х		
Washington		х											х					
Wilcox	х	х								х	х		х	х		х		

## Table 36 Black Belt Region Propane Providers by County

## 4.6. BROADBAND

Black Belt counties are served by one, two, and in some instances, three broadband internet service providers (ISPs) (Tables 37-40). Service speeds range from a minimum of 4/1 to a maximum of 25 megabytes (Mbps) per second (minimal speeds by national comparison). Although satellite internet service is a far less reliable, and most often more expensive substitute for broadband, all areas of the Black Belt region do have satellite internet service access, even in the most rural of areas. A table listing the technologies utilized by ISPs to deliver internet service by county is listed in Appendix B.

Compte	Percer More S	it of Area Service Pro	w/ 1 or oviders	Percen More S	it of Area Service Pro	w/ 2 or oviders	Percent of Area w/ 3 or More Service Providers			
County	All Areas	Urban Areas	Rural Areas	All Areas	Urban Areas	Rural Areas	All Areas	Urban Areas	Rural Areas	
Barbour	100	100	100	100	100	100	91.34	100	86.90	
Bullock	100	100	100	100	100	100	94.62	92.03	96.74	
Butler	100	100	100	100	100	100	100	100	100	
Choctaw	100	100	100	100	100	100	47.37		47.37	
Clarke	100	100	100	100	100	100	75.80	96.03	69.24	
Conecuh	100	100	100	100	100	100	85.37	98.52	83.32	
Dallas	100	100	100	100	100	100	85.89	99.77	69.48	
Escambia	100	100	100	100	100	100	88.29	99.63	81.60	
Greene	100	100	100	100	100	100	83.80		83.80	
Hale	100	100	100	100	100	100	92.49	100	91.65	
Lowndes	100	100	100	100	100	100	72.62		72.62	
Macon	100	100	100	100	100	100	90.08	99.02	84.68	
Marengo	100	100	100	100	100	100	60.84	7.29	82.27	
Monroe	100	100	100	100	100	100	95.35	100	94.21	
Perry	100	100	100	100	100	100	53.39		53.39	
Pickens	100	100	100	100	100	100	74.13		74.13	
Russell	100	100	100	100	100	100	95.70	100	89.00	
Sumter	100	100	100	100	100	100	79.95		79.95	
Washington	100	100	100	100	100	100	57.19		57.19	
Wilcox	100	100	100	100	100	100	63.73		`	

Table 37 Broadband Coverage with Speeds of  $\geq 4/1$  Mbps, Including Satellite Providers

Cometra	Percent o Ser	of Area w/ 1 vice Provid	or More lers	Percent o Ser	of Area w/ 2 vice Provid	or More lers	Percent of Area w/ 3 or More Service Providers			
County	All Areas	Urban Areas	Rural Areas	All Areas	Urban Areas	Rural Areas	All Areas	Urban Areas	Rural Areas	
Barbour	91.34	100	86.90	33.32	36.95	31.46	2.79	0.00	4.22	
Bullock	94.62	92.03	96.74	1.06	0.00	1.93	0.00	0.00	0.00	
Butler	100	100	100	80.51	100	72.71	41.44	72.51	29.00	
Choctaw	47.31		47.37	13.30		13.30	0.00	0.00	0.00	
Clarke	75.80	96.03	69.24	14.58	4.99	17.69	0.13	0.00	0.17	
Conecuh	85.37	98.52	83.32	40.81	83.65	34.13	3.40	0.00	3.93	
Dallas	85.89	99.77	69.48	3.43	0.76	6.58	0.00	0.00	0.00	
Escambia	88.29	99.63	81.60	40.19	51.10	33.75	10.71	15.08	8.12	
Greene	83.80		83.80	6.82		6.82	0.00	0.00	0.00	
Hale	92.49	100	91.65	55.15	100	50.13	2.38	8.20	1.72	
Lowndes	72.62		72.62	12.71		12.71	0.00	0.00	0.00	
Macon	90.08	99.02	84.68	5.90	0.95	8.90	0.00	0.00	0.00	
Marengo	60.84	7.29	82.27	13.04	0.00	18.26	2.18	0.00	3.06	
Monroe	95.34	100	94.21	87.39	100	84.35	50.89	97.97	39.52	
Perry	53.39		53.39	2.87		2.87	0.00	0.00	0.00	
Pickens	74.13		74.13	40.32		40.32	0.33		0.33	
Russell	95.70	100	89.00	49.30	52.29	44.64	0.00	0.00	0.00	
Sumter	79.95		79.95	7.98		7.98	0.00	0.00	0.00	
Washington	57.19		57.19	9.88		9.88	0.55		0.55	
Wilcox	63.73		63.73	23.61		23.61	0.31		31.00	

Table 38 Broadband Coverage with Speeds of  $\geq 4/1$  Mbps, Excluding Satellite Providers

Cometre	Percent o Ser	of Area w/ 1 vice Provid	l or More lers	Percent o Ser	of Area w/ 2 vice Provid	2 or More lers	Percent of Area w/ 3 or More Service Providers			
County	All Areas	Urban Areas	Rural Areas	All Areas	Urban Areas	Rural Areas	All Areas	Urban Areas	Rural Areas	
Barbour	100	100	100	100	100	100	69.40	100	53.72	
Bullock	100	100	100	100	100	100	94.35	92.03	96.24	
Butler	100	100	100	100	100	100	71.87	100	60.61	
Choctaw	100	100	100	100	100	100	33.00		33.00	
Clarke	100	100	100	100	100	100	58.26	96.03	46.00	
Conecuh	100	100	100	100	100	100	44.90	98.52	36.54	
Dallas	100	100	100	100	100	100	77.31	90.77	50.74	
Escambia	100	100	100	100	100	100	74.76	99.29	60.28	
Greene	100	100	100	100	100	100	0.85		0.85	
Hale	100	100	100	100	100	100	50.94	100	45.44	
Lowndes	100	100	100	100	100	100	12.64		12.64	
Macon	100	100	100	100	100	100	65.08	99.02	44.58	
Marengo	100	100	100	100	100	100	17.09	0.26	23.82	
Monroe	100	100	100	100	100	100	90.70	100	88.45	
Perry	100	100	100	100	100	100	0.27		0.27	
Pickens	100	100	100	100	100	100	61.40		61.40	
Russell	100	100	100	100	100	100	89.68	100	73.64	
Sumter	100	100	100	100	100	100	47.99		47.99	
Washington	100	100	100	100	100	100	34.21		34.21	
Wilcox	100	100	100	100	100	100	45.15		45.15	

County	Percent of Area w/ 1 or More Service Providers			Percent o Serv	f Area w/ 2 vice Provid	or More lers	Percent of Area w/ 3 or More Service Providers			
	All Areas	Urban Areas	Rural Areas	All Areas	Urban Areas	Rural Areas	All Areas	Urban Areas	Rural Areas	
Barbour	69.40	100	53.72	17.03	26.65	12.11	0.60	0.00	0.91	
Bullock	94.35	92.03	96.24	0.90	0.00	1.64	0.00	0.00	0.00	
Butler	71.87	100	60.61	15.46	7.45	18.66	1.37	2.09	1.08	
Choctaw	33.00		33.00	0.00	0.00	0.00	0.00	0.00	0.00	
Clarke	58.26	96.03	46.00	51.00	2.09	0.00	0.00	0.00	0.00	
Conecuh	44.90	98.52	36.54	9.89	0.00	11.44	0.00	0.00	0.00	
Dallas	77.31	99.77	50.74	0.08	0.15	0.00	0.00	0.00	0.00	
Escambia	74.76	99.29	60.28	9.55	7.43	10.81	0.76	0.00	1.20	
Greene	0.85		0.85	0.00	0.00	0.00	0.00	0.00	0.00	
Hale	50.94	100	45.44	10.01	34.15	7.30	0.00	0.00	0.00	
Lowndes	12.64		12.64	0.00	0.00	0.00	0.00	0.00	0.00	
Macon	65.08	99.02	44.58	0.40	0.00	0.65%	0.00	0.00	0.00	
Marengo	17.09	26.00	23.82	0.40	0.00	0.60	0.00	0.00	0.00	
Monroe	90.70	100	88.45	65.39	98.07	57.50	12.31	24.21	9.43	
Perry	0.27		0.27	0.00	0.00	0.00	0.00	0.00	0.00	
Pickens	61.40		61.40	28.17		28.17	0.00	0.00	0.00	
Russell	89.68	100	73.64	40.41	51.85	22.60	0.00	0.00	0.00	
Sumter	47.99		47.99	0.19		0.19	0.00	0.00	0.00	
Washington	34.21		34.21	1.72		1.72	0.00	0.00	0.00	
Wilcox	45.15		45.15	4.89		4.89	0.00	0.00	0.00	

Table 40 Broadband Coverage with Speeds of  $\geq 25/3$  Mbps, Excluding Satellite Providers

## 4.7. CELLULAR WIRELESS

AT&T, Verizon, and T-Mobile are the three primary cellular service providers in the Alabama Black Belt region. Cellular service can be purchased directly from these providers or from mobile virtual network operators who purchase services from AT&T, Verizon, or T-Mobile to sell to consumers. LTE cellular voice and data services are widely available throughout the Black Belt (Figures 2-7).



Figure 5 AT&T LTE Voice Availability

Figure 6 T-Mobile LTE Voice Availability



Figure 7 Verizon LTE Voice Availability



Figure 8 AT&T Data Availability



Figure 9 T-Mobile LTE Data Availability



Figure 10 Verizon LTE Data Availability



## 4.8. DISCUSSION

The compiled data shows the availability of critical infrastructure in the Alabama Black Belt region, which could provide opportunities for economic growth. The areas with established infrastructure for every category researched are likely suitable for establishing new businesses without the immediate need for infrastructure expansion. Other areas, which do not currently have established infrastructure for every category researched, provide opportunities for expansion, which can foster economic growth.

Drinking water and natural gas or propane services appear to be available throughout the target counties. These infrastructure categories could still benefit from investments for upgrades and necessary repairs, which would also stimulate economic activity. Cellular voice and data coverage are available in most parts of the target area, and continued expansion of these service areas could be beneficial. Satellite broadband is available to all areas in the region. However, expanding service areas utilizing other technologies, such as fiber and cable, would provide area users with more reliable and affordable service. Since the Covid-19 pandemic began, access to reliable, fast, and affordable broadband service has become increasingly important.

Municipal wastewater service is the most limited infrastructure category in the Alabama Black Belt region. Service area expansions are recommended for wastewater service providers with the capacity to expand their service areas without investing in wastewater treatment facility upgrades. All other service providers in the area could benefit from investing in expanding both their treatment facilities and service areas. The establishment of new municipal wastewater systems or decentralized cluster wastewater models could also be beneficial in the targeted counties. These expansions would create job and economic growth and provide opportunities to establish new housing, businesses, and industries.

# 5. Watershed and Ecosystem Assessment

## **5.1. INTRODUCTION**

Natural waterways and waterbodies provide many ecosystem services and resources that support economic development. For example, surface waters are used throughout the state to provide recreational opportunities, including fishing, swimming, and boating. Surface waters also serve as critical water resources that support crop irrigation, industrial processes, thermoelectric cooling, and domestic water supply. All these critical uses are contingent on unpolluted water and healthy aquatic and riparian ecosystems. Ecotourism activities, in particular, are perhaps the most reliant on healthy, robust ecosystems and pristine water quality.

The health of streams and rivers is primarily a function of land use and land cover in surrounding watersheds. For example, pollution that drains from land surfaces (i.e., non-point source pollution) and pollution that is discharged directly into surface waters (i.e., point source pollution) degrade water quality and related habitats. This degradation limits surface waters' abilities to support ecosystem services and provide appropriate resources for economic development. We reviewed the current environmental status of streams and rivers in the Alabama Black Belt region regarding their abilities to meet designated use criteria established by ADEM and mandated by the U.S. Clean Water Act (CWA). We also extracted and reviewed land use and land cover data from the 2019 National Land Cover Database (NLCD) to relate water impairment to land use and land cover and identify economic growth opportunities provided by clean waters.

Our primary objective is to evaluate current surface water quality and related ecosystem conditions in the Alabama Black Belt Region regarding their abilities to support vital ecosystem services, economic development, and ecotourism activities (e.g., fishing, swimming, hiking, canoeing, kayaking, and similar activities). Our secondary objective is to rank and prioritize surface waters for ecotourism opportunities or restoration activities that will enhance economic development.

## **5.2. LITERATURE**

The Alabama Black Belt region is a crescent-shaped, physiographic region spanning through central and west-central Alabama. The term "Black Belt" was initially used to describe the region's fertile, organic-rich black soils that developed due to the underlying Cretaceous-aged limestone. The limestone bedrock tends to have poor drainage characteristics and provides natural lime buffering in contrast to the well-drained, acidic soils in southern Alabama. Black Belt region soils have been highly prized for agricultural development since the 19th century (Smith, 1883).

Although the soils and geology of the region are desirable for agriculture, development within the Black Belt region has not been without some environmental concerns. Notably, the clay-rich soils, high seasonal groundwater table, and likelihood of flooding present challenges for rural development (Cook, 1993). According to the EPA (2002), over 40% of Black Belt households rely on onsite wastewater treatment systems (OWTS). OWTS are designed to discharge treated wastewater to the land surface where filtration and percolation further degrade and dilute harmful contaminants. However, poor drainage characteristics of the Black Belt region's soils lead to poor OWTS performance and a failure rate that is one of the highest in the nation (EPA 2002). The immediate impact on water quality and health is most notable in areas of higher population density and OWTS demand (He et al., 2011).

While wastewater management presents a unique challenge for new development, much of the Black Belt region is undeveloped or used for agriculture and animal pasture. The 2019 National Land Cover Dataset from the United States Geological Survey (USGS) indicates that land cover is dominated by forests (51.6%) and wetlands (19.7%). The major land uses include pastureland (10.1%) and cropland (2.4%). Development is sparse at only 4% of land use, of which 2.8% is classified as cleared "open space" (Table 41; Figure 11).

Land Use or Cover	Percentage
Evergreen Forest	30.60%
Woody Wetland	18.80%
Mixed Forest	14.90%
Pastureland	10.10%
Shrubland	7.40%
Deciduous Forest	6.10%
Grassland	3.40%
Open Space	2.80%
Cropland	2.40%
Open Water	1.40%
Emergent Wetland	0.90%
Low Development	0.80%
Medium Development	0.30%
Barren	0.20%
High Development	0.10%
12019 National Land Cover Database (NLCD).	

Table 41 Land Use/Land Cover for the Alabama Black Belt



Figure 11 2019 National Land Cover Database (NLCD) for Alabama Black Belt

Numerous streams and rivers dissect the Black Belt region. Four major river systems or "basins" traverse the region and include the Mobile-Tombigbee, Alabama, Choctawhatchee-Escambia, and Apalachicola River systems (Figure 12). These basins drain across the Gulf Coastal Plain before eventually discharging to the Gulf of Mexico in Alabama and Florida. River system drainage boundaries do not follow geopolitical boundaries such as state or county lines. Because instead, they extend beyond the Black Belt region, water quality is not entirely dependent on land use or land cover within the region. In other words, pollution from the upstream watershed area may linger in surface waters and migrate into the Black Belt region.



Figure 12 USGS Subregion (HUC-4) Boundaries Covering the Alabama Black Belt Region

There are 22 more minor "subbasins" that drain into Black Belt tributary streams and rivers (Figure 13). Again, the boundaries of these subbasins ignore geopolitical boundaries, especially county lines. Therefore, cooperation among adjacent counties that share sub-watershed boundaries is vital for environmental protection and preservation of surface water.





Water quality and ecosystem health are regularly monitored by ADEM throughout the state and reported to the EPA as part of Section 305(b) of the CWA. The scope of monitoring is intended to determine whether surface waters are meeting pre-assigned designated use criteria. Water quality and habitat criteria for designated uses are tiered, with the highest tier designated as Outstanding Alabama Water (OWA). Below OWAs, public water supply is the next tier, followed by swimming (i.e., whole-body contact), fish and wildlife support, and lastly, agriculture and industry use. Surface waters with higher-tiered designated uses must also meet the criteria of every lower tier. For example, OWAs must also meet criteria for public water supply, swimming, fish and wildlife support, and agriculture and industry use.

Suppose surface water quality does not meet the pre-assigned designated use criteria. In that case, the waterbody is placed on the EPA's CWA Section 303(d) impaired waters list. The reason for impairment must also be submitted and approved by the EPA. Impaired waters remain on the list until the quality criteria are met, the impairment has been determined to be natural, or a total maximum daily load (TMDL) has been developed and approved by the EPA to address the cause of impairment.

The Section 303(d) list of impaired waters provides a snapshot of a region's surface water quality. Impairment sources can be analyzed to determine regional issues affecting water and habitat quality. Furthermore, because the surrounding land use and cover affect water quality, the Section 303(d) list provides a unique perspective of the environmental quality of both land and water within an area.

Designated uses in the Black Belt region are diverse. They include OWA, public water supply, swimming, and fish and wildlife support (Figure 14). Outstanding Alabama Water has the highest quality criteria, while agriculture and industry use have the lowest criteria. Higher tier designated uses to meet the criteria of all tiers below. Many of the assessed streams in the Alabama Black Belt region are designated for high tier uses, including Outstanding Alabama Water, public water supply, and whole-body contact (i.e., swimming), thus providing ample opportunities for economic development. None of the Black Belt Region streams are designated for the lowest tier – agriculture and industry. None of the assessed waters are designated for the lowest tier designated agriculture and industry uses. Because of the tiering of designated uses, all surface waters within the Black Belt region must meet at least fish and wildlife support.

Figure 14 Highest Designated Uses for Assessed Waters and Waterbodies from ADEM, as part of CWA Section 303(d).



The latest Section 303(d) list for Alabama identifies several impaired waters within the Black Belt region and the rest of the state (Figure 15). Impaired waters do not meet designated use criteria (e.g., fish and wildlife, swimming, water supply). Almost every county within the Black Belt region has at least one impaired waterway or waterbody; Lowndes County is the sole exception.



With only a few exceptions, causes of impairment and 303(d) listing are mainly related to land use and land cover and related activities on the land surface. Pathogens were the most significant cause of impairment affecting the Black Belt region (Figure 16). Pathogen impairment is determined by elevated counts of E. coli, which are bacteria that live within the intestines of people and animals. Waterways and waterbodies are at risk of pathogen impairment due to direct discharges of untreated sewage, failed wastewater treatment systems, wastewater system overflows, and runoff from livestock waste.



Mercury contamination was the second largest contributor to impairment. Mercury impairment is typically assigned based on fish consumption advisories issued by the Alabama Department of Public Health. Predatory fish species such as largemouth bass accumulate methylmercury in their tissues. This accumulation is a potential health concern because of the risks of consuming mercury-contaminated fish. The source of mercury is most commonly from atmospheric fallout related to coal-burning power plants. Mercury impairment is not necessarily related to land use activities in the vicinity of a stream or river.

Following pathogen and mercury impairment, siltation, nutrients, lead, biochemical oxygen demand (i.e., organic enrichment), and total dissolved solids (i.e., salts) contributed to 303(d) listings. The sources of impairment generally relate to land use or land cover within the region, with the notable exception of mercury (Figure 17). Pathogens and siltation impairment are primarily attributed to livestock raising (pasture and animal feeding operations) and agriculture. Atmospheric deposition is from coal-burning power plants and not watershed activities. Infrastructure concerns (collection system failure, urban runoff, and on-site wastewater) contribute to about 10% of the listings.



Figure 17 Sources of Impairment in the Black Belt Region from the 98 Entries in the 2020 ADEM 303(d) list

In summary, the literature review provides salient takeaways revealing the watershed and ecosystem health in the Black Belt region.

- 1. Brick and mortar development may be limited in the Black Belt region, where centralized wastewater collection and treatment are unavailable. OWTSs have high failure rates due to impermeable soils and seasonally high water tables.
- 2. Primary Black Belt land uses and land covers are forests, wetlands, and pasture lands. Therefore, potential sources of impairment to surface waters attributed to surrounding watersheds are limited in contrast to more developed portions of the state.
- 3. Designated uses within the Black Belt region broadly support recreational and ecotourism activities, including swimming, boating, fishing, hunting, and many others. The numerous streams and rivers in the area provide multiple opportunities for these recreational activities.
- 4. Impairment in the Black Belt region is most commonly attributed to pathogens from livestock pastures and animal feed operations, and mercury from coal-burning power plants.

Our initial findings suggest that the Black Belt watershed and related ecosystem quality are highly desirable for low-impact ecotourism activities that do not rely on the significant development of brick-and-mortar industries.

## 5.3. DATA AND METHODOLOGY

A preliminary framework for the watershed and ecosystem assessment was adopted from the watershed management plans recently released by the Mobile Bay National Estuary Program (MBNEP). In these plans, significant waterways and watershed conditions are assessed by pooling data from various public sources to identify opportunities for watershed improvements that enhance environmental resiliency, address threats to water and ecosystem quality, and enhance stakeholder engagement.

Following the watershed management plan framework, we completed a top-down, non-exhaustive scouring of published government agency reports, gray literature, and peer-reviewed literature to compile resources delineating major watersheds and sub-watersheds and further describe the condition of surface waters and associated ecosystems within the Black Belt (Figure 8). Data collection began at the national level through the United States Geological Survey's (USGS) National Hydrography Dataset (NHD) and Watershed Boundary Dataset (WBD). The NHD and WBD are geospatial datasets identifying navigable waterways and the drainage divides (i.e., watershed boundaries) that delineate catchment areas for these waterways. The WBD was used to identify subregions, subbasins, and sub-watersheds overlapping the Alabama Black Belt region. The NHD was used to identify waterways and impoundments. Additional data retrieved from the USGS include land use and land cover, soils, and other factors that may influence watershed quality.

After identifying surface waters and their associated boundaries, we reviewed the Section 303(d) list of impaired waters to identify surface waters that are either impaired or threatened and no longer meet designated use criteria established by the State of Alabama. ADEM maintains and submits an updated Section 303(d) list to the EPA every two years. The most recent update was completed in 2020. ADEM also provides information regarding the specific criteria for impairment for each Section 303(d) listing, suspected causes for impairment, designated uses for all assessed surface waters in the state (Section 303(d) listed or otherwise), and special designations for high-quality waters, termed Outstanding Alabama Waters (OAWs). We parsed ADEM's 2020 Section 303(d) list at the county level to extract water and ecosystem quality identifiers, including designated uses, 303(d) listed streams, causes of impairments, and sources of impairments. Additional morphometric data, including reach lengths for streams and impoundment areas for lakes, were also compiled to rank water quality between Black Belt region counties and reveal threats and opportunities for economic development. ADEM's 303(d) list provided the bulk of our analysis's granular water and ecosystem quality data. We also reviewed additional gray literature retrieved from the Geological Survey of Alabama (GSA) and scientific studies to provide additional context and insight.

Since most of the counties in the Black Belt region share similar environmental properties, regional findings were synthesized as an initial assessment. From there, county-level parsed environmental data were compared to develop county scores based on land use or land cover parameters, designated uses, and impairment. We calculated means and standard deviations from the aggregate Black Belt region county data from each category (land use, land cover, and impairment). A numeric score was determined for each county by subtracting the average Black Belt region value from the county metric and dividing the difference by the Black Belt standard deviation:

$$Score = \frac{X - \underline{X}}{\sigma}$$

where  $\mathbf{X}$  is the county metric (i.e., percentage of wooded area and average designated use value),  $\mathbf{X}$  is the Black Belt region average, and  $\mathbf{\rho}$  is the Black Belt region standard deviation. Designated uses were scored based on tiers with normalized percentages of waterways or waterbodies multiplied by higher scaling factors for higher tiers (OWA = 9, public water supply = 6, swimming = 3, and fish and wildlife use = 1). A similar approach was used for scoring impaired and unimpaired waters within each county. The resulting scores for each category were summed to provide final county composite scores. The composite scores indicate environmental conditions relative to other Black Belt region counties. Scores greater than zero indicate better than average environmental conditions, while negative scores indicate lower than average. Indeed, the scores are simply relative indicators and do not indicate the overall quality of the conditions. Positive scores indicate better than average conditions, and therefore, suggest a priority for economic development involving environmental resources (e.g., ecotourism).

# 5.4. RESULTS

## 5.4.1. Land Use and Land Cover Scores

We parsed the 2019 NLCD to determine county-specific land use and land cover metrics. Raw land use or land cover areas were converted to percentages for normalized comparisons between counties (Table 42). Before scoring, similar categories were grouped to reduce granularity. For example, low intensity developed, medium intensity developed, and high intensity developed percentages were added together and categorized as developed (Table 43).

County	Water	Open Space	Developed Low Intensity	Developed Medium Intensity	Developed High Intensity	B r r e n	Deciduous Forest	Evergreen Forest	Mixed Forest	Shrubs	Grass	Pasture	Crops	Woody Wetland	Emergent Wetland
Barbour	1.7	2.7	1.1	0.4	0.1	0. 2	7.0	32.3	17.8	10.5	4.7	8.3	4.6	8.6	0.3
Bullock	1.1	2.0	0.8	0.2	0.0	0. 1	11.0	28.1	15.6	8.5	4.2	13.5	2.0	12.6	0.4
Butler	0.4	3.4	0.7	0.3	0.1	0. 1	9.1	37.0	15.9	9.9	4.7	7.2	1.0	10.0	0.4
Choctaw	0.8	2.5	0.6	0.2	0.1	0. 2	2.9	36.7	20.3	10.2	4.4	3.0	0.1	17.1	0.8
Clarke	1.1	2.5	0.5	0.2	0.1	0. 3	1.4	41.0	18.8	8.3	3.8	1.8	0.1	19.6	0.6
Conecuh	0.3	2.7	0.6	0.1	0.0	0. 2	2.0	44.4	13.7	9.1	4.9	6.6	1.9	13.0	0.4
Dallas	2.2	3.4	1.2	0.5	0.2	0. 2	8.5	21.7	9.2	5.0	2.0	16.1	4.4	24.0	1.6
Escambia	0.6	3.2	1.4	0.5	0.1	0. 5	0.3	44.4	4.0	6.9	3.7	4.5	9.0	20.0	1.0
Greene	3.3	2.5	0.6	0.2	0.0	0. 0	5.9	15.6	14.6	4.2	2.4	16.0	0.9	31.8	1.9
Hale	3.7	3.2	0.6	0.3	0.1	0. 0	9.7	15.0	15.2	3.9	2.5	23.1	1.4	19.8	1.4
Macon	1.0	3.0	1.5	0.4	0.1	0. 4	7.6	24.6	20.2	6.3	2.3	10.7	3.0	18.4	0.5
Marengo	1.1	2.6	0.7	0.3	0.1	0. 2	3.6	26.7	15.2	7.4	2.8	15.3	1.2	21.9	1.0
Monroe	0.9	2.8	0.7	0.2	0.1	0. 1	2.4	37.8	15.5	7.6	3.8	4.0	5.4	18.1	0.6
Perry	1.3	2.6	0.7	0.2	0.0	0. 1	9.9	26.8	17.2	5.0	3.9	15.2	3.2	13.1	1.0
Pickens	1.4	3.3	0.8	0.3	0.1	0. 1	14.1	19.0	20.1	6.1	3.4	9.9	1.7	18.7	1.2
Russell	1.2	3.4	2.6	1.1	0.3	0. 1	12.9	27.8	15.9	8.9	3.5	6.8	3.6	11.6	0.3
Sumter	1.7	2.2	0.8	0.3	0.1	0. 2	3.6	24.2	15.3	5.5	2.4	17.9	0.9	23.7	1.2
Washington	0.9	2.2	0.7	0.2	0.1	0. 3	0.3	33.5	12.6	8.5	3.8	3.4	0.5	31.6	1.4
Wilcox	2.3	2.6	0.5	0.1	0.0	0. 1	6.0	34.2	14.2	7.9	3.2	6.7	0.8	20.6	0.9

County	Water	Undeveloped <sup>1</sup>	Wetland <sup>2</sup>	<b>Open Space</b>	Developed <sup>3</sup>	Agriculture <sup>4</sup>			
Barbour	1.7	72.2	8.9	2.8	1.6	12.8			
Bullock	1.1	67.4	13.0	2.0	1.0	15.5			
Butler	0.4	76.6	10.4	3.5	1.0	8.1			
Choctaw	0.8	74.6	17.9	2.8	0.8	3.1			
Clarke	1.1	73.3	20.2	2.7	0.8	1.9			
Conecuh	0.3	74.1	13.4	2.9	0.8	8.6			
Dallas	2.2	46.4	25.5	3.5	1.8	20.4			
Escambia	0.6	59.3	21.0	3.7	2.0	13.5			
Greene	3.3	42.7	33.8	2.5	0.9	16.8			
Hale	3.7	46.4	21.3	3.2	1.0	24.5			
Lowndes	1.4	53.3	14.9	2.7	0.9	26.9			
Macon	1.0	61.0	18.9	3.4	2.0	13.7			
Marengo	1.1	55.7	22.9	2.8	1.0	16.5			
Monroe	0.9	67.1	18.7	3.0	0.9	9.5			
Perry	1.3	62.8	14.0	2.7	0.8	18.4			
Pickens	1.4	62.6	19.9	3.3	1.2	11.6			
Russell	1.2	69.0	11.9	3.5	4.0	10.4			
Sumter	1.7	51.1	24.9	2.4	1.1	18.9			
Washington	0.9	58.6	33.0	2.5	1.0	3.9			
Wilcox	2.3	65.5	21.4	2.7	0.6	7.5			
Average	1.4	62.0	19.3	2.9	1.3	13.1			
σ5	0.9	10.2	6.7	0.4	0.8	6.8			
<sup>1</sup> Undeveloped includes deciduous forest, evergreen forest, mixed forest, shrubland, and grassland									
<sup>2</sup> Wetland includes woody and emergent wetlands									
3Developed includes	<sup>3</sup> Developed includes high, medium, and low intensity developed								
<sup>4</sup> Agriculture includes pastureland and cropland									
5Denotes standard dev	viation								

 Table 43 Reduced NLCD Land Use/Land Cover Categories for the Black Belt Region (in percent)

County-level data from each of the reduced NLCD land use or land cover categories were compared to the average and standard deviation to develop scores. Because open water, undeveloped land, and wetlands are desirable for environmental robustness, counties received positive scores for above-average metrics in each of these categories. In contrast, open space (i.e., cleared space), developed land, and agricultural land all have the potential to degrade the environment; thus, negative scores were assigned to counties with above-average metrics in each of these categories (Table 44).

County	Water	Undeveloped	Wetland	Open Space	Developed	Agriculture	Aggregate <sup>1</sup>				
Wilcox	0.98	0.35	0.32	0.56	0.83	0.83	3.87				
Washington	-0.56	-0.33	2.04	0.89	0.37	1.36	3.77				
Clarke	-0.34	1.11	0.13	0.45	0.61	1.65	3.61				
Greene	2.13	-1.89	2.15	0.92	0.48	-0.55	3.24				
Choctaw	-0.71	1.24	-0.2	0.41	0.58	1.47	2.78				
Bullock	-0.35	0.53	-0.94	2.04	0.34	-0.35	1.26				
Sumter	0.32	-1.07	0.84	1.27	0.23	-0.85	0.74				
Monroe	-0.62	0.5	-0.09	-0.1	0.43	0.54	0.66				
Conecuh	-1.24	1.18	-0.87	0.09	0.66	0.67	0.5				
Barbour	0.35	1	-1.55	0.21	-0.44	0.04	-0.39				
Marengo	-0.34	-0.62	0.53	0.25	0.28	-0.5	-0.4				
Pickens	-0.04	0.06	0.09	-0.89	0.11	0.22	-0.44				
Hale	2.59	-1.52	0.3	-0.61	0.4	-1.67	-0.52				
Perry	-0.17	0.08	-0.78	0.52	0.54	-0.77	-0.59				
Butler	-1.17	1.44	-1.33	-1.19	0.32	0.74	-1.2				
Lowndes	-0.05	-0.85	-0.65	0.61	0.52	-2.03	-2.46				
Macon	-0.42	-0.1	-0.06	-0.98	-0.93	-0.09	-2.57				
Dallas	0.91	-1.52	0.93	-1.41	-0.73	-1.08	-2.9				
Escambia	-0.99	-0.26	0.25	-1.72	-0.97	-0.05	-3.75				
Russell	Russell -0.28 0.69 -1.1 -1.31 -3.61 0.4 -5.21										
1Aggregate score	e is the sur	n of the six land	use/land cov	er category scor	res.						

Table 44 Land Use/Land Cover Scores for the Black Belt by Aggregate Score

## 5.4.2. ADEM Designated Uses

We extracted county-level designated uses for each waterway and waterbody from the 2020 ADEM Sections 303(d) and 305(b) reports. Total assessed waterway length for streams and waterbody area for lakes and other impoundments were calculated for each category. We normalized lengths and areas of each designated use tier (i.e., OAW, public water supply, swimming, and fish and wildlife use) to total lengths and areas to determine each county's respective percentages (Tables 45 and 6).

County	Outstanding Alabama Water	Public Water Supply	Swimming	Fish and Wildlife
Barbour	0	0	35	65
Bullock	0	0	23	77
Butler	0	0	30	70
Choctaw	0	0	29	71
Clarke	0	1	28	71
Conecuh	0	0	10	90
Dallas	5	0	41	54
Escambia	0	0	18	82
Greene	0	0	0	100
Hale	0	0	0	100
Lowndes	0	0	29	71
Macon	0	9	11	80
Marengo	0	0	27	73
Monroe	0	0	18	82
Perry	13	0	23	64
Pickens	0	0	14	86
Russell	0	4	38	58
Sumter	0	8	0	92
Washington	0	2	58	40
Wilcox	0	0	42	58
Higher tiers include	criteria for all lower tiers.			

### Table 45 Designated Use Tier for Black Belt Waterways (in percent)

County	Outstanding Alabama Water	Public Water Supply	Swimming	Fish and Wildlife						
Barbour	0	0	86	14						
Bullock <sup>1</sup>	-	-	-	-						
Butler <sup>1</sup>		-	-	-						
Choctaw	0	3	42	55						
Clarke	0	0	69	31						
Conecuh <sup>1</sup>	-	-	-	-						
Dallas	0	0	95	5						
Escambia	0	0	100	0						
Greene	0	1	57	42						
Hale	0	1	39	59						
Lowndes	0	0	100	0						
Macon <sup>1</sup>	-	-	-	-						
Marengo	0	2	50	47						
Monroe	0	0	100	0						
Perry <sup>1</sup>		-	-	-						
Pickens	0	0	95	5						
Russell	0	0	14	86						
Sumter	0	0	64	36						
Washington	0	0	0	100						
Wilcox 0 6 86 8										
1No waterbodies asse	<sup>1</sup> No waterbodies assessed by ADEM									
Higher tiers include of	riteria for all lower tiers.									

#### Table 46 Designated Use Tier for Black Belt Waterbodies (in percent)

Because higher-tiered designated uses like OAW and public water supply include criteria for lower-tiered designated uses, waters with higher-tiered designated uses can provide more ecosystem services than lower-tiered waters. Therefore, the proportion of each designated use was weighted by tier to develop county-level scores and rankings (Tables 47-49). Note that a few counties do not contain waterbodies that have been assessed by ADEM and therefore do not receive any additional points. This methodology is justified because waterbodies like impoundments and lakes provide several opportunities for economic development (e.g., water supply, recreation, and tourism).

County	Outstanding Alabama Water	Public Water Supply	Swimming	Fish and Wildlife	Aggregate
Perry	1.21	0.00	0.68	0.64	2.53
Washington	0.00	0.12	1.74	0.40	2.26
Dallas	0.47	0.00	1.22	0.54	2.23
Russell	0.00	0.26	1.14	0.58	1.97
Wilcox	0.00	0.00	1.25	0.58	1.83
Barbour	0.00	0.00	1.06	0.65	1.71
Macon	0.00	0.56	0.33	0.80	1.69
Clarke	0.00	0.09	0.83	0.71	1.63
Butler	0.00	0.00	0.89	0.70	1.60
Choctaw	0.00	0.00	0.88	0.71	1.58
Lowndes	0.00	0.00	0.86	0.71	1.57
Marengo	0.00	0.00	0.80	0.73	1.54
Bullock	0.00	0.00	0.69	0.77	1.46
Sumter	0.00	0.48	0.00	0.92	1.40
Escambia	0.00	0.00	0.54	0.82	1.36
Monroe	0.00	0.00	0.54	0.82	1.36
Pickens	0.00	0.00	0.42	0.86	1.28
Conecuh	0.00	0.00	0.29	0.90	1.19
Greene	0.00	0.00	0.00	1.00	1.00
Hale	0.00	0.00	0.00	1.00	1.00
Counties sorted from highest to lowest aggregate score.					

#### Table 47 Black Belt Region County Scores for Designated Waterway Uses

Scores calculated by multiplying percentages in Table 46 with weighting factors for each tier. OAW = 9 points, public water supply = 6 points, swimming = 3 points, and fish and wildlife = 1 point

County	Outstanding Alabama Water	Public Water Supply	Swimming	Fish and Wildlife	Aggregate
Wilcox	0.00	0.38	2.58	0.08	3.03
Escambia	0.00	0.00	3.00	0.00	3.00
Lowndes	0.00	0.00	3.00	0.00	3.00
Monroe	0.00	0.00	3.00	0.00	3.00
Pickens	0.00	0.00	2.85	0.05	2.90
Dallas	0.00	0.00	2.85	0.05	2.90
Barbour	0.00	0.00	2.59	0.14	2.73
Clarke	0.00	0.00	2.08	0.31	2.39
Sumter	0.00	0.03	1.91	0.36	2.29
Greene	0.00	0.04	1.72	0.42	2.18
Marengo	0.00	0.13	1.51	0.47	2.12
Choctaw	0.00	0.18	1.25	0.55	1.99
Hale	0.00	0.09	1.18	0.59	1.86
Russell	0.00	0.00	0.42	0.86	1.28
Washington	0.00	0.00	0.00	1.00	1.00
Bullock	0.00	0.00	0.00	0.00	0.00
Butler	0.00	0.00	0.00	0.00	0.00
Conecuh	0.00	0.00	0.00	0.00	0.00
Macon	0.00	0.00	0.00	0.00	0.00
Perry	0.00	0.00	0.00	0.00	0.00

#### Table 48 Black Belt Region County Scores for Designated Waterbody Uses

Counties sorted from highest to lowest aggregate score. Scores calculated by multiplying percentages in Table 47 with weighting factors for each tier. OAW = 9 points, public water supply = 6 points, swimming = 3 points, and fish and wildlife = 1 point

County	Waterway Score	Waterbody Score	Aggregate		
Dallas	2.23	2.90	5.13		
Wilcox	1.83	3.03	4.87		
Lowndes	1.57	3.00	4.57		
Barbour	1.71	2.73	4.43		
Escambia	1.36	3.00	4.36		
Monroe	1.36	3.00	4.36		
Pickens	1.28	2.90	4.18		
Clarke	1.63	2.39	4.01		
Sumter	1.40	2.29	3.69		
Marengo	1.54	2.12	3.66		
Choctaw	1.58	1.99	3.57		
Washington	2.26	1.00	3.26		
Russell	1.97	1.28	3.25		
Greene	1.00	2.18	3.18		
Hale	1.00	1.86	2.86		
Perry	2.53	0.00	2.53		
Macon	1.69	0.00	1.69		
Butler	1.60	0.00	1.60		
Bullock	1.46	0.00	1.46		
Conecuh	1.19	0.00	1.19		
Waterway Scores (Table 47) and Waterbody Scores (Table 48) summed to yield aggregate designated use scores.					

#### Table 49 Aggregate Designated Use Scores for Black Belt Region Counties

#### 5.4.3. Section 303(d) List of Impaired Waters

Waters on the Section 303(d) list of impaired waters are waterways and waterbodies that fail to meet the EPA's water and ecosystem quality criteria. Waterbodies failing to meet designated use criteria are only removed or de-listed when the impairment source is addressed by establishing total daily maximum limits (TMDL) or when the cause of impairment is deemed natural. Delisting may also occur when new assessment data demonstrate that designated criteria have been met. Waters that have been de-listed may still fail to meet designated use criteria even though TMDLs have been established.

Additionally, waters that meet all designated use criteria and have been thoroughly assessed are considered Category 1 waters. However, many waters fall between impaired and Category 1 waters when insufficient data have been collected to determine impairment.

We extracted impaired water data from the Section 303(d) list and parsed it at the county level. We normalized the length of impaired waterways and area of impaired waterbodies to total waterway length or total waterway area to determine impairment percentages for each county. The percentage of impaired waterways and waterbodies was multiplied by negative three as a preliminary score for each county. We extracted additional data on waterbodies meeting designated use criteria from the 305(b) list. The percentage of waterways and waterbodies that met designated use criteria (EPA Category 1) were multiplied by positive three. The impaired and unimpaired scores were summed for each county to provide aggregate scores and permit percentage calculations (Tables 50 and 51). We determined final scores for each county by summing the aggregate scores from each assessed category (i.e., land use, land cover, designated uses, and impairment) (Table 12 and Figure 9).

	Waterways		Wate	rbodies	
County	Impaired	Category 1	Impaired	Category 1	
Barbour	37%	28%	83%	16%	
Bullock <sup>1</sup>	28%	19%	-	-	
Butler <sup>1</sup>	6%	46%	-	-	
Choctaw	5%	27%	0%	100%	
Clarke	31%	21%	40%	60%	
Conecuh <sup>1</sup>	5%	50%	-	-	
Dallas	18%	47%	0%	89%	
Escambia	20%	31%	0%	0%	
Greene	17%	29%	2%	98%	
Hale	23%	20%	0%	100%	
Lowndes	0%	42%	0%	100%	
Macon <sup>1</sup>	41%	40%	-		
Marengo	20%	30%	14%	86%	
Monroe	4%	37%	100%	0%	
Perry <sup>1</sup>	31%	14%	-	-	
Pickens	2%	51%	5%	64%	
Russell	13%	49%	4%	90%	
Sumter	38%	11%	11%	89%	
Washington	53%	0%	100%	0%	
Wilcox	0%	49%	6%	87%	
<sup>1</sup> No waterbodies assessed by ADEM					

Table 50 Percentages of Impaired and Category 1 (i.e. unimpaired) Waterways and Waterbodies

	Waterway		Wat	Waterbody		
County	Impaired	Category 1	Impaired	Category 1	Aggregate	
Lowndes	0	1.25	0	3	4.25	
Wilcox	0	1.47	-0.17	2.6	3.9	
Choctaw	-0.14	0.8	0	3	3.67	
Russell	-0.4	1.47	-0.13	2.71	3.65	
Dallas	-0.53	1.41	0	2.67	3.55	
Greene	-0.5	0.88	-0.07	2.93	3.25	
Pickens	-0.05	1.52	-0.16	1.92	3.24	
Hale	-0.7	0.6	0	3	2.9	
Marengo	-0.61	0.89	-0.41	2.59	2.46	
Sumter	-1.13	0.32	-0.33	2.66	1.52	
Conecuh	-0.15	1.49	0	0	1.33	
Butler	-0.18	1.38	0	0	1.2	
Escambia	-0.61	0.94	0	0	0.33	
Clarke	-0.93	0.62	-1.21	1.79	0.27	
Macon	-1.24	1.21	0	0	-0.03	
Bullock	-0.83	0.56	0	0	-0.27	
Perry	-0.92	0.42	0	0	-0.5	
Monroe	-0.11	1.12	-3	0	-1.99	
Barbour	-1.1	0.85	-2.48	0.47	-2.27	
Washington	-1.6	0	-3	0	-4.6	
Waterway Scores and Waterbody Scores (Table 50) summed to yield aggregate designated use scores.						

#### Table 51 Aggregate Designated Use Scores

## 5.5. DISCUSSION

Several counties within the Alabama Black Belt region offer desirable watershed and ecosystem qualities for economic development (Table 52 and Figure 18). The comparison is based on land use, land cover, designated uses for surface waters and the degree of surface water impairment. In particular, Wilcox, Choctaw, Greene, and Clarke counties had positive scores in each of the three categories and total scores exceeding 7.5. These counties should be prioritized for economic development that takes advantage of the high-quality environmental conditions. For example, area waterways and waterbodies could be expressly targeted for the economic development of recreation, tourism, and ecotourism activities. Although Wilcox, Choctaw, Greene, and Clarke counties had the highest scores, no counties received negative scores in all three categories, suggesting that each county has desirable conditions suitable for economic development.

County	LU/LC	Designated Use	Impairment	Total Score	
Wilcox	3.87	4.87	3.9	12.64	
Choctaw	2.78	3.57	3.67	10.02	
Greene	3.24	3.18	3.25	9.67	
Clarke	3.61	4.01	0.27	7.89	
Pickens	-0.44	4.18	3.24	6.98	
Lowndes	-2.46	4.57	4.25	6.36	
Sumter	0.74	3.69	1.52	5.95	
Dallas	-2.9	5.13	3.55	5.78	
Marengo	-0.4	3.66	2.46	5.72	
Hale	-0.52	2.86	2.9	5.24	
Monroe	0.66	4.36	-1.99	3.03	
Conecuh	0.5	1.19	1.33	3.02	
Bullock	1.26	1.46	-0.27	2.45	
Washington	3.77	3.26	-4.6	2.43	
Barbour	-0.39	4.43	-2.27	1.77	
Russell	-5.21	3.25	3.65	1.69	
Butler	-1.2	1.6	1.2	1.6	
Perry	-0.59	2.53	-0.5	1.44	
Escambia	-3.75	4.36	0.33	0.94	
Macon	-2.57	1.69	-0.03	-0.91	
Higher scores indicate higher environmental quality relative to other Black Belt counties.					

## Table 52 Category Scores and Total Scores for Black Belt Counties



# 6. Geographic Information Systems Mapping

# **6.1. INTRODUCTION**

The University of South Alabama GIS Center created a Digital Atlas for Alabama's Black Belt region. It features spatial information spanning a wide range of datasets available for viewing through the University of South Alabama's GIS Server, housed through ESRI's ArcGIS Online outlet. This product can be considered a "Living Atlas" in that data can be added and updated as new data sources become available.

## 6.2. LITERATURE

Similar "Living Atlas" projects hosted by ESRI's ArcGIS Online outlet can be found for many projects. These projects can display many data types and are typically created with public access and ease of use in mind. The hyperlinks below show the wide range of examples and this concept's utility in several fields, ranging from transportation infrastructure to forest fire hotspot mapping to urban flood zone mapping.

# 6.3. DATA AND METHODOLOGY

Among other data sources, the beta version included the following Black Belt region data layers:

- Detailed census data by county
- Detailed census data by zip code
- Rivers and Streams
- Impaired Rivers and Streams
- Simplified land use
- · Address, location, and contact data for hospitals and urgent care facilities
- · Address, location, and contact data for public and private school facilities
- Address, location, and contact data for higher education facilities
- · Address, location, and contact data for child-care facilities
- Simplified climate characteristics

University of South Alabama staff will continue developing and refining available GIS resources to create additional informational map layers and the Digital Atlas will continue to grow in size, providing users with increasing amounts of information. Additionally, data can be edited, and visualizations can be updated or improved. Compared to other atlas forms, the primary benefit of our Digital Atlas is that updating can be a continual process. Future layer additions may include information on fire stations, police precincts, airports, bridges, and other items of interest.

# 6.4. ALABAMA BLACK BELT DIGITAL ATLAS HYPERLINK

https://www.southalabama.edu/colleges/artsandsci/earthsci/geography/dra\_digital\_atlas.html

# 7. Data Visualization

## 7.1. INTRODUCTION

Descriptive analytics enables examining and analyzing historical and current data to describe "what happened" or "what has been happening." In contrast, diagnostic analytics enables answering the "why did it happen" question (Banerjee et al., 2013; Delen and Ram, 2018). Historically, data has most often been presented in tabular format. Modern, practical visualization tools, such as interactive dashboards, help decrease the time and effort needed for accurate data interpretation.

We designed and developed a series of Black Belt Dashboards to provide leaders and policymakers with leading economic indicators and infrastructure data at their fingertips. The Dashboards will be accessible on any internet browser using publicly available hyperlinks. Additionally, users can embed Dashboards into their websites using the embed code ("Share" button in each Dashboard's lower right corner).

Each Dashboard is designed to answer a single question outlined in its title. A brief explanation of metrics used is summarized immediately under the title. Each Dashboard's footer section contains data source links, a button users can use to download a PDF version, and where applicable, an "About Data" button for further methodology explanation. Charts and other dashboard elements are introduced by descriptive titles or by a question to be answered by the chart. Additional details about the topic become visible by hovering over the charts or other dashboard elements. Where applicable, they can also be clicked on and serve as filters to customize the dashboard view to provide additional insights.

Data visualization is a process that transforms data and information into intuitive graphics serving a specific purpose (Thorp, 2013; Valkanova et al., 2015). For the project, we considered several questions while preparing to visualize project data, including:

- 1. What data are available?
- 2. What questions can a dataset answer?
- 3. Who is the audience?
- 4. What answers are users likely to seek from the data?
- 5. What are users' data literacy levels?

We worked with proprietary and publicly available data to develop the visualizations and perform descriptive and diagnostic analytics. Our goal was to provide a "data toolbox" that makes it effortless to obtain Black Belt economic and utility infrastructure data to assist leaders and policymakers in focusing on data-driven strategic decision-making.

# 7.2. LITERATURE

Technology adoption and advancement throughout the 21st century has gradually enabled businesses and organizations to collect and store ever-increasing volumes of data related to many aspects of managing an organization. Asset management, financial data, employee performance, marketing performance, operations, and sales are but a few examples. Therefore, the importance of recognizing the value of data for businesses and organizations has become critical (Fosso Wamba et al., 2015). One of the challenges that large datasets present is making sense of all the rows and columns.

We kept this scientific evidence in mind while designing project dashboards. For the most part, we opted to use commonly used presentations (bar charts, line charts, pie charts). In some cases, though, newer and more practical data visualization techniques were utilized. The features easily identifiable by the human eye, such as color or size, have been used strategically to draw the user's attention to the targeted area and increase the data's faster interpretability (Barcellos et al., 2017; Barrera-Leon et al., 2020; Wolfe and Horowitz, 2004). Well-designed visualizations are tools that can help increase public awareness, inspire discussion by a wider audience, and spur much-needed public discourse between citizens, public agencies, and civic groups (Valkanova et al., 2015).

# 7.3. DATA AND METHODOLOGY

We used both proprietary and public data to depict the region's economic overview and utility infrastructure. In addition, the datasets have been cleaned and shaped to accommodate the project. The sources are described in previous sections.

# 7.4. DASHBOARDS

## 7.4.1.

## **Alabama Black Belt Population Trends**

https://public.tableau.com/app/profile/sabre/viz/PopulationTrends-AlabamaBlackBeltregion/PopulationTrends-DE1-1?publish=yes

## **Alabama Black Belt Population Demographics**

https://public.tableau.com/app/profile/sabre/viz/PopulationDemographics-AlabamaBlackBeltRegion/PopulationDemographicsDE1-2?publish=yes

## **Alabama Black Belt Economy**

https://public.tableau.com/app/profile/sabre/viz/EconomyatGlance-AlabamaBlackBeltRegion/Economyat-GlanceDE1-3?publish=yes

## **Alabama Black Belt Major Industries**

https://public.tableau.com/app/profile/sabre/viz/MajorIndustries-AlabamaBlackBeltRegion/PopulationDemographicsDE2

## Alabama Black Belt Top 25 Industries Shift

https://public.tableau.com/app/profile/sabre/viz/Top25IndustriesShift-AlabamaBlackBeltRegion/Top25Shift?pub-lish=yes

## Alabama Black Belt Future Jobs in Selected Industries

https://public.tableau.com/app/profile/sabre/viz/FutureJobsinSelectedClusters-AlabamaBlackBeltRegion/Clusters-FutureJobs?publish=yes

## Alabama Black Belt Top 25 Occupations Shift

https://public.tableau.com/app/profile/sabre/viz/IndustriesbyTotalRequirementsandImportGap-AlabamaBlackBel-tRegion/ImportgapandTotReq?publish=yes

## Alabama Black Belt Import Gap By Cluster By County

https://public.tableau.com/app/profile/sabre/viz/ImportGapEconomicImpactofClustersbyCounty-AlabamaBlackBeltRegion/Importgap-BYCOunty-Bars?publish=yes

## Alabama Black Belt Import Gap Economic Impact By Cluster

https://public.tableau.com/app/profile/sabre/viz/ImportGapEconomicImpactbyClusters-AlabamaBlackBeltRegion/ ImportgapandTotReq2?publish=yes

### Alabama Black Belt Wastewater Infrastructure

https://public.tableau.com/app/profile/sabre/viz/WastewaterSystems-AlabamaBlackBeltRegion/FlowRates?pub-lish=yes

### Alabama Black Belt Drinking Water Infrastructure

https://public.tableau.com/app/profile/sabre/viz/DrinkingWater-AlabamaBlackBeltRegion/Water-Dahsboard?pub-lish=yes

#### Alabama Black Belt Natural Gas and Propane Infrastructure

https://public.tableau.com/app/profile/sabre/viz/GasProviders-AlabamaBlackBeltRegion/GasDashboard?pub-lish=yes

### Alabama Black Belt Broadband Internet Infrastructure

https://public.tableau.com/app/profile/sabre/viz/InternetAccess-AlabamaBlackBeltRegion/Coverage-Dashboard?-publish=yes
# 8. Strategic Recommendations

### 8.1. SWOT ANALYSIS

A SWOT Analysis focuses on the four elements included in the acronym: Strengths, Weakness, Opportunities, and Threats. A SWOT Analysis is an analytical framework that identifies internal and external influences, which companies and organizations can use to identify existing challenges and difficulties, and then develop future operational and growth strategies designed to overcome roadblocks and chart a course for success. Often used in strategic planning efforts, a SWOT Analysis can serve effectively as a precursor to any organizational decision or action.

#### 8.1.1. Strengths and Weaknesses

Strengths and Weaknesses typically refer to internalities: financial, physical, personnel, and organizational systems and processes. Key questions to examine include:

#### Strengths:

- What does the organization do well?
- Upon what unique resources can the organization draw?
- What do others see as the organization's strengths?

#### Weaknesses:

- What could the organization improve?
- Where does the organization have fewer resources than others?
- · What are others likely to see as the organization's weaknesses?

#### 8.1.2 Opportunities and Threats

Opportunities and Threats typically refer to externalities: markets, economics, politics, and demographics. Organizations must act strategically in their external response and leverage perceived strengths as opportunities (e.g., in support of an organization's expansion or to highlight its unique attributes to build brand awareness and increase demand). Similarly, identified weaknesses can provide informed platforms for improvements. Key questions to examine include:

#### **Opportunities:**

- What opportunities are open to the organization?
- What trends could the organization turn to its advantage?
- How could the organization turn its strengths into opportunities?

#### Threats:

- What threats could harm the organization?
- What is the organization's competition doing?
- What threats do the organization's weaknesses create for the organization?

### 8.2. BLACK BELT SWOT ANALYSIS SUMMARY

#### 8.2.1. Strengths

#### **Economic Impact Assessment**

- The GIWW is a critical asset to the Black Belt region, connecting 20 largely rural economies to those of the Gulf Coast, the Great Lakes, and beyond.
- Gross Regional Product (GRP) in the Black Belt is \$12.5 billion and has increased in recent years.
- The Waterway & Logistics Cluster GRP is \$258.8 million (2.1% of total Black Belt GRP)
- The Recreation & Tourism Cluster GRP is \$327.9 million (2.7% of total Black Belt GRP)
- The GIWW and its tributaries are closely connected to local Black Belt economies.

#### **Environmental Housing Impact Assessment**

- Close geographic proximity to the GIWW's tributaries, not the GIWW itself, is a preferred choice of homebuyers.
- The external financial benefit of close proximity to GIWW tributaries is approximately \$29,000 per household (28% higher than no proximity).
- The average aggregate financial benefit of GIWW tributaries within the Black Belt is \$722,512 per household.

#### Wastewater and Infrastructure Assessment

- Areas with all critical infrastructures in place are immediately ready for the expansion of residential areas and the establishment of new businesses.
- Drinking water is available throughout the Black Belt.
- Natural gas or propane service is available throughout the Black Belt.
- Electricity infrastructure is available throughout the Black Belt.
- Internet service is available via satellite throughout the Black Belt region where cable, fiber, and ADSL technologies are unavailable.

#### Watershed and Ecosystem Assessment

- Land use within the Black Belt is generally undeveloped.
- For waterways within the Black Belt, designated tier uses from the Alabama Department of Environmental Management are for fish and wildlife or higher.
- The Black Belt has numerous unimpaired waterbodies and waterways.

### 8.3. WEAKNESSES

#### **Economic Impact Assessment**

- The Black Belt receives no economic benefits from the value of the freight that is moved through its portion of the GIWW.
- Black Belt land area is 33.4% of Alabama's total, yet Black Belt GRP is only 5.6% of Alabama's total as a region.
- Black Belt household income levels are lower than for Alabama as a whole.
- Most current Black Belt occupations are relatively low-skilled.

#### **Environmental Housing Impact Assessment**

- Water pollution creates an external cost of \$5,065 per mile of impaired river per household.
- The median residential property value is lower compared to other areas in Alabama.

#### Wastewater and Infrastructure Assessment

- Adequate wastewater infrastructure is not currently available in many areas of the Black Belt, which may suggest that in some places untreated sewage is being directly discharged onto the ground and which, as a result, may negatively impact water quality.
- Many areas of the Black Belt have soils that are unsuitable for septic tank usage, forcing reliance on alternative and often more expensive wastewater management systems.
- While cellular voice and data are available in most areas, some notable gaps are present.
- Fast and reliable broadband internet service is limited throughout the Black Belt.
- Areas within the Black Belt lacking critical infrastructures, such as adequate wastewater systems, may not support economic growth.

#### Watershed and Ecosystem Assessment

- Waterbody impairment is an issue, especially downstream of livestock pasture and feeding operations.
- Pathogens are a major cause of impairment, limiting many recreational uses, including swimming.

## 8.4. OPPORTUNITIES

#### **Economic Impact Assessment**

- Target economic development to industries with Black Belt region Import Gaps totaling \$10.3 billion.
- Specifically, target economic development to industries within WLC and RTC Clusters with combined Import Gaps totaling \$430.2 million.
- If filled, WLC Import Gap's potential economic impacts would result in 371 jobs, \$12 million in new wages, \$15.3 million in new value creation, \$38.5 million new revenues, \$1 million in new taxes.
- If filled, RTC Import Gap's potential economic impacts would result in 71 jobs, \$1.4 million in new wages, \$3.3 million in new value creation, \$14.7 million new revenues, and \$232,500 in new taxes.

#### **Environmental Housing Impact Assessment**

- Adopt policies that maintain dredging and protect water quality, increase property values, and generate higher tax revenues to support economic development.
- Promote GIWW tributaries as aesthetical and recreational assets.

#### Wastewater and Infrastructure Assessment

- Fill the Black Belt's water and wastewater infrastructure investment gap and potentially provide 1,500 jobs, labor income of \$89 million, and total annual revenues of \$260 million.
- Boost economic output of \$2.88 million per every \$1 million spent expanding broadband internet service infrastructure.

#### Watershed and Ecosystem Assessment

- Promote the many Black Belt waterbodies and waterways suitable for recreational activities such as swimming, skiing, fishing, kayaking, boating, and other water-related activities.
- Utilize Black Belt waterbodies and waterways suitable for public water supply to expand infrastructure.
- The Black Belt has large expanses of undeveloped land with unimpaired waters that may be desirable for housing.

## 8.5. THREATS

#### **Economic Impact Assessment**

- Failure to maintain dredging activities within the GIWW could impact navigability and devalue the industries that depend on its use.
- Failure to maintain dredging activities within the GIWW could devalue property values in the region.
- Continued outward population migration poses a threat to the Black Belt region.
- Automation could replace low-wage jobs (e.g., a French fry machine could replace a low-wage worker in a fast-food restaurant), which would place additional pressure on employment and the labor force.
- Failing to adopt policies and legislation designed to promote and support economic expansion could result in long-term negative consequences for the Black Belt region.

#### **Environmental Housing Impact Assessment**

- Farming activities and other nonpoint sources of water pollution could impair waterbodies and waterways and diminish property values.
- There are multiple potential health issues associated with poor water quality.

#### Wastewater and Infrastructure Assessment

- Failing to invest in correcting wastewater system deficiencies and constructing new wastewater treatment infrastructure will deter residential and economic growth within the Black Belt.
- Failing to invest in wastewater infrastructure will continue to impact the Black Belt's environmental and community health negatively.
- Failure to invest in drinking water infrastructure updates and repairs could cause disruptions of service and result in negative economic impacts.

#### Watershed and Ecosystem Assessment

- Land development may degrade surface water quality.
- Mercury impairment is present, but it is caused mainly by factors external to the Black Belt region.

#### 8.6. STRATEGIC RECOMMENDATIONS

We used SWOT Analysis results to formulate multiple strategic policy, statutory, and investment recommendations. Guiding the effort were some key questions:

- · How can the Black Belt use its strengths to succeed?
- · Which weaknesses can the Black Belt improve that maximize success?
- Which opportunities should the Black Belt pursue?
- What strategies can the Black Belt employ to be prepared for threats?

#### 8.6.1. Economic Impact Assessment

Maintaining the navigability of the GIWW is critical. Even though the Black Belt derives no economic benefit from the actual value of the cargo that flows through it, area residents, businesses, and industries do benefit from jobs and economic activity tied to GIWW operation. Any constrictions on waterway navigability are potential constrictions on economic output. Additionally, our results showed that people value the properties surrounding the many tributaries of the GIWW. Inadequate dredging could reduce access, and as a result, potentially lead to reduced property values. Black Belt leaders must continue to push national and state political leaders to ensure adequate financial appropriations for GIWW dredging within the Black Belt.

Economic development does not happen in a vacuum and is most often due to synergies between community groups. Failing to provide policy support may reduce outcomes. Assemble a group of key policymakers, local leaders, and economic development officials to form a coalition that represents and lobbies at both the federal and state levels for the economic and social welfare interests of the Black Belt.

Some counties may be too small or lack the necessary experience or financial resources to pursue economic development projects at the county level. Just as regionally, there is strength in numbers, even more so for a small area. Leaders in these counties should consider partnering with neighboring counties and organizations to promote each area's complementary attributes and work together to promote their mutual interests.

The Black Belt economy is small relative to Alabama. Even so, opportunities for expanding it do exist. Earlier, we identified substantial Import Gap opportunities in two critical Black Belt economic clusters. We then used our economic impact analysis to evaluate how filling all Import Gaps would affect the economy with respect to jobs, wages, value creation, revenues, and taxes. Logic would urge economic development pursuit.

In addition to the identified cluster opportunities, consider that the Black Belt has 993 industries. However, only 74 of these are from either the WLC or RTC. Given that the WLC and RTC account for only 4.2% of the Import

Gaps in the region, leaders should make efforts to conduct similar analyses on remaining Import Gap opportunities within the Black Belt and use results to inform a broader economic development strategy.

The Recreation and Tourism industries offer opportunities for expansion in some areas within the Black Belt. Officials should utilize and take full advantage of the many local attractions and amenities described earlier to develop a comprehensive plan for advancing interests and adding value by recruiting outside the region. They should partner efforts at the county level with regional economic development officials to introduce sustained, targeted marketing and promotion strategies. Involve not only local officials but also local businesses in campaign discussions and development.

#### 8.6.2. Environmental Housing Impact Assessment

Our results indicated that people highly value close proximity to GIWW tributaries. Higher property values are the result. As a contribution to efforts to realize increased economic activity, Black Belt policymakers should work to maximize the aesthetical and recreational values of the GIWW tributaries.

Water quality and aesthetic appeal influence property values. Our results showed aggregate financial benefit increases related to GIWW tributaries. Local leaders should work with policymakers to enforce high water quality management to preserve and increase tributaries' aesthetical and recreational values and minimize property value losses.

Our results showed that agricultural practices are contributors to water quality impairment in some areas. Agriculture is a critical industry in the Black Belt region that is essential not only to the economy but in many ways to the fabric of people's lives. Leaders must look for ways to decrease agricultural land use waterway pollution while at the same time not impeding the agricultural industry's ability to operate and succeed. One suggestion might be to engage an agriculture extension office to design and host best practices educational programs for area farmers.

#### 8.6.3. Wastewater and Infrastructure Assessment

Key to any area's economic development prospects is its ability to provide a range of competitively priced and reliable infrastructure services to area residents. New infrastructure services development, existing systems maintenance, sufficient service supply and system capacity demand, and operations within environmental and regulatory compliant are all keys to economic welfare and uninterrupted service.

Focus economic expansion in the areas already supported by the necessary infrastructure. Adding to existing systems and expanding existing supplies is less costly and time-consuming than starting from nothing. Local government owners and operators of wastewater treatment facilities should seek grants and other funding and assistance from federal and state agencies. Area leaders, policymakers, and elected officials should focus on increased investment in increasing and updating wastewater treatment facilities.

Conflicts between federal, state, and local environmental laws can lead to confusion and create gaps in enforceability. Although some can often view any change in the law with skepticism, some changes to environmental statutes may need to be addressed. Regulators and policymakers should consider joining forces to update and standardize state and local infrastructure regulations to match U.S. Environmental Protection Agency's standards.

In some areas, soils in the Black Belt simply will not accommodate a typical residential septic tank system. This deficiency poses an obvious challenge to residential and business development. Alternate systems and designs may offer opportunities. Utility authorities should adopt strategies for expanding the use of decentralized wastewater infrastructure and exploring new, more cost-effective technologies to meet rural and underserved areas' unique needs.

#### 8.6.4. Watershed and Ecosystem Assessment

The Black Belt region has numerous waterbodies that are unimpaired. These waters present opportunities for increased recreational use and residential development. Leaders should incorporate the natural attractiveness of Black Belt waters into marketing and promotional efforts to encourage investment and expand real estate development.

Because much of the Black Belt region is undeveloped, Black Belt leaders can modify existing land use regulations to encourage and promote real estate development. At the same time, any policy that encourages development must also embrace sustainability and environmental protection concepts. Allowing real estate development that degrades land or impairs lakes, streams, and rivers will not likely lead to positive economic outcomes.

Agriculture-related waterway impairment can be detrimental to the region. Policymakers must recognize that as vital as the agriculture industry is, potential adverse effects from agricultural practices may well hinder positive future growth within the Black Belt region. Work to increase awareness and education about links between agriculture and water pollution, and set policies that promote safe, environmentally sustainable agricultural practices.

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## Appendix A – Alabama Black Belt Recreational and Tourism Opportunities

The Alabama Black Belt offers many opportunities for recreation. Hunting, fishing, swimming, boating, canoeing, kayaking, paddle boarding, skiing, hiking, exploring, wildlife viewing, and horseback riding are just some of the many things residents and visitors alike enjoy throughout the year. Many tourism opportunities are available as well. Each year thousands of people from the Black Belt and beyond visit the region's many historical sites, museums, playhouse productions, state and national parks, and athletic events. Each county is unique, and each offers many outlets that if properly marketed and promoted could serve as economic drivers that do not require significant resource investment.

#### **BARBOUR COUNTY**

Lakepoint State Park is situated along the banks of Lake Eufaula, a 45,000-acre lake known as "The Bass Capital of the World." Waterways are the Chattahoochee and Choctawhatchee Rivers. Amenities include campgrounds, on-water gas pumps, and boat launches. State parks, preserves, historical landmarks, and museums include Shorter Mansion and Fendall Hall.

#### **BUTLER COUNTY**

The waterway is Pigeon Creek. Bent Creek Lodge offers 30,000 acres for bow and gun hunting, with abundant white tail deer and eastern wild turkey throughout. State parks, preserves, historical landmarks, and museums include the Hank Williams Boyhood Home and Museum, offering visitors opportunities to learn more about one of country music's biggest stars.

#### **BULLOCK COUNTY**

Blue Heron Lake supports many recreational activities. The waterway is the Conecuh River. Amenities include stables, paddocks, and campsites. Providence Canyon and Blue Springs are state parks. State parks, preserves, historical landmarks, and museums include Josephine Arts Center, Bullock Count Jail Museum, and the Log Cabin Museum.

#### **CHOCTAW COUNTY**

The waterway is the Tombigbee River. Numerous hunting lodges and campgrounds are available, including the Choctaw National Wildlife Refuge, Bladon State Park, Coffeeville Lake, Lenoir Landing Park. State parks, preserves, historical landmarks, and museums include Broadhead Memorial Park, Choctaw County Historical Museum, and Military Memorial Walkway.

#### **CLARKE COUNTY**

The waterways are the Tombigbee and Alabama Rivers. Amenities include the Claiborne Lake Dam, with camping facilities and boat ramp. State parks, preserves, historical landmarks, and museums include Alabama Southern Community College Regional Art Museum, Clarke County Historical Museum, and the Kathryn Tucker Windham Museum.

#### **CONECUH COUNTY**

The waterway is the Sepulga River. Amenities include Boggs & Boulders Off Road Park and Campground, and the Bull Slough Bridge Canoe Launch. State parks, preserves, historical landmarks, and museums include the Brown Hawkins Rural Learning Center, Booker's Mill, and the Historic Evergreen Train Depot.

#### **DALLAS COUNTY**

The waterways are the Cahaba and Alabama Rivers. Amenities include a fishing center at Dallas County Public Lake and numerous hunting lodges. State parks, preserves, historical landmarks, and museums include the Ancient Africa Enslavement and Civil War Museum, the Bienville Monument Museum, and the National Voting Rights Museum of Selma.

#### **ESCAMBIA COUNTY**

The waterway is the Conecuh River. Amenities include a boat ramp and fishing pier at Leon Brooks Hines Public Lake. State parks, preserves, historical landmarks, and museums include the Magnolia Branch Wildlife Reserve, the Poarch Creek Band of Indians Museum, the Thomas E. McMillan Museum and Alabama Room, and the Turtle Point Environmental Science Center.

#### **GREENE COUNTY**

The waterway is the Black Warrior River. Amenities include Forkland Park Campground that has campsites with views of Rattlesnake Bend, a 12-mile ox-bow loop of flat water on an arm of the river. State parks, preserves, historical landmarks, and museums include Boligee Hill, the Coleman-Banks House, and the Greene County Courthouse Square District.

#### HALE COUNTY

The waterway is the Black Warrior River. Amenities include the Payne Lake Recreational Area, with campsites and cooking and campfire areas. State parks, preserves, historical landmarks, and museums include the Safehouse Black History Museum.

#### **LOWNDES COUNTY**

The waterway is the Alabama River, including the Robert F Henry Lock and Dam. Amenities include campsites and hiking trails. State parks, preserves, historical landmarks, and museums include the Original Site of Tent City, the Lowndes County Interpretive Center, the Elmore Bolling Historic Site, the Jonathan Daniels Memorial Site, and the Viola Liuzzo Memorial.

#### **MACON COUNTY**

The waterway is the Tallapoosa River. Amenities include campsites and shooting ranges. State parks, preserves, historical landmarks, and museums include Tuskegee National Forest, the George Washington Carver Museum, the Tuskegee Heritage Museum, and the Tuskegee Human and Civil Rights Multicultural Center.

#### **MARENGO COUNTY**

The waterways are the Tombigbee River and Black Warrior Rivers. Amenities include hunting lodges, campgrounds, boat ramps, and boat docks. State parks, preserves, historical landmarks, and museums include Foscue Creek Park, Kingfisher Bay Marina, Bluff Hall, Laird Cottage and Geneva Mercer Museum, the Marengo County History and Archive Museum, and the Gaineswood National Historic Landmark

#### **MONROE COUNTY**

The waterway is the Alabama River, including the Claiborne Lock and Dam. Amenities include boat ramps, campgrounds, and lodges. State parks, preserves, historical landmarks, and museums include the Davis River Ferry, Little River State Forest, Monroe County Lake, the Old Courthouse Museum, the Southwest Alabama Regional Arts Museum, Lyle Salter Park, and Rikard's Mill Historical Park.

#### PERRY COUNTY

The waterway is the Cahaba River. Amenities include a 100-foot-tall canopy birding tower, boat ramps, and Barton's Beach Cahaba River Preserve with sand and gravel bars, beaver ponds, swamps, and the hardwood forest. State parks, preserves, historical landmarks, and museums include the Alabama Military Hall of Honor Museum, the Alabama Women's Hall of Fame, and the Marion Female Seminary Building.

#### **PICKENS COUNTY**

The waterway is the Tombigbee River. Amenities include campsites, fire pits, and a 25-foot diameter floating trampoline. State parks, preserves, historical landmarks, and museums include Shark Tooth Creek Outdoor Adventures, the Aliceville Museum and the Tom Bevell Visitor Center.

#### **RUSSELL COUNTY**

The waterway is the Chattahoochee River. Amenities include Big Uchee Creek. State parks, preserves, historical landmarks, and museums include the Fort Mitchell Visitors Center, the Infantry Museum, the Phenix Cit Museum, and the Greene Museum.

#### **SUMTER COUNTY**

The waterway is the Tombigbee River. Amenities include campgrounds and boat ramps. State parks, preserves, historical landmarks, and museums include the Spence-Moon House, listed on the Alabama Register of Landmarks and Heritage, the Alamuchee Covered Bridge, built in 1861 by Captain William A. C. Jones, and the Black Belt Museum on the campus of the University of West Alabama.

#### WASHINGTON COUNTY

The waterway is the Tombigbee River. Amenities include boat rentals, boat ramps, tackle shops, kayak rentals, fishing piers, and campgrounds. State parks, preserves, historical landmarks, and museums include Healing Springs and the Washington County History Museum.

#### WILCOX COUNTY

The waterway is the Alabama River. Amenities include boat ramps and campgrounds, and fishing tournaments. State parks, preserves, historical landmarks, and museums include Chilatchee Creek Campground, the Pine Hill Depot Museum, Moore Academy at Pine Apple, the Wilcox Female Institute, and the Snow Hill Institute.

## Appendix B – Technology and Highest Speeds Offered by ISPs

County	Service Provider	Technology	Highest Speed (Mbps)
	Charter Communications	Cable	300/20
	ViaSat Inc	Satellite	35/3
	Hughes Network Systems LLC	Satellite	25/3
Parhour	AT&T Inc	Fixed wireless, ADSL	10/1
Barbour	VSAT Systems LLC	Satellite	2/1.3
	Comcast Corporation	Cable	200/10
	CenturyLink Inc	ADSL	40/3
	Troy Cablevision Inc	Fiber, ADSL	1000/1000
	Mon-Cre Telephone Cooperative	Fiber	100/50
	Troy Cablevision Inc	Fiber, ADSL	50/25
Dullask	ViaSat Inc	Satellite	35/3
BUIIOCK	Hughes Network Systems, LLC	Satellite	25/3
	VSAT Systems LLC	Satellite	2/1.3
	AT&T Inc	Fixed wireless	10/1
	CenturyLink Inc	ADSL	60/5
	ViaSat Inc	Satellite	35/3
	Hughes Network Systems LLC	Satellite	25/3
	Haynewill Holding Company LLC	ADSL, Fiber	500/500
Butler	VSAT Systems LLC	Satellite	2/1.3
	Charter Communications	Cable	300/20
	Mediacom Communications Corp	Cable	1000/50
	Troy Cablevision	Fiber	1000/1000
	AT&T Inc	Fixed wireless	10/1
	ViaSat Inc	Satellite	35/3
	Hughes Network Systems LLC	Satellite	25/3
Ch. (	VSAT Systems LLC	Satellite	2/1.3
Choctaw	Pine Belt Communications Co.	Cable	15/3
	Telephone and Data Systems Inc	ADSL	15/2
	Millry Corporation	Fiber, ADSL	100/20

County	Service Provider	Technology	Highest Speed (Mbps)
	ViaSat Inc	Satellite	100/3
	Hughes Network Systems LLC	Satellite	25/3
	VSAT Systems LLC	Satellite	2/1.3
	Pine Belt Communications Co.	ADSL, Fiber	100/100
	Mediacom Communications Corp	Cable	1000/50
Clarke	AT&T Inc	ADSL, Fixed wireless	25/2
	Telephone and Data Systems Inc	Fiber, ADSL	1000/400
	Frontier Communications Corp	ADSL	115/7
	Point Broadband Fiber Holding	Fixed wireless	20/2
	Conexus Communications Inc	Fixed wireless	30/5
	Harbor Communications	Fiber Fixed wireless	20/20
	ViaSat Inc	Satellite	100/3
	Hughes Network Systems LLC	Satellite	25/3
	VSAT Systems LLC	Satellite	2/1.3
	Frontier Communications Corp	ADSL	90/5
G	Conexus Communications Inc	Fixed wireless	30/5
Conecun	Castleberry Communications	ADSL	10/1
	Mediacom Communications Corp	Cable	1000/50
	AT&T Inc	Fixed wireless	10/1
	Mon-Cre Telephone Cooperative	Fiber	100/50
	CenturyLink Inc	ADSL	20/1.5
	ViaSat Inc	Satellite	100/3
Dallas	Hughes Network Systems LLC	Satellite	25/3
	VSAT Systems LLC	Satellite	2/1.3
	Pine Belt Communications	Fiber	100/100
	Charter Communications	Cable	940/35
	CenturyLink Inc	ADSL	40/3
	AT&T Inc	Fixed wireless, ADSL	18/1

County	Service Provider	Technology	Highest Speed (Mbps)
	ViaSat Inc	Satellite	100/3
	Hughes Network Systems LLC	Satellite	25/3
	VSAT Systems LLC	Satellite	2/1.3
	Mediacom Communications Corp	Cable	1000/50
Escambia	AT&T Inc	ADSL, Fixed wireless	18/1
	Frontier Communications Corp	ADSL	115/7
	Point Broadband Fiber Holding	Fixed wireless	20/2
	Conexus Communications Inc	Fixed wireless	30/5
	Charter Communications	Cable	300/20
	ViaSat Inc	Satellite	100/3
	Hughes Network Systems LLC	Satellite	25/3
Greene	VSAT Systems LLC	Satellite	2/1.3
	Mediacom Communications Corp	Cable	1000/50
	AT&T Inc	Fixed wireless, ADSL	25/5
	ViaSat Inc	Satellite	100/3
	Hughes Network Systems LLC	Satellite	25/3
	VSAT Systems LLC	Satellite	2/1.3
Hala	Mediacom Communications Corp	Cable	1000/50
Hale	AT&T Inc	ADSL, Fixed wireless	25/5
	BDA Wireless LLC	Fixed wireless	12/4
	Comcast Corporation	Cable	987/35
	Moundville Communications	ADSL, Fiber	100/100
	ViaSat Inc	Satellite	100/3
Lowndes	Hughes Network Systems LLC	Satellite	25/3
	VSAT Systems LLC	Satellite	2/1.3
	Charter Communications	Cable	300/20
	AT&T Inc	ADSL, Fixed wireless	18/1
	Hayneville Holding Company	ADSL	500/500
	Comcast Corporation	Cable	987/35

County	Service Provider	Technology	Highest Speed (Mbps)
	ViaSat Inc	Satellite	100/3
	Hughes Network Systems LLC	Satellite	25/3
	VSAT Systems LLC	Satellite	2/1.3
Macon	Troy Cablevision Inc	Fiber, ADSL	50/25
	CenturyLink Inc	ADSL	10/1
	AT&T Inc	ADSL, Fixed wireless	25/2
	Charter Communications	Cable	940/35
	ViaSat Inc	Satellite	100/3
	Hughes Network Systems LLC	Satellite	25/3
	VSAT Systems LLC	Satellite	2/1.3
	Pine Belt Communications Co.	ADSL, Fiber	1000/1000
	Mediacom Communications Corp	Cable	1000/50
Marengo	AT&T Inc	ADSL, Fixed wireless	18/1
	Frontier Communications Corp	ADSL	115/7
	Total Radio Service Inc	Fixed wireless	5/4
	BDA Wireless	Fixed wireless	12/4
	Eagle Internet Services LLC	Fixed wireless, ADSL	12/2
	ViaSat Inc	Satellite	100/3
	Hughes Network Systems LLC	Satellite	25/3
M	VSAT Systems LLC	Satellite	2/1.3
Monroe	Mediacom Communications Corp	Cable	1000/50
	Frontier Communications Corp	ADSL	115/7
	Conexus Communications Inc	Fixed wireless	30/5
	ViaSat Inc	Satellite	100/3
	Hughes Network Systems LLC	Satellite	25/3
	VSAT Systems LLC	Satellite	2/1.3
Perry	AT&T Inc	ADSL, Fixed wireless	18/1
	Frontier Communications Corp	ADSL	6/1
	BDA Wireless	Fixed wireless	12/4
	Eagle Internet Services LLC	Fixed wireless	4/2

County	Service Provider	Technology	Highest Speed (Mbps)
Pickens	ViaSat Inc	Satellite	100/3
	Hughes Network Systems LLC	Satellite	25/3
	VSAT Systems LLC	Satellite	2/1.3
	AT&T Inc	Fiber, Fixed wireless	1000/1000
	Frontier Communications Corp	ADSL	115/7
	CenturyLink Inc	ADSL	10/1
	GCTR	Cable	100/10
	ViaSat Inc	Satellite	100/3
	Hughes Network Systems LLC	Satellite	25/3
Bussell	VSAT Systems LLC	Satellite	2/1.3
Russell	AT&T Inc	ADSL, Fiber	1000/1000
	R. M. Greene Inc	Cable	100/5
	Charter Communications	Cable	940/35
	ViaSat Inc	Satellite	100/3
	Hughes Network Systems LLC	Satellite	25/3
S	VSAT Systems LLC	Satellite	2/1.3
Sumter	CenturyLink Inc	ASDL	40/3
	Mediacom Communications Corp	Cable	1000/50
	AT&T Inc	ADSL, Fixed wireless	18/1
	ViaSat Inc	Satellite	100/3
	Hughes Network Systems LLC	Satellite	25/3
Washington	VSAT Systems LLC	Satellite	2/1.3
	Mediacom Communications Corp	Cable	1000/50
	AT&T Inc	ADSL, Fixed wireless	25/2
	Telapex Inc	Fiber	1000/1000
	Millry Corporation	ADSL	25/3

County	Service Provider	Technology	Highest Speed (Mbps)
Wilcox	ViaSat Inc	Satellite	100/3
	Hughes Network Systems LLC	Satellite	25/3
	VSAT Systems LLC	Satellite	2/1.3
	Pine Belt Communications Co.	ADSL	15/1.5
	Mediacom Communications Corp	Cable	1000/50
	AT&T Inc	ADSL, Fixed wireless	25/2
	Frontier Communications Corp	ADSL	18/1
	CenturyLink Inc	ASDL	60/5
	Cable One Inc	Cable	1000/50
	Mon-Cre Telephone Cooperative	Fiber	100/50



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