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The Future of the Louisiana Waterways Transport System: A System Analysis and Plan to Move Commerce by Water

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13. Abstract
Moving commerce by water represents 25 percent of all goods movements within the state of Louisiana and is a critical component of the multimodal transportation system in the state [1]. To be best positioned for future development and investment, the Louisiana Department of Transportation and Development's (DOTD) Office of Multimodal Commerce (OMC) requested a comprehensive, statewide waterways transportation system plan. The plan would be capable of dovetailing into, and be a complement for, the Louisiana Statewide Transportation Plan. In doing so, it will provide the OMC the ability to identify potential chokepoints in the multimodal commerce network and ultimately assist in the development of strategies and capital investment programs to relieve these chokepoints through running “what-if” scenarios of the impacts of potential modal shifts on localized congestion.

To be able to develop this plan with a capability of providing a level of planning and forecasting guidance, it was necessary to identify the type and value of waterborne commerce, thereby providing the focus for the analysis and documentation of the impact and importance of waterborne commerce on the state of Louisiana, its transportation system, and, as such, identify the regional and national level of returns on investment in the network. By implementing the Louisiana Waterways Analysis Tool Evaluating Regional Systems (LA WATERS) technical support platform, OMC is provided the basis for present and future analysis in support of identifying opportunities for alleviating multimodal bottlenecks relative to waterways. Finally, the compilation of research, analysis, and technical deliverables provide the basis for the draft Louisiana Waterways State Transportation Plan that can be streamlined into the Louisiana Statewide Transportation Plan.

The type and economic significance of waterborne commerce within Louisiana was identified to support planning and forecasting guidance through Freight Analysis Framework (FAF) [2] analysis and a statewide economic survey. This approach focused on the analysis and documentation of the impact and importance of waterborne commerce on the state of Louisiana and its transportation system, and enabled the identification and quantification of regional and national level of returns on investment in the inland waterways network of Louisiana. The output provided an assessment of Louisiana's waterborne commerce by both commodity and industry at a regional level. In addition, businesses, and port terminals (public and privately owned/operated) that depend on Louisiana's navigable waterway systems are identified by industry type, company name, and product.

Because of the disparate nature of the type, source, and reporting structure of relevant data as it relates to all aspects of waterborne commerce and the infrastructure associated with it, the development of the LA WATERS platform was a critical step in being able to collect, aggregate, process, and analyze a multitude of data from a wide and diverse range of data sources into a first of its kind data management portal. LA WATERS enabled the compilation of historical data and trends, statistical analysis, infrastructure condition assessments, prevailing environmental and economic conditions, and micro- and macro-market trigger events, along with an extensive library of available data into a "what-if" scenario customizable planning tool for determining effective waterway infrastructure solutions to improve economic activity and throughput, evaluate projects and strategies to alleviate multimodal bottlenecks, and assist in operational decision-making across a set of user-defined geopolitical boundaries.

While the COVID-19 pandemic is generally regarded as a once in a generation type economic shock, and there is significant uncertainty surrounding the impacts of climate change, it is evident that the region is expected to continue to experience an increasing trend to more frequent storms of higher magnitude. This Louisiana Waterways State Transportation Plan recognizes and emphasizes the need to mitigate against the risk to the waterways system resulting from these increased frequent extreme weather conditions and macro-economic shocks, as typified by the COVID-19 pandemic.

This program of study sponsored a dedicated, port-specific, customized survey designed to solicit waterways-user generated information that can best assist DOTD in understanding Louisiana's waterborne commerce community conditions relative to the waterways and to generate perspectives on recommended future improvements to commerce and infrastructure.

A comprehensive analysis of port surveys, economic impact survey, and key industry sector and automatic identification system (AIS) source data identified a list of projects that could potentially increase economic throughput of the waterways within their jurisdictions. These projects were evaluated and recorded within the LA WATERS platform, and sensitivity analyses were performed to assess response to both micro- and macro-dynamic drivers.

Louisiana's intracoastal and inland waterway system is well-established, with nearly 2,820 miles of navigable waterways, making it the second largest navigable waterway in the nation. Louisiana is highly dependent upon trucks for the movement of most of its freight. Waterway transportation is an essential component in the transportation system and is currently underutilized. Louisiana requires a transportation paradigm shift through the implementation of appropriate planning and management in order to seize upon this competitive advantage of an abundance of navigable waterways and, in doing so, the development of the increased utility of these waterways.

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Abstract

Louisiana transported 238.7 million tons of freight on the inland waterway system, valued at $59 billion. Equivalent to 6 million, 40-ton trucks if transported by road, this represents a significant, avoided congestion emissions impact as well as significantly reduced wear-and-tear of highway infrastructure. Moving commerce by water represents 25 percent of all goods movements within the state of Louisiana and is a critical component of the multimodal transportation system within the state. Not only is waterborne commerce in Louisiana a critical component of the transportation system, with an estimated one in five jobs within the state being connected to the maritime industry, it is also of fundamental importance to the region's economy.

With 2,820 miles of navigable waterways crisscrossing the state, Louisiana's network of inland waterways is the second largest navigable waterway in the nation. Despite the extent of Louisiana's navigable inland waterways, Louisiana is still highly dependent upon trucks for the movement of three-quarters of its freight. While waterborne transportation is an essential component of Louisiana's transportation system, it is currently underutilized in terms of unrealized potential and capacity.

To be best positioned for this future investment to promote increased commercial activities of the inland waterways of Louisiana, the Louisiana Department of Transportation and Development's (DOTD's) Office of Multimodal Commerce (OMC) developed a comprehensive, statewide waterways transportation system plan as a framework to guide this investment. This is capable of both dovetailing into, and be a complement for, the Louisiana Statewide Transportation Plan.

By nesting the Louisiana Waterways State Transportation Plan within the overall Louisiana Statewide Transportation Plan, the OMC is provided with the ability to identify potential chokepoints in the multimodal commerce network. The Louisiana Waterways State Transportation Plan will assist in the development of strategies and capital investment programs to relieve these chokepoints through running "what-if" scenarios of the impacts of potential modal shifts on localized congestion. Assessing the potential for modal shifts at nodal junctures will provide the ability to optimize the transport of commerce across all modes of the Louisiana transportation system and, in particular, look for opportunities to fully capitalize on the connectivity of Louisiana's inland waterways and increase economic activity and throughput on these waterways.

The type and economic significance of waterborne commerce within Louisiana was identified to support planning and forecasting guidance. Focusing on the analysis and documentation of the impact and importance of waterborne commerce on Louisiana and its transportation system enabled the identification and quantification of regional and national level of returns on investment in the inland waterways network of Louisiana. The output provided an assessment of Louisiana's waterborne commerce by both commodity and industry at a regional level. In addition, businesses, and port terminals (public and privately owned/operated) that depend on Louisiana's navigable waterways system are identified by industry type, company name, and product.

Because of the disparate nature of the type, source, and reporting structure of relevant data as it relates to all aspects of waterborne commerce and the infrastructure associated with it, the development of the Louisiana Waterways Analysis Tool Evaluating Regional Systems (LA WATERS) platform was a critical step in being able to collect, aggregate, process, and analyze a multitude of data from a wide and diverse range of data sources into a first of its kind data management portal. LA WATERS enabled the compilation of historical data and trends, statistical analysis, infrastructure condition assessments, prevailing environmental and economic conditions, micro- and macro-market trigger events, and an extensive library of available data for "what-if" scenarios. This customizable planning tool is used for determining effective waterway infrastructure solutions to improve economic activity and throughput, evaluating projects and strategies to alleviate multimodal bottlenecks, and assisting in operational decision-making across a set of user defined geo-political boundaries.

While the COVID-19 pandemic is generally regarded as a once-in-a-generation type economic shock and there is significant uncertainty surrounding the impacts of climate change, it is evident that the region is expected to continue to experience an increasing trend of more frequent storms of higher magnitude. This Louisiana Waterways State Transportation Plan recognizes and emphasizes the need to mitigate against risks to the waterways system resulting from these increased frequent extreme weather conditions and macro-economic shocks, as typified by the COVID-19 pandemic.

This program of study sponsored a dedicated, port-specific, customized survey designed to solicit waterways-user generated information that can best assist DOTD in understanding Louisiana's waterborne commerce community conditions relative to the waterways and to generate perspectives on recommended future improvements to commerce and infrastructure.

Findings

Louisiana has 32 publicly owned ports, including 6 deep water ports located on the Mississippi River. There were 238.7 million tons of waterborne freight valued at $59 billion transported on the Louisiana inland waterways system. This tonnage represents the equivalent of 6 million, 40-ton trucks, which represents significant, avoided congestion emissions and additional wear-and-tear on the Louisiana highway infrastructure. Freight Analysis Framework (FAF) forecasts suggest that total water tonnage will continue to increase at an annual growth of 0.7 percent per year through 2040, without any additional investment in the inland waterways system of Louisiana.

Despite the extent of Louisiana's navigable inland waterways, Louisiana is still highly dependent upon trucks for the movement of most of its freight. While waterborne transportation is an essential component of Louisiana's transportation system, it is currently underutilized in terms of unrealized potential and capacity. In order to be able to realize this untapped potential and fully leverage this competitive advantage of such an abundance of navigable waterways, Louisiana requires a paradigm shift in its approach to waterborne transportation through the implementation of appropriate planning and management of investment in these navigable waterways.

The connectivity of the inland shallow-draft network provides a significant opportunity for transshipment to shallow draft for further distribution and deeper penetration into the Louisiana inland waterways system. However, stakeholder inputs characterized the Louisiana's intracoastal and inland waterways as not optimized "as a reliable means of transporting goods," a perspective that is supported by economic studies and data analyses. These analyses quantified the delta between actual utilization and potential capacity for waterborne commerce. As such, the waterways should, at a minimum, be predictably maintained at authorized depth levels as they provide numerous economic and recreational opportunities to the local and regional economy.

The intracoastal and inland waterways are a significant source of economic activity, development, vitality, and growth for the parishes and areas that they serve. These waterways contribute socioeconomic benefits that are measured in value by business activity, personal income, employment, recreational opportunities, environmental appreciation, and many other aspects important to the parishes and areas that these inland waterways serve. A major challenge will be how to appropriately monetize the socioeconomic benefits of intracoastal and inland waterways as part of Benefit Cost Analyses (BCAs) conducted to secure funding for improvements and maintenance.

Direct waterborne commerce generates 52,400 direct jobs that are associated with $5.5 billion in labor income, $22.2 billion in value added to Louisiana's economy, and $83.2 billion in new output (or sales) across Louisiana. The 52,400 jobs directly related to Louisiana's waterborne commerce generate more than 207,000 additional jobs. This includes 96,300 jobs created through business-to-business transactions. While another 58,600 jobs are created by the increase in payroll from direct jobs and associated consumer spending. Furthermore, water-dependent industries generate a total of 525,000 jobs, or one in five jobs in the state. It is also estimated that waterborne freight through the ports and waterways in Louisiana generate more than $182 billion in economic output.

Shallow-draft transportation is fundamentally a more efficient mode of goods movement that can reduce road congestion and fuel costs, which is significant given the continued increase in fuel prices. Considering one barge is the equivalent of 15 rail cars and 60 40-ton trucks, and one standard 15-barge tow moves the equivalent volume of 216 rail cars or 864 40-ton trucks [3], expanded shallow-draft operations and improved integration with the Louisiana Statewide Transportation Plan is a key strategic approach to reduce road/rail congestions, reduce carbon emissions, and reduce the burden on the state highway transportation system.

The total economic impact of the waterborne commerce labor market is equivalent to more than $14.4 billion in labor income, $40.7 billion in value added, and $125.5 billion in output (or sales). However, significant opportunities exist to take even greater advantage of enhancing waterborne transportation than is currently being achieved, which in turn has cascading economic impacts on waterway transportation-related businesses at both the regional and local levels.

The Ports of Baton Rouge and New Orleans (by far the largest economic driver of waterborne commerce in Louisiana) represent the key opportunities for transshipment of dry and liquid bulk commodities due the volumes of freight transiting through these ports. This connection was especially important for port cities situated on the upper Mississippi River valley and its key tributaries heavily engaged in the export of agricultural products.

A comprehensive analysis of port surveys, economic impact survey, key industry sector, and AIS source data identified a list of projects that could potentially increase economic throughput of the waterways within their jurisdictions. These projects were evaluated and recorded within the LA WATERS platform and sensitivity analyses were performed to assess response to both micro- and macro-dynamic drivers.

Recommendations

- Provide leadership and regularly update the Louisiana Waterways State Transportation Plan, at a minimum once every five years. The DOTD OMC should continue to be the lead agency for monitoring waterway systems and serve as the lead agency in waterborne commerce related data management. This will help facilitate DOTD in improving integration of the waterborne commerce system with the Louisiana Statewide Transportation Plan and the state's overall transportation system.
- Establish a standardized data reporting protocol for goods, commerce, and economic reporting data. This will greatly improve the cost-effectiveness and timeliness of future updates and keep the database updated to the greatest extent possible. This will fundamentally establish the database as a state-of-the-art, industry-leading framework for the analysis of waterborne commerce transportation systems.
- Maintain an up-to-date database of Louisiana's intracoastal and inland waterway system. To maintain and manage Louisiana's waterways, an extensive record of all commercial waterways should be compiled in a dedicated database. Tonnage should not be the only factor that determines a waterway's significance. More emphasis should be on the regional economic impact that a waterway contributes. The results and application of the "Economic Impact and Importance of Waterborne Commerce" study provides a baseline from which to establish data source and analysis guidelines.
- Record and track inputs from stakeholders through the LA WATERS platform for establishing historical baseline data, benchmarks, and trend analysis.
- Continue to develop the LA WATERS Platform. Consolidation of data sources and analysis methodologies through the LA WATERS platform should be on-going in assessing the ability of recommended operational strategies and individual projects in mitigating the dynamic challenges of the waterways.
- Coordinate Louisiana inland waterway planning activities. Most of Louisiana's waterborne tonnage is reported through its individual ports. By increasing focus on the improved integration of system-wide solutions to waterway throughput efficiencies, it will be possible to develop strategies to mitigate waterway congestion throughout Louisiana's transportation network.

- Partner with local waterway sponsors and stakeholders. DOTD should partner with local waterway system administrators, such as the Red River Authority and the Gulf Intracoastal Canal Association, to keep an open dialogue regarding the issues concerning waterways. As witnessed by the recent severe and extreme weather events as well as the global COVID-19 pandemic, promoting active communications with waterway system stakeholders will keep DOTD abreast of current conditions and will enable improved dynamic response to these micro- and macro-challenges to the overall transportation system.
- Quantify the magnitude of economic impact of the waterway system not being optimized for improved efficiencies. DOTD should perform high-level economic impact studies to establish the return on investment in maintaining waterways at their authorized depths. This will also enable DOTD to rapidly perform a BCA and project-specific Least Cost Market Analysis (LCMA) of system improvement impacts. Deeper draft is not always the answer to improved throughput, and LCMA sensitivity analyses can rapidly demonstrate the best, most cost-effective efficiency improvements. Such a framework can also position DOTD to rapidly and cost effectively respond to grant funding requests for information.
- Provide higher-level resolution economic impact analyses and BCAs of proposed projects, evaluated both individually and as a portfolio of projects implemented together. Apply the LCMA framework to further define remedial actions and identify required resources when moving forward with programmed projects. Application of the LCMA can also be used to better target limited funding resources for these projects.

Implementation Statement

The implementation of the Louisiana Waterways State Transportation Plan is centered on providing the capability of providing a level of planning and forecasting guidance necessary to identify the type and value of waterborne commerce. By providing the focus for the analysis and documentation of the impact and importance of waterborne commerce on the state of Louisiana and its transportation system, the plan identifies the regional and national level of returns on investment in the network. By implementing the LA WATERS technical support platform, OMC provided the basis for present and future analysis in support of identifying opportunities for alleviating multimodal bottlenecks relative to waterways, and targeting funding of projects with positive impact on the waterways and commerce provided the state. Finally, the consolidation of research, analysis, and technical deliverables provide the basis for the draft Louisiana Waterways State Transportation Plan that can be streamlined into the Louisiana Statewide Transportation Plan.

Because of the disparate nature of the type, source, and reporting structure of relevant data as it relates to all aspects of waterborne commerce and the infrastructure associated with it, the development of the LA WATERS platform is a critical step in being able to collect, aggregate, process, and analyze a multitude of data from a wide and diverse range of data sources into a first of its kind data management portal. LA WATERS enabled the consolidation of historical data and trends, statistical analysis, infrastructure condition assessments, prevailing environmental and economic conditions, and micro- and macro-market trigger events, along with an extensive library of available data into a customizable planning tool for determining effective waterway infrastructure solutions. LA WATERS supports the improvement of economic activity and movement of goods throughput, evaluates projects, alleviates multimodal bottlenecks, and assists in operational decision-making across a set of defined geopolitical boundaries.

By coordinating Louisiana inland waterway planning activities and concentrating on improved integration of system-wide solutions to waterway throughput efficiencies, it will be possible to develop strategies to mitigate waterway congestion throughout Louisiana’s transportation network.

This report will provide leadership the ability to establish benchmarks and trend analysis supporting the regular updating of the Louisiana Waterways State Transportation Plan every five years. The DOTD OMC will continue to be the lead agency for monitoring

waterway systems and serve as the lead agency in waterborne commerce related data management. This will help facilitate DOTD in improving integration of the waterborne commerce system with the Louisiana Statewide Transportation Plan and the state's overall transportation system.

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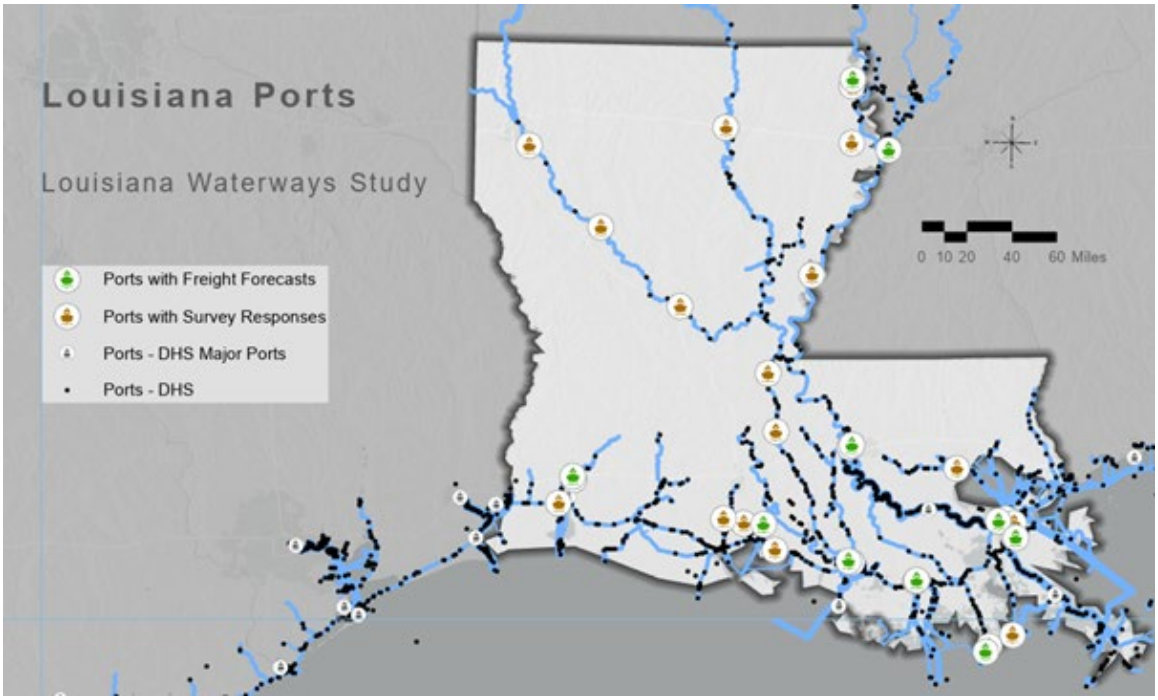
Introduction

Moving commerce by water is a critical component of the transportation system in Louisiana. Furthermore, with an estimated one in five jobs in Louisiana being connected to the maritime industry and movement of goods throughout Louisiana's 2,820 miles of inland waterways, it is also of fundamental importance to the region's economy. Louisiana has 238.7 million tons [4] of freight valued at $59 billion transported on the waterway system on an annual basis. This tonnage represents the equivalent of 6 million, 40-ton trucks. As such, waterborne transport of commerce significantly reduces congestion and emissions, and contributes to the state of good repair of the highway infrastructure.

Positioning Louisiana for future development and investment in its uniquely important inland waterways, the DOTD OMC initiated the development of a comprehensive, statewide waterways transportation system plan. This plan will provide Louisiana with a planning framework that will enable it to proactively prepare for long-term macro-economic shifts in transportation networks, as we respond to near-term switches in modal needs. To develop this plan, it is necessary to first analyze, quantify, and document the impact and economic importance of waterborne commerce on Louisiana, its transportation system network, and the nation (Figure 1).

Figure 1. Map of Louisiana ports



Background

Moving commerce by water represents 25 percent of all goods movements within the state of Louisiana and is a critical component of the multimodal transportation system in the state. To be best positioned for future development and investment, DOTD's OMC needed to develop a comprehensive, statewide waterways transportation system plan. The plan would be capable of dovetailing into, and be a complement for, the Louisiana Statewide Transportation Plan. In doing so, it will provide the OMC the ability to identify potential "chokepoints" in the multimodal commerce network, and ultimately assist in the development of strategies and capital investment programs to relieve these "chokepoints" through running "what-if" scenarios of the impacts of potential modal shifts on localized congestion.

To be able to develop this plan with a capability of providing this level of planning and forecasting guidance, it is necessary to identify the type and value of waterborne commerce, thereby providing the focus for the analysis and documentation of the impact and importance of waterborne commerce on Louisiana and its transportation system. As such, the plan identifies the regional and national level of returns on investment in the network. By implementing the LA WATERS technical support platform, OMC provides

the basis for present and future analysis in support of identifying opportunities for alleviating multimodal bottlenecks relative to waterways. Finally, the compilation of research, analysis, and technical deliverables provide the basis for the draft Louisiana Waterways State Transportation Plan that can be streamlined into the Louisiana Statewide Transportation Plan.

Literature Review

The information/data used in the analysis of Louisiana waterway volumes comes from a variety of public sources. The main source of information is the United States Army Corp of Engineers (USACE), which collects cargo data through its Waterborne Commerce Statistics Center. The volumes are published in multiple forms, showing specific characteristics of waterway volumes. The link tons data that is supplied by the USACE shows the overall tonnage of cargo moving through certain sections of United States (U.S.) waterways. The sections, called links in the documentation, vary greatly in size, and do not show the destinations or origins of the cargo, but only show the total tonnage that has passed through that section. Two other USACE sources of data were used in this analysis. The first focuses on total volumes at individual ports. This data provides only the total tonnage at the port and the year that the tonnage was recorded. The final source provides detailed cargo data for specific waterways and ports, but some waterways do not have consistent reporting. These USACE databases were used in conjunction with data from the U.S. Census through U.S. Trade Online, an online portal that gives access to U.S. commerce data. The Census data provides information on imports and exports from certain ports, allowing these volumes to be compared to the total port volumes provided by the USACE. When combined, the databases provide a comprehensive view of the type and quantity of cargo moving throughout the U.S. waterways.

In addition to cargo trade data, information from the FAF was used in this analysis. The FAF is a Department of Transportation-managed database of freight movement and estimated forecasts. The FAF data was used to estimate future cargo volumes as well as establish historical trends that could be validated through the USACE volume data. Because the FAF data is collected for all modes of transportation, only inbound and outbound waterborne cargo was considered from the overall dataset.

Objective

1. Identify the type and value of waterborne commerce.

   The objective of this task was to depict the current state of waterborne transportation in Louisiana. The output of this provided a detailed assessment of Louisiana's waterborne commerce by commodity and industry at a parish level. This task also identified business and port terminals that depend on Louisiana's navigable waterway system by industry type, company name, and product. The type and value of waterborne commerce was documented using domestic freight flows of imports and exports from the FAF. This data captured trade flows between locations in the U.S. and four zones within Louisiana. To further disaggregate those data to smaller geographies aligned with each Louisiana port, industry, and employment, data from the Quarterly Census of Employment and Wages (QCEW) and County Business Patterns (CBP) were used. This process determined the distribution of activity based on the concentration of water transportation activities within each zone, paying particular attention to estimates of tonnage handled by individual Louisiana ports.

2. Analyze and document the impact and importance of waterborne commerce.

   The objective of this task was to measure the impact and importance of waterborne commerce based on the economic output, jobs, salaries, and tax revenues of industries of waterborne commerce that rely directly and indirectly on the Louisiana inland waterway system. This was achieved utilizing a two-fold approach: first by looking at activities directly associated with waterborne commerce (e.g., operation of vessels and ports) followed by analysis of the contribution of waterborne commerce to other industries that are dependent on Louisiana's waterways as part of their supply chain (e.g., petrochemical). In addition, the flow of goods to trade-dependent industries was studied to determine the degree to which those industries rely on waterborne commerce from a particular port, or ports in general. The broader economic impact of this core group of economic activity was estimated based on an established regional economic model to account for indirect and induced economic effects. The main driver of measuring the economic impact of this core group would be changes in transportation costs should the identified industries substitute the waterborne transportation component of their supply chains with land-based routes (truck or rail).

3. Identify the improvements needed to achieve greater utilization of waterways.

   The objective of this component was to assess impacts of potential "what-if" planning on a range of temporal and spatial scales of resolution that could potentially promote increased use of the Louisiana inland waterways system. The framework also established the ability to quantify the response of the Louisiana marine highway response to micro- and macro-market changes. This would also help identify early priorities for more detailed investigation and analysis. Macro-market influences can be regarded as external shifts at the global or regional level. Micro-market shifts can be regarded as much more local and represent shifts in the Louisiana economy. Both have significant impacts on the waterborne economies. However, it is the micro-market influences that are of greater concern to this program, as it is these that the statewide waterborne transportation plan can have greatest consequence over and provide greater insight into "what-if" scenario planning. Doing so provides the greatest level of accuracy and precision in not only establishing a waterborne commerce transportation plan that can react to future market shifts, but also one that is based on an analytical information systems platform capable of supporting future decision-making processes.

4. Identify the improvements for alleviating multimodal bottlenecks relative to waterways.

   The objective of this task was to quantify the potential impact of each improvement proposal based on engineering input and impact on Louisiana's economy. The project team created a cost/time model that shows the door-to-door (i.e., FAF, region to parish) cost/time of transportation for a multimodal system (i.e., truck, rail, and waterways) along with a modal choice model to explain the current modal shift of cargo in Louisiana. Proposed improvements were "applied" to the multimodal network to estimate their impact on transportation cost/time and, ultimately, impacts to the modal choice model. Finally, the new modal split combined with new transportation costs can be used to measure the impact on economic output, jobs, salaries, and tax revenues. Potential improvement projects were then ranked based on high-level cost-to-benefit assessments. Delays and complications created by inefficient transfers in multimodal and intermodal transportation can provide targeted opportunities to increase the overall efficiency and competitiveness of transportation on Louisiana's waterways. The general location and types of multimodal waterway transfers were identified based on the FAF data, followed by investigation of specific multimodal hubs including outreach to port and associated hub operators. This baseline understanding of

bottlenecks was layered with estimated trade elasticities to assess the competitive improvement and potential increases in commerce that can be expected from alleviating existing bottlenecks.

5. Develop a draft Louisiana Waterways State Transportation Plan.

   To best plan for future development and investment, the OMC will develop a comprehensive, statewide waterways transportation system plan. The waterways transportation plan provides analysis and documentation of the impact and importance of waterborne commerce on Louisiana, its transportation system, and the nation. The plan provides an update on the inventory and condition of the waterway system through an updated geographic representation of the system as a part of Louisiana's transportation intermodal system. Effective integration of the waterway system into the state's overall transportation system is critical as it offers alternatives to the increasingly congested rail and highway networks as well as positions the state to best compete for available transportation funds. The plan must be capable of dovetailing into, and be a complement for, the Louisiana Statewide Transportation Plan. In doing so, it will provide the OMC the ability to identify potential chokepoints in the multimodal commerce network and ultimately assist in the development of strategies and capital investment programs to relieve these chokepoints through running "what-if" scenarios of the impacts of potential modal shifts on localized congestion.

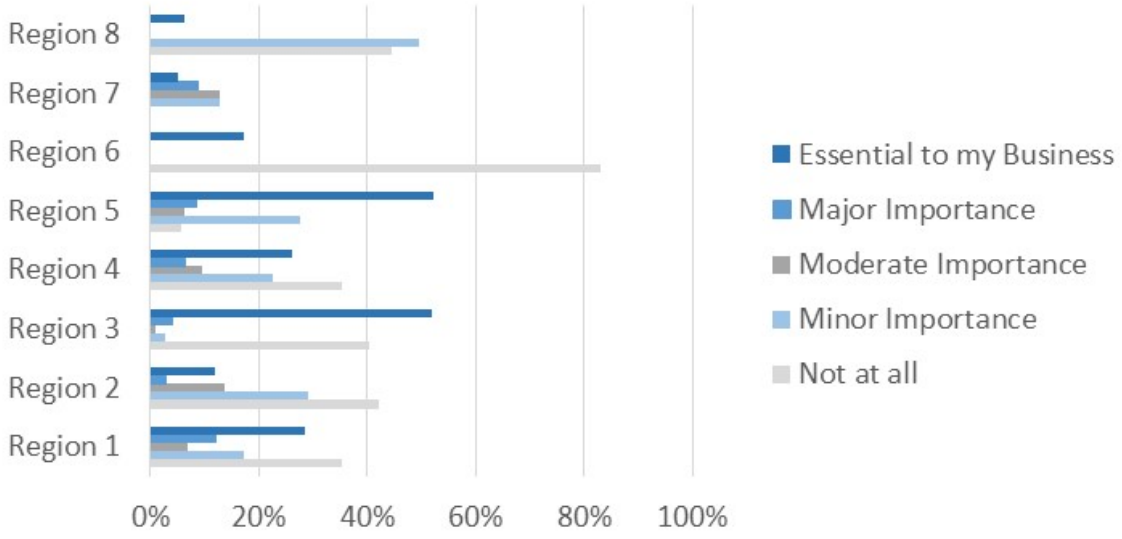
6. Incorporate data management/GIS spatial analysis and reporting for storyboarding.

   Storyboard mapping presentations are being used to support information transfer and collaboration for multiple aspects of the project. Internally, online storyboard mapping allows project engineers to access information from disparate sources in a geographical context that demonstrates the spatial relationships between the different potential projects and the various components of the state's waterway transportation system.

Methodology

In establishing a depiction of Louisiana's current state of waterborne transportation, this study identifies the type and value of waterborne commerce as well as analyzes and documents the impact and importance of waterborne commerce. The output of these tasks provides an assessment of Louisiana's waterborne commerce by commodity and industry at a regional level.

Figure 2. Importance of waterborne commerce by region

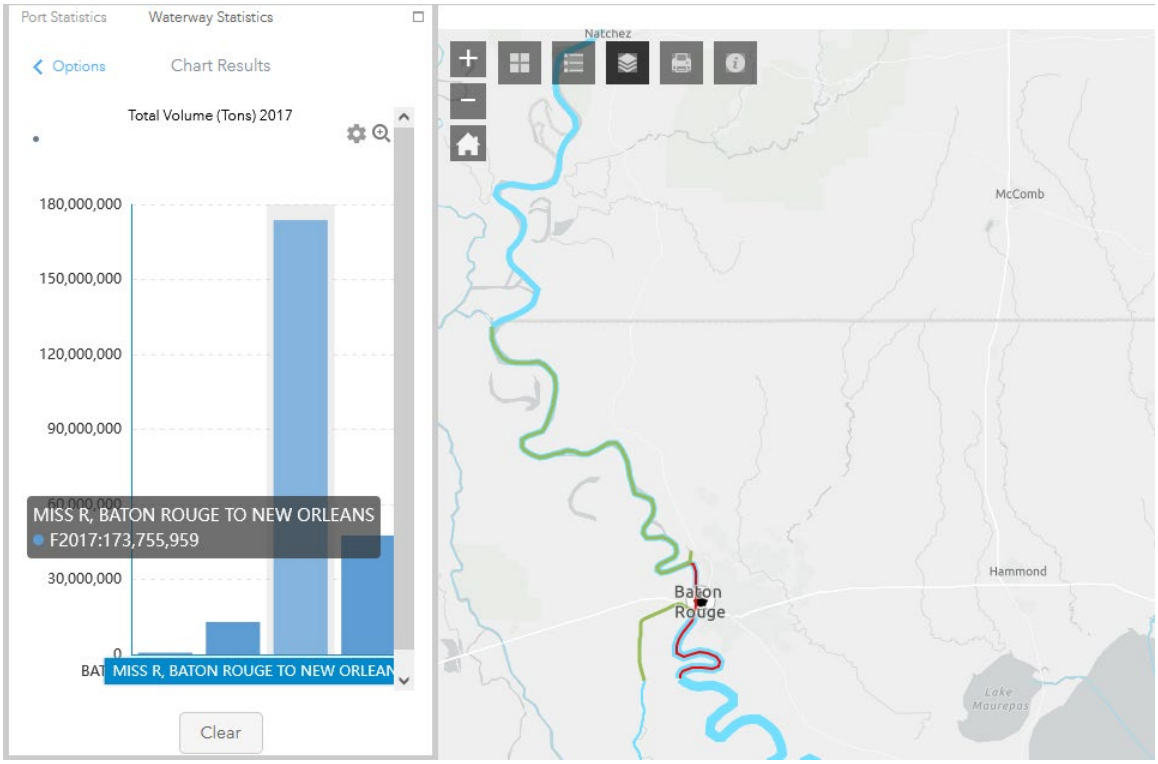


The chart above (Figure 2) shows how the importance of waterborne commerce varies by region of the state, as documented in the responses to the Economic Impact Survey. In general, regions in coastal areas tended to respond that waterborne commerce was "essential to my business," including Region 5 (Lake Charles–Jennings at 52 percent), Region 3 (Houma at 52 percent), Region 1 (New Orleans at 29 percent), and Region 4 (Lafayette at 26 percent). However, even areas much further inland had some businesses for whom waterborne commerce was essential due to waterways that stretch across much of the state, offering direct access to far inland areas such as Shreveport and Monroe.

In addition, businesses and port terminals that depend on Louisiana's navigable waterways system are identified by industry type, company name, and product, within LAWATERS.

The type and value of waterborne commerce is documented by using domestic freight flows of imports and exports from the FAF. These data capture trade flows between locations in the U.S. and four zones within Louisiana. To further disaggregate those data to smaller geographies aligned with each Louisiana port, industry, and employment data from the QCEW and CBP were used.

Figure 3. Bottleneck visualization



AIS data was transformed into a temporal spatial data set of vessels and their movements. The Commercially Navigable Waterway V5 data set [5], published by the U.S. Department of Transportation and the Pipeline and Hazardous Materials Safety Administration, is a network suitable for network analysis of the navigable waterways. Boundary geometries were created to represent the water's surface that could be used to capture vessels that entered a waterway segment. The comparison of waterway traffic through specific years demonstrates potential delays that can be targeted for further analysis, potential solutions, and project selection analysis (Figure 3).

Technical Deliverables

In support of the OMC's program goals and objectives, the technical approach outlines the development of a web-based system designed to establish a geographic information system (GIS) platform, analysis, and data management tool set. This system is scalable and adaptable to accommodate increased database complexity and availability as more data sources become available. It also provides the ability to restructure the boundary geometries to reflect different political subdivisions that economic queries could be run (parish, harbor terminal district, congressional, etc.).

The established framework provides system specifications in meeting project requirements, goals, and objectives. This dynamic approach provides the department with scalability as well as flexibility built into the system that is capable of meeting dynamic requirements created by a continually evolving focus, micro- and macro-market influences, new data sources, modern modeling data needs, and other analytical and system requirements.

Identify the Type and Value of Waterborne Commerce

Background

To best plan for future development and investment in the Louisiana waterways system, the OMC has developed a comprehensive, statewide waterways transportation system master plan.

In response to the hazardous weather and pandemic-related economic challenges in 2020 that impacted Louisiana's waterway community, the OMC conducted a port survey designed to gather appropriate and realistic information that can best assist DOTD in understanding Louisiana's port community conditions and perspectives on future improvements to commerce and infrastructure. The survey and economic analysis are tools used by the DOTD and stakeholders to validate public and private investment and guide legislative policy that could benefit port and waterborne commerce.

Port Survey

To support the successful development of the statewide waterways transportation system master plan, a Louisiana waterway ports survey was conducted to initiate conversations with the primary users of the Louisiana waterways system, such as ports, harbor and terminal districts, their tenants, logistics operators, and carriers. Discussions with stakeholders and primary beneficiaries of an efficient inland waterways system proved to be the best way to understand what is needed to support future growth as input came "direct from the horse's mouth." As part of the process, a detailed preliminary analysis of currently available data was performed as it relates to port and associated waterway operations. In performing this initial analysis, specific trends were identified, highlighted, and incorporated in the port survey.

Initial survey input was included as part of an overall summary of stakeholder opinions and input. Individual comments were anonymous and confidential. This information will be managed within the LA WATERS platform and will serve as a baseline for evaluating impacts of weather events (hurricanes, flooding, etc.) as well as economic impacts, such as those experienced through the COVID-19 pandemic. Overall review of relevant information through multiple data sources is available through the LA WATERS tool and will be used in future analysis of waterway focus areas.

Stakeholders Opinions and Input Summary

Figures 4, 5, and 6 below represent the information collected through the port survey as output from the LA WATERS platform. Further details can be accessed through the real time use of the LA WATERS platform tools.

Figure 4. Georeferenced listing of participating ports

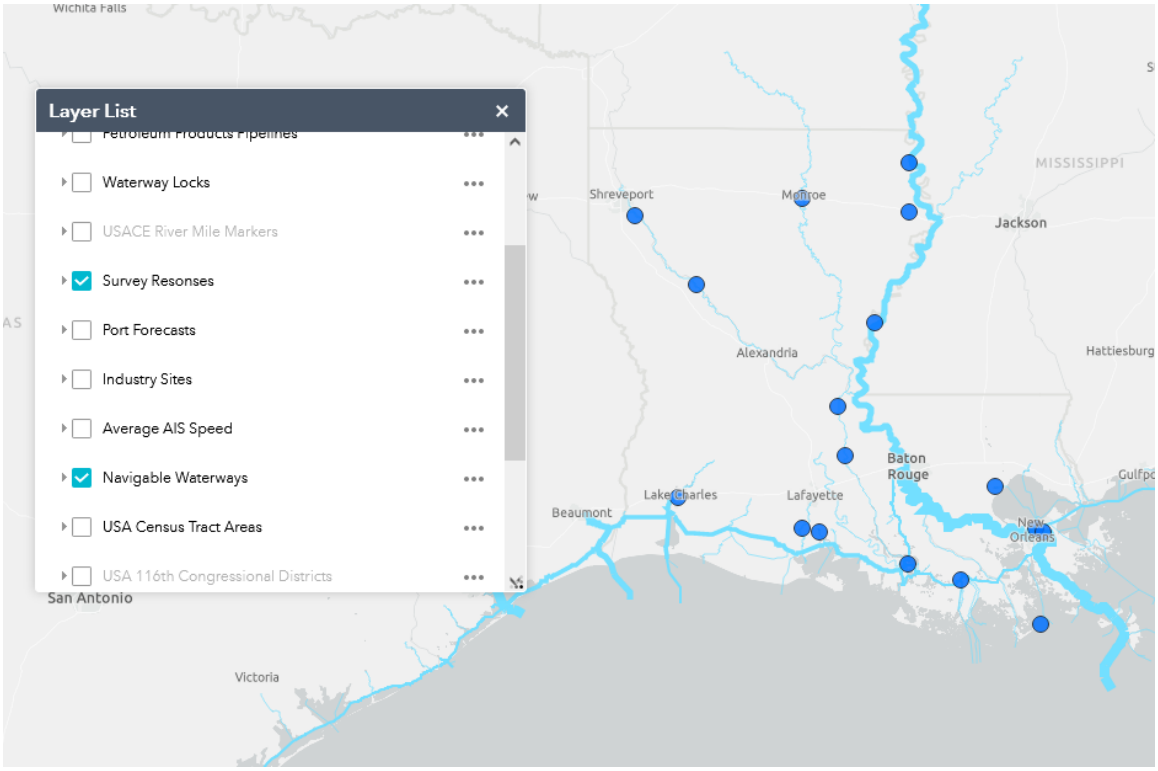


Figure 5. Example of available survey results georeferenced by participants

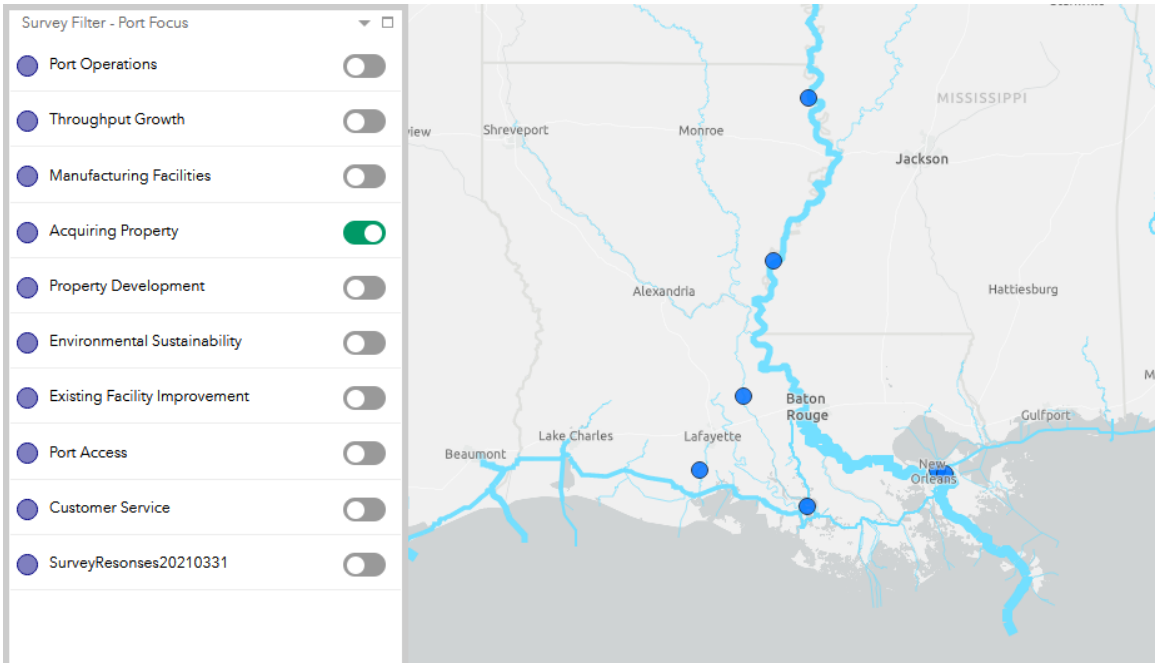
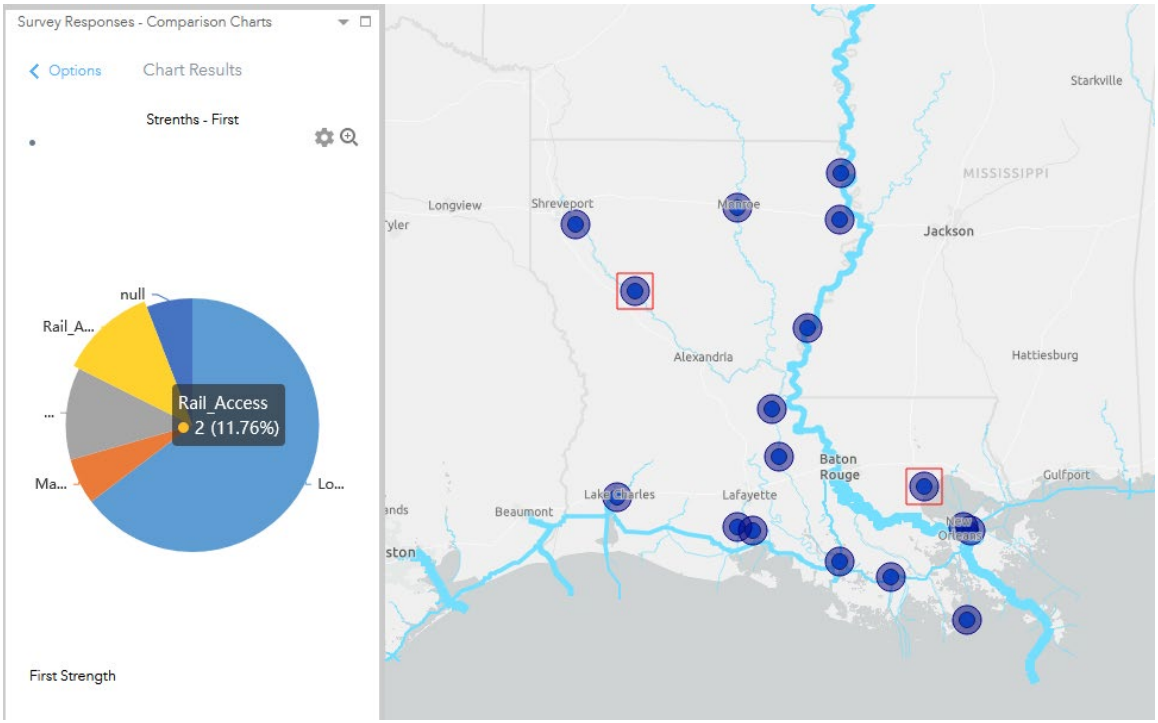


Figure 6. Analysis based on survey responses



Potential Waterway, Port, and Intermodal Related Projects

This study developed analysis of potential waterway related projects as identified through the port survey. The initial analysis was based on the following: project type, magnitude, river/waterway, project description, economic background, statement of need, how the project addresses the need, project scope, project cost, and additional studies-data bearing on project evaluation. Below are three examples of the performed analysis (the port survey results and evaluations are detailed in the GIS tool, and the project summary may be found in the project storyboard).

Waterway—OID 10-12

Initial Project Description: Maintenance of 20-ft. federally authorized depth of lower Atchafalaya River Navigation Channel.

Statement of Need: Maintaining the Atchafalaya Bar Navigation Channel and Atchafalaya Bay Navigation Channel at 20 ft. as mandated by Congress would not only help the Port of Morgan City keep the business it has developed with great effort but could increase that business. A key consequence could be the potential for smaller vessels calling at larger Louisiana ports could start calling at the Port of Morgan City. These vessels are more efficient in serving the smaller north-south trade lanes. Larger ports could focus on the larger vessels to continue growing exports on the large east-west trade lanes. Given that Louisiana producers and its ports have been losing share of U.S. agricultural exports, investing in the Port of Morgan City should be a priority to the state. Despite the channel averaging a 14-ft. depth, the Port of Morgan City was selected by a shipper operating in the U.S. Midwest/Gulf Coast to Central America/Caribbean market. However, the inability to fully load vessels that would require a 20-ft. channel depth challenges the sustainability of this activity. Each ship call at Morgan City generates about $100,000 to the local and state economy and positively impacts the local economies along the Mississippi waterway. At 20 ft., each call would contribute significantly more ($162,500 at 14-ft. draft vs. $296,500 at 20-ft. draft) based on 2015 numbers. Insufficient channel depth maintenance has put the Port of Morgan City at a competitive disadvantage and that has a negative economic and potentially environmental impact.

Ports with deeper water depth that serve deeper draft vessels would be able to serve them better if vessels requiring less draft could be served at the Port of Morgan City.

Project Scope: The maintenance dredging issues have historically focused on:

1. Atchafalaya Bar Channel: Need for maintaining a reliable 20-ft. draft Atchafalaya Bar Navigation Channel bar channel depth, currently 12 to 14 ft. and authorized up to 20 ft.
2. Atchafalaya Bay Channel: Project to focus on the sandy shoals in the bay channel, the location of which is moving increasingly further south. Such a focus falls under routine maintenance dredging/or location of sediment traps in the Atchafalaya River.

Historically, the vast majority of the Port of Morgan City's operations budget was dedicated to management of fluid mud in the bar channel (10 million cubic yards per year [mcyds/yr]). Previous dredging strategies only maintained advertised depth for 2-3 weeks per year, before channel depth became prohibitive for even shallow-draft navigation.

Project Costs: Opinions of probable cost focused on the costs of agitation dredging strategies of the Atchafalaya Bar Channel at a cost $8 million per year for 20-ft. channel 365 days a year (vs historical hydraulic cutter head suction dredging ~$20 million per year), which was reimbursed by the USACE New Orleans District (MVN) out of operations budget. This would then promote a more efficient re-allocation of annual operations budget over greater areas of focus.

Port—OID 18_Lake Providence Stack Chute Diversion Structure

Initial Project Description: Plug and divert the stack chute back into the Mississippi River channel to minimize port entrance shoal development.

Statement of Need: Without structural modifications (closure) to stack chute and/or event specific dredging events (typically associated with Mississippi River discharges > 1.5-mcfs[1]n), agriproduct export is significantly impacted at the time of greatest need (i.e., during harvest and export). Because of shoaling, barges must light load (increase export costs) and/or divert to rail (increase export costs). Is rail export a viable option to a more cost-effective export location where economies of scale could justify structural investment? An analysis of FAF data and product flows would reveal potential of this option. Such individual LCMAs are beyond the recommended scope of this study.

Project Scope: A sand bar develops annually at the mouth of the entrance to the port access. By developing a stack chute closure structure and diverting flow back into the Mississippi River, it is anticipated to prevent the shoal from forming under operational conditions. However, the entire stack chute spit is inundated when the Mississippi River

discharge exceeds 1.5-mcfs, after which event specific dredging would be required. This event has occurred 8 times in the past 13 years and, as such, would result in dedicated dredging contracts nearly every other year, even under a diverted stack chute scenario.

By inspecting USACE dredging records, it is possible to separate out the dredging events that would potentially not be required if the structural modifications to the stack chute are made. A Mississippi River discharge analysis will determine the event specific dredging requirements (volume and cost) and can be compared on a CBA to that of the structural approach.

Project Costs—Structural Modification:

1. Develop stack chute closure/bypass structure:
    a. Channel Excavation: ~ 18,000 cubic yards
    b. Closure Fill: ~ 18,000 cubic yards
    c. Graded Stone "C":
        i. Stone Pad: 3 ft. thick x 200 ft. wide x 230 ft. long = ~6,670 tons
        ii. Closure Fill Cap: 3 ft. thick = ~ 8,530 tons
    d. Preliminary Diversion Plan Cost = $1.1 million U.S. Dollar (USD)

Rail—OID 6—Morgan City Harbor & Terminal District

Initial Project Description: Additional rail improvements and purchase of new equipment will improve current capabilities to move product.

Statement of Need:

1. Morgan City Harbor & Terminal District has opportunity to increase shipping of agricultural products to Caribbean and Central American customers, to increase capacity for shipbuilding and maintenance/repair, and to increase service for offshore oil and gas facilities. Morgan City is well located to serve the smaller bulk product ships serving Caribbean and Central American destinations for agricultural products and for serving the oil/gas and shipbuilding/repair industries.
2. Rail capacity and offload facility improvements will increase the port's ability to increase the shipment from rail to/from waterway traffic. Additional railcar load/unload capacity provides substantial increase in opportunity to provide handling and storage of unit trains for export of agricultural products to Caribbean

and Central American customers. Additional rail capacity would provide benefits for handling of materials for shipbuilding/repair and oil/gas industry.

3. Agricultural products for export to Caribbean and Central American destinations originates domestically: for rice, in parishes in and near Morgan City; for corn, throughout the southern and central United States.

Project Scope: Construct up to 2,000 ft. of additional rail storage/unloading track; construct bulk agricultural product storage and loading facilities.

Project Costs: Rail and switches: $1 million USD; bulk storage and loading facilities: $6 million USD.

Notes: There is a white paper and an economic report available that expands on the specific drivers for expansion of the existing capabilities of the Morgan City Harbor & Terminal District facilities. The primary issue is maintenance of the Atchafalaya River channel at the authorized 20-ft. depth. The issue involving significant port improvements involves the opportunity to increase use of the port facility for shipping agricultural products to Caribbean and Central American customers, as the products for these customers typically ship in smaller vessels that are well suited for the Morgan City terminal. Noted in the reports, improved rail capacity and storage/unloading capabilities will expand the port's ability to service its agricultural, oil/gas, and shipbuilding/repair clients (Morgan City White Paper 042715; Economic Analysis of Maintaining Channel Depth for the Port of Morgan City).

Freight Analysis Framework

Analysis Methodology

The U.S. Department of Transportation's FAF from 2018 was examined to observe the economic influence Louisiana's ports have on global trade. The 2018 dataset was the most recent complete dataset that was not compromised by hurricanes or the COVID-19 pandemic. The dataset was filtered to include instances where a Louisiana port is either the domestic importer or domestic exporter. In cases where international trade stops over in a different coastal city, Louisiana was reclassified as both the domestic importer and domestic exporter. The analysis was limited by the FAF, which groups together geographic data into FAF Zones, defined in Table 1 below. It is important to note that the two largest ports in Louisiana, Port of South Louisiana, and the Port of New Orleans, are both captured in the New Orleans FAF Zone. The dataset was further refined so that transactions must represent one percent or more of a city's total imports/exports for a specific commodity. Finally, the charts only included Louisiana trading partners that incurred more than 2,000 tons in annual trade.

Table 1. FAF Zones in Louisiana

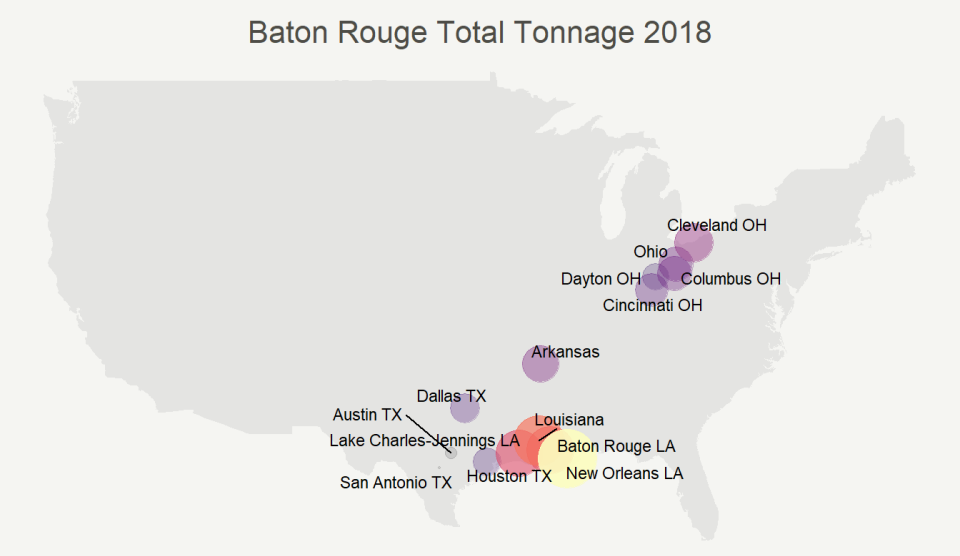
FAF Zone Name	Parishes
Baton Rouge FAF Zone	Ascension, East Baton Rouge, East Feliciana, Iberville, Livingston, Pointe Coupee, St. Helena, West Baton Rouge, West Feliciana
New Orleans FAF Zone	Jefferson, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, St. John the Baptist, St. Tammany, Tangipahoa, Washington
Lake Charles–Jennings FAF Zone	Calcasieu, Cameron, Jefferson Davis
Louisiana (all other cities combined)	Balance of State

Findings

Baton Rouge FAF Zone: The Baton Rouge FAF Zone connected around 40 million tons of international waterborne commerce in 2018 (Figure 7-8). These transactions were mostly within Louisiana and included cereal grains, other agricultural products, fuel oils, and coal. Some international trades only involve one domestic city. In this specific instance, the Baton Rouge FAF Zone was solely responsible for $2.8 billion in foreign

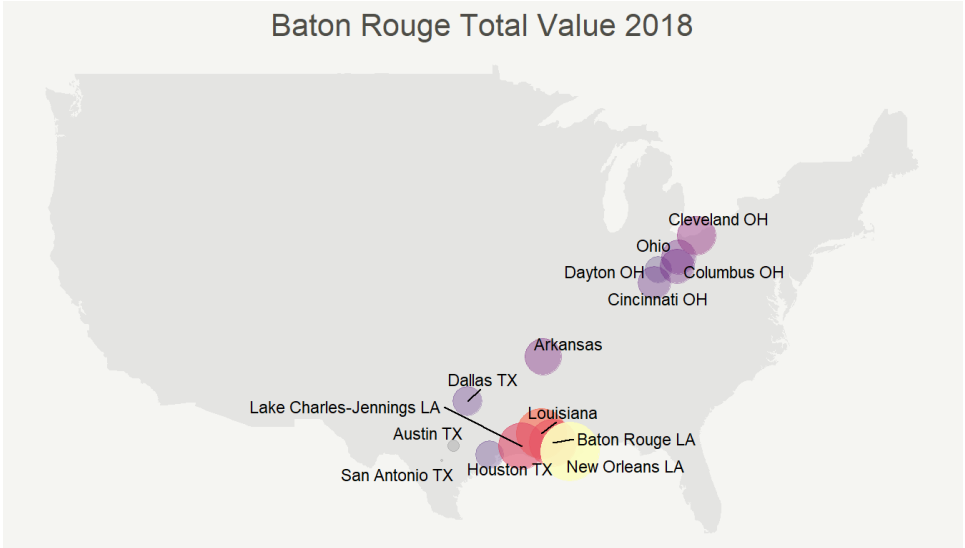
waterborne commerce, either originating or ending there. Over $10 billion in annual economic activity transited the Baton Rouge FAF Zone in 2018 (Table 2). This connection was especially important for cities in Ohio on the upper Mississippi valley waterway that trades agricultural products.

Figure 7. Baton Rouge FAF Zone trading partners by total tons



Source: Freight Analysis Framework, 2018

Figure 8. Baton Rouge FAF Zone trading partners by value



Source: Freight Analysis Framework, 2018

Table 2. Baton Rouge FAF Zone trading partners by FAF zone, by total value

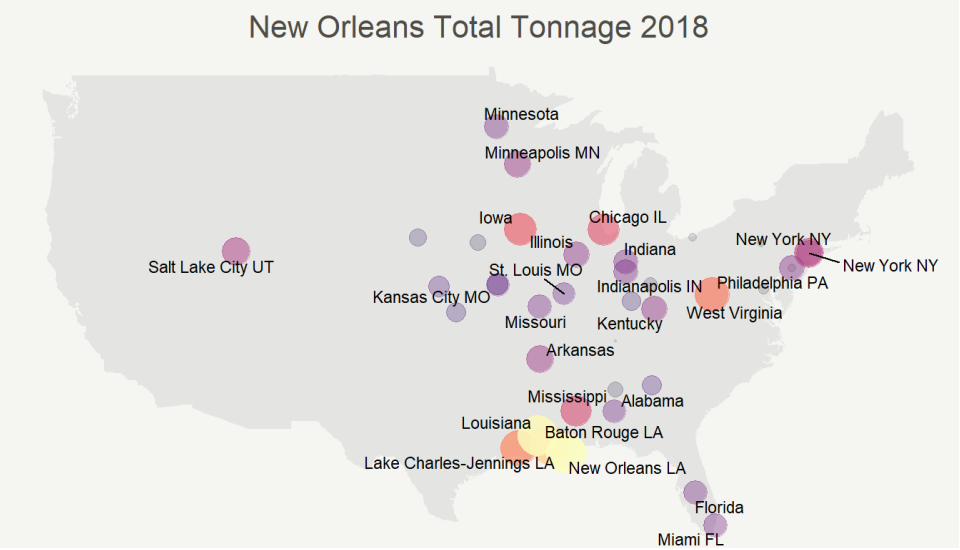
No.	Name	Tons	Dollars
1	New Orleans, LA	30,195,000	$6,507,000,000
2	Louisiana (all other cities combined)	3.865,000	$1,496,000,000
3	Baton Rouge, LA	2,224,000	$2,817,000,000
4	Lake Charles–Jennings, LA	1,787,000	$1,602,000,000
5	Cleveland, OH	475,000	$172,000,000
6	Arkansas (all cities combined)	334,000	$121,000,000
7	Columbus, OH	249,000	$90,000,000
8	Ohio (all other cities combined)	247,000	$90,000,000
9	Cincinnati, OH	193,000	$70,000,000
10	Dallas, TX	129,000	$62,000,000
11	Houston, TX	109,000	$53,000,000
12	Dayton, OH	90,000	$33,000,000
13	Austin, TX	30,000	$14,000,000
14	San Antonio, TX	25,000	$12,000,000

New Orleans FAF Zone: The New Orleans FAF Zone had 38 different trading partners resulting from international waterborne commerce in 2018 (Figure 9-10). This amounted to 183 million tons of shipments. The 20 largest domestic connection cities have been highlighted (Table 3-4).

Metallic ore is traded frequently between the New Orleans FAF Zone and the New York, Salt Lake City, and Florida FAF Zones. New Orleans is one of only a few cities that houses metals traded on the London Metal Exchange. The New Orleans FAF Zone also trades base metals with the New York FAF Zone. Metallic ore from the New Orleans FAF Zone represented 95 percent of Salt Lake City FAF Zone and 48 percent of Miami FAF Zone total ore imports.

There is $40 billion of waterborne commerce transited the New Orleans FAF Zone, making it by far the largest economic driver of waterborne commerce in Louisiana by FAF zone, according to the analysis. Iowa, Mississippi, West Virginia, and Chicago were responsible for coal, cereal grains, base metals, and basic chemical trades exported through the port.

Figure 9. New Orleans FAF Zone trading partners by total tons



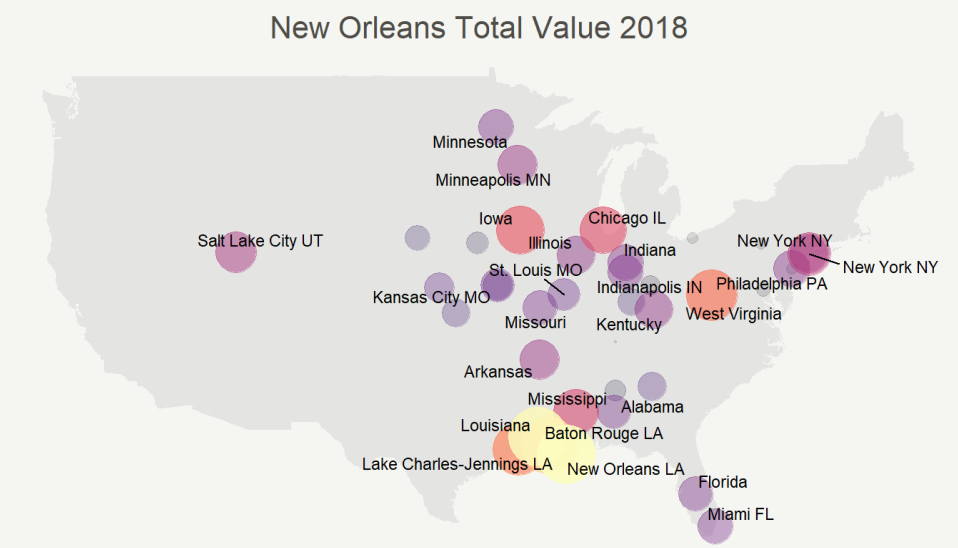
Source: Freight Analysis Framework, 2018

Table 3. New Orleans FAF Zone Trading Partners by FAF zone, by total tons, top 20

No.	Name	Tons	Dollars
1	New Orleans, LA	70,868,000	$17,275,000,000
2	Louisiana (all other cities combined)	63,185,000	$13,024,000,000
3	Baton Rouge, LA	30,195,000	$6,507,000,000
4	Lake Charles–Jennings, LA	6,611,000	$1,544,000,000
5	West Virginia (all cities combined)	4,690,000	$75,000,000
6	Iowa (all cities combined)	2,097,000	$342,000,000
7	Chicago, IL	1,552,000	$243,000,000
8	Mississippi (all cities combined)	1,126,000	$273,000,000
9	New York, NY	791,000	$209,000,000
10	Salt Lake City, UT	382,000	$27,000,000
11	Arkansas (all cities combined)	266,000	$68,000,000
12	Minneapolis, MN	252,000	$41,000,000
13	Kentucky (all cities combined)	188,000	$50,000,000
14	Illinois (all cities combined)	181,000	$38,000,000
15	Philadelphia, PA	150,000	$40,000,000

No.	Name	Tons	Dollars
16	Indiana (all cities combined)	127,000	$9,000,000
17	Minnesota (all cities combined)	110,000	$18,000,000
18	Indianapolis, IN	110,000	$8,000,000
19	Miami, FL	102,000	$7,000,000
20	Missouri (all cities combined)	94,000	$18,000,000

Figure 10. New Orleans FAF Zone trading partners by total value



Source: Freight Analysis Framework, 2018

Table 4. New Orleans FAF Zone trading partners by FAF zone, by total value, top 20

No.	Name	Tons	Dollars
1	New Orleans, LA	70,868,000	$17,275,000,000
2	Louisiana (all other cities combined)	63,185,000	$13,024,000,000
3	Baton Rouge, LA	30,195,000	$6,507,000,000
4	Lake Charles–Jennings, LA	6,611,000	$1,544,000,000
5	Iowa (all cities combined)	2,097,000	$342,000,000
6	Mississippi (all cities combined)	1,126,000	$273,000,000
7	Chicago, IL	1,552,000	$243,000,000
8	New York, NY	791,000	$209,000,000

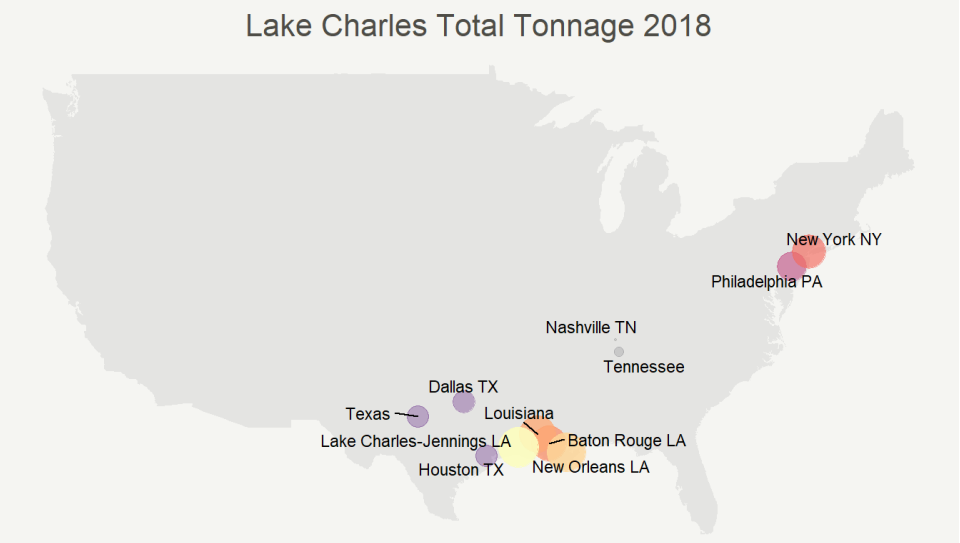
No.	Name	Tons	Dollars
9	West Virginia (all cities combined)	4,690,000	$75,000,000
10	Arkansas (all cities combined)	266,000	$68,000,000
11	Kentucky (all cities combined)	188,000	$50,000,000
12	Minneapolis, MN	252,000	$41,000,000
13	Alabama (all cities combined)	85,000	$40,000,000
14	Philadelphia, PA	150,000	$40,000,000
15	Illinois (all cities combined)	181,000	$38,000,000
16	Salt Lake City, UT	382,000	$27,000,000
17	Minnesota (all cities combined)	110,000	$18,000,000
18	Missouri (all cities combined)	94,000	$18,000,000
19	Kansas City, MO	76,000	$15,000,000
20	St. Louis, MO	62,000	$11,000,000

Lake Charles FAF Zone: Lake Charles–Jennings FAF Zone was responsible for 26 million tons of international waterborne commerce in 2018 (Tables 5-6). Most of these trade routes were with other Louisiana ports; however, Lake Charles–Jennings' proximity to Texas makes it a major hub on the Gulf.

Cities like Dallas, Houston, and other Texas metropolises frequently trade metallic ores with the Lake Charles–Jennings FAF Zone (Figures 11 and 13). While there is a large petroleum/oil trade between these hubs, it is only a small fraction of Texas' total annual output and, therefore, did not pass this screening. Philadelphia and New York are also involved in the metallic ore trade with the Lake Charles–Jennings FAF Zone.

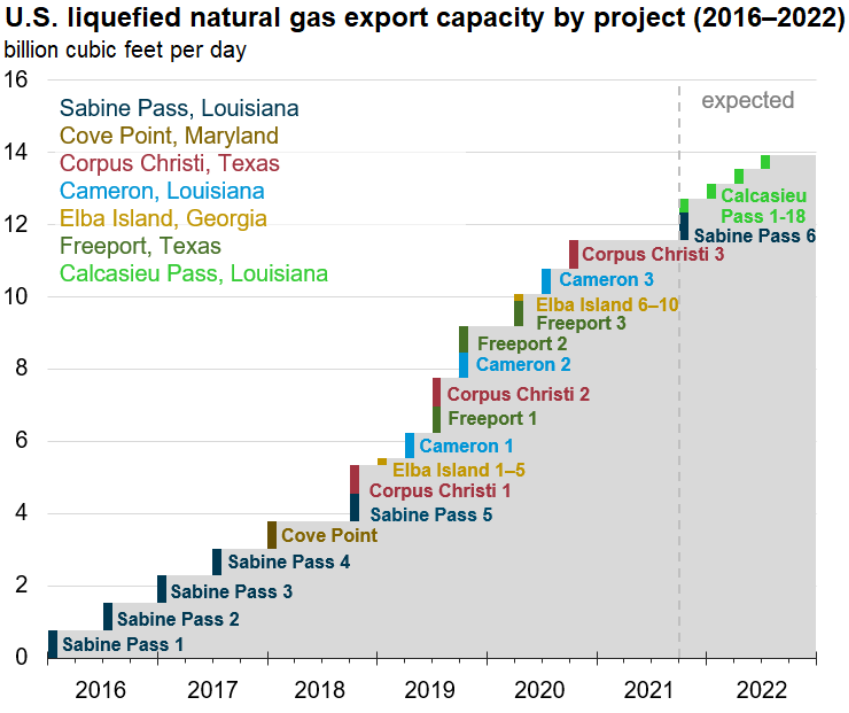
In recent years, the Lake Charles area has seen development of massive new liquified natural gas (LNG) export facilities, which have expanded exports dramatically since 2018 (Figure 12). While not yet reflected in regional FAF data, LNG export estimates from the U.S. Energy Information Administration show that exports grew nationally from 2.97 billion cubic feet per day in 2018 to 10.85 billion cubic feet per day in 2022.

Figure 11. Lake Charles FAF Zone trading partners by total tons



Source: Freight Analysis Framework, 2018

Figure 12. LNG exports by project

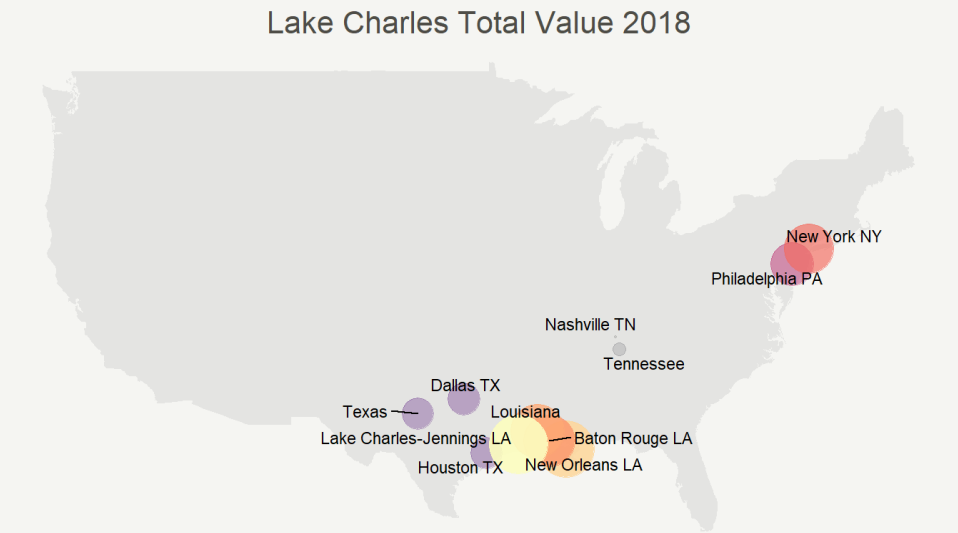


eia Source: Graph created by the U.S. Energy Information Administration (EIA)
Note: The chart shows U.S. LNG peak export capacity buildout by quarter, project, and liquefaction train

Table 5. Lake Charles FAF Zone trading partners by FAF zone, by total tons

	Name	Tons	Dollars
1	Lake Charles–Jennings, LA	13,472,000	$6,262,000,000
2	New Orleans, LA	6,611,000	$1,544,000,000
3	Louisiana (all other cities combined)	2,950,000	$3,119,000,000
4	Baton Rouge, LA	1,787,000	$1,602,000,000
5	New York, NY	956,000	$65,000,000
6	Philadelphia, PA	245,000	$17,000,000
7	Dallas, TX	31,000	$2,000,000
8	Houston, TX	28,000	$2,000,000
9	Texas (all other cities combined)	27,000	$2,000,000
10	Tennessee (all other cities combined)	4,000	$11,000,000
11	Nashville, TN	3,000	$9,000,000

Figure 13. Lake Charles FAF Zone trading partners by total value



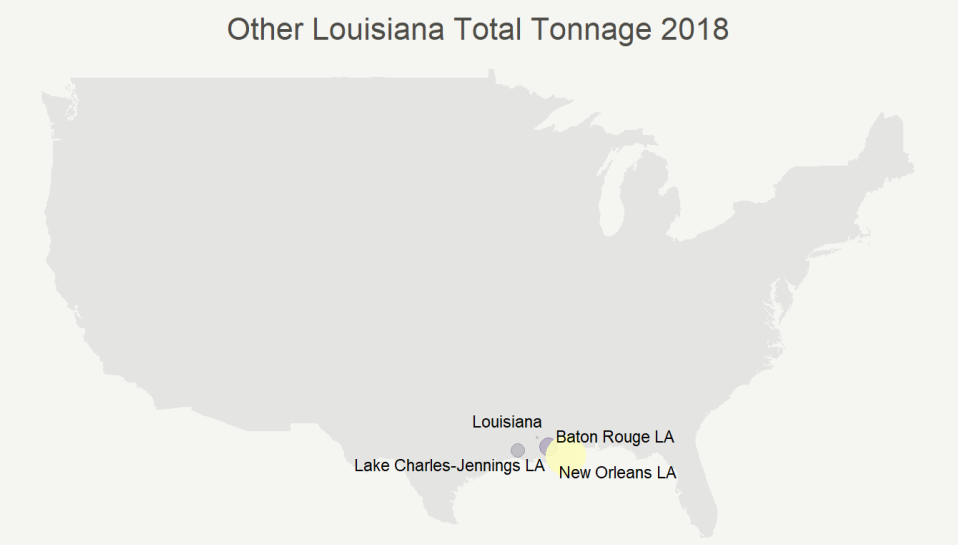
Source: Freight Analysis Framework, 2018

Table 6. Lake Charles FAF Zone trading partners by FAF zone, by total value

No.	Name	Tons	Dollars
1	Lake Charles–Jennings, LA	13,472,000	$6,262,000,000
2	Louisiana (all other cities combined)	2,950,000	$3,119,000,000
3	Baton Rouge, LA	1,787,000	$1,602,000,000
4	New Orleans, LA	6,611,000	$1,544,000,000
5	New York, NY	956,000	$65,000,000
6	Philadelphia, PA	245,000	$17,000,000
7	Tennessee (all other cities combined)	4,000	$1,000,000
8	Nashville, TN	3,000	$9,000,000
9	Dallas, TX	31,000	$2,000,000
10	Houston, TX	28,000	$2,000,000
11	Texas (all other cities combined)	27,000	$2,000,000

Other Louisiana Trading Partners: The FAF also includes other Louisiana ports outside of the Baton Rouge, New Orleans, and Lake Charles FAF Zones. However, these ports trade entirely within Louisiana when it comes to international waterborne commerce (Figures 14-15). There were 63 million tons of commerce transited between the New Orleans FAF Zone and these other Louisiana ports (Tables 7-8). Some of the largest trades include cereal grains, fuel oils, coal, gasoline, other agricultural products, and metallic ore. This totaled over $20 billion in annual economic activity in 2018.

Figure 14. Other Louisiana trading partners by total tons



Source: Freight Analysis Framework, 2018

Table 7. Other Louisiana ports trading partners by FAF Zone, by total tons

No.	Name	Tons	Dollars
1	New Orleans, LA	63,185,000	$13,024,000,000
2	Baton Rouge, LA	3,862,000	$1,496,000,000
3	Lake Charles–Jennings, LA	2,950,000	$3,119,000,000
4	Louisiana (all other cities combined)	2,160,000	$4,049,000,000

Figure 15. Other Louisiana ports trading partners by total value

Source: Freight Analysis Framework, 2018

Table 8. Other Louisiana ports trading partners by FAF Zone, by total value

	Name	Tons	Dollars
1	New Orleans, LA	63,185,000	$13,024,000,000
2	Louisiana (all other cities combined)	2,160,000	$4,049,000,000
3	Lake Charles–Jennings, LA	2,950,000	$3,119,000,000
4	Baton Rouge, LA	3,862,000	$1,496,000,000

Analysis Methodology

Economic Impact Methodology

This chapter focuses on the indirect and induced economic impacts:

- Statewide and national economic impacts estimated using a standard regional economic model.
- Statewide results allocated to smaller geographic areas based on QCEW and CBP base data.

Economic impact assessments aim to capture the broader set of economic activities generated by an initial infusion of new dollars into the economy. When new economic activity occurs, businesses will purchase additional inputs and workers will have additional dollars for purchasing goods and services. These added purchases provide an additional boost to the economy, and the ripple effect continues. With each round of spending, some dollars may be spent outside of the area of focus or be captured (i.e., value added and final demand) and so the effect of subsequent rounds of spending is dampened. The total economic effect accounts for indirect spending by businesses and induced spending by workers benefiting from additional dollars.

Economic impact assessments are based on the inter-industry linkages across the economy and commonly utilize the input-output method developed by Nobel Prize-winning economist Wassily Leontief [6]. Advances in data and analytical approaches have improved the method over time, but the same basic framework is still used today. The modeling tool IMPLAN [7] was used in this analysis and is a widely used tool that uses region- and industry-specific multipliers to summarize the inter-industry relationships and overall economic impacts of an infusion of new dollars into the economy. These multipliers generate estimates of economic impact in terms of output, value added, employment, and earnings.

For this study, the economic impact was studied for two regions: Louisiana as a whole and the U.S. statewide impacts were allocated to smaller geographic areas based on the QCEW in proportion to the direct jobs in each parish tied to industries used as the basis for the statewide analysis. This approach identifies the geographic area that serves to generate the economic value for the state as opposed to a focus on the areas that are recipients of beneficiaries of those indirect and induced benefits.

Analysis of Waterway Commerce

Economic Impact Survey — Waterway Dependent Jobs

Table 9. Baseline data

NAICS	Industry Group	2019	2020	Essential	Major	Moderate	Total
483	Water Transportation	9,328	8,822	73.1%	10.6%	16.3%	100.0%
484	Truck Transportation	16,929	16,340	28.8%	8.7%	8.9%	46.4%
487	Scenic and Sightseeing Transportation	799	415	74.2%	0.0%	6.6%	80.7%
488	Support Activities for Transportation	20,192	18,572	45.4%	10.2%	7.1%	62.6%
493	Warehousing and Storage	8,097	7,763	14.3%	0.0%	0.0%	14.3%
31-33	Manufacturing	137,729	131,430	14.2%	5.9%	7.9%	28.0%

Baseline data from the QCEW and results from the survey were used to determine jobs tied directly to waterborne commerce, which in turn served as the basis for the economic impact analysis [8]. The data in Table 9 show employment in each major industry included in the survey scope as well as the percentage of businesses within each industry indicating each level of importance for waterborne commerce (with low and none excluded) that businesses indicated on the survey. While the most recent full year of data available were from 2020, the economic distortions caused by the COVID-19 pandemic make 2020 a poor base year for understanding longer-term trends; therefore, 2019 data were ultimately used as a basis for this analysis.

Input Data

Table 10. Port importance by industry

NAICS	Industry Group	2019	Essential	Major	Moderate	Water Dependent Jobs
483	Water Transportation	9,328	73.1%	10.6%	16.3%	7,703
484	Truck Transportation	16,929	28.8%	8.7%	8.9%	5,989
487	Scenic and Sightseeing Transportation	799	74.2%	0.0%	6.6%	606
488	Support Activities for Transportation	20,192	45.4%	10.2%	7.1%	10,555
493	Warehousing and Storage	8,097	14.3%	0.0%	0.0%	1,158
31-33	Manufacturing	137,729	14.2%	5.9%	7.9%	26,341
Total	Importance of Waterborne Commerce and Size of Impact		100%	50%	25%	52,351

To translate the survey responses regarding the importance of waterborne commerce to business operations into an estimate of direct jobs tied to waterborne commerce, the following additional assumptions for inclusion were used: 100 percent of jobs at businesses indicating waterborne commerce was essential to operations; 50 percent of jobs at businesses indicating waterborne commerce was of major importance to operations; and 25 percent of jobs at businesses indicating waterborne commerce was of moderate importance to operations. In total, this led to an estimate of just over 52,000 jobs tied directly to waterborne commerce, or around 27 percent of all jobs in the industries engaged in, or with strong ties to, waterborne commerce (Table 10).

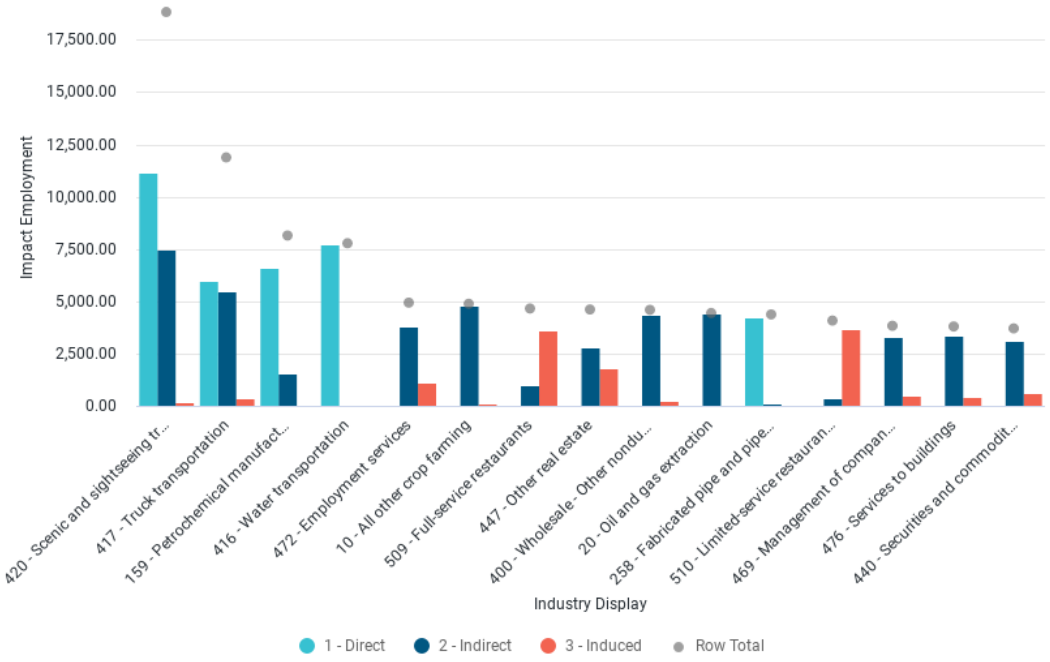
Statewide Economic Impact

Table 11. Statewide economic impact

Impact	Employment	Labor Income	Value Added	Output
Direct	52,400	$5,549,000,000	$22,243,000,000	$83,240,000,000
Indirect	96,300	$6,278,000,000	$13,565,000,000	$33,625,000,000
Induced	58,600	$2,574,000,000	$4,849,000,000	$8,607,000,000
Total	207,200	$14,401,000,000	$40,657,000,000	$125,472,000,000

The results of the statewide economic impact are presented in Table 11 above. The approximately 52,400 direct jobs are associated with $5.5 billion in labor income, $22.2 billion in value added to the state economy, and $83.2 billion in new output (or sales) across Louisiana. The 52,400 direct jobs lead to a total of more than 207,000 jobs, including an additional 96,300 jobs created through business-to-business transactions while another 58,600 jobs are created by the increase in payroll from direct jobs and associated consumer spending. Those total impacts also imply more than $14.4 billion in labor income, $40.7 billion in value added, and $125.5 billion in output (or sales) due to waterborne commerce.

Figure 16. Statewide impact by industry



Top industries in terms of job creation include a large cluster of jobs at ports or port tenants including several key manufacturing and transportation-related industries (Figure 16). Additional jobs are created in transportation as well as several business service and consumer-oriented industries.

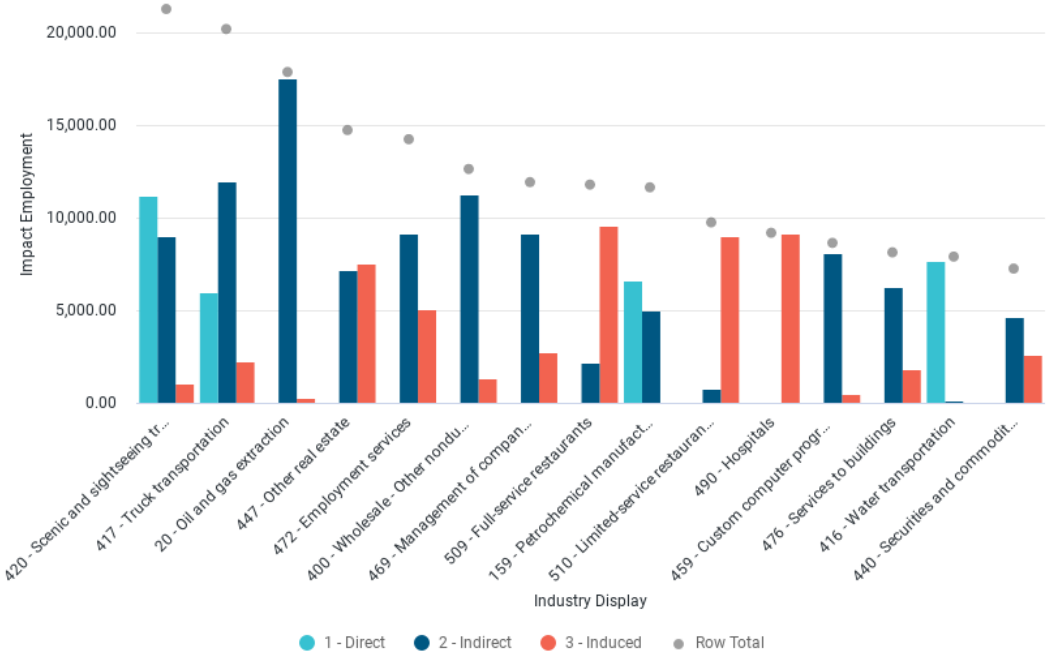
Table 12. United States economic impact

Impact	Employment	Labor Income	Value Added	Output
Direct	52,400	$5,549,000,000	$22,243,000,000	$83,240,000,000
Indirect	238,800	$22,266,000,000	$44,615,000,000	$110,843,000,000
Induced	221,200	$12,998,000,000	$23,056,000,000	$41,129,000,000
Total	512,300	$40,813,000,000	$89,914,000,000	$235,212,000,000

The results of the national economic impact are presented in Table 12 above. The 52,400 direct jobs lead to a total of more than 512,000 jobs, including an additional 238,800 jobs created through business-to-business transactions while another 221,200 jobs are created by the increase in payroll from direct jobs and associated consumer spending. Those total

impacts also imply more than $40.8 billion in labor income, $89.9 billion in value added, and $235.2 billion in output (or sales) due to waterborne commerce in Louisiana.

Figure 17. United States impacts by industry



As with the Louisiana analysis, top industries in terms of job creation nationally include a large cluster of jobs at ports or port tenants, including several key manufacturing and transportation-related industries (Figure 17). In addition, a significant number of jobs are created in oil and gas extraction, transportation as well as several business service and consumer-oriented industries.

Figure 18. Importance of waterborne commerce by region

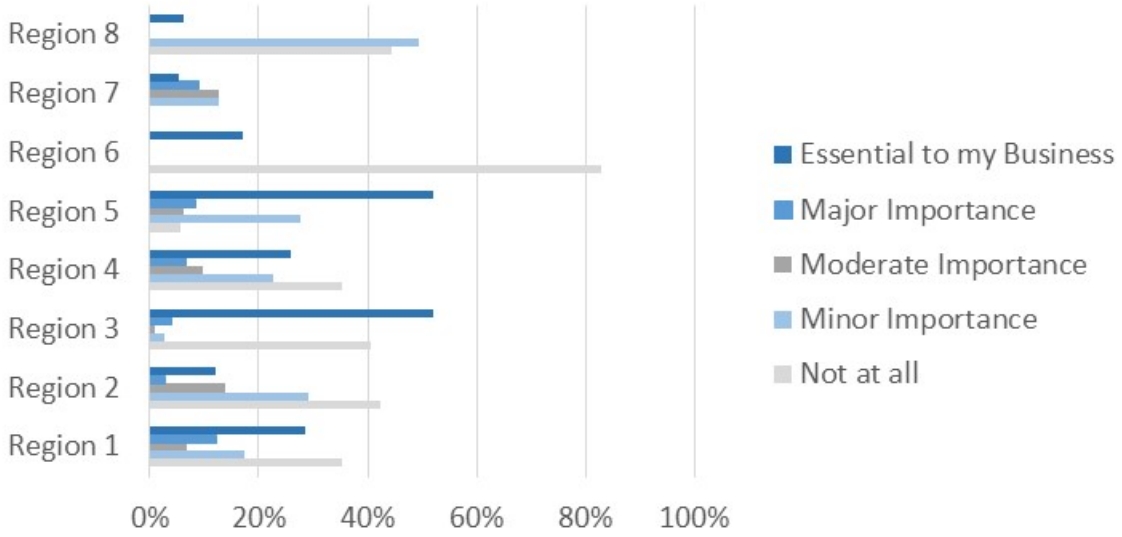


Figure 18 above shows how the importance of waterborne commerce varies by region of the state. In general, regions in coastal areas tended to have higher responses that waterborne commerce was essential to the business, including Region 5 (Lake Charles at 52 percent), Region 3 (Houma at 52 percent), Region 1 (New Orleans at 29 percent), and Region 4 (Lafayette at 26 percent). However, even areas much further inland had some businesses for which waterborne commerce was essential due to waterways that stretch across much of the state, offering direct access to areas as far inland as Shreveport and Monroe, with inland waterways link to the Mississippi River via the Red River and the Atchafalaya River/Old River Control Structure Complex.

Opportunities and Challenges for the Waterway System

Identify the Improvements Needed to Achieve Greater Utilization of Waterways

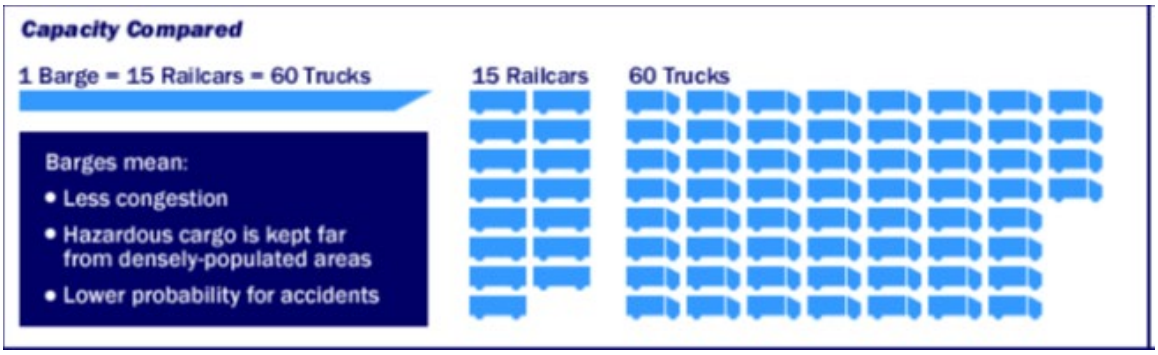
This chapter will focus on the opportunities and challenges for the waterway system and is organized as follows:

- Identify the improvements needed to achieve greater utilization of the Louisiana waterways.
- Identifying opportunities for relieving multimodal bottlenecks to waterways.

Port by port, economic impact analysis surveys and data analysis of the Louisiana's intracoastal and inland waterways revealed that they are not optimized to be a "reliable means of transporting goods." The Mississippi River has been authorized funds to dredge to a depth of 50 ft. up to Baton Rouge, increasing deep draft capabilities along this waterway corridor. The depth of other inland waterways supporting shallow-draft cargo is not sufficient to realize the full tonnage needed to make full use of the connectivity of these waterways. However, because of the network and connectivity of the inland shallow-draft network, there exists significant opportunity for transshipment to shallow draft for further distribution and deeper penetration into the Louisiana inland waterways system. Therefore, the inland waterways should, at a minimum, be maintained at current levels as they do provide many local and regional economic and recreational opportunities.

Louisiana's regions are predominantly dependent upon trucks for the movement of freight, despite access to 2,820 miles of navigable waterways throughout the state. Marine transportation is an essential, but often overlooked, component in the transportation system. Louisiana requires a paradigm shift to overcome this dependency through the implementation of appropriate planning and management to improve and develop the waterways.

Figure 19. Cargo capacity comparisons by mode



Source: Gulf Intracoastal Canal Association

Expanded shallow-draft operations, on a statewide level, is one approach to reduce landside congestion. Shallow-draft transportation is regarded as a more efficient mode of goods movement that can reduce road congestion and fuel costs, which is significant given the continued increase in fuel prices and considering (Figure 19):

- One barge is the equivalent of 15 rail cars and 60 trucks.
- One standard 15-barge tow moves the equivalent volume of 216 rail cars or 864 trucks.
- Significant opportunities do exist for Louisiana to take much greater advantage of enhancing waterborne transportation than is currently being achieved. These opportunities include increasing the efficiency of waterborne transportation and augmenting the economic impacts of waterway transportation-related businesses at both the regional and local levels. According to the economic impact analysis surveys, businesses indicating a strong connection to waterborne commerce in Region 3 (Houma) and Region 1 (New Orleans) were far more likely to relocate if the ports were not available.
- The economic survey revealed that businesses' most common mode of transport was via truck. For those businesses that reported not having a strong connection to waterborne commerce, among that group, by far the most common mode of transport was by truck (72 percent) or a combination of air, rail, and road (23 percent).
- This study developed a comprehensive analysis of potential projects as identified through the analysis of a port survey, economic impact survey, and source data. Those projects identified were evaluated and recorded within the LA WATERS platform as a means of applying current information when evaluating extreme weather and

additional economic conditions altering previous project parameters. The storyboard function provides historic insight into the analysis based on current information at the time of the evaluations.

AIS Data Analysis

Raw AIS data was transformed into a temporal spatial data set of vessels and their movements. The Commercially Navigable Waterway V5 data set, published by the U.S. Department of Transportation and the Pipeline and Hazardous Materials Safety Administration, is a network suitable for network analysis of the navigable waterways. Boundary geometries were created to represent the water's surface that could be used to capture vessels that entered a segment. Vessel movements were analyzed and grouped into segment traversal events. Each event detailed the duration within the segment, the average speed, direction (upstream/downstream/incomplete), and status flags indicating whether the vessel used its anchor or became moored.

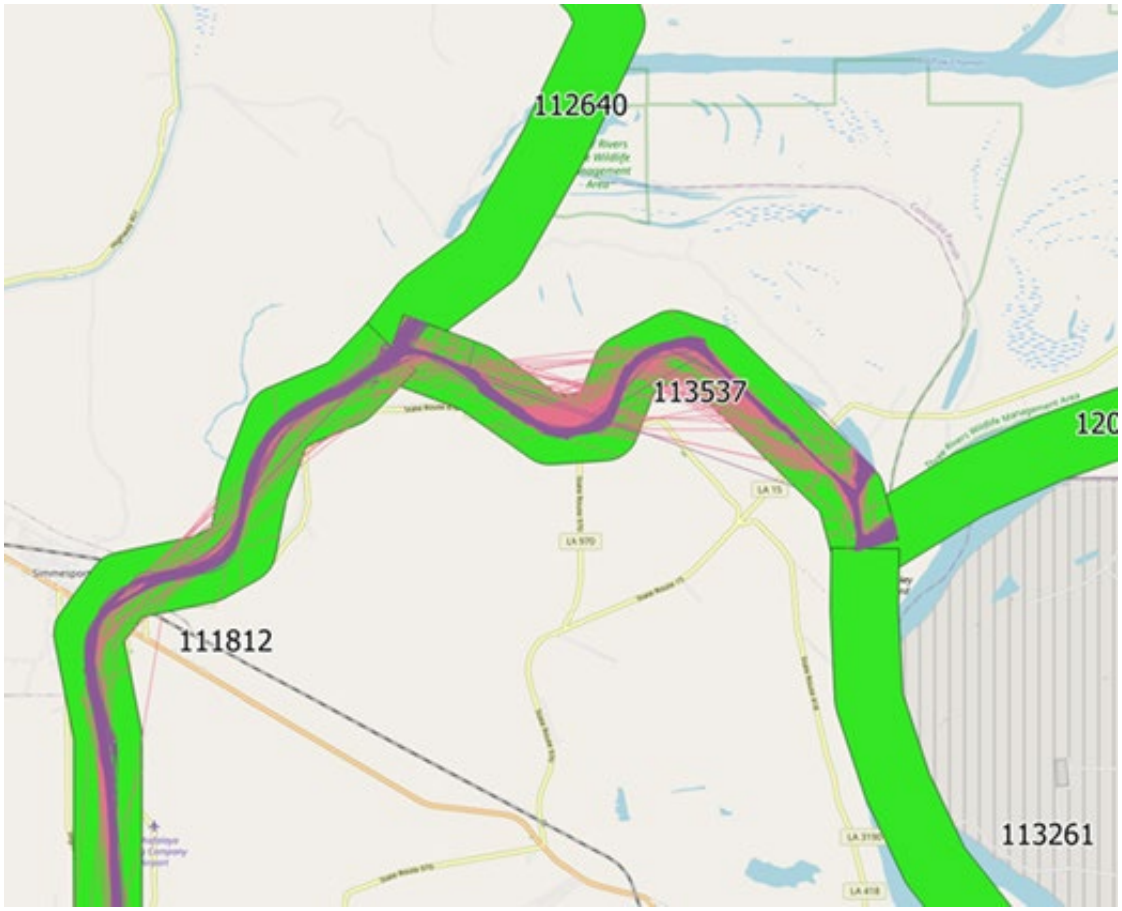
By aggregating the events, average transit times can be derived for each river segment, using the status effects to filter out vessels that did not just pass through a segment. These averages are displayed on the following chart. Each segment has the average traversal duration (shown in days) in the upstream and downstream direction for January 2009 and 2017. Several of the segments show a very clear increase in transit times, while a few shows a small decrease (Table 13).

Table 13. Sample of raw AIS data produced spatially in GIS tool for spatial analysis (2017)

OID	Traversal duration	Entry time	Depart time	Travel distance	Section length	Segment ID
1	00:06:25.02	2017-01-08 16:58:56.817011+00	2017-01-08 17:05:22+00	920.7152531	185231.0459	111812
2	00:04:33.01	2017-01-23 14:59:49.881046+00	2017-01-23 15:04:23+00	742.7182051	185231.0459	111812
3	00:02:41.03	2017-01-28 15:18:38.677105+00	2017-01-28 15:21:20+00	770.3259817	901.7492785	128868
4	00:00:52.10	2017-01-12 19:25:26.022354+00	2017-01-12 19:26:19+00	298.4778765	901.7492785	128868

OID	Traversal duration	Entry time	Depart time	Travel distance	Section length	Segment ID
5	00:01:17.01	2017-01-27 11:51:44.920456+00	2017-01-27 11:53:02+00	492.9260952	901.7492785	128868

Figure 20. Visual comparison of AIS data



Note: Segment 111812, visualizing the 2009(pink) and 2017(purple) AIS data around the Old River Lock with segment polygons. A visual comparison of AIS data for the respective years demonstrates an increase in traverse duration along the waterways (Figure 20).

Figure 21. Raw AIS trips plotted on a map

In Figure 21, Raw AIS data was transformed into a temporal spatial data set of vessels and their movements. Below, Figures 22, 23, and 24 are an example of combining additional photos and AIS data relevant to identified points of interest (Old River Control Structure).

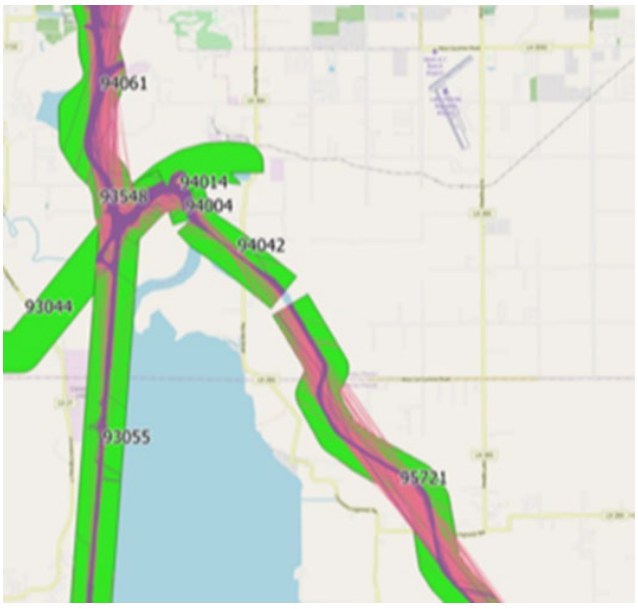
Figure 22. The Old River Control Structure complex—view is to the east-southeast, looking downriver on the Mississippi, with the three dams across channels leading to the Atchafalaya River to the right of the Mississippi

Source: Michael Maples, USACE—USACE Digital Visual Library

Figure 23. Sample river segments showing the varying size of segments

Figure 23 and Figure 24 further highlight potential bottlenecks and are georeferenced in LA WATERS.

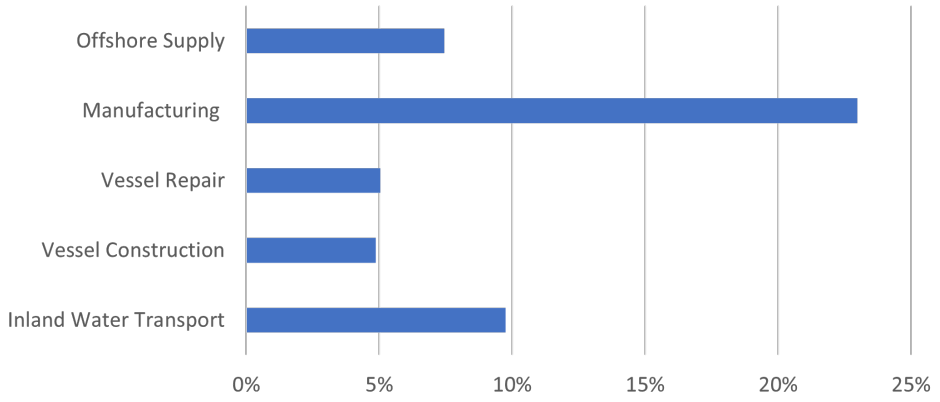
Figure 24. Identifying waterway challenges—visualizing the 2009 (pink) and 2017 (purple) AIS data around the Calcasieu Locks with segment polygons



Data Analysis

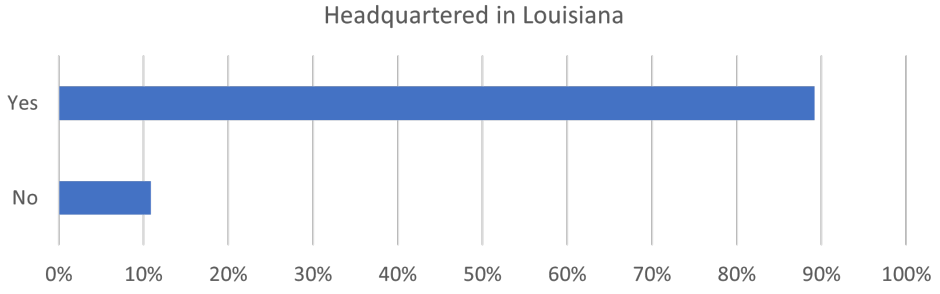
Data is represented through the LA WATERS platform. By using these tools, basic analysis and superimposing of diverse data, reports, analysis, and additional information can be visually represented and further analyzed. As an example, the collation of economic impact data is shown in the following chart (Figure 25).

Figure 25. Business activities in Louisiana



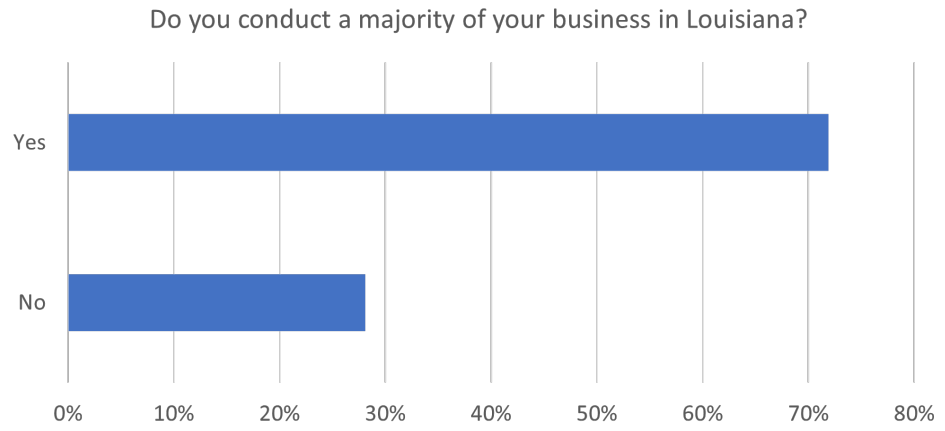
In addition to the specific industry code that identifies the main activity of the business, the survey asked businesses to report their business type as it relates to waterborne commerce.

Figure 26. Percentage of businesses reporting that they are headquartered in Louisiana



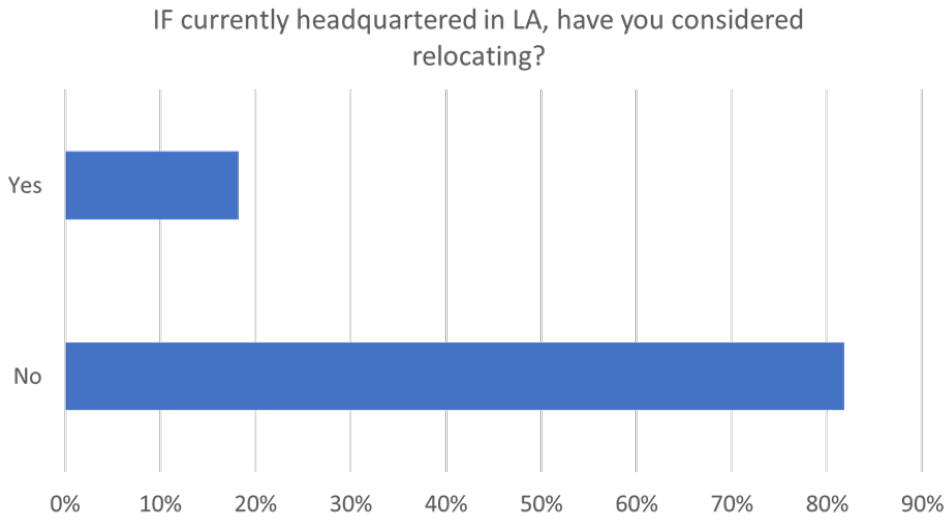
Among surveyed businesses, nearly 90% were headquartered in Louisiana (Figure 26).

Figure 27. Percentage of businesses reporting that they conduct most of their business in Louisiana



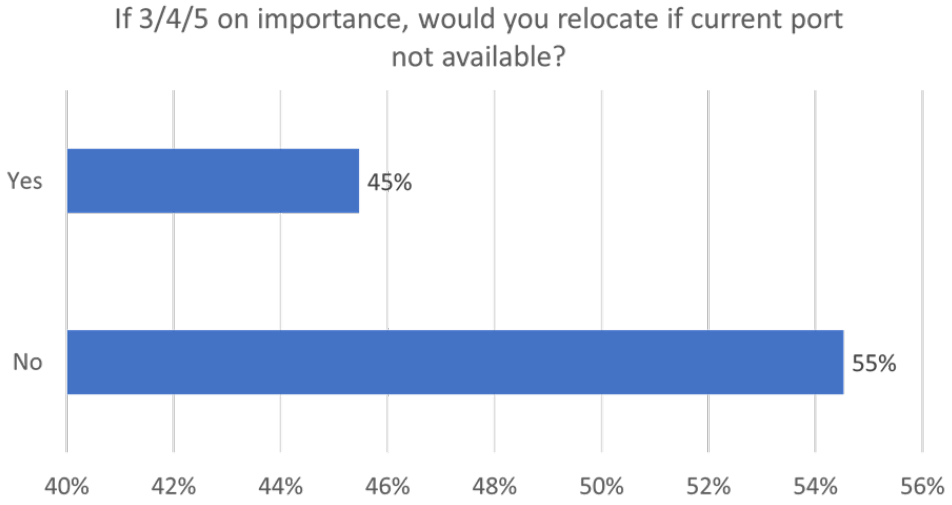
Among survey respondents, more than 70 percent indicated that most of the company's business was in the state of Louisiana (Figure 27).

Figure 28. Percentage of businesses reporting relocation consideration



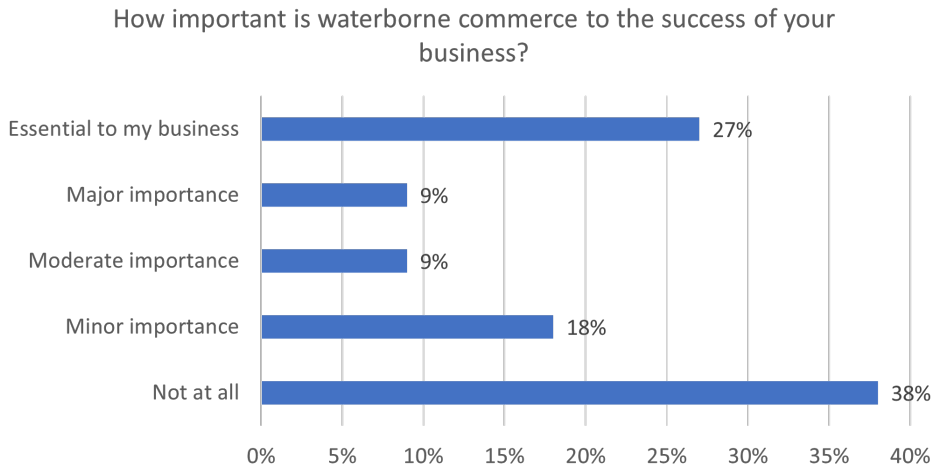
The survey was also used to capture the strength of business ties to Louisiana and waterborne commerce. Among businesses currently headquartered in Louisiana, only a small portion (18 percent) indicated they had considered relocating (Figure 28).

Figure 29. Percentage of businesses reporting relocation intentions based on port availability



Another way that the survey assessed the strength of business connections to waterborne commerce was a question about relocation. Among firms indicating a strong connection to waterborne commerce, 45 percent indicated they would relocate if the current port were not available (Figure 29).

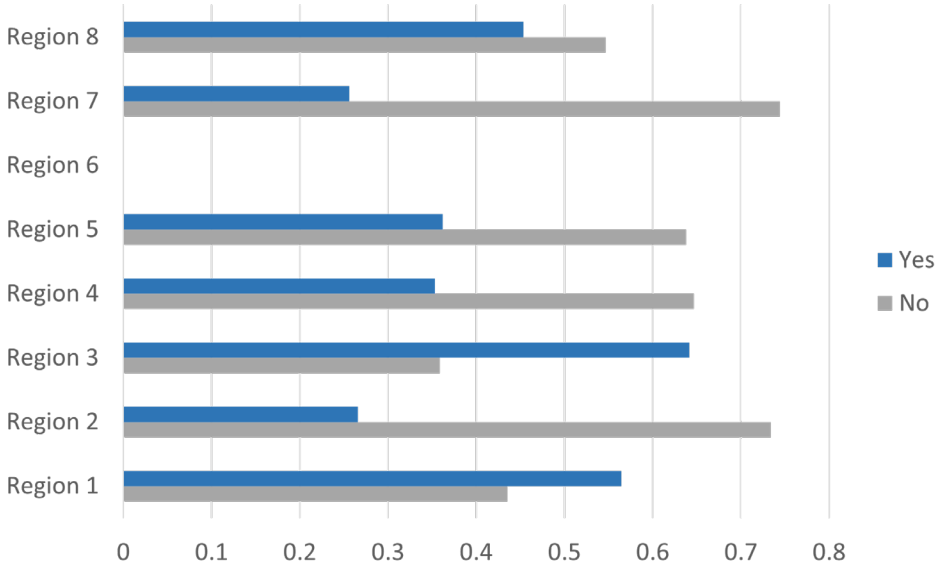
Figure 30. Importance of waterborne commerce rated by businesses



The survey was designed with broad scope to help assess the full extent of connections to waterborne commerce within Louisiana. Among survey respondents, 27 percent indicated

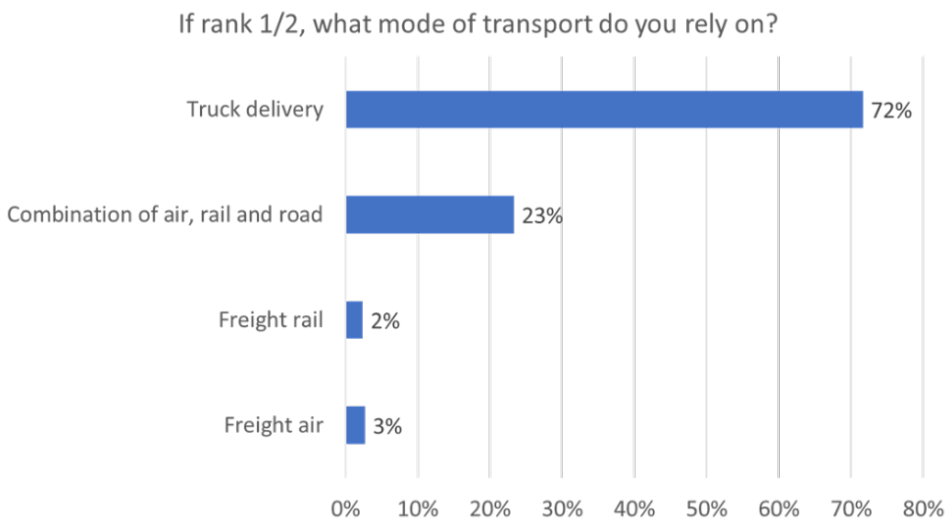
that waterborne commerce was essential to the success of the business, 9 percent said it was of major importance, and 9 percent said it was of moderate importance (Figure 30).

Figure 31. Businesses that report an intent to relocate based on port availability by region



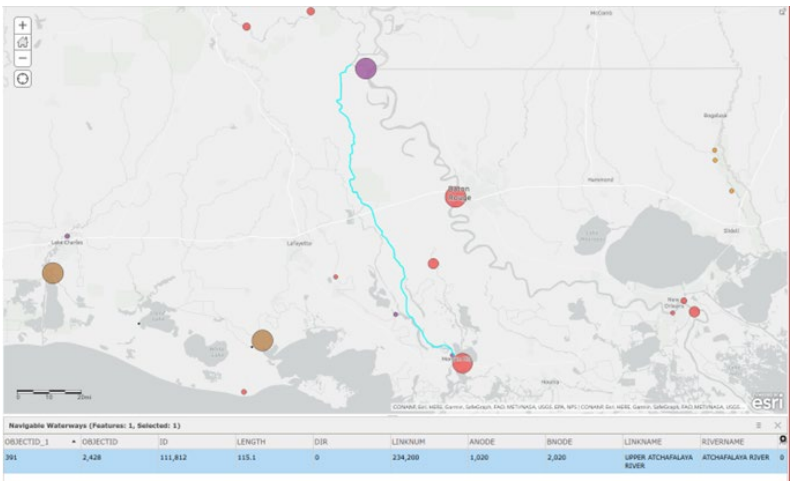
The chart above (Figure 31) shows response by region when asked if the business would relocate if the port currently used was not available. Businesses indicating a strong connection to waterborne commerce in Region 3 (Houma) and Region 1 (New Orleans) were far more likely to say yes, the business would relocate if the port were not available.

Figure 32. Businesses and the modes of transport



The survey also asked about common modes of transport for those businesses who said they did not have a strong connection to waterborne commerce. Among that group, by far the most common was truck (72 percent) or a combination of air, rail, and road (23 percent) (Figure 32).

Figure 33. Georeferenced analysis of Atchafalaya River



Identifying opportunities for relieving multimodal bottlenecks to waterways

Based on FAF data and studies, and datasets available from the USACE Institute for Water Resources and Economic Impact Study, a detailed analysis of current and projected

freight flows was integrated with employment and economic impact analysis. As an example, by using AIS data, tanker path density is shown over one month for a stretch of river in New Orleans. From this data, mooring locations can be determined and demonstrate the ability to use AIS data to create paths. The analysis can also discriminate for cargo, vessel characteristics, and time ranges (Figure 33). The estimates of future commodity flows are built up from historic data and trends by industry, by trade lane, and by commodity. This analysis produces the potential geographic areas of focus based on the delay of commerce, commodity, and tie-in to economic impact.

Figure 34. Tanker trajectories and speeds captured and illustrated through web-based data system

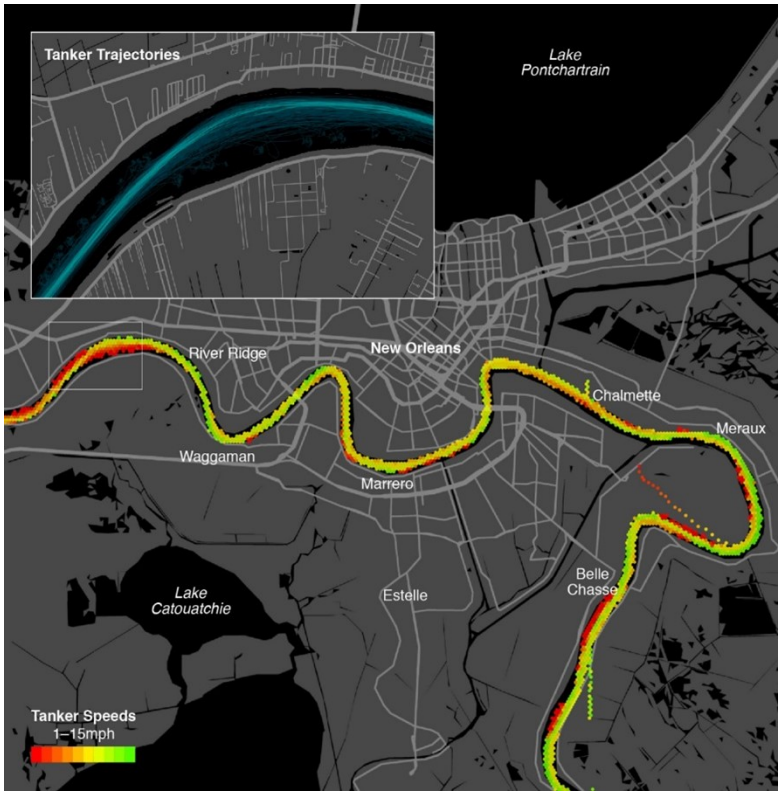
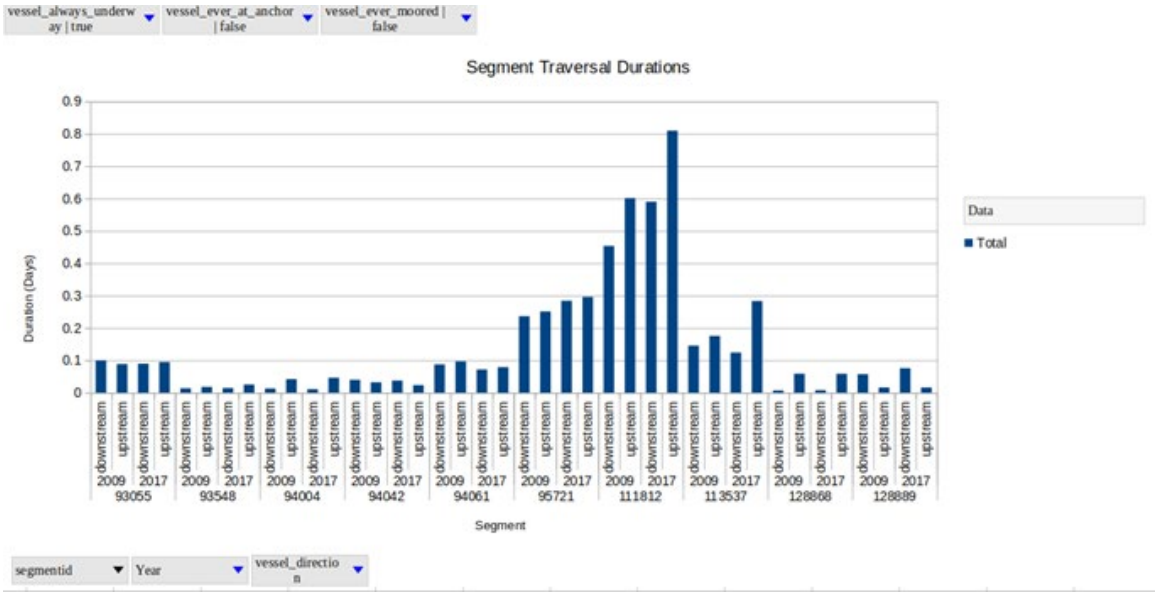


Figure 34 is a sample of the output of the AIS data collected. This graphic depicts tanker path density over one month for a stretch of river in New Orleans. This data can be used to determine mooring locations and it demonstrates the ability to use AIS data to create paths. It can also discriminate for cargo, vessel characteristics and time ranges.

Figure 35. Example of segment traversal durations



The above chart (Figure 35) demonstrates how AIS data is used in recognizing delay anomalies along the segmented river. Note Segment 111812 (Old River Lock), the traversal durations spike, demonstrating a bottleneck of traffic. By comparing multiple years (2009–2017), distinctive trends can be readily identified and used to complement and reinforce evaluations and project identification. This information can also be represented geographically through the LA WATERS tools.

Impact of Liquefied Natural Gas on Waterways

St. James, Calcasieu, and Cameron parishes are at the center of significant expansion of industrial facilities in Louisiana. Projects by Yuhang Chemical, Formosa, Wanhua Chemical, South Louisiana Methanol, and others coalesce in St. James Parish, with construction costs in the order of billions of dollars. In southwest Louisiana, LNG plant development dominates the industrial expansion, including Driftwood LNG, Lake Charles LNG, Sabine Pass LNG, and Calcasieu LNG [9] [10].

Figure 36. Calcasieu Ship Channel

The Calcasieu Ship Channel (CSC) (Figure 36) is a 68-mile long, deep draft commercial waterway located in southwest Louisiana, from Lake Charles into the Gulf of Mexico. Beginning in the 1920s, the CSC was channelized by straightening, widening, and deepening the Calcasieu River to its current dimensions of 400 ft. wide by 40 ft. deep.

For the LNG and other industries along the waterway, a draft of -40/-42 ft. is preferred to handle Panamax vessels fully laden, reducing cost per delivered ton and, therefore, more competitive in relative markets [11] (Figure 37).

Figure 37. Cameron LNG output in tons

COMMODITY	2019	2020	2021
LNG	1,679,567	7,752,711	10,165,792

Other Industries

An example of how waterway conditions impact industry is voiced by Jim Newport, Wanhua Chemical's general manager in St. James Parish. He cites his current biggest concern is high-water levels of the Mississippi River, as Wanhua is fabricating several modularized process units at its Yantai, China, petrochemical facility, then shipping them upriver to the site. "It will be important to plan these large module movements to avoid high Mississippi River levels," Newport says.

Data Management Tools

Through the collection of information, historical precedent, statistics, conditions, assessments, and extensive data available, this study included the development of an LA WATERS platform required for applying relative information in determining effective waterway infrastructure solutions and assisting in operational decisions. Furthermore, this platform serves as the basis for developing and applying systematic, transparent, and consistent protocols and processes in the assessment of the waterway systems and application of available resources. This emphasis in the waterway plan is recognized as an attempt to mitigate the dynamic nature of the opportunities and challenges as evidenced in preceding years because of extreme weather conditions and the COVID-19 pandemic. The ability to follow the protocol progression and processes in existing project evaluation, selection, and prioritization allows the timely application of relevant information in addressing waterway conditions.

The objective in developing the LA WATERS platform was to depict a picture of the current state of waterborne transportation in Louisiana based on the extensive data sources and historical information. The output provided a detailed assessment of Louisiana's waterborne commerce by commodity and industry at the parish level. This task also identified businesses and port terminals that depend on Louisiana's navigable waterway system by industry type, company name, and product. The type and value of waterborne commerce was documented using domestic freight flows of imports and exports from the FAF, maintained by the U.S. Department of Transportation's Bureau of

Transportation Statistics and Federal Highway Administration. This data captured trade flows between locations in the U.S. and four zones within Louisiana. To further disaggregate those data to smaller geographies aligned with each Louisiana port, industry, and employment, data from the QCEW and CBP was used. This process determined the distribution of activity based on the concentration of water transportation activities within each zone, paying particular attention to estimates of tonnage handled by individual Louisiana ports.

To provide the DOTD staff easy and intuitive access to the information, findings, recommendations, and conclusions of this plan, the LA WATERS platform provides context for the stand-alone "dynamic analysis tool" in serving the following:

- Study Results and Report Conclusions: Present project recommendations in an interactive map format that allows users to explore report findings and recommendations, the data and analysis that support the findings, and related data that allows users to understand project findings with historical and geographic context.
- Context: Provide DOTD users access to geographic data that drives the day-to-day work of DOTD waterway planners and managers. By placing existing datasets in one location, analysts and planners can collect and share a range of data related to waterway operations that currently reside across several internal and external systems.
- Analysis: The dynamic analysis tool provides the user with standard GIS tools for comparing and analyzing study results in the context of existing GIS data. Users can query all layers by location and by attributes and use selection tools to find the details of individual records. Basic GIS tools like location lookup, point, and area measurement tools allow users full access to the data that supports the report. Information and status are available for datasets such as river gauges and waterway locks, and inland and coastal digital navigation layers are available, as well as study-generated data such as freight history and projections for a variety of years and commodity types. The dynamic analysis tool allows the users to juxtapose these datasets with study project recommendations and use this information to drive decision processes.

Dynamic analysis tools give the user the ability to query port surveys, freight trends and forecasts for waterway segments and ports, and display dynamic informational graphs. Interactive selection tools allow the user to limit queries to selected waterways or ports to keep results relevant to the areas impacted by a single or group of potential projects.

DOTD staff often respond to requests from lawmakers, coworkers, and the general public to provide information about and related to Louisiana waterway systems. The dynamic analysis tool brings together data that is needed to respond to these requests. The tool contains census boundaries, parish boundaries, state, and national legislative districts and DOTD divisions, providing context to staff and allowing them to identify affected populations and responsible authorities quickly and accurately at multiple different scales or geo-political boundaries.

- Data Management Tool: The data management tool is designed to allow DOTD to update layers and supporting data in a timely manner whenever needed. The development of the tool is handled by off-the-shelf Environmental Systems Research Institute (ESRI) ArcGIS Online tools that require no custom programming or development. As much as possible, links to reference and context data are provided through linking to external mapping layers from authoritative sources, such as National Oceanic and Atmospheric Administration (NOAA) and the USACE. This means that updates to the supporting data happens automatically as the hosting agency updates the layer. Since these links are external, there is no data storage requirement for this data, which reduces the cost of hosting and maintaining the tool and makes managing updates simpler.

Basic Tools:

- Standard Webmap Navigation tools. These tools are familiar to most casual online map users.
- Zoom in/out
- Open Basemap Gallery
- Turn on Legend—the legend is interactive and will only display layers that are turned on in the layer visibility menu
- Layer Visibility Menu—allows users to select which layers are visible in the map and available for interactive selection
- Print Map—allows the user to design and produce a map in image file format using the visible layers in the map

Figure 38. Print and layer menu

- The Print Layouts tool (Figure 38) is an interactive tool that allows users to compose a map by choosing layer visibility, setting extent, and choosing layout options. Layout is printed as a downloadable portable document format (PDF). The user has control to turn on or off all active layers in the view and select a zoom level and center for the desired print. This allows the user to compose a custom map and allows the user to share the results of quick overlay analyses. The user titles the map, chooses the layout type, and chooses from a variety of output types (Figure 39). Output is saved as a shareable file at a location determined by the user.

Figure 39. ArcGIS WebMap features

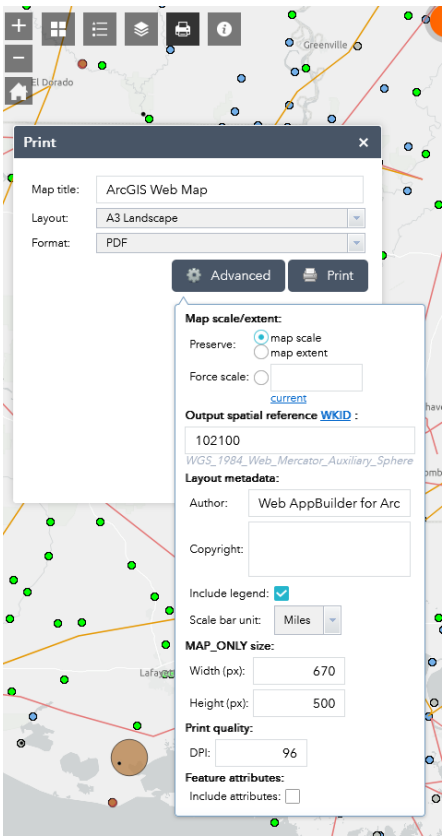
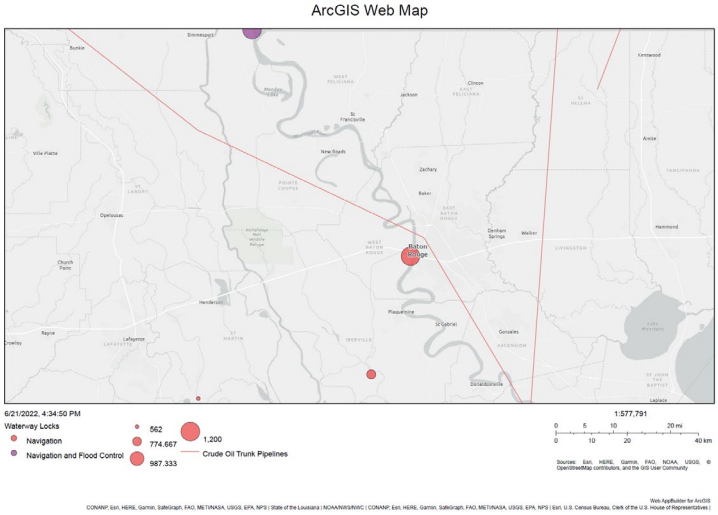
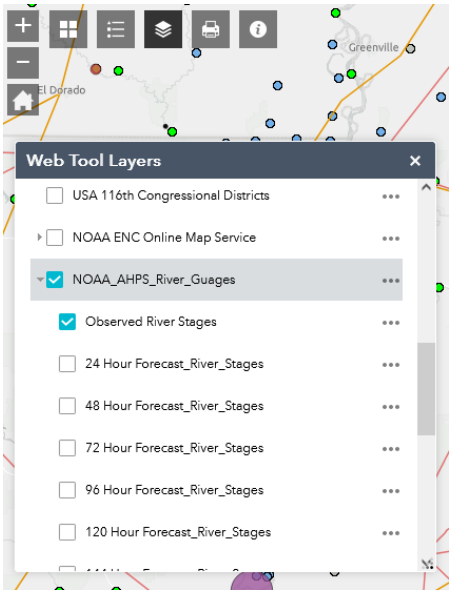


Figure 40. Example print output



- The Layer Visibility tool is an interactive tool that allows the user to select which layers are visible in the map view (Figure 40). All the layers in the tool are available for the user to turn on and off. This too is familiar to most users familiar with basic web map tools.

Figure 41. Basemap gallery menu

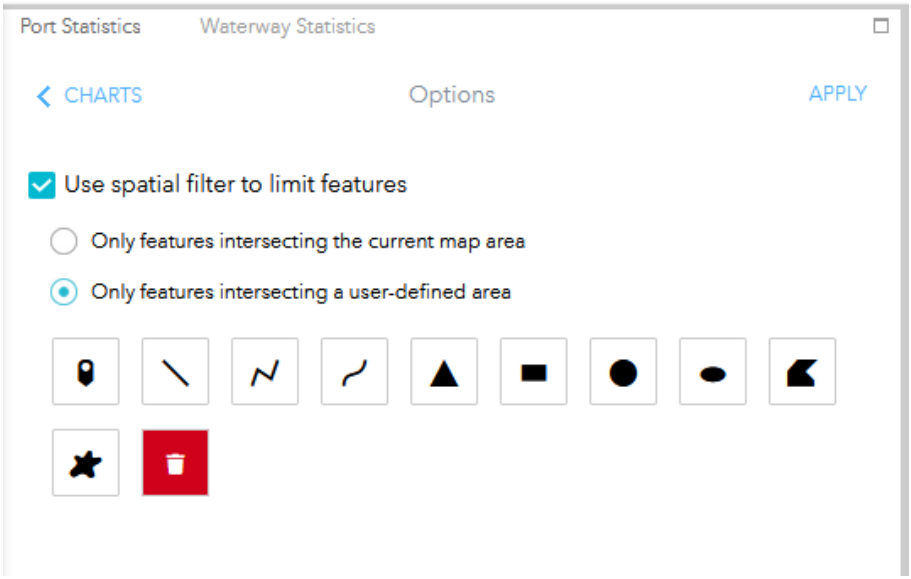


- Basemap gallery (Figure 41) is an interactive tool that allows the user to select basemap. Default basemap is ESRI Streets View. Basemap availability is determined by the user's organization.

GIS Dynamic Analysis tools

Port and waterway volume infographics tools (Figure 42) are interactive and are used to communicate historical commodity trends by waterway and port. The user sets the extent or uses the interactive selection tool to select ports or waterway segments. Pie charts and histograms update in real time to display summaries for the user's selection.

Figure 42. Port and waterway infographics



In Figures 43-45, LA Waters can combine point data from multiple datasets and present this information in various charts, maps, and formats.

Figure 43. Analysis by selected area/region

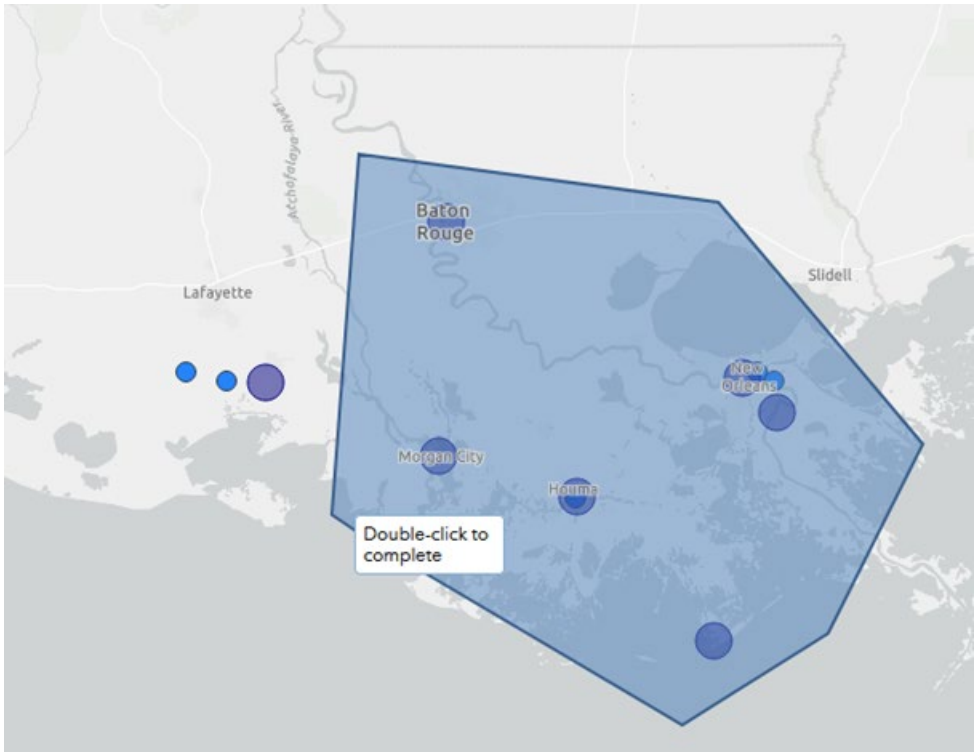
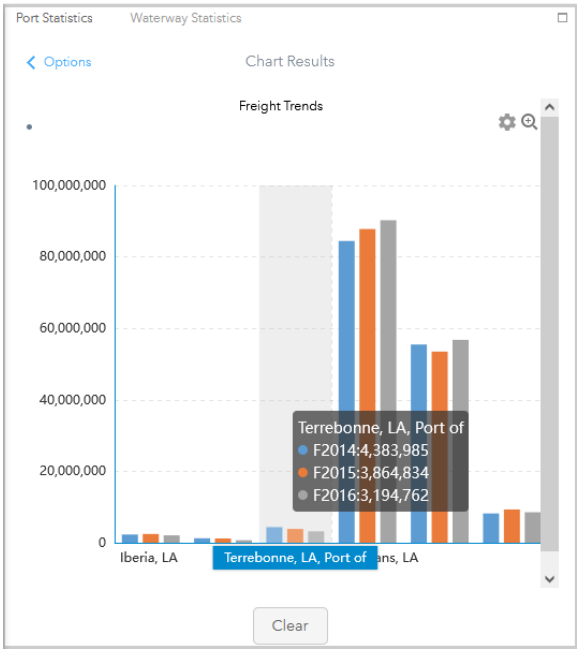
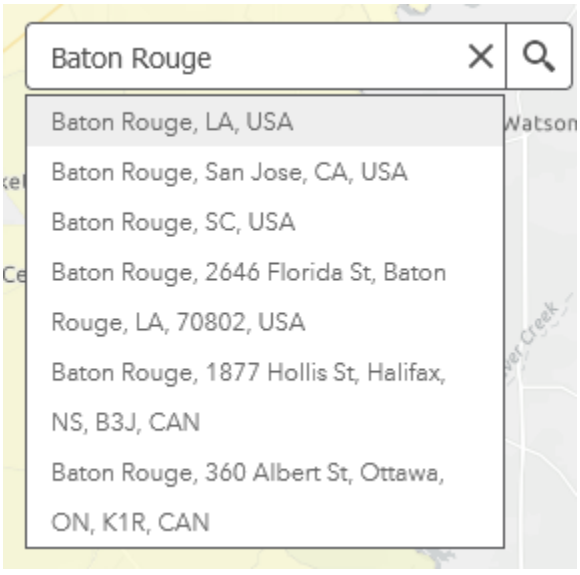


Figure 44. Port freight trends



- Figure 44, Economic Impact Statewide Infographic—Same as above for economic impact data
- Figure 45, Selected Project Infographics—Same as above for recommended projects

Figure 45. A Geography selection drop menu



Layers & Data Sources

- Crude Oil Trunk Pipelines—Energy Information Administration
- Petroleum Product Terminals—Energy Information Administration
- Petroleum Products Pipelines—Energy Information Administration
- Waterway Locks—USACE
- USACE River Mile Markers—USACE
- Survey Responses by Port—Moffatt & Nichol, with metadata
- Port Forecasts by—Moffatt & Nichol, with metadata
- Economic historical summary—tonnage by waterway & port
- Tonnage projections—tonnage by waterway and port
- Coal
- Petrol
- Industry Sites—Kathleen Babineaux Blanco Public Policy Center, University of Louisiana Lafayette
- AIS Analysis (Moffatt & Nichol) —identifying chokepoints and locations with significant slowdown
- Least Cost Route Modeling (LCRM) —Moffatt & Nichol
- Bathymetry—NOAA
- Navigable Waterways—USACE/NOAA
- Boundaries
- USA Block Groups—U.S. Census/ESRI
- USA Census Tracts —U.S. Census/ESRI
- USA 116th Congressional Districts—U.S. Census/ESRI
- Louisiana State Legislative Boundaries—Louisiana State GIS
- Parish Boundaries—U.S. Census/ESRI
- North American Rail Lines—Federal Railroad Administration (FRA)

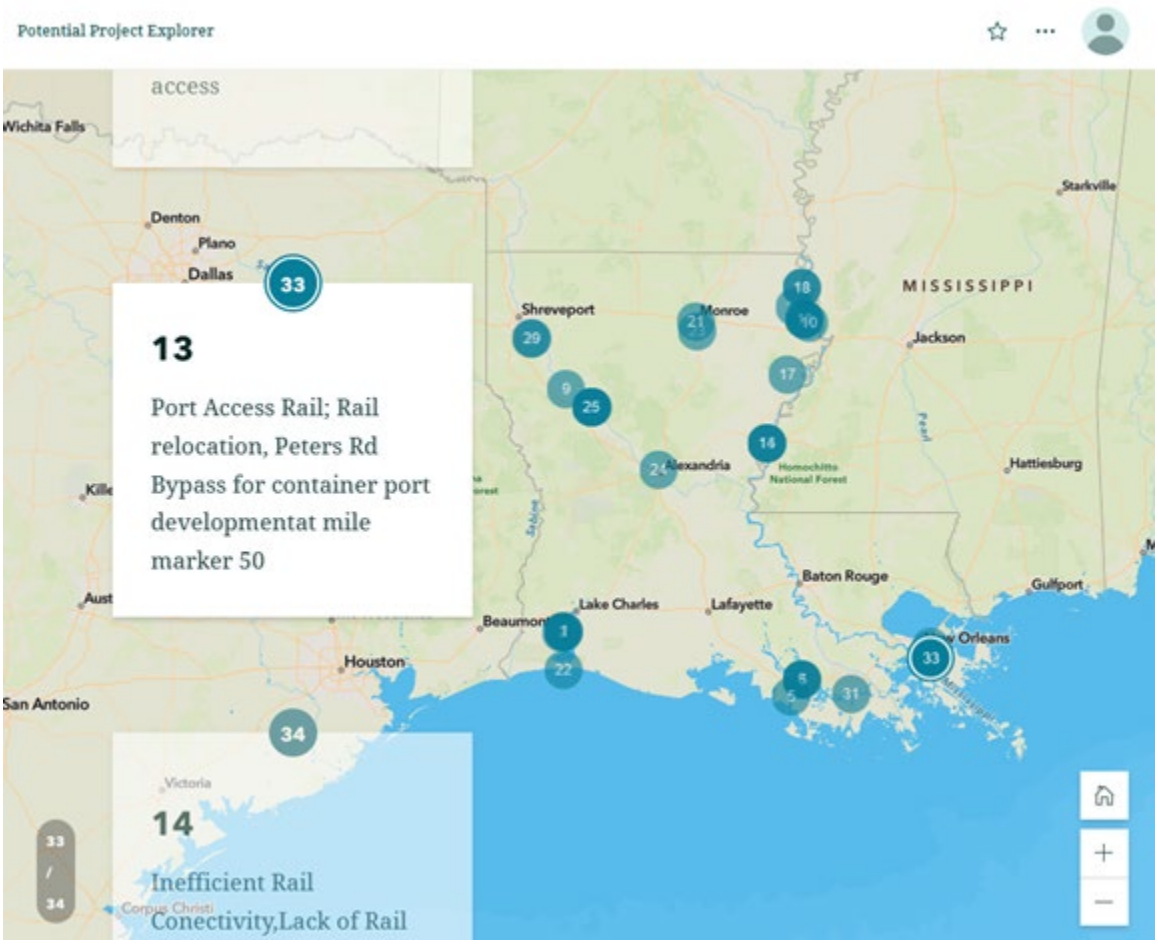
- DOTD Roads—DOTD
- U.S. Highways & Major Roads—ESRI
- Economic impact by region/parish—Kathleen Babineaux Blanco Public Policy Center, University of Louisiana Lafayette
- Cadastral (Data.gov)
- City
- Parish
- Legislative districts
- U.S. Congress
- State Representatives
- State Senate

Report Story Map

- The context and conclusions of the report are fundamentally geographic in nature and maps are the most intuitive and efficient way to convey the analysis and conclusions. In addition to providing the report in standard document form, Moffatt & Nichol has provided the report in story map form.
- Story maps are interactive presentation web pages created using ESRI ArcGIS online tools. The interactive format allows for text, static graphics, charts, and figures interspersed with special-focus interactive maps that allow the user limited web mapping input to explore the geographic and attribute content of the subject being presented.
- All the elements of the document report are reproduced in the story map, with additional mapping content to enhance the contextual understanding of discussion and conclusions.

The story map (Figure 46), in contrast to the dynamic analysis tool, is intended to convey the ideas and content of the final report, and not as a living tool to be updated on a continuing basis. The data and the story map are hosted on DOTD's ArcGIS Portal.

Figure 46. Story Map



Example of Story map with georeferenced potential projects with summary information.

Discussion of Results

The following presents a list of findings resulting from the analysis of Louisiana's intracoastal and inland waterways system:

- Louisiana's intracoastal and inland waterway system is well established, with nearly 2,820 miles of navigable waterways, making it the second largest navigable waterway in the nation.
- Louisiana has 32 active ports including 6 deep water ports, with 238.7 million tons (2018) of freight valued at $59 billion transported on the waterway system. This tonnage represents the equivalent of 6 million trucks, thus reducing congestion and emissions, and contributing to the state of good repair of the highway infrastructure.
- Water-dependent industries generate 525,000 jobs, or one in five jobs in the state. It is also estimated that ports in Louisiana generate more than $182 billion in economic output.
- Louisiana is highly dependent upon trucks for the movement of most of its freight, despite 2,820 miles of inland waterways throughout the state. Marine transportation is an essential component in the transportation system and is currently underutilized. Louisiana requires a transportation paradigm shift through the implementation of appropriate planning and management in order seize upon this competitive advantage of an abundance of navigable waterways and, in doing so, the development of the increased utility of these waterways.
- The intracoastal and inland waterways are a source of economic activity, development, vitality, and growth for the parishes and areas that they serve. In addition, the intracoastal waterway is a major shallow-draft thoroughfare connecting Texas to Florida and upward through the eastern seaboard. The FAF freight forecasts suggest total water tonnage will increase at an annual growth of 0.7 percent per year through 2040. These waterways contribute socioeconomic benefits that are measured in value by business activity, personal income, employment, recreational opportunities, environmental appreciation, and many other aspects important to the parishes and areas that these inland waterways serve. A major challenge will be how to appropriately monetize the socioeconomic benefits of intracoastal and inland waterways to secure funding for improvements and maintenance.

- Waterborne commerce generates 52,400 direct jobs that are associated with $5.5 billion in labor income, $22.2 billion in value added to Louisiana's economy, and $83.2 billion in new output (or sales) across Louisiana.
- The 52,400 jobs directly related to Louisiana's waterborne commerce generate more than 207,000 jobs. This includes 96,300 jobs created through business-to-business transactions. While another 58,600 jobs are created by the increase in payroll from direct jobs and associated consumer spending.
- The total economic impact of the waterborne commerce labor market is equivalent to more than $14.4 billion in labor income, $40.7 billion in value added, and $125.5 billion in output (or sales) due to waterborne commerce.
- As per the individual port consultation surveys, economic surveys, and data analysis, Louisiana's intracoastal and inland waterways are not optimized "as a reliable means of transporting goods." The connectivity of the inland shallow-draft network provides significant opportunity for transshipment to shallow draft for further distribution and deeper penetration into the Louisiana inland waterways system. As such, the waterways should, at a minimum, be predictably maintained at advertised depth levels as they do provide numerous economic and recreational opportunities to the local and regional economy.
- Expanded shallow-draft operations and improved integration with the Louisiana Statewide Transportation Plan is a key strategic approach to reduce road/rail congestions, reduce carbon emissions, and reduce the burden on the land transportation system. Shallow-draft transportation is fundamentally a more efficient mode of goods movement that can reduce road congestion and fuel costs, which is significant given the continued increase in fuel prices and considering:
- One barge is the equivalent of 15 rail cars and 60 40-ton trucks.
- One standard 15-barge tow moves the equivalent volume of 216 rail cars or 864, 40-ton trucks.
- Significant opportunities do exist for Louisiana to take greater advantage of enhancing waterborne transportation than is currently being achieved. Key opportunities include increasing the efficiency of waterborne transportation, which in turn has cascading economic impacts on waterway transportation-related businesses, at both the regional and local levels. The impacts of a lack of investment in these

improvements can be seen in some of the key findings in the individual port surveys, specifically:

- Businesses indicating a strong connection to and reliance upon waterborne commerce in Region 3 (Houma) and Region 1 (New Orleans) were far more likely to relocate if access to waterborne transport and/or ports were not available.
- The economic survey conducted with businesses with clear economic ties to the Louisiana waterways system revealed that most of all goods movement transport was achieved by truck. For those businesses that did not have a strong connection to, or need for, waterborne commerce, 72 percent of goods movement was achieved by truck alone or a combination of air, rail, and road (23 percent).
- A comprehensive analysis of port executive's survey and economic impact survey, with key industry sector businesses and source data, identified a list of projects that could potentially increase economic activity of the waterways within their jurisdictions. These projects were evaluated and recorded within the LA WATERS platform. This tool provides a framework for assessing the potential for the project to increase economic activity on the regional waters in response to both micro- and macro-dynamic drivers. This evaluation can also be assessed for individual projects as well as the cumulative impacts/benefits of a suite of projects when considered in a single analysis portfolio. The story board function within the platform provides a powerful historic and highly informative context to these analyses.
- The Port of Greater Baton Rouge was responsible for the movement of approximately 40 million tons of waterborne commerce in 2018, involving transactions mostly within Louisiana and included cereal grains, other agricultural products, fuel oils, and coal. This represents $2.8 billion in foreign waterborne commerce, generating over $10 billion in annual economic activity throughput through the port. This connection was especially important for port cities deep in the U.S. agricultural heartland situated on the Mississippi River valley and its key tributaries heavily engaged in the export of agricultural products.
- $40 billion dollars of waterborne commerce went through the Port of New Orleans, making it by far the largest economic driver of waterborne commerce in Louisiana. It also represents a significant opportunity for transshipment into shallow-draft waterborne transportation.

Conclusions

Louisiana waterways have seen an overall growth based on port volumes according to data collected from the FAF, USACE, and U.S. Census data from 2003 to 2019. This growth was not seen in all ports but was focused on larger ports that were able to improve infrastructure and adapt to market changes. The largest increase in volume, according to the link ton data, was found along the coast and specifically in the Lake Charles section of the Calcasieu River. The waterways with the greatest decline in volumes were in smaller coastal channels and waterways. This would suggest that cargo volumes are becoming more concentrated in larger ports and smaller ports are losing market share.

In the past decade, major ports in Louisiana have been able to grow their cargo volumes, recovering from declines caused by the global financial crisis in 2008. Ports such as New Orleans, Lake Charles, and the Port of Plaquemines all experienced volume growth or consistent volumes between 2010 and 2018. These ports have had the advantage of consistent improvement projects, establishing new infrastructure, and allowing for different types of cargo to be brought into the port. A key difference between ports like larger ports and smaller regional ports is the diversity of cargo being moved through them.

Using information collected through the survey responses, there appears to be a general need for dredging and waterway maintenance at smaller ports along the coast and in the interior of Louisiana. Many ports responded to the survey saying that the greatest weakness or threat to the port is channel depth and stabilizing their banks against erosion. Similar problems were not reported by larger ports, with the exception of Lake Charles Harbor and Terminal District, which has a constant need to maintain its navigational channel connecting it to the Gulf. Many of the ports that reported a need for dredging are situated in waterways that are offshoot channels, or tributaries connecting to major waterways. For example, the Abbeville Harbor and Terminal District sits on the Vermillion River, which connects to the nearby Intercoastal Waterway. On the interior of the state, the ports of Caddo-Bossier and Natchitoches Parish both reported that the 9-ft. draft of the Red River was a limiting factor to the economic growth of the ports.

To maintain and manage Louisiana’s waterways, an extensive record of all commercial waterways should be compiled in a dedicated database. Tonnage should not be the only factor that determines a waterway’s significance. More emphasis should be on the regional economic impact that a waterway contributes. The results and application of the

Economic Impact and Importance of Waterborne Commerce study provides a baseline from which to establish data source and analysis guidelines.

LA WATERS establishes consolidation of data sources and analysis methodologies and should be an on-going dynamic resource used in assessing the ability of recommended operational strategies and individual projects in mitigating the dynamic challenges of the waterways.

Recommendations

The following recommendations should be considered in the effective improved management of Louisiana's waterway systems to best position the Louisiana inland waterways system to capitalize on its competitive market advantages of highly interconnectivity and opportunity for intermodal shifts.

- Provide leadership and regularly update the Statewide Waterborne Commerce Plan at a minimum once every five years. The DOTD OMC should continue to be the lead agency for monitoring waterway systems and serve as the lead agency in Waterborne Commerce related data management. This will help facilitate DOTD in improving integration of the waterborne commerce system with the Louisiana Statewide Transportation Plan and the state's overall transportation system.
- Establish a standardized data reporting protocol for goods, commerce, and economic reporting data. This will greatly improve the cost-effectiveness and timeliness of future updates and keep the database updated to the greatest extent possible. This will fundamentally establish the database as a state-of-the-art, industry leading framework for the analysis of waterborne commerce transportation systems.
- Maintain an up-to-date database of Louisiana's intracoastal and inland waterway system. To maintain and manage Louisiana's waterways, an extensive record of all commercial waterways should be compiled in a dedicated database. Tonnage should not be the only factor that determines a waterway's significance. More emphasis should be on the regional economic impact that a waterway contributes. The results and application of the Economic Impact and Importance of Waterborne Commerce study provides a baseline from which to establish data source and analysis guidelines.
- Continue to build the data sources and analysis methodologies through the LA WATERS platform in assessing the ability of recommended operational strategies and individual projects in mitigating the dynamic challenges of the waterways.
- Coordinate waterway planning activities. Most of Louisiana's waterborne tonnage is reported through its individual ports. By increasing focus on the improved integration of system-wide solutions to waterway throughput efficiencies, it will be possible to develop strategies to mitigate waterway congestion throughout Louisiana's transportation network.

- Partner with local waterway sponsors and stakeholders. DOTD should continue to expand its partnerships with local waterway administrators, such as the Red River Authority and the Gulf Intracoastal Canal Association, to maintain an open dialogue of the issues concerning waterways, as localized strategies can readily aggregate to cumulative benefits on a regional scale. As witnessed by the multiple hurricanes within the last two years as well as the national pandemic, promoting active communications with waterway system stakeholders will keep the DOTD abreast of current conditions and will enable improved dynamic response to these micro- and macro-challenges to the overall transportation system.
- Record and track inputs from stakeholders through the LA WATERS platform for establishing historical baseline data, benchmarks, and trend analysis.
- Quantify the economic impact of the waterway system not being optimized for improved efficiencies. DOTD should perform high-level economic impact studies to establish the return on investment in maintaining waterways at their advertised depths. This will also enable the DOTD to rapidly perform a BCA and project-specific LCMA of system improvement impacts. Deeper draft is not always the answer to improved throughput, and LCMA sensitivity analyses can rapidly demonstrate the best most cost-effective efficiency improvements. Such a framework can also position the DOTD to rapidly and cost effectively respond to grant funding requests for information.
- Provide higher level resolution economic impact analyses and BCAs of proposed projects, evaluated both individually and as a portfolio of projects implemented together. Apply the LCMA framework to define, identify, and target remedial actions and required resources when moving forward with programmed projects of the LCMA that can also be used to better target limited funding resources for these projects.
- Recommend comprehensive training in the implementation of the LA WATERS platform and analysis tools. The wide spectrum of economic, engineering, and planning information available for the management of the waterway systems requires training in the application of these tools and developing both user and manager skill levels to fully realize the benefit of this centralized data repository. The platform is dynamic in its evolution and will require continued regular maintenance and update to keep up with the ability to quantify micro- and macro-economic impacts to the Louisiana waterways system.

Acronyms, Abbreviations, and Symbols

Term	Description
AIS	Automatic Identification System
BCA	Benefit Cost Analysis
CBP	County Business Patterns
CSC	Calcasieu Ship Channel
DOTD	Department of Transportation and Development
ESRI	Environmental Systems Research Institute
FAF	Freight Analysis Framework
FRA	Federal Railroad Administration
GIS	Geographic Information System
LA WATERS	Louisiana Waterways Analysis Tool Evaluating Regional Systems
LCMA	Least Cost Market Analysis
LCRM	Least Cost Route Modeling
LNG	Liquified Natural Gas
mcyds/yr	million cubic yards per year
NOAA	National Oceanic and Atmospheric Administration
OMC	Office of Multimodal Commerce
PDF	Portable Document Format
QCEW	Quarterly Census of Employment and Wages
U.S.	United States
USD	United States Dollar(s)
USACE	US Army Corp of Engineers

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Appendix

The following tables and figures are representative of the Louisiana waterways based on the economic impact survey and FAF analysis.

Economic Impact

Survey Responses Weighted by Industry

Table 14. Survey responses weighted by industry by NAICS code

Industry	Unweighted	Weighted	Census
NAICS 311 Food manufacturing	6.4%	5.6%	5.6%
NAICS 312 Beverage and tobacco product manufacturing	0.2%	0.9%	0.9%
NAICS 314 Textile product mills	0.6%	1.1%	1.1%
NAICS 315 Apparel manufacturing	0.4%	0.5%	0.5%
NAICS 321 Wood product manufacturing	1.2%	2.3%	2.3%
NAICS 322 Paper manufacturing	0.4%	0.8%	0.8%
NAICS 323 Printing and related support activities	7.2%	4.4%	4.4%
NAICS 324 Petroleum and coal products manufacturing	0.4%	1.1%	1.1%
NAICS 325 Chemical manufacturing	3.0%	5.3%	5.3%
NAICS 326 Plastics and rubber products manufacturing	1.0%	1.3%	1.3%
NAICS 327 Nonmetallic mineral product manufacturing	2.2%	3.3%	3.3%
NAICS 331 Primary metal manufacturing	2.2%	0.7%	0.7%
NAICS 332 Fabricated metal product manufacturing	16.9%	11.4%	11.4%
NAICS 333 Machinery manufacturing	7.0%	5.3%	5.3%
NAICS 334 Computer and electronic product manufacturing	1.6%	1.4%	1.4%
NAICS 335 Electrical equipment and appliance mfg.	1.8%	0.9%	0.9%
NAICS 336 Transportation equipment manufacturing	2.6%	2.5%	2.5%
NAICS 337 Furniture and related product manufacturing	3.8%	2.4%	2.4%

Industry	Unweighted	Weighted	Census
NAICS 339 Miscellaneous manufacturing	8.2%	4.5%	4.5%
NAICS 483 Water transportation	2.4%	3.3%	3.3%
NAICS 484 Truck transportation	13.1%	24.5%	24.5%
NAICS 487 Scenic and sightseeing transportation	2.4%	0.9%	0.9%
NAICS 488 Support activities for transportation	12.5%	12.0%	12.0%
NAICS 493 Warehousing and storage	2.2%	3.6%	3.6%

The survey responses were weighted based on industry, region of state, and firm size to ensure that the final analysis was representative of all businesses in Louisiana within the scope of the survey. Table 14 shows the percentage of survey respondents from each industry before and after assigning survey weights as well as a comparison to Census data on the distribution of firms across industries. Given the large size of the sample, the unweighted data follow a similar pattern to the overall population of firms in the Census data, but that distribution matches after assigning sample weights to make the survey respondents more representative of the full population of firms.

Table 15. Statistics by regional labor market area

Regional Labor Market Area	Unweighted	Weighted	Census
1-New Orleans	26%	26%	26%
2-Baton Rouge	20%	20%	20%
3-Houma	8%	7%	7%
4-Lafayette	23%	17%	17%
5-Lake Charles	7%	7%	7%
6-Alexandria	2%	5%	5%
7-Shreveport	10%	12%	12%
8-Monroe	5%	6%	6%

Table 15 shows the percentage of survey respondents from each regional labor market area before and after assigning survey weights as well as a comparison to Census data on the distribution of firms across regions. Given the large size of the sample, the unweighted data follow a similar pattern to the overall population of firms in the Census

data, but that distribution matches the Census after assigning sample weights to make the survey respondents more representative of the full population of firms.

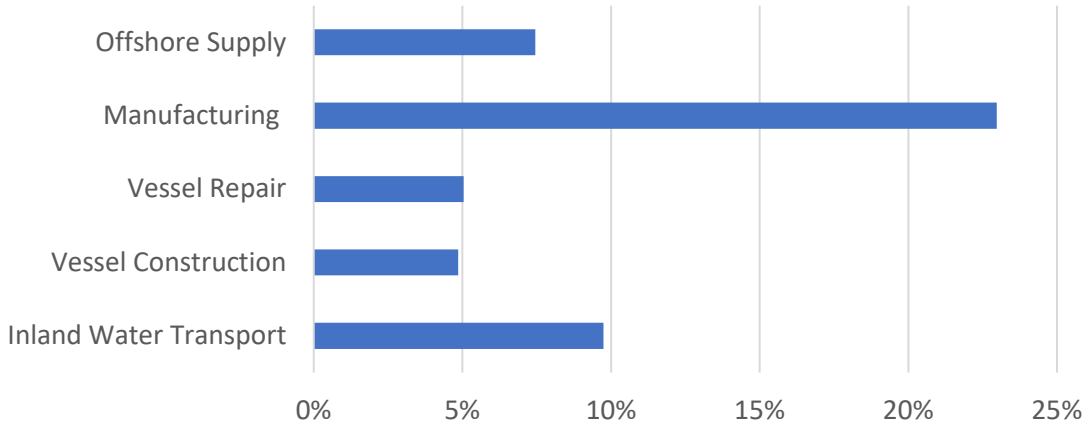
Table 16. Sample statistics by firm size

Firm Size Category	Unweighted	Weighted	Census
Fewer than 5 employees per establishment	25%	49%	49%
5 to 9 employees per establishment	20%	15%	15%
10 to 19 employees per establishment	19%	13%	13%
20 to 49 employees per establishment	17%	12%	12%
50 to 99 employees per establishment	11%	5%	5%
100 to 249 employees per establishment	5%	3%	3%
250 or more employees per establishment	4%	1%	1%

Table 16 shows the percentage of survey respondents from each size category before and after assigning survey weights as well as a comparison to Census data on the distribution of firms across size category. Aside from the smallest firms, the unweighted data follow a similar pattern to the overall population of firms in the Census data given the relatively large size of the sample of firms. The distribution matches the Census after assigning sample weights to make the survey respondents more representative of the full population of firms.

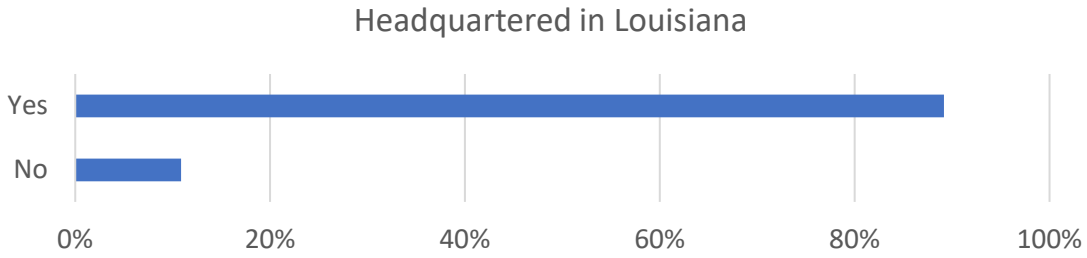
Business Industries

Figure 47. Businesses by primary activity



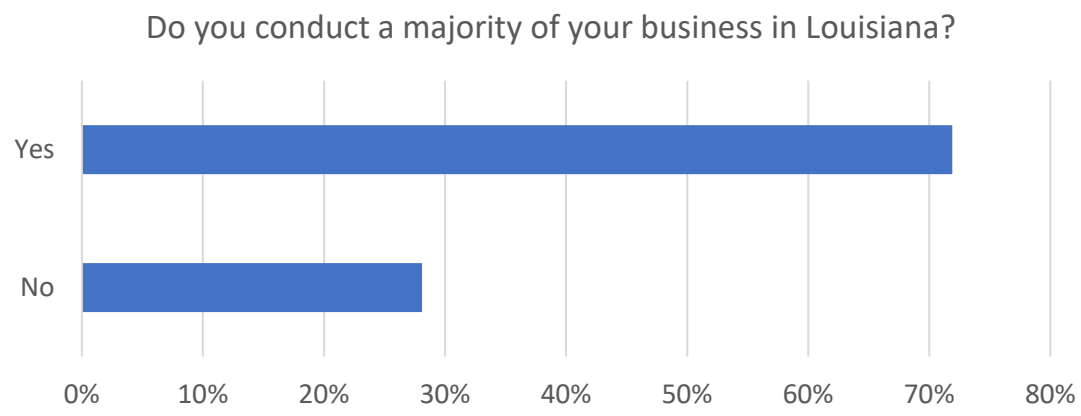
In addition to the specific industry code that identifies the main activity of the business, the survey asked businesses to report their business type as it relates to waterborne commerce (Figure 47).

Figure 48. Percentage of businesses headquartered in Louisiana



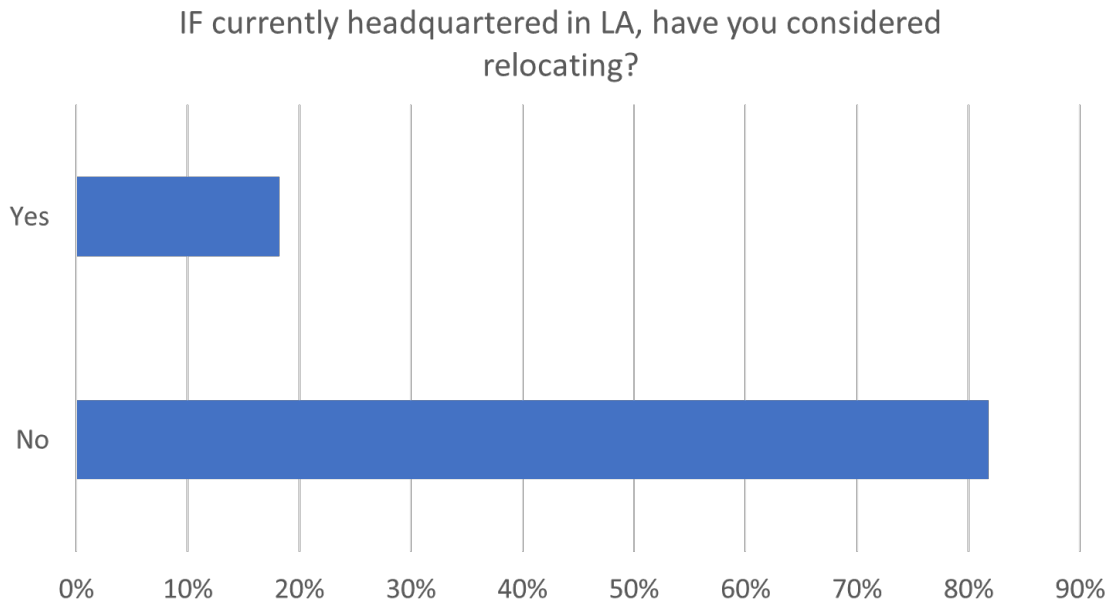
Among surveyed businesses, nearly 90 percent were headquartered in Louisiana (Figure 48).

Figure 49. Percentage of businesses conducting a majority of business in Louisiana



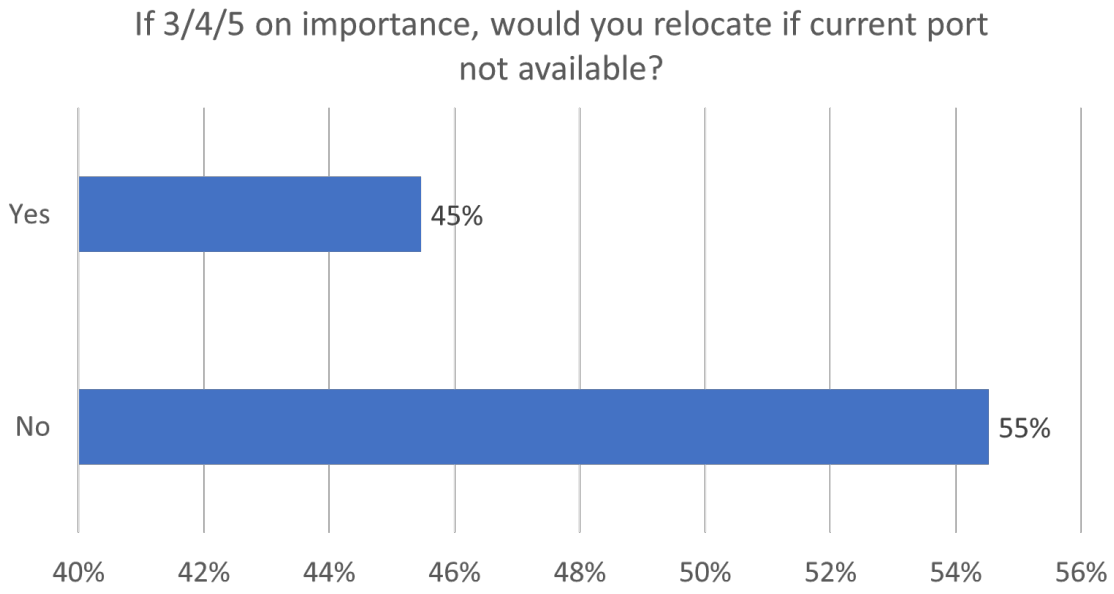
Among survey respondents, more than 70 percent indicated that a majority of the company's business was in the State of Louisiana (Figure 49).

Figure 50. Businesses headquartered in Louisiana with relocation considerations



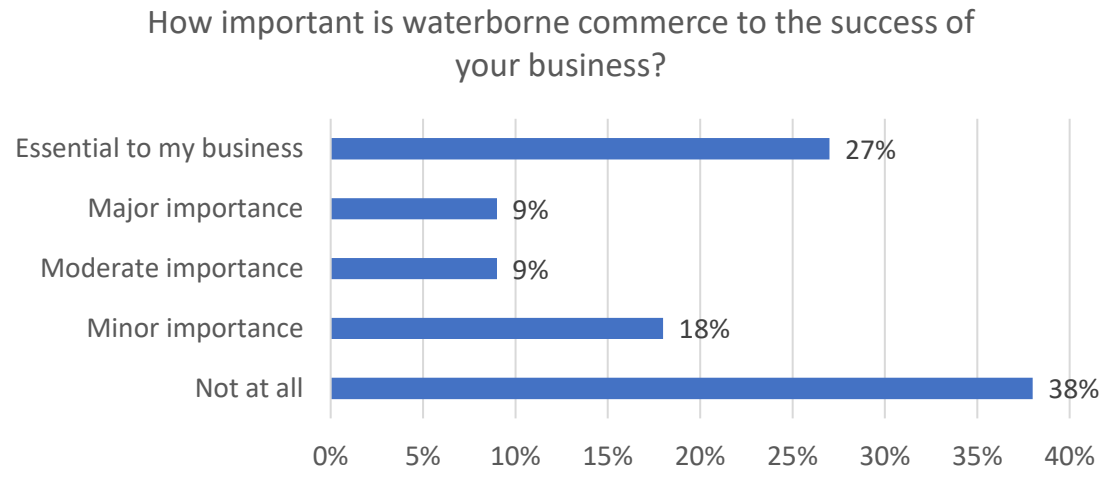
The survey was also used to capture the strength of business ties to Louisiana and waterborne commerce. Among businesses currently headquartered in Louisiana, only a small portion (18 percent) indicated they had considered relocating (Figure 50).

Figure 51. Businesses with relocation intentions based on port availability



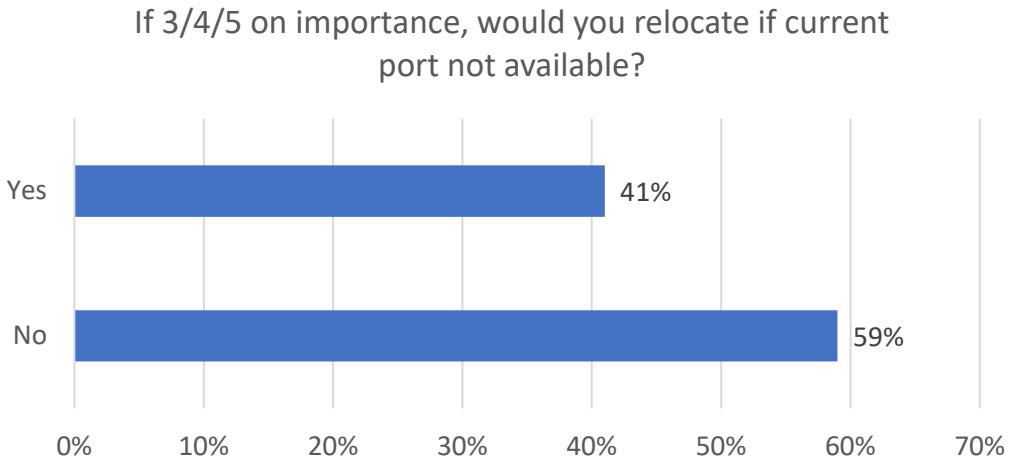
Another way that the survey assessed the strength of business connections to waterborne commerce was a question about relocation. Among firms indicating a strong connection to waterborne commerce, 45 percent indicated they would relocate if the current port were not available (Figure 51).

Figure 52. Importance of waterborne commerce to businesses



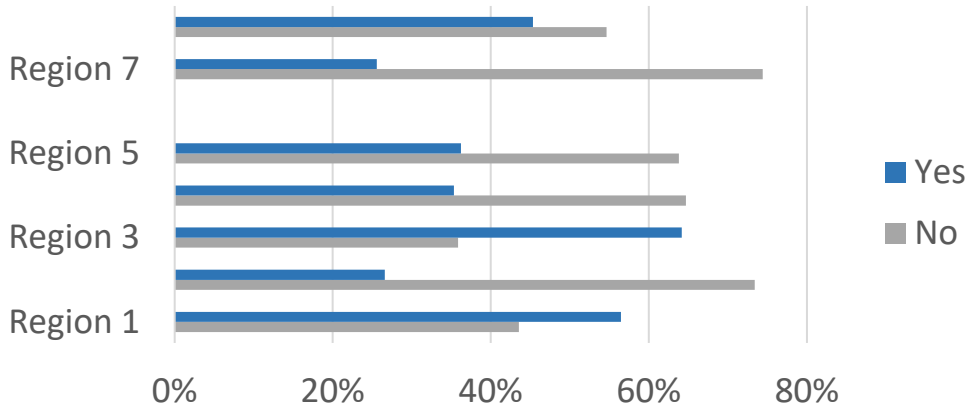
The survey was designed with broad scope to help assess the full extent of connections to waterborne commerce within Louisiana. Among survey respondents, 27 percent indicated that waterborne commerce was essential to the success of the business, 9 percent said it was of major importance, and 9 percent said it was of moderate importance (Figure 52).

Figure 53. Relocation intentions for businesses with high reliance on waterborne commerce



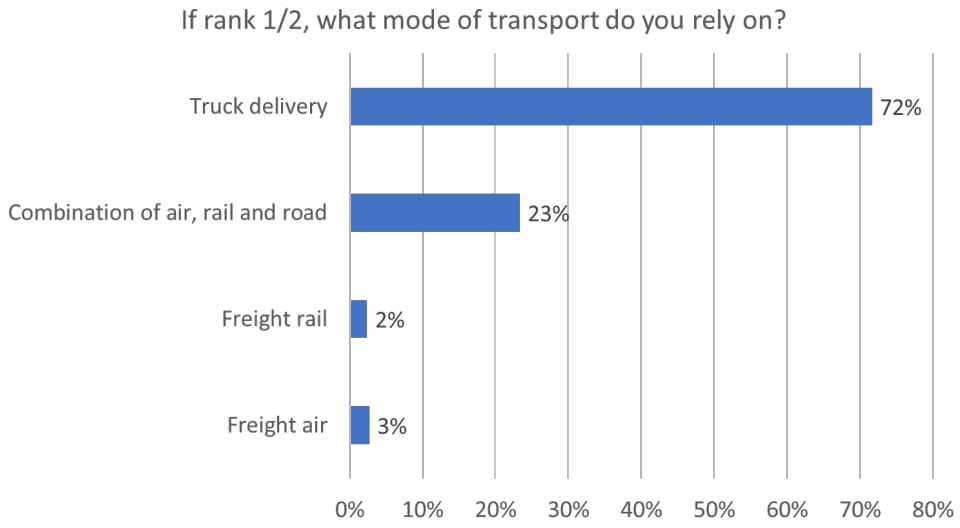
Another way that the survey assessed the strength of business connections to waterborne commerce was a question about relocation. Among firms indicating a strong connection to waterborne commerce, 41 percent indicated they would relocate if the current port were not available (Figure 53).

Figure 54. Relocation intentions based on port availability by region



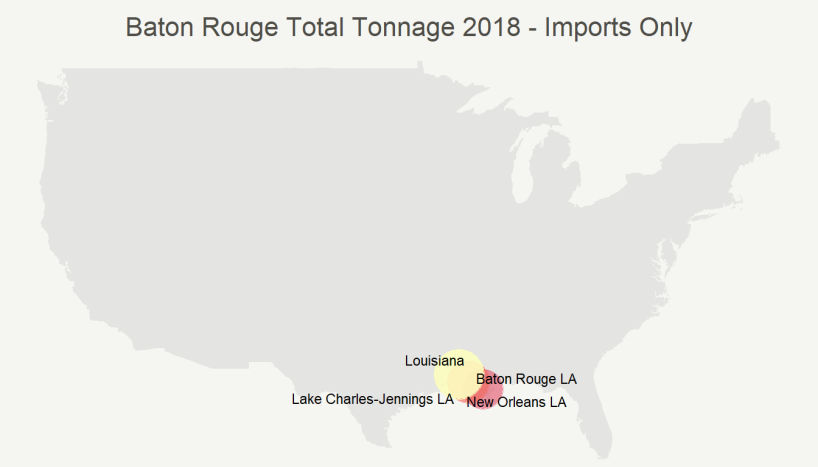
The chart above (Figure 54) shows response by region when asked if the business would relocate if the port currently used was not available. Businesses indicating a strong connection to waterborne commerce in Region 3 (Houma) and Region 1 (New Orleans) were far more likely to say yes, the business would relocate if the port were not available.

Figure 55. Reliance on other modes of transport



The survey also asked about common modes of transport for those businesses who said they did not have a strong connection to waterborne commerce. Among that group, by far the most common was truck (72 percent) or a combination of air, rail, and road (23 percent) (Figure 55). [13]

Figure 56. Baton Rouge trading partners by total tons, imports only

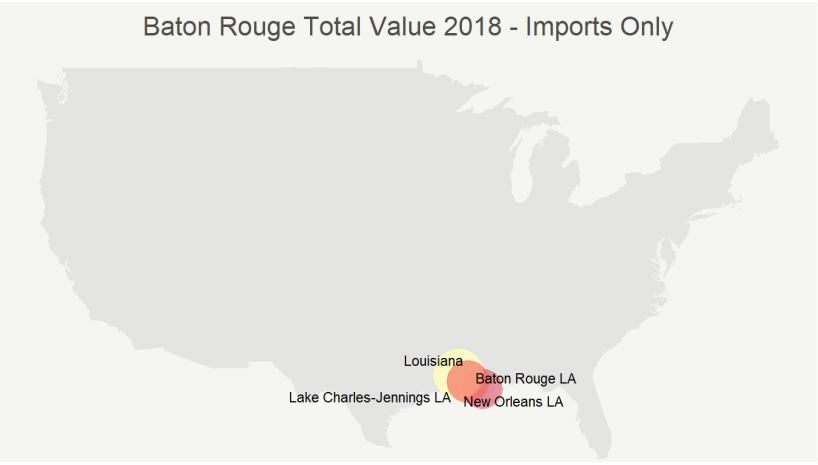


Source: Freight Analysis Framework, 2018

Table 17. Baton Rouge trading partners by FAF Area, by total tons, imports only

	Name	Tons	Dollars
1	Louisiana (all other cities combined)	1,597,000	$383,000,000
2	Baton Rouge, LA	539,000	$759,000,000
3	New Orleans, LA	418,000	$29,000,000
4	Lake Charles–Jennings, LA	51,000	$4,000,000

Figure 57. Baton Rouge trading partners by total value, imports only

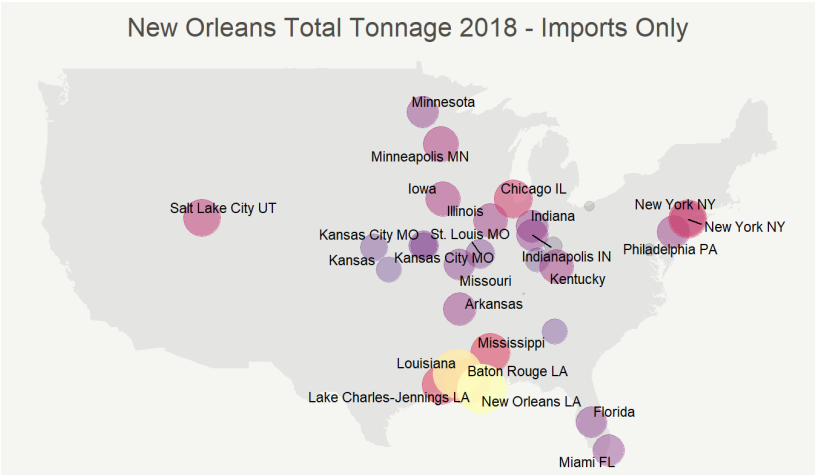


Source: Freight Analysis Framework, 2018

Table 18. Baton Rouge trading partners by FAF Area, by total value, imports only

	Name	Tons	Dollars
1	Baton Rouge, LA	539,000	$759,000,000
2	Louisiana (all other cities combined)	1,597,000	$383,000,000
3	New Orleans, LA	418,000	$29,000,000
4	Lake Charles–Jennings, LA	51,000	$4,000,000

Figure 58. New Orleans trading partners by total tons, imports only, top 20



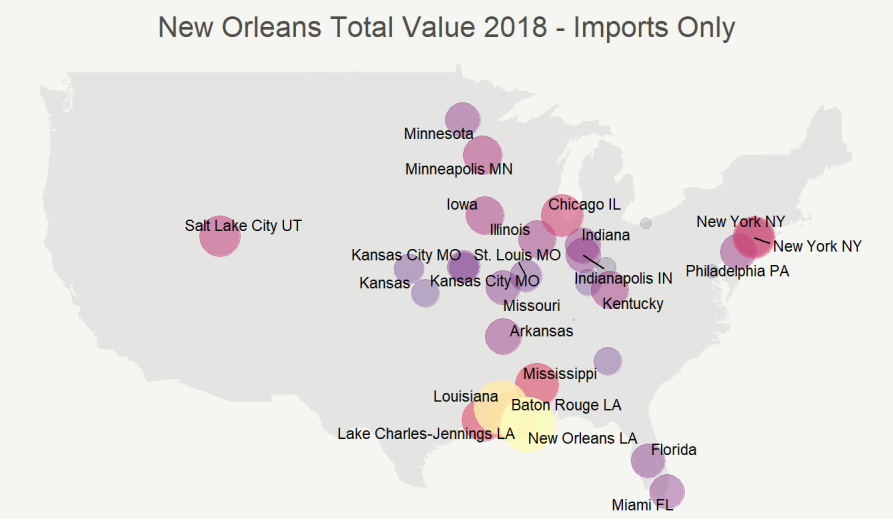
Source: Freight Analysis Framework, 2018

Table 19. New Orleans trading partners by FAF Area, total tons, imports only, top 20

	Name	Tons	Dollars
1	New Orleans, LA	22,231,000	$7,923,000,000
2	Louisiana (all other cities combined)	16,107,000	$2,594,000,000
3	Baton Rouge, LA	4,761,000	$728,000,000
4	New York, NY	791,000	$209,000,000
5	Mississippi (all cities combined)	726,000	$118,000,000
6	Lake Charles–Jennings, LA	691,000	$98,000,000
7	Chicago, IL	515,000	$106,000,000
8	Salt Lake City, UT	382,000	$27,000,000

	Name	Tons	Dollars
9	Minneapolis, MN	252,000	$41,000,000
10	Iowa (all cities combined)	232,000	$37,000,000
11	Kentucky (all cities combined)	188,000	$50,000,000
12	Illinois (all cities combined)	181,000	$38,000,000
13	Arkansas (all cities combined)	151,000	$29,000,000
14	Philadelphia, PA	150,000	$40,000,000
15	Indiana (all other cities combined)	127,000	$9,000,000
16	Minnesota (all cities combined)	110,000	$18,000,000
17	Indianapolis, IN	110,000	$8,000,000
18	Miami, FL	102,000	$7,000,000
19	Missouri (all cities combined)	94,000	$18,000,000
20	Florida (all cities combined)	93,000	$6,000,000

Figure 59. New Orleans trading partners by total value, imports only, top 20

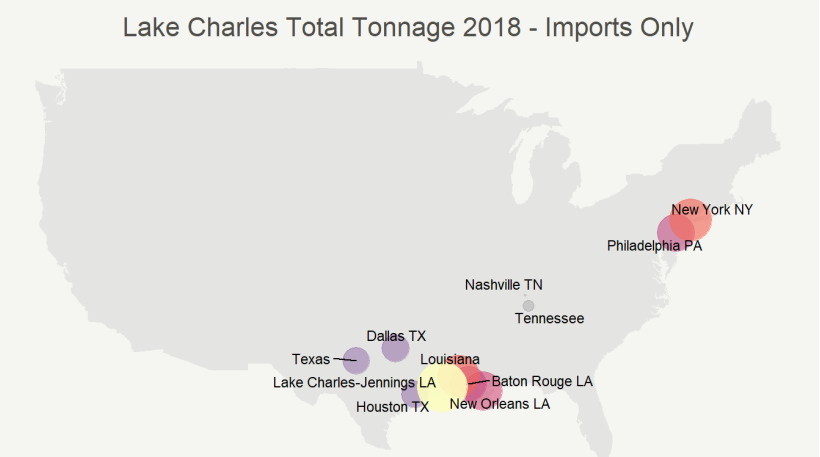


Source: Freight Analysis Framework, 2018

Table 20. New Orleans trading partners by FAF Area, by total value, imports only, top 20

	Name	Tons	Dollars
1	New Orleans, LA	22,231,000	$7,923,000,000
2	Louisiana (all other cities combined)	16,107,000	$2,594,000,000
3	Baton Rouge, LA	4,761,000	$728,000,000
4	New York, NY	791,000	$209,000,000
5	Mississippi (all cities combined)	726,000	$118,000,000
6	Chicago, IL	515,000	$106,000,000
7	Lake Charles–Jennings, LA	691,000	$98,000,000
8	Kentucky (all cities combined)	188,000	$50,000,000
9	Minneapolis, MN	252,000	$41,000,000
10	Philadelphia, PA	15,000	$40,000,000
11	Illinois (all other cities combined)	181,000	$38,000,000
12	Iowa (all cities combined)	232,000	$37,000,000
13	Arkansas (all cities combined)	151,000	$29,000,000
14	Salt Lake City, UT	382,000	$27,000,000
15	Minnesota (all other cities combined)	110,000	$18,000,000
16	Missouri (all other cities combined)	94,000	$18,000,000
17	Kansas City, MO	76,000	$15,000,000
18	St. Louis, MO	62,000	$11,000,000
19	Indiana (all cities combined)	127,000	$9,000,000
20	Kansas City, MO	41,000	$9,000,000

Figure 60. Lake Charles trading partners by total tons, imports only

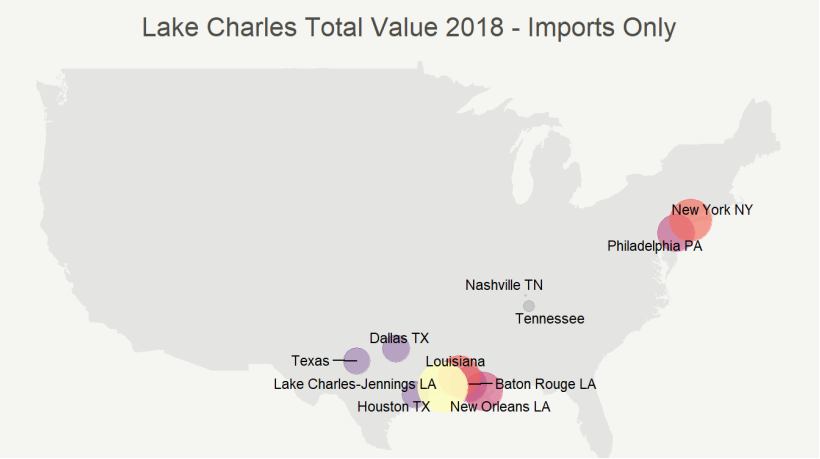


Source: Freight Analysis Framework, 2018

Table 21. Lake Charles trading partners by FAF Area, by total tons, imports only

	Name	Tons	Dollars
1	Lake Charles–Jennings, LA	13,124,000	$5,660,000,000
2	New York, NY	956,000	$65,000,000
3	Louisiana (all other cities combined)	879,000	$821,000,000
4	New Orleans, LA	342,000	$22,000,000
5	Philadelphia, PA	245,000	$17,000,000
6	Baton Rouge, LA	160,000	$11,000,000
7	Dallas, TX	31,000	$2,000,000
8	Houston, TX	28,000	$2,000,000
9	Texas (all other cities combined)	27,000	$2,000,000
10	Tennessee (all other cities combined)	4,000	$11,000,000
11	Nashville, TN	3,000	$9,000,000

Figure 61. Lake Charles trading partners by total value, imports only

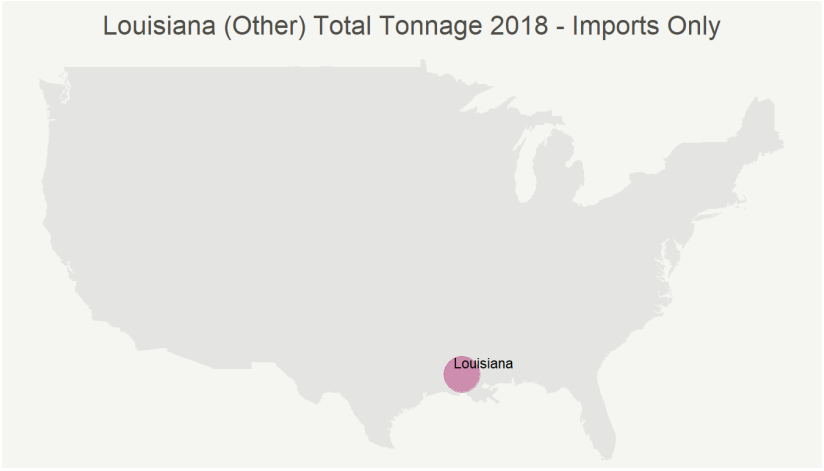


Source: Freight Analysis Framework, 2018

Table 22. Lake Charles trading partners by FAF Area, by total value, imports only

	Name	Tons	Dollars
1	Lake Charles–Jennings, LA	13,124,000	$5,660,000,000
2	Louisiana (all other cities combined)	879,000	$821,000,000
3	New York, NY	956,000	$65,000,000
4	New Orleans, LA	342,000	$22,000,000
5	Philadelphia, PA	245,000	$17,000,000
6	Baton Rouge, LA	160,000	$11,000,000
7	Tennessee (all other cities combined)	4,000	$11,000,000
8	Nashville, TN	3,000	$9,000,000
9	Dallas, TX	31,000	$2,000,000
10	Houston, TX	28,000	$2,000,000
11	Texas (all other cities combined)	27,000	$2,000,000

Figure 62. Other Louisiana ports trading partners by total tons, imports only

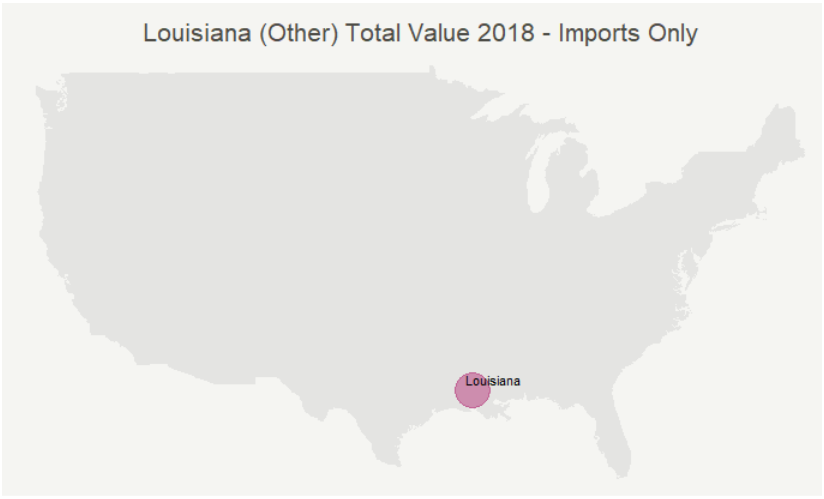


Source: Freight Analysis Framework, 2018

Table 23. Other Louisiana ports trading partners by FAF Area, by total tons, imports only

	Name	Tons	Dollars
1	Louisiana (all cities combined)	846,000	$2,229,000,000

Figure 63. Other Louisiana ports trading partners by total value, imports only

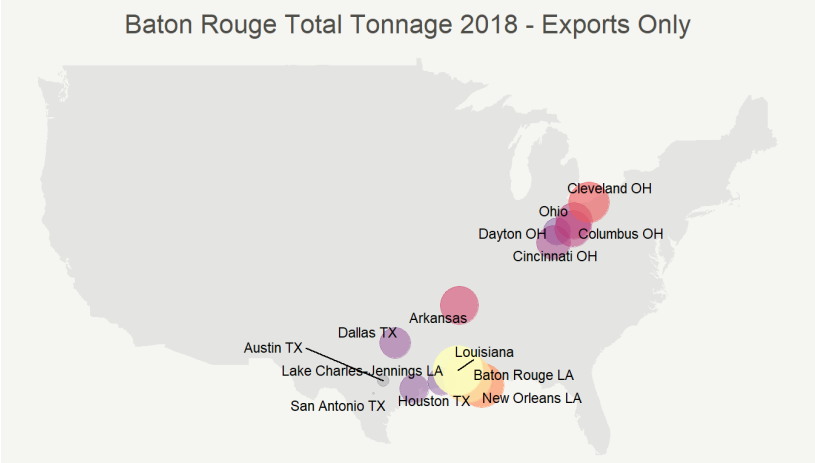


Source: Freight Analysis Framework, 2018

Table 24. Other Louisiana ports trading partners by FAF Area, by total value, imports only

	Name	Tons	Dollars
1	Louisiana (all other cities combined)	846,000	$2,229,000,000

Figure 64. Baton Rouge trading partners by total tons, exports only



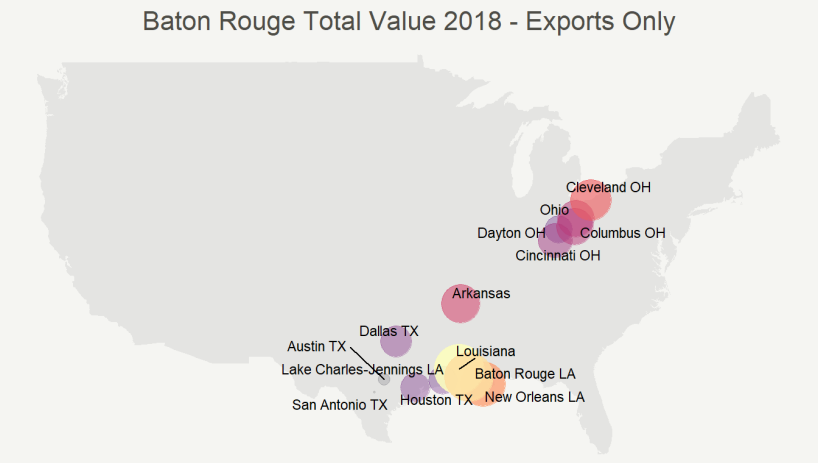
Source: Freight Analysis Framework, 2018

Table 25. Baton Rouge trading partners by FAF Area, by total tons, exports only

	Name	Tons	Dollars
1	Louisiana (all other cities combined)	2,265,000	$1,113,000,000
2	Baton Rouge, LA	1,685,000	$2,058,000,000
3	New Orleans, LA	864,000	$375,000,000
4	Cleveland, OH	475,000	$172,000,000
5	Arkansas (all cities combined)	334,000	$121,000,000
6	Columbus, OH	249,000	$90,000,000
7	Ohio (all other cities combined)	247,000	$90,000,000
8	Cincinnati, OH	193,000	$70,000,000
9	Dallas, TX	129,000	$62,000,000
10	Houston, TX	109,000	$53,000,000
11	Lake Charles–Jennings, LA	95,000	$50,000,000

	Name	Tons	Dollars
12	Dayton, OH	90,000	$33,000,000
13	Austin, TX	30,000	$14,000,000
14	San Antonio, TX	25,000	$12,000,000

Figure 65. Baton Rouge trading partners by total value, exports only



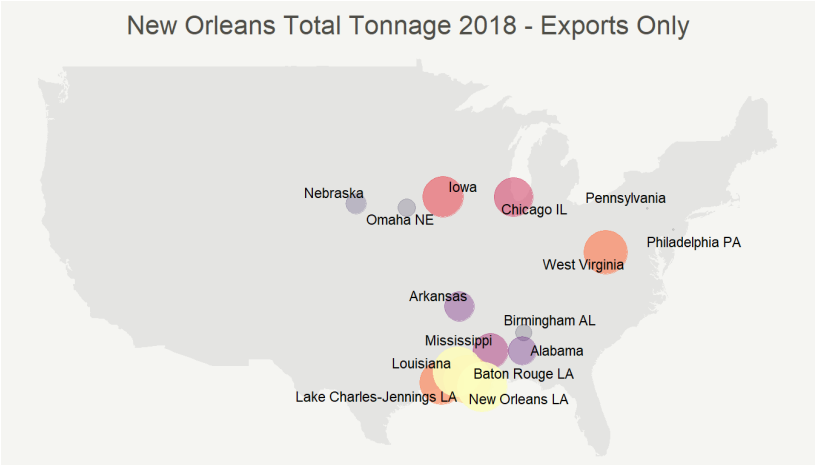
Source: Freight Analysis Framework, 2018

Table 26. Baton Rouge trading partners by FAF Area, by total value, exports only

	Name	Tons	Dollars
1	Baton Rouge, LA	1,685,000	$2,058,000,000
2	Louisiana (all other cities combined)	2,265,000	$1,113,000,000
3	New Orleans, LA	864,000	$375,000,000
4	Cleveland, OH	475,000	$172,000,000
5	Arkansas (all cities combined)	334,000	$121,000,000
6	Columbus, OH	249,000	$90,000,000
7	Ohio (all other cities combined)	247,000	$90,000,000
8	Cincinnati, OH	193,000	$70,000,000
9	Dallas, TX	129,000	$62,000,000
10	Houston, TX	109,000	$53,000,000

	Name	Tons	Dollars
11	Lake Charles–Jennings, LA	95,000	$50,000,000
12	Dayton, OH	90,000	$33,000,000
13	Austin, TX	30,000	$14,000,000
14	San Antonio, TX	25,000	$12,000,000

Figure 66. New Orleans trading partners by total tons, exports only



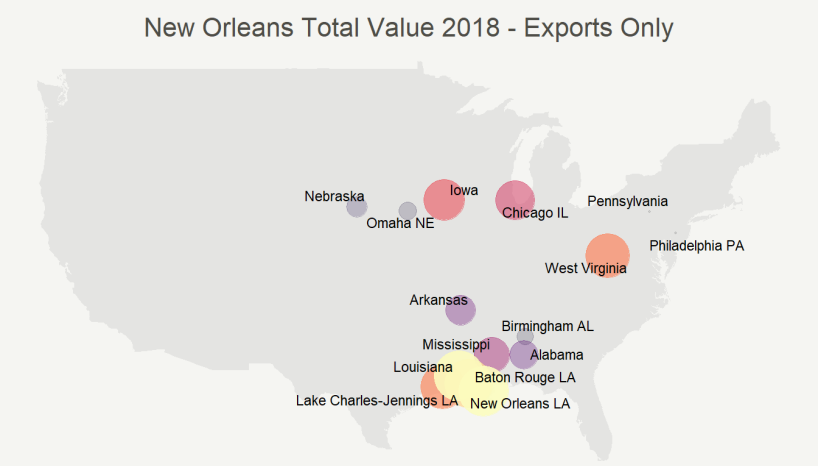
Source: Freight Analysis Framework, 2018

Table 27. New Orleans trading partners by FAF Area, by total tons, exports only

	Name	Tons	Dollars
1	New Orleans, LA	48,637,000	$9,352,000,000
2	Louisiana (all other cities combined)	47,078,000	$10,430,000,000
3	Baton Rouge, LA	24,152,000	$5,375,000,000
4	Lake Charles–Jennings, LA	5,489,000	$1,403,000,000
5	West Virginia (all cities combined)	4,690,000	$75,000,000
6	Iowa (all cities combined)	1,865,000	$305,000,000
7	Chicago, IL	1,037,000	$137,000,000
8	Mississippi (all cities combined)	400,000	$155,000,000
9	Arkansas (all cities combined)	115,000	$39,000,000

	Name	Tons	Dollars
10	Alabama (all other cities combined)	85,000	$40,000,000
11	Nebraska (all other cities combined)	20,000	$9,000,000
12	Omaha, NE	14,000	$7,000,000
13	Birmingham, AL	12,000	$5,000,000
14	Philadelphia, PA	5,000	$2,000,000
15	Pennsylvania	5,000	$2,000,000

Figure 67. New Orleans trading partners by total value, exports only



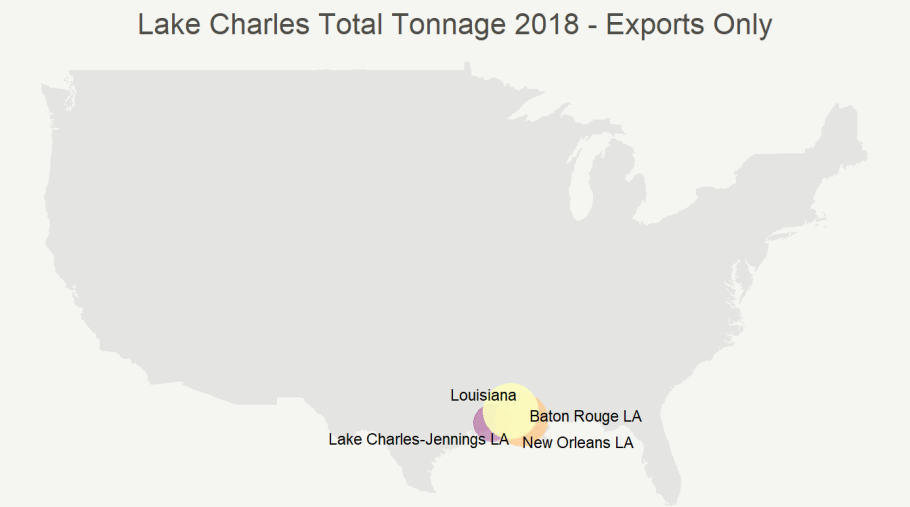
Source: Freight Analysis Framework, 2018

Table 28. New Orleans trading partners by FAF Area, by total value, exports only

	Name	Tons	Dollars
1	Louisiana (all other cities combined)	47,078,000	$10,430,000,000
2	New Orleans, LA	48,637,000	$9,352,000,000
3	Baton Rouge, LA	24,152,000	$5,375,000,000
4	Lake Charles–Jennings, LA	5,489,000	$1,403,000,000
5	Iowa (all cities combined)	1,865,000	$305,000,000
6	Mississippi (all cities combined)	400,000	$155,000,000
7	Chicago, IL	1,037,000	$137,000,000

	Name	Tons	Dollars
8	West Virginia (all cities combined)	4,690,000	$75,000,000
9	Alabama (all other cities combined)	85,000	$40,000,000
10	Arkansas (all cities combined)	115,000	$39,000,000
11	Nebraska (all other cities combined)	20,000	$9,000,000
12	Omaha, NE	14,000	$7,000,000
13	Birmingham, AL	12,000	$5,000,000
14	Philadelphia, PA	5,000	$2,000,000
15	Pennsylvania (all other cities combined)	5,000	$2,000,000

Figure 68. Lake Charles trading partners by total tons, exports only

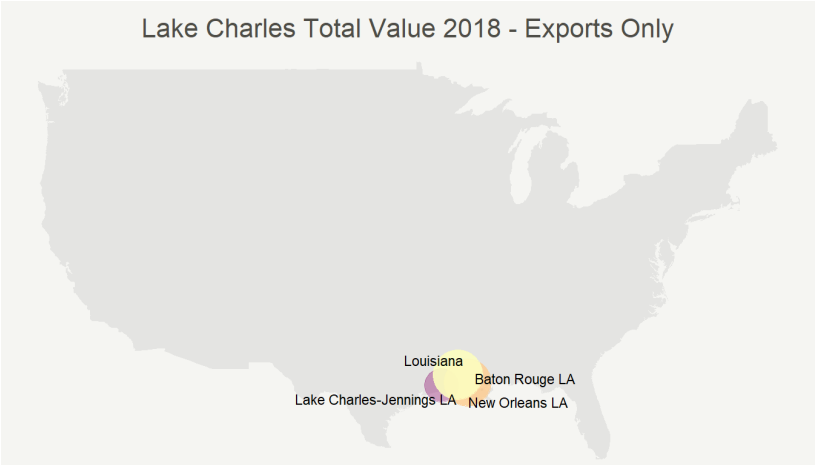


Source: Freight Analysis Framework, 2018

Table 29. Lake Charles trading partners by FAF Area, by total tons, exports only

	Name	Tons	Dollars
1	Louisiana (all other cities combined)	2,071,000	$2,298,000,000
2	Baton Rouge, LA	1,481,000	$1,537,000,000
3	Lake Charles–Jennings, LA	348,000	$602,000,000
4	New Orleans, LA	89,000	$21,000,000

Figure 69. Lake Charles trading partners by total value, exports only

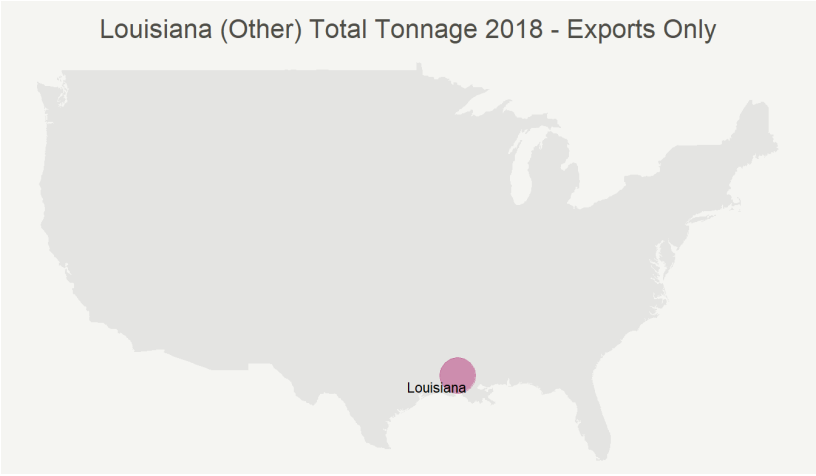


Source: Freight Analysis Framework, 2018

Table 30. Lake Charles trading partners by FAF Area, by total value, exports only

	Name	Tons	Dollars
1	Louisiana (all other cities combined)	2,071,000	$2,298,000,000
2	Baton Rouge, LA	1,481,000	$1,537,000,000
3	Lake Charles–Jennings, LA	348,000	$602,000,000
4	New Orleans, LA	89,000	$21,000,000

Figure 70. Other Louisiana ports trading partners by total value, exports only



Source: Freight Analysis Framework, 2018

Table 31. Other Louisiana ports trading partners by FAF Area, by total tons, exports only

	Name	Tons	Dollars
1	Louisiana (all cities combined)	1,314,000	$1,820,000,000

Figure 71. Other Louisiana ports trading partners by total value, exports only

Source: Freight Analysis Framework, 2018

Table 32. Other Louisiana ports trading partners by FAF Area, by total value, exports only

	Name	Tons	Dollars
1	Louisiana (all cities combined)	1,314,000	$1,820,000,000