2045 Metropolitan Transportation Plan

Technical Report #4
Needs Assessment

Gulf Regional Planning Commission
Metropolitan Planning Organization

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Gulf Regional Planning Commission

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1.0 Introduction

This report discusses transportation needs for the Gulf Regional Planning Commission (GRPC) Metropolitan Planning Area (MPA), also known as the Gulf Coast. It is informed by the analysis in *Technical Report #2: Existing Conditions* and an assessment of future needs based on:

- current and forecasted trends,
- existing plans, and
- public and stakeholder involvement.

2.0 Special Considerations

Federal regulations require long-range transportation plans to consider resilience and tourism as they relate to transportation.

2.1 Resilience

In the context of this plan, “resilience” is the ability of transportation systems to withstand or recover from extreme or changing conditions and continue to provide reliable mobility and accessibility. The impacts of weather, natural disasters, or man-made events need to be considered in resiliency.

Regional Considerations

The Metropolitan Planning Organization (MPO) for the MPA is GRPC, which should carefully consider transportation resiliency needs related to the following regional issues:

- **High wind events:** The MPA can experience severe thunderstorms that produce damaging winds. Additionally, there is a risk for tornadoes within the MPA as it is located in “Dixie Alley”, an area of the Southern United States that is particularly vulnerable to tornadoes. The MPA is also prone to hurricane events since it is situated on the Gulf of Mexico. These high wind events can affect transportation systems, such as debris blocking roadways.
- **Floods:** In the MPA, flooding hazards are typically flash flooding, river or small stream flooding, or flooding from tropical systems that pass through the MPA. However, flooding and storm surge are also threats during hurricane events. Flooding can result in significant damage to transportation systems, such as roads being washed out by floodwaters.
- **Snow and Ice:** The MPA, like most of the Southeastern United States, does not usually experience significant winter weather. However, even a small amount of winter precipitation (snow and ice) can have a significant impact on the MPA’s transportation system, such as road and bridge closures due to icy conditions. Most drivers will also be unfamiliar with driving in these conditions, increasing safety concerns.
- **Temperature Extremes:** The Gulf Coast MPA can experience both extremely high and extremely low temperatures at times. Both temperature extremes can affect transportation systems, such as extremely high temperatures affecting the integrity of pavement and extremely low temperatures resulting in road and bridge closures due to icy conditions.
- **Earthquakes:** Earthquakes can result in damages to transportation systems. However, the risk of earthquakes within the MPA is relatively low. According to the USGS, there were no reported

earthquakes in the MPA between 2014 and 2018[1]. Nonetheless, distant earthquakes, such as those that could occur in the New Madrid Seismic Zone, may still impact transportation systems within the MPA.

Resiliency Needs

Ensuring resiliency involves understanding hazards and identifying mitigation strategies. The MPO should continue to coordinate with local and regional hazard mitigation planners to proactively plan for a transportation system that is responsive to hazards. The MPO should also continue to advocate for best stormwater management practices and green infrastructure in the design of transportation projects.

Stormwater Mitigation

As an area grows and changes, its land use and infrastructure change with it. These changes affect how precipitation events, the product of which is stormwater, affect roadways, homes, runoff, ground water, and more. Stormwater can become ground water through runoff or evaporation. When stormwater becomes runoff, it ends up in nearby streams, rivers, or other water bodies as surface water.

The overall effect precipitation from a storm can have is heavily influenced by land use and development. Any change in these factors will change how stormwater behaves within the area. As areas develop, previously pervious areas, such as, grass, wetlands, and wooded areas, are replaced by impervious surfaces. Examples of developed impervious areas include new roadways, sidewalks and driveways in new subdivisions, and parking lots for shopping centers. The increase in impervious areas can significantly decrease the runoff time in an area, which can lead to an increase in flooding.

[1] United States Geological Survey Search Earthquake Catalog

Significant rainfall in an urban area within a short amount of time can lead to flooding issues for a municipality. This flooding can damage property and create environmental and public health hazards by introducing contaminants into new areas. Without proper drainage and stormwater mitigation efforts, new transportation projects have the potential to exacerbate existing stormwater issues. With well-planned, coordinated efforts and using "green infrastructure" design, projects can create a more natural looking environment and decrease the chances of detrimental stormwater runoff issues. In fact, in some cases, stormwater drainage may even be improved.

Green Infrastructure

Green infrastructure is a cost-effective approach to managing weather events, while providing benefits to the community. When rain falls onto impervious areas, stormwater is forced to drain through gutters, storm sewers, and other collection systems. This runoff may collect trash, bacteria, and other pollutants from the urban environment and introduce them to the community at large, creating health risks. Green infrastructure uses vegetation, soils, and other elements to mimic a more natural environment, treating stormwater at its source and using the ground and plants as a filter to eliminate potential pollutants. With an increase in green space, the health benefits to a community are obvious.

A natural environment approach to development positively impacts a community's stormwater drainage system in several ways. It can mitigate flood risk by slowing runoff and reducing stormwater discharge. With less water to divert, the risk of flooding is lower. Green infrastructure may also decrease the size of the system needed. A smaller system would reduce the overall cost of materials, maintenance, and future repairs. Effective examples of Green Infrastructure, as seen below, include permeable pavements, bioswales or vegetative swales, green streets and alleys, and green parking. Green Infrastructure can also be applied to commercial buildings and residential homes, but when used as stormwater mitigation for transportation development, the health and cost benefits are certainly worth exploring for any community.

Figure 2.1: Green Infrastructure Examples

Source: https://www.epa.gov/green-infrastructure/what-green-infrastructure

Transportation Related Strategies

- During the project design, minimize impervious surfaces and alterations to natural landscapes.
- Promote the use of “green infrastructure” and other Low-Impact Development (LID) practices. Examples include the use of rain barrels, rain gardens, buffer strips, bioswales, and replacement of impervious surfaces on property with pervious materials such as gravel or permeable pavers.
- Adopt ordinances that include stormwater mitigation practices, including landscaping standards, tree preservation, and “green streets”.
- Develop a Standard Urban Stormwater Mitigation Plan (SUSMP) at multiple levels; including state, region, and municipality. A SUSMP is a useful tool where municipalities put into writing, requirements for stormwater control measures for development, as well as, redevelopment. Incorporating LID practices into a SUSMP is an effective method of reducing a development’s impact on its environment. Efforts should be made to coordinate these plans, even though multiple agencies would have them in place.

Additional Strategies

- Educate residents, business owners, elected officials, and developers on the impacts of stormwater and how they can assist with mitigation.
- Identify the areas most likely to flood during heavy storm events and prioritize mitigation efforts in that area and areas upstream from it.
- Adopt open space preservation plans, which will balance land use and local developments with preservation and conservation of the existing open space.
- Establish stormwater fees to support the funding of stormwater management projects and practices.
- Reduce the amount of impervious surfaces on residential, commercial, and public properties and offer incentives to encourage the change.

Existing Policies and Considerations

The State of Mississippi has a statewide Stormwater Management Plan that has been published through the Mississippi Department of Transportation (MDOT). Information about the plan can be found at: http://sp.mdot.ms.gov/Environmental/Pages/Stormwater-Management-Plan.aspx

All three counties within the MPA (Hancock, Harrison, and Jackson) maintain stormwater management plans. In addition to the county plans, the cities of Bay St. Louis, Gulfport, and Biloxi have a stormwater management plan within their jurisdictions. The MPO should coordinate with all of the agencies above to ensure consistency in the plans and ordinances, as well as to create additional documents and policies necessary to mitigate stormwater impacts within the MPA. Additionally, the MPO should work with the City of Pascagoula to create its own Stormwater Management Program or SUSMP.

2.2 Tourism

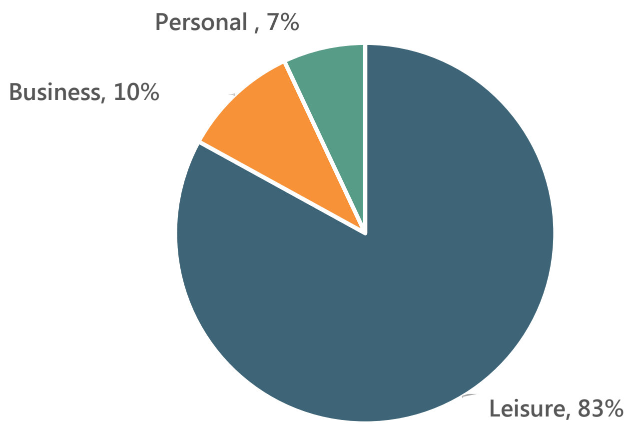
Tourism Overview

Tourism plays an increasingly important role in economies as jobs shift into the service and information sectors and as an expanding middle class travels more frequently.[2] According to the *2017 Mississippi Tourism Economic Impact Report* by Visit Mississippi, "Travel and tourism is one of Mississippi's largest export industries," creating $3 billion in 2017 from labor income. In 2017, 87,335 jobs, or 10.9 percent of all state jobs, were in direct travel and tourism fields. The state also collects property taxes from hotels, motels, restaurants, and casinos as well as motor vehicle rental taxes and gas taxes. Figure 2.2 shows that most visitors to Mississippi come for leisure. In 2017 visitors spent almost $5 billion in the state.

The local tourism agency for the Mississippi Gulf Coast, *Coastal Mississippi*, highlighted the following information in its 2017-2018 Visitor Research reports:

- There were an estimated 13.5 million trips to the region in 2017.
- Most visitors came from Louisiana, Mississippi, or Florida. The cities that most visitors came from are New Orleans, Mobile, and Jackson.
- Of all trips, 57 percent of visits are day trips, and 43 percent are overnight trips. The overnight trips generated $1.17 billion in spending in 2017 and 62 percent were for marketable purposes (so not for visiting friends and relatives, but for reasons that could be increased through marketing). About ten percent of overnight trips were for conferences or business.
- The region is home to a large portion of the state's tourism industry largely because of its beaches and casinos.

Figure 2.2: Purpose for Visiting Mississippi, 2017



Source: Visit Mississippi

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[2] *OECD Tourism Trends and Policies*, 2018, Organisation for Economic Cooperation and Development

Transportation Options

Strong transportation networks are critical to get visitors into and around the region.

Roads and highways are a critical component to the tourism network as 80 percent of tourists arrive by personal vehicle. Interstate 10 (I-10) is a critical roadway getting people across the region and connecting to Louisiana and Alabama. U.S. Highway 90 (US 90) is an important road for locals, running parallel to I-10 and along the beach in some places. U.S. Highway 49 (US 49) runs north-south and connects the Gulf Region to Hattiesburg and Jackson.

Planes and buses also serve the region. There are four public airports and several small private or military airports. Gulfport-Biloxi Airport is the largest commercial airport and the second busiest airport in Mississippi with over 300,000 annual flights and daily nonstop flights to Atlanta, Charlotte, Dallas-Ft. Worth, and Houston. The Greyhound bus stops in Biloxi. The region also has Coast Transit Authority operating fixed route and paratransit services.

The region is also served by rideshare companies like Uber and Lyft and has bicycle and pedestrian infrastructure in some areas.

Lodging Options

While some visitors may stay with friends and family, many others require lodging. The largest concentration of hotels is where I-10 and US 49 intersect in Gulfport and along US 90/Beach Boulevard. In Biloxi. Other hotspots Include around the intersection of I-10 and Tucker Road in Vancleave, along US 90 In Ocean Springs, in Downtown Pascagoula, and around the intersection of I-10 and MS 63 In Moss Point.

Tourism Attractions and Amenities

The Gulf Coast region offers a variety of gaming, family-friendly, cultural, and outdoors attractions. Table 2.1 shows some of the main tourist attractions in the region.

The largest tourist attractions in the region are beaches and casinos. Other attractions involve outdoor and water recreation, like golfing and boating, and cultural attractions like the historic districts and downtowns with museums, art centers, and small theaters.

Retail, restaurants, and bars also attract and support tourism. The three biggest retail hotspots in the region include: the intersection of I-10 and US-49 In Gulfport, Downtown Biloxi, and along I-10 In D'Iberville. Other concentrations occur In Waveland, Ocean Springs, and Pascagoula. Restaurant and bar hotspots in the region include US-90 in Bay St. Louis, Biloxi, Gulfport, Ocean Springs, and Pascagoula. There are additional hotspots along the I-10 corridor through Gulfport, D'Iberville, and Moss Point. Local seafood is a big draw for visitors.

Table 2.1: Gulf Coast Tourism Attractions

Type	Name
Museums and Cultural Attractions	Bay St. Louis Historic L&N Train Depot & Mardi Gras Museum
	Bay St Louis Little Theatre
	Beauvoir: Jefferson Davis Home & Presidential Library
	Biloxi Little Theatre
	Center Stage Biloxi
	Charnley-Norwood House
	Ground Zero Hurricane Museum
	Gulf Coast Symphony Orchestra
	Gulfport Little Theatre
	Hancock Performing Arts Center
	Infinity Science Center
	Lynn Meadows Discovery Center
	Maritime & Seafood Industry Museum
	Mary O'Keefe Cultural Center
	Ohr-O'Keefe Museum of Art
	Trent Lott Performing Arts Theater
Casinos	Beau Rivage Resort & Casino
	Boomtown Casino
	Golden Nugget Casino
	Hard Rock Hotel & Casino
	Harrah's Gulf Coast Casino
	Hollywood Casino Gulf Coast
	IP Casino Resort & Spa
	Island View Casino Resort
	Palace Casino Resort
	Scarlet Pearl Casino Resort
	Silver Slipper Casino
	Treasure Bay Casino
Outdoor Recreation	Big Play Entertainment Center
	Buccaneer State Park
	Deer Island Coastal Preserve
	Finishline Performance Karting

Type	Name
	Gulf Islands National Seashore Visitor Center & Campground
	Gulf Islands Water Park
	Jordan River Blueway
	Ocean Adventures Marine Park
	Old Fort Bayou Blueway
	Pascagoula River Audubon Center
	Pascagoula River Blueway
Breweries	Chandeleur Brewing Co
	Crittendon Distillery LLC
	Crooked Letter Brewing Co
	Fort Bayou Brewing Co
	Hops and Growlers
	Lazy Magnolia Brewing Co
Golf Courses	Bayou Vista Golf Course
	Diamondhead Country Club
	Dogwood Hills Golf Course
	Fallen Oak- Beau Rivage Resort & Casino
	Grand Bear Golf Course
	Great Southern Golf Club
	Gulf Hills Golf Club
	Hickory Hill Country Club
	Keesler Air Force Bay Breeze Golf Course
	Oaks Golf Club
	Pascagoula Country Club
	Pass Christian Isles Golf Club

Source: Coastal Mississippi; NSI

Tourism Transportation Needs

Many amenities and attractions are located near major roadways and are accessible by car. However, there are some ways that transportation improvements can improve mobility for tourism activity, including the following:

- **Wayfinding**: Wayfinding materials such as signs and electronic maps can help visitors easily find their way around the region and use different modes of transportation. Wayfinding can also help visitors learn how close other towns are and perhaps encourage tourists to discover other areas.
- **Expanded Public Transportation**: The Gulf Coast Is a large region that generally requires a vehicle to cross. Expanded public transportation can allow people without vehicles to access other parts of the region, or to spend less money on travel costs.
- **Expanded Sidewalks and Bike Facilities**: Currently the bicycle and pedestrian infrastructure is limited. Improving and expanding sidewalks, bike lanes, and pathways in major tourist areas will improve visitor mobility and reduce the need for additional car traffic. Being able to walk or bike in the denser downtown areas or along beaches can also be a draw for some tourists.

3.0 Emerging Trends

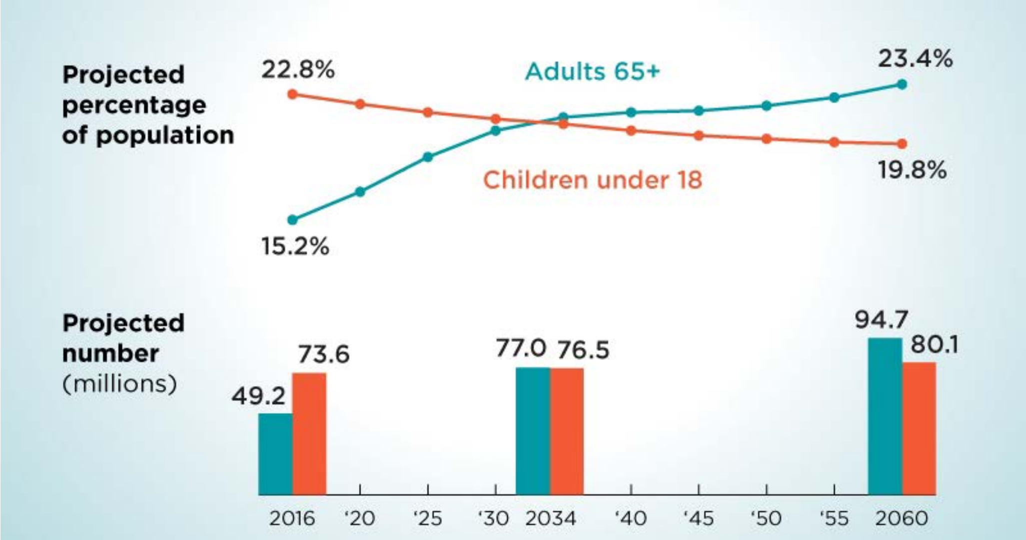
In recent years, travel patterns have changed dramatically due to demographic changes and technological advances. Many of these changes are part of longer-term trends, while others are newer, emerging trends.

3.1 Changing Demographics and Travel Patterns

An Aging Population

The population aged 65 or older will grow rapidly over the next 25 years, nearly doubling from 2012 to 2050.[3] This growth will increase the demand for alternatives to driving, especially for public transportation for people with limited mobility or disabilities.

Figure 3.1: Growth in Senior Population



Source: U.S. Census Bureau

[3] https://www.census.gov/data/tables/2017/demo/popproj/2017-summary-tables.html

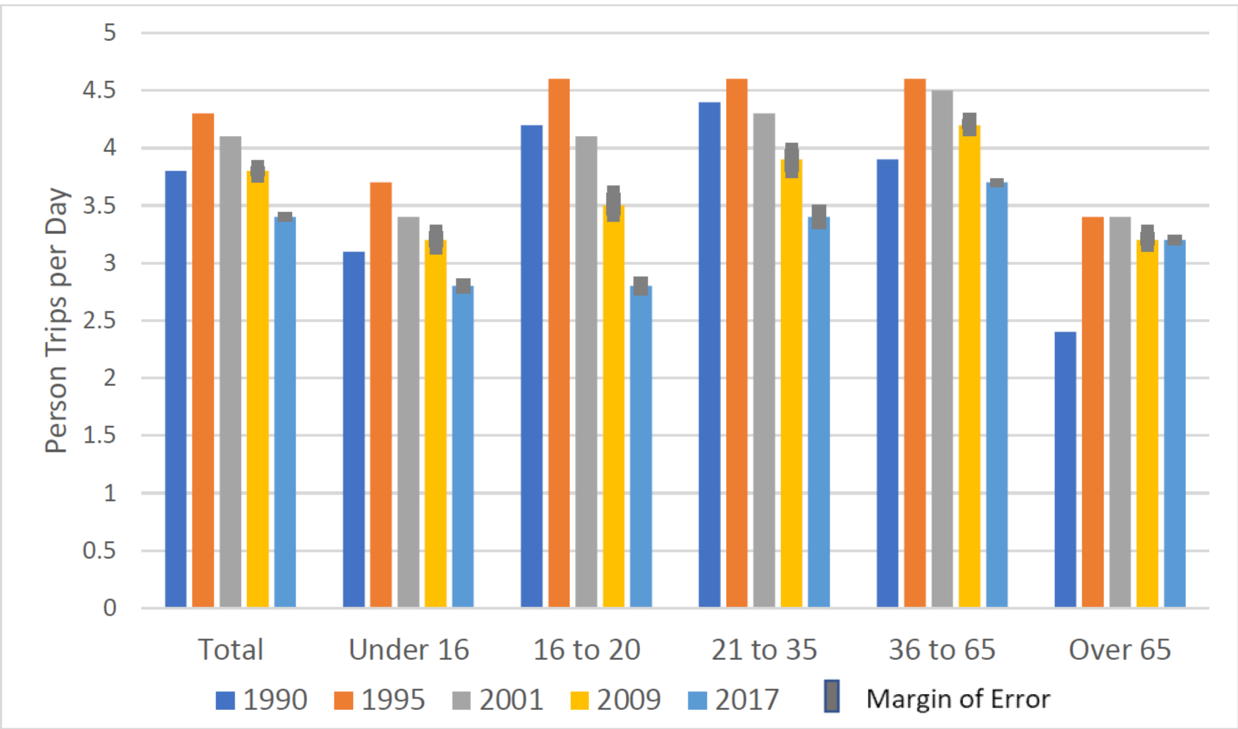
Most People are Traveling Less

Except for people over age 65, all age groups are making fewer trips per day.

There are many factors driving this trend, including less face-to-face socializing, online shopping, and working from home.

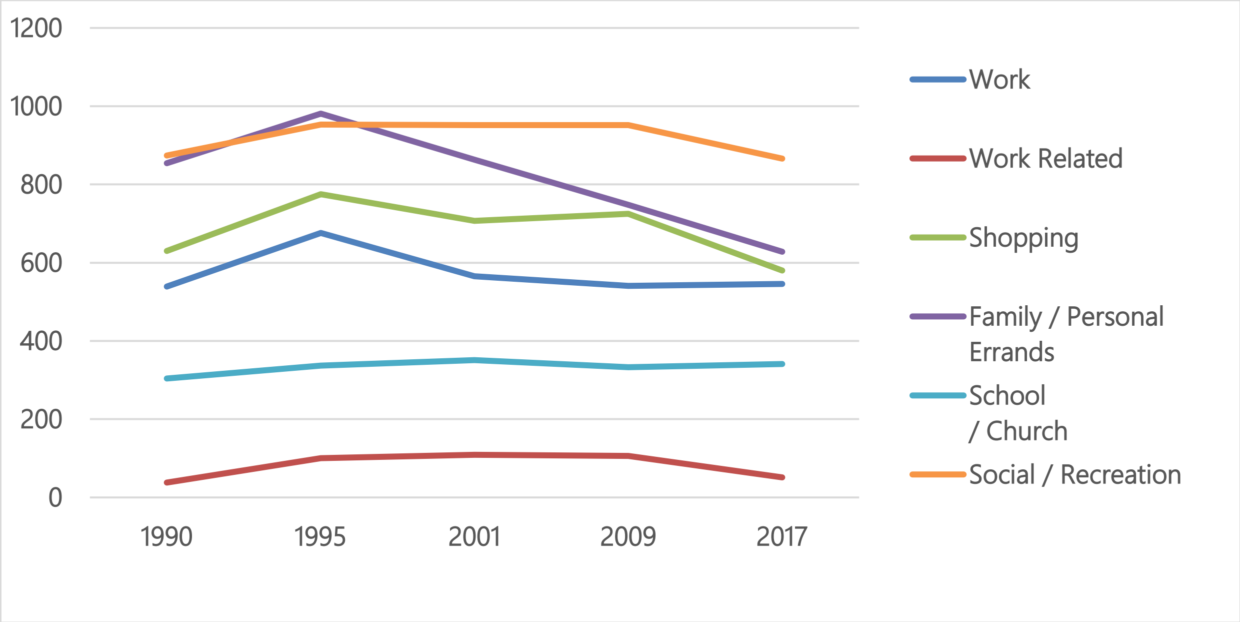
If this trend continues, travel demand may be noticeably impacted. Some major roadway projects may no longer be required and smaller improvements, such as intersection or turn lane improvements, may be sufficient for these needs.

Figure 3.2: Trends in the Average Daily Person Trips by Age



Source: 2017 National Household Travel Survey

Figure 3.3: Trends in the Average Annual Person Trips per Household by Trip Purpose



Source: 2017 National Household Travel Survey

3.2 Shared Mobility

People are increasingly interested in car-free or car-lite lifestyles. In the short-term, people are paying premiums for walkable and bikeable neighborhoods, and they are more frequently using ridehailing (Uber/Lyft) and shared mobility (car-sharing/bike-sharing) services. This could result in a long-term decrease in car ownership rates, increasing the need for investments in bicycle, pedestrian, transit, and other mobility options.

A major impetus for the change in travel behavior and reduced reliance on cars is the emergence of shared mobility options. Broadly defined, shared mobility options are transportation services and resources that are shared among users, either concurrently or one after another. They include:

- **Bike-sharing and Scooter-sharing (Micromobility)** – These can be dockless or dock/station-based systems where people rent bikes and scooters for short periods of time. Scooters are all electric while bikes may be electric or not. Examples include BCycle, Social Bicycles, Lime, Bird, and Jump.
- **Taxis** - Examples include Taxi Gulfport, Beach Taxi, and Hospitality Taxi.
- Ridesharing/Ridehailing (Transportation Network Companies) - Examples include Uber, Lyft, and Via.
- **Car-Sharing** – This includes traditional car sharing, where you rent a company-owned vehicle and peer-to-peer car sharing services. Examples include Zipcar and Turo.
- **Public Transit and Microtransit** – Public transit is itself a form of shared mobility and is evolving to incorporate new mobility options like Microtransit.

Source: Corporate Knights

Micromobility

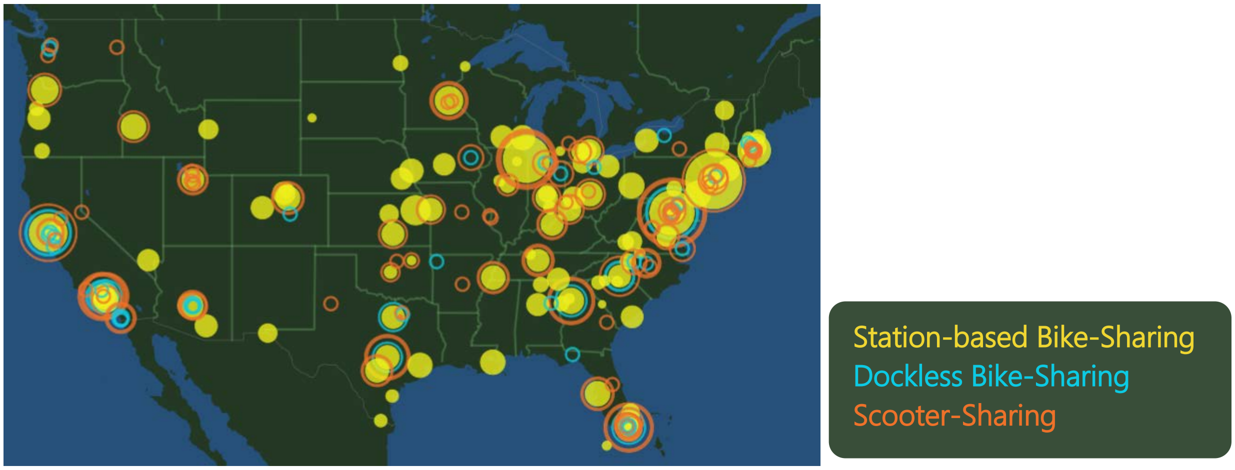
Bike-sharing and scooter-sharing, collectively referred to as micromobility options, are relatively new mobility options and continue to evolve. Modern, station-based bike-sharing emerged around 2010 and dominated the micromobility landscape from 2010 to 2016 until dockless bike-sharing systems emerged. Soon after, in late 2017, electric scooter-sharing emerged and overlapped much of the dockless bike-sharing market.

Today, most bike-sharing and scooter-sharing in the United States occurs in the major urban areas. However, these services are becoming more common in smaller urban areas and around major universities throughout the country.

Survey data from major U.S. cities shows the following micromobility trends[4]:

- People use micromobility services for a variety of trip purposes.
- People use micromobility to travel relatively short distances (one (1) to two (2) miles) for short durations (10 to 20 minutes). However, infrequent users of station-based bike-sharing services tend to make longer distance and duration trips.
- Regular users of station-based bike-sharing services are more likely to be traveling to/from work or to connect to transit. They are also more likely to have shorter trip durations and to have cheaper trips.
- People using scooter-sharing services are more likely to be riding for recreational or exercise reasons.

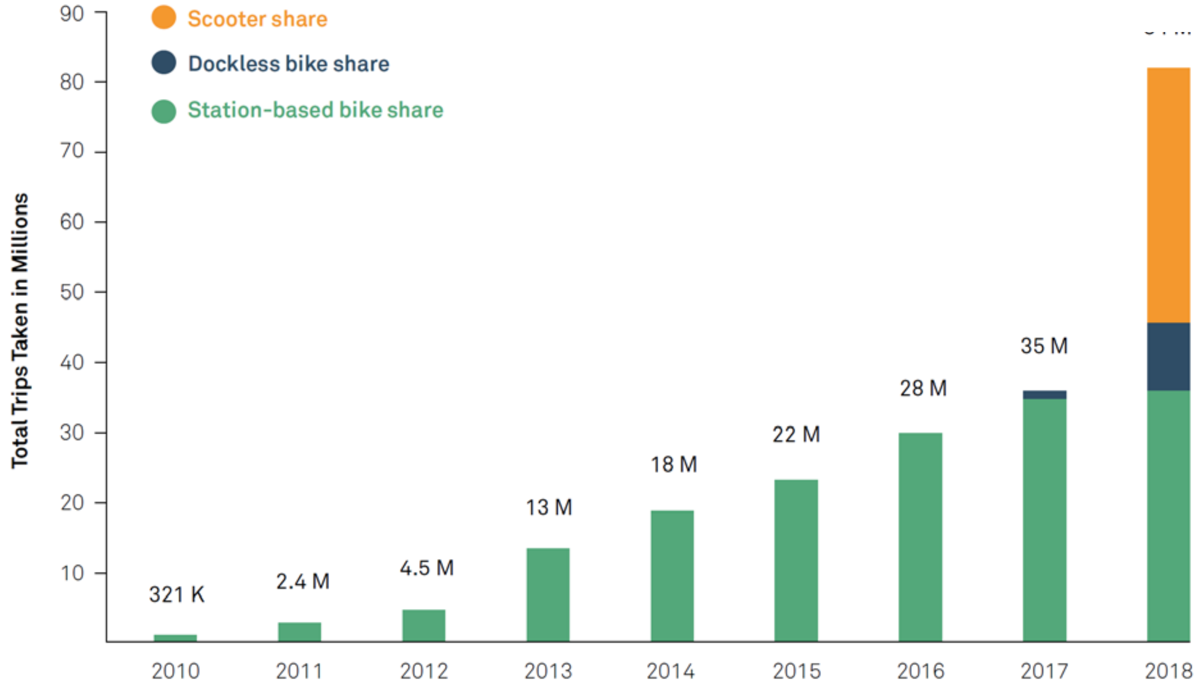
Figure 3.4: Public Bike-Sharing and Scooter-Sharing Systems in United States, 2019



Source: U.S. Department of Transportation, Bureau of Transportation Statistics

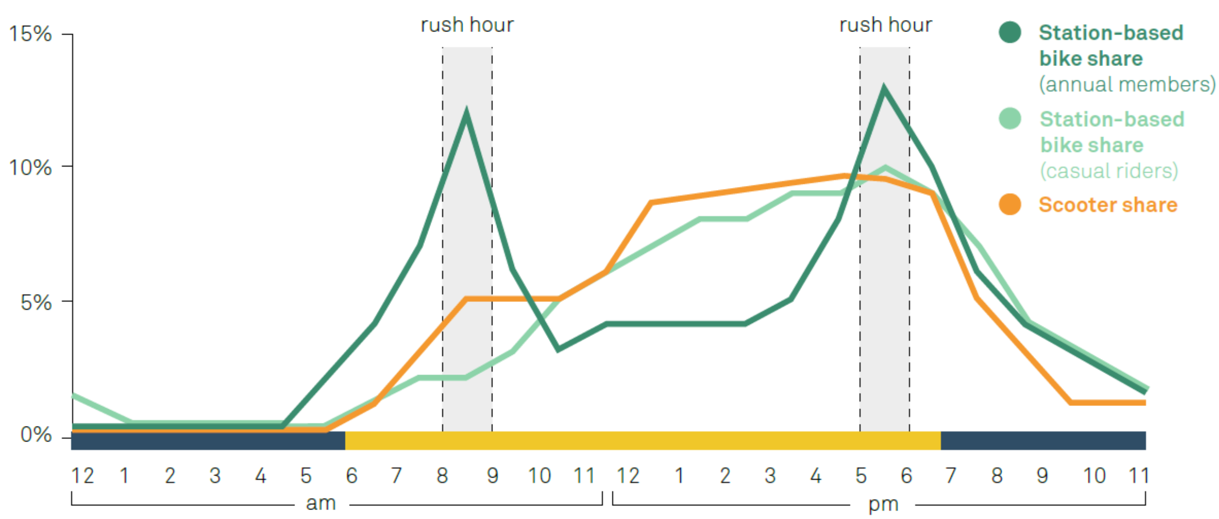
[4] https://nacto.org/wp-content/uploads/2019/04/NACTO_Shared-Micromobility-in-2018_Web.pdf

Figure 3.5: U.S. Micromobility Trips, 2010 to 2018



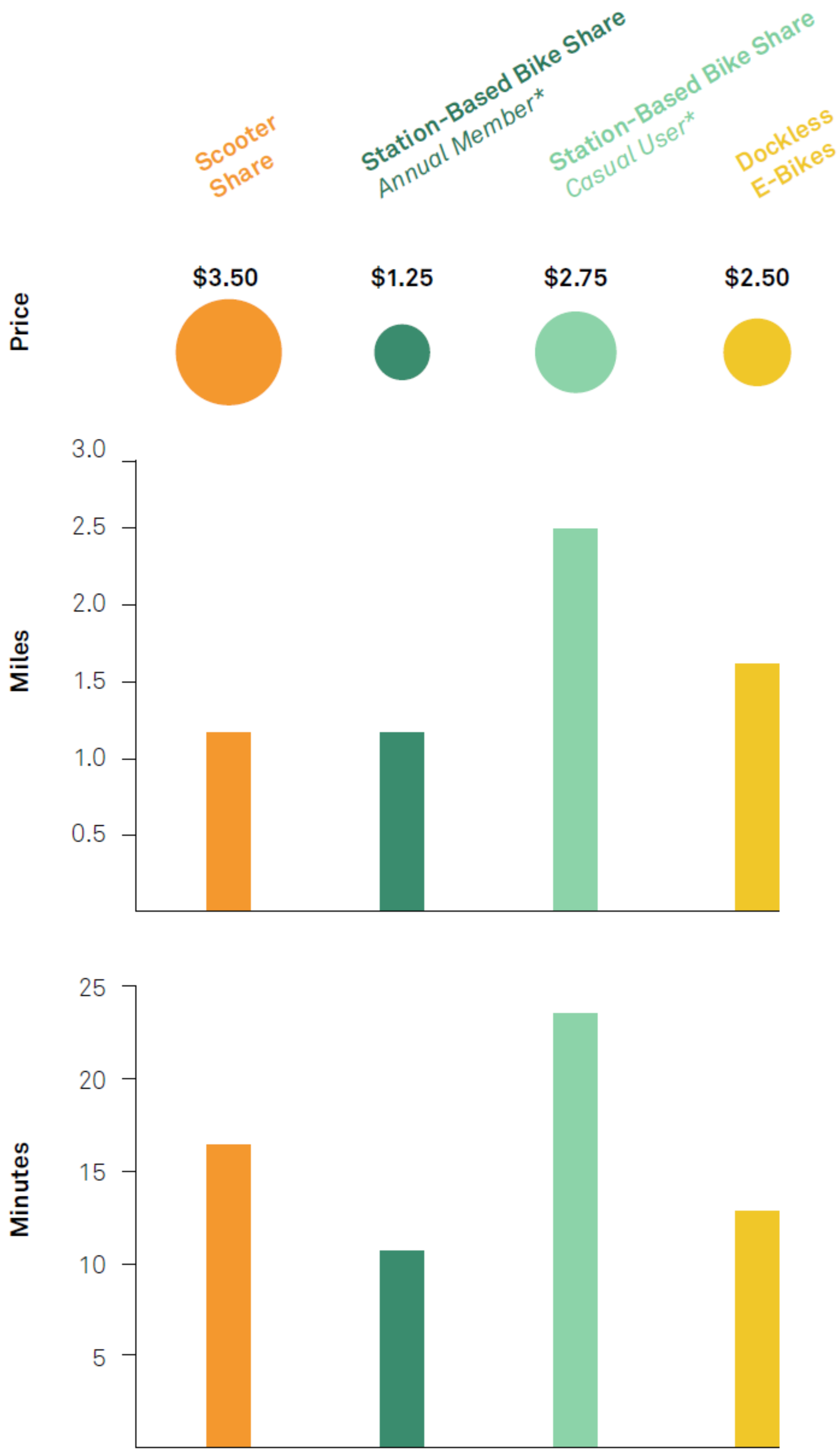
Source: NACTO

Figure 3.6: Average Micromobility Trips by Hour



Source: NACTO

Figure 3.7: Average Micromobility Trip Characteristics



Source: NACTO

Transportation Network Companies

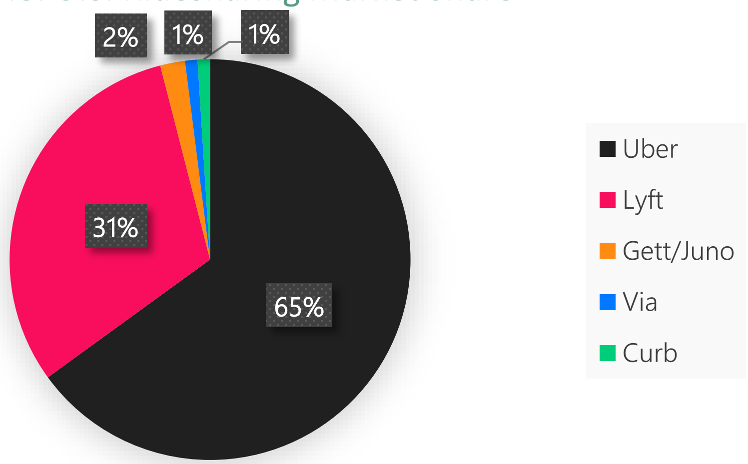
Ridehailing and ridesharing are the terms typically used to describe the services provided by Transportation Network Companies (TNCs) like Uber and Lyft. These TNCs emerged between 2010 and 2012 and have since grown rapidly, surpassing taxis in many metropolitan areas.

Today, TNCs are operating in most urban areas in the United States, including the Gulf Coast area. Outside of these urban areas though, service is limited or non-existent. And even with the growth into most urban areas, some TNC services are still limited to larger markets (e.g. UberPool and Lyft Shared for shared rides) or are being tested in certain markets (e.g. Uber Assist for people with disabilities).

While TNCs continue to evolve, research suggests the following TNC trends[5]:

- Trips are disproportionately work-related and social/recreational.
- Customers are predominantly affluent, well-educated, and tend to be younger.
- The market for TNC trips overlaps the market for transit service.
- People appear to use it as a replacement for transit when transit is unreliable or inconvenient, as a replacement for driving when parking is expensive or scarce, or to avoid drinking and driving.
- The heaviest TNC trip volumes occur in the late evening/early morning.
- Average trip lengths are around 6 miles with a duration of 20-25 minutes.
- Trips in large, densely-populated areas tend to be somewhat shorter and slower while trips in suburban and rural areas tend to be somewhat longer and faster.

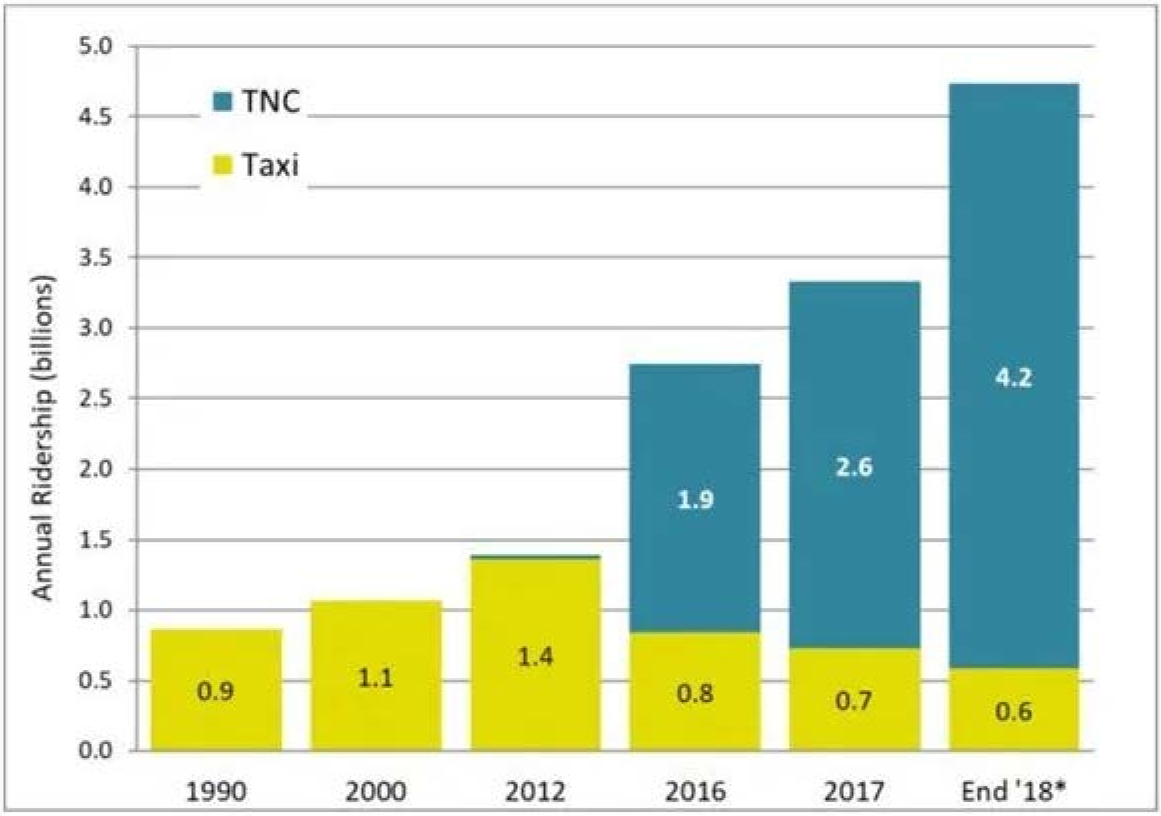
Figure 3.8: U.S. Ridesharing Market Share



Source: Edison Trends

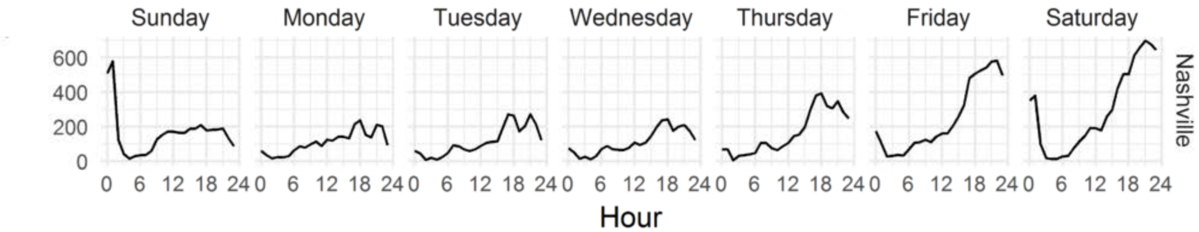
[5] http://www.schallerconsult.com/rideservices/automobility.htm

Figure 3.9: TNC and Taxi Ridership in the U.S., 1990 to 2018



Source: Schaller Consulting

Figure 3.10: TNC Ridership by Time of Day in Nashville



Source: TCRP RESEARCH REPORT 195: Broadening Understanding of the Interplay Among Public Transit, Shared Mobility, and Personal Automobiles

Car-Sharing

Car-sharing allows for people to conveniently live car-free or car-lite lifestyles and has been shown to increase walking and biking, reduce vehicle miles traveled, increase accessibility for formerly carless households, and reduce fuel consumption.[6]

Car-sharing has been around for decades and has continued to evolve in recent years. Today, there are three models of car-sharing:

- **Roundtrip car-sharing (as station-based car-sharing):** This accounts for the majority of all car-sharing activity. These services, such as Zipcar and Maven, serve a market for longer or day-trips, particularly where carrying supplies is a factor (such as shopping, moving, etc.). These car-share trips are typically calculated on a per hour or per day basis.
- **One-way car-sharing (free-floating car-sharing):** This allows members to pick up a vehicle at one location and drop it off at another location. These car-sharing operations, including car2go, ReachNow, and Gig, are typically calculated on a per minute basis.
- **Peer-to-Peer car-sharing (personal vehicle sharing):** This is characterized by short-term access to privately owned vehicles. An example of P2P car-sharing scheme is Turo.

Due to the varied car-sharing models, there are no typical usage patterns. Some car-sharing trips are short and local while others may be longer distance. Trips can be recurring or infrequent.

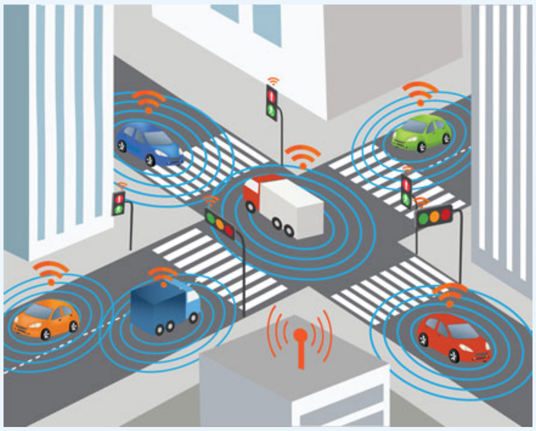
Outside of large urban areas, car-sharing is not that common. However, as connected and autonomous vehicles become more common, it is anticipated that car-sharing will become more widespread.

[6] https://www.planning.org/publications/report/9107556/

3.3 Connected and Autonomous Vehicles (CAV)

Today, most newer vehicles have some elements of both connected and autonomous vehicle technologies. These technologies are advancing rapidly and becoming more common.

Connected Vehicles



Connected vehicles are vehicles that use various communication technologies to exchange information with other cars, roadside infrastructure, and the Cloud.

VS.

Autonomous Vehicles

Autonomous, or "self-driving" vehicles, are vehicles in which operation of the vehicle occurs with limited, if any, direct driver input.

Communication Types

V2I	Vehicle to Infrastructure
V2V	Vehicle to Vehicle
V2C	Vehicle to Cloud
V2X	Others

Levels of Automation

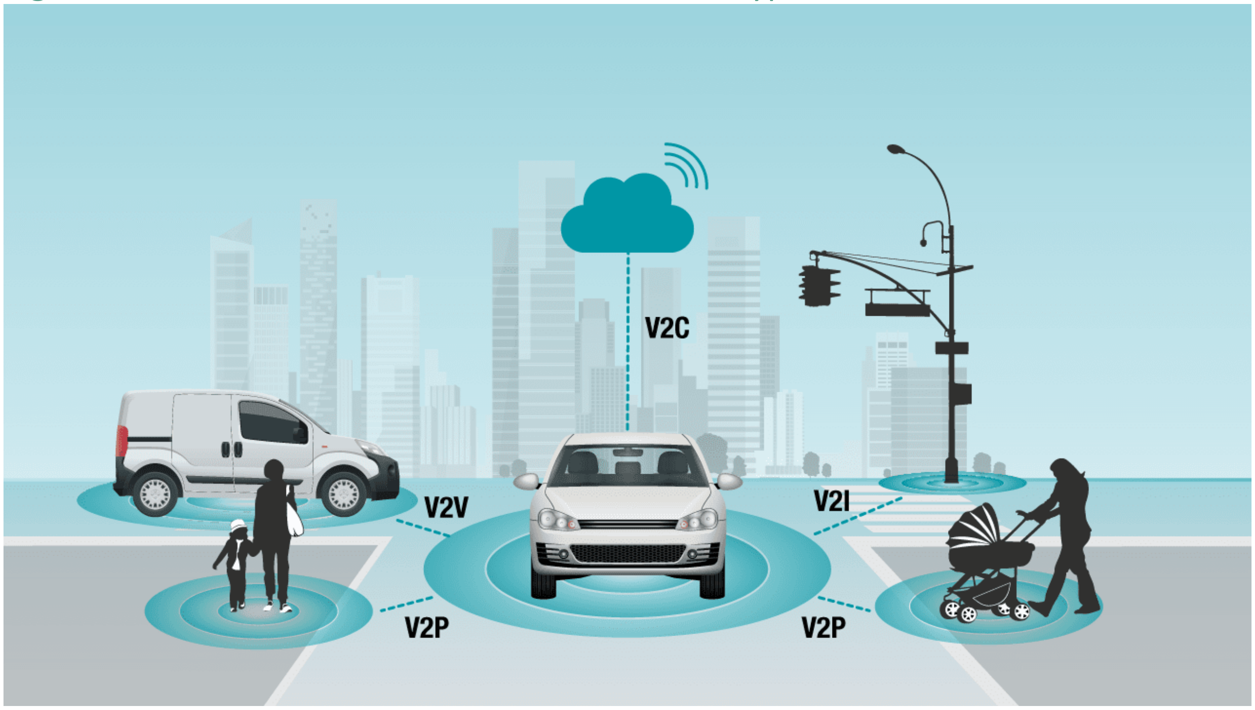
1	Driver Assistance
2	Partial Automation
3	Conditional Automation
4	High Automation
5	Full Automation

Connected Vehicle Communication Types

Connected and autonomous vehicles use multiple communications technologies to share and receive information. These technologies are illustrated in Figure 3.11 and include:

- **V2I: Vehicle-to-Infrastructure** – Vehicle-to-infrastructure (V2I) communication is the two-way exchange of information between vehicles and traffic signals, lane markings and other smart road infrastructure via a wireless connection.
- **V2V: Vehicle-to-Vehicle** – Vehicle-to-vehicle (V2V) communication lets cars speak with one another directly and share information about their location, direction, speed, and braking/acceleration status.
- **V2N/V2C: Vehicle-to-Network/Cloud** – Vehicle-to-network (V2N) communication systems connect vehicles to cellular infrastructure and the cloud so drivers can take advantage of in-vehicle services like traffic updates and media streaming.
- **V2P: Vehicle-to-Pedestrian** – Vehicle-to-pedestrian (V2P) communication allows drivers, pedestrians, bicyclists, and motorcyclists to receive warnings to prevent collisions. Pedestrians receive alerts via smartphone applications or through connected wearable devices.
- **V2X: Vehicle-to-Everything** – Vehicle-to-everything (V2X) communication combines all of the above technologies. The idea behind this technology is that a vehicle with built-in electronics will be able to communicate in real-time with its surroundings.

Figure 3.11: Connected Vehicle Communication Types



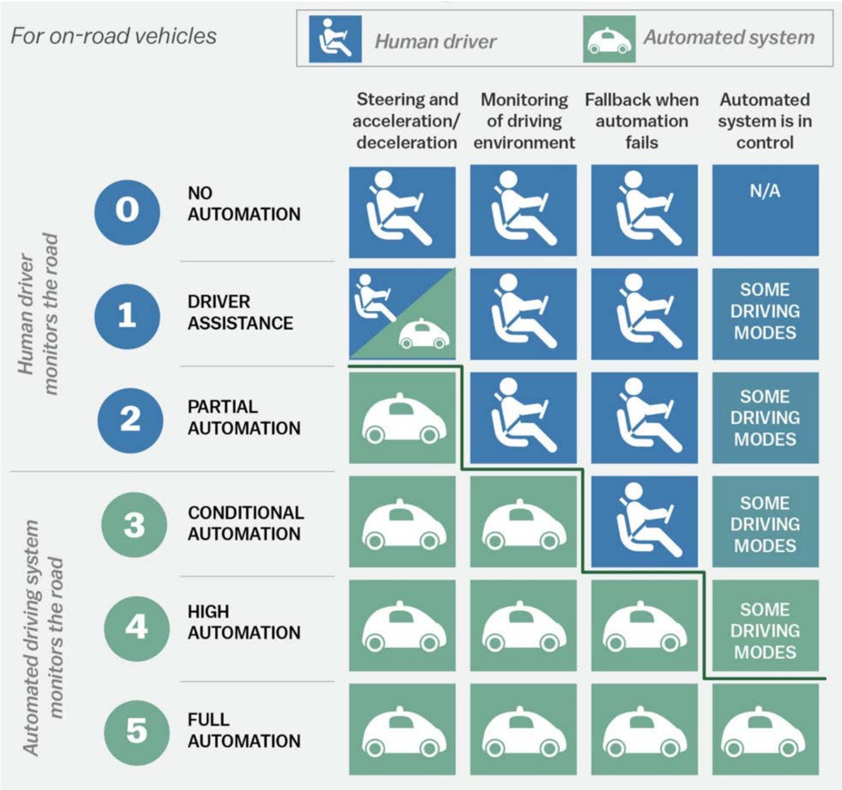
Source: Texas Instruments

Autonomous Vehicle Levels

According to the National Highway Traffic Safety Administration (NHTSA), there are five (5) levels of automation. These levels are illustrated in Figure 3.12 and include:

- **Level 1:** An Advanced Driver Assistance System (ADAS) can sometimes assist the human driver with steering or braking/accelerating, but not both simultaneously.
- **Level 2:** An Advanced Driver Assistance System (ADAS) can control both steering and braking/accelerating simultaneously under some circumstances. The human driver must continue to pay full attention at all times and perform the rest of the driving task.
- **Level 3:** An Automated Driving System (ADS) on the vehicle can perform all aspects of driving under some circumstances. In those circumstances, the human driver must be ready to take back control at any time when the ADS requests the human driver to do so.
- **Level 4:** An Automated Driving System (ADS) on the vehicle can perform all driving tasks and monitor the driving environment – essentially, do all the driving – in certain circumstances. The human need not pay attention in those circumstances.
- **Level 5:** An Automated Driving System (ADS) on the vehicle can do all the driving in all circumstances. The human occupants are just passengers.

Figure 3.12: Levels of Automation



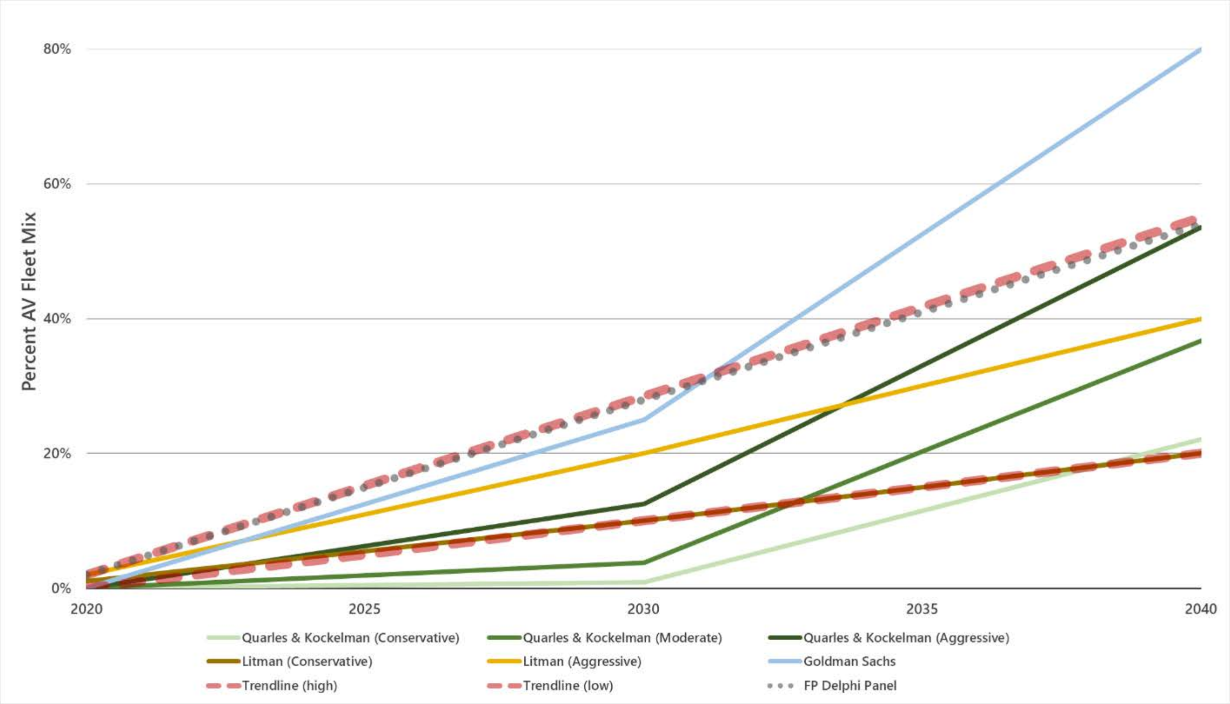
Source: SAE J3016 Levels of Automation (Photo from Vox)

Potential Timeline

While mid-level connected and autonomous vehicles are already on the market and traveling our roadways, there is uncertainty about the long-term future of these vehicles, especially Level 5, fully autonomous vehicles. However, over the past couple of years, some level of consensus has emerged about the timeline over the next 20 years. [7][8][9]

- Over the next five years, partially automated safety features will continue to improve and become less expensive. This includes features such as lane keeping assist, adaptive cruise control, traffic jam assist, and self-park.
- By 2025, fully automated safety features, such as a "highway autopilot," are anticipated to be on the market.
- Through 2030, autonomous vehicles will continue to make up a small percentage of all vehicles on the road due to the large number of legacy vehicles and slow adoption rates resulting from higher initial costs, safety concerns, and unknown regulations.
- By 2040, autonomous vehicles are more common, accounting for 20-50% of all vehicles.

Figure 3.13: Potential Autonomous Vehicle Market Share, 2020 to 2040



Source: Fehr and Peers

[7] https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety
[8] http://library.rpa.org/pdf/RPA-New-Mobility-Autonomous-Vehicles-and-the-Region.pdf
[9] https://www.fehrandpeers.com/av-adoption/

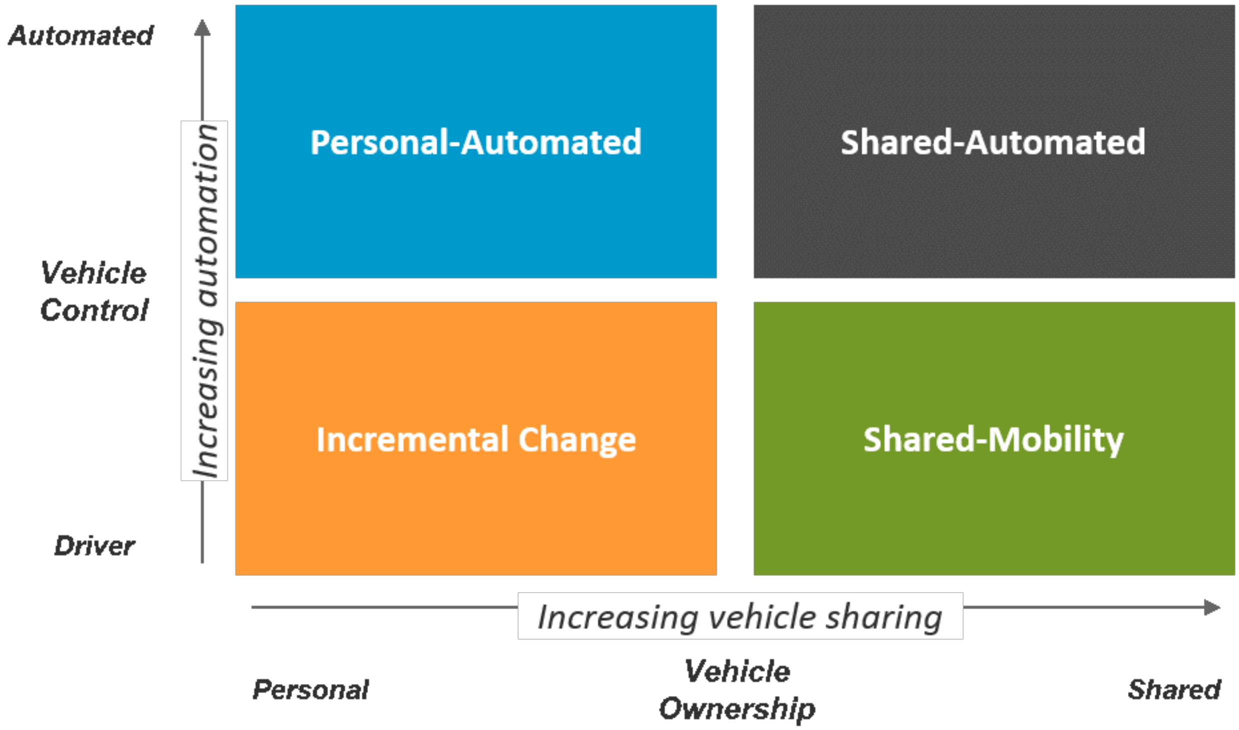
Potential Impacts

The development of connected and autonomous vehicles will change travel patterns, safety, and planning considerations. Ultimately, the actual impact of these vehicles will depend on how prevalent the technology is and the extent to which vehicles are privately owned or shared.

As shown in Figure 3.14, there are four (4) potential scenarios, each with unique implications for transportation planning.

- **Personal-Automated scenario**: vehicles are highly autonomous and mostly privately owned.
- **Shared-Automated scenario:** vehicles are highly autonomous and mostly shared.
- **Incremental Change scenario:** vehicles are not highly autonomous and are mostly privately owned.
- **Shared-Mobility scenario:** vehicles are not highly autonomous and are mostly shared.

Figure 3.14: Future Mobility Scenarios



Source: U.S. Department of Energy/Deloitte

Safety

In the long-term, CAV technology is anticipated to reduce human error and improve overall traffic safety. CAVs are capable of sensing and quickly reacting to the environment via:

- External sensors (ultrasonic sensors, cameras, radar, lidar, etc.)
- Connectivity to other vehicles
- GPS

These features allow the CAV to create a 360-degree visual of its surroundings and detect lane lines, other vehicles, road curves, pedestrians, buildings, and other obstacles. The sensor data is processed in the vehicle's central processing unit and allows it to react accordingly. As this technology becomes more common on the roadways, it should result in increased safety by removing human error as a crash factor. However, this can only be achieved when CAVs are in the majority on the road, if not the only vehicles in use.

CAV interactions with bicyclists and pedestrians is a major area of concern that still needs improvement. However, the use of CAV technologies can be applied at intersections by communicating with the traffic lights and crossing signals. This will result in increased safety for bicyclists, pedestrians, and those with mobility needs or disabilities.

Traffic

CAVs have the potential to improve overall traffic flow and reduce congestion, even as they may increase vehicle miles traveled. However, these benefits, such as increased roadway capacity from high-speed cars moving at closer distances (platooning), are achieved when CAV saturation is very high.

As a whole, CAVs are likely to increase driving, as measured by Vehicle Miles Traveled (VMT). This increase would come in part from people making longer and potentially more trips, due to the increased comfort of traveling by car. People could perform other tasks, such as working or entertainment, instead of driving and longer trips would become more bearable. The increase in VMT would also come from “dead head” mileage, or the time that vehicles are driving on the road without passengers, before and after picking up people.

Transit

CAV technology has the potential to drastically reduce the cost of operating transit in environments that are safe for autonomous transit. For many agencies, labor is their highest operating expense. While not all routes may be appropriate for autonomous transit, there may be opportunities to create dedicated lanes and infrastructure for autonomous transit and other vehicles. Even with some lines operating autonomously, costs can be lowered, and these savings can be used to increase and improve service.

From a reliability standpoint, connected vehicle technology can also improve on-time performance and travel times through applications like Transit Signal Priority (TSP) and dynamic dispatching. TSP is an application that provides priority to transit at signalized intersections and along arterial corridors. Dispatching and scheduling could be improved with dynamic, real-time information that more effectively and efficiently matches resources to demand.

Even with the potential improvements to transit operations, transit ridership could decrease if transportation network companies (e.g. Uber/Lyft) become competitively priced. This could be possible if autonomy allows these private transportation providers to eliminate drivers and reduce their operating costs.

Freight

Both delivery and long-haul freight look to be early adopters of CAV technology, reducing costs and improving safety and congestion.

Freight vehicles will also benefit from CAV technology by allowing them to travel in small groups, known as truck platooning. The use of CAV will safely decrease the amount of space between the platooning trucks thereby allowing consistent traffic flow. Platooning reduces congestion as vehicles travel at constant speed, with less stop-and-go, which results in fuel savings and reduces carbon dioxide emissions.

Land Use and Parking

Autonomous vehicles could dramatically reduce demand for parking, opening this space up for other uses. They may also require new curbside and parking considerations and encourage urban sprawl.

Autonomous vehicle technology has the potential to reduce the demand for parking in a few ways.

- Shared-Automated: If autonomous vehicles are mostly shared and not privately owned, there will be less need for parking as these vehicles will primarily move from dropping one passenger off to picking up or dropping off another passenger.
- Personal-Automated: If autonomous vehicles are mostly privately owned, it is also possible that they could return home or go to a shared parking facility that is not on site. In this scenario, some parking demand may simply shift from onsite parking to centralized parking.
- Smart Parking: Connected parking spaces allow communication from the parking lot to your vehicle, letting the vehicle know which spaces are available. This reduces the need for circling or idling in search of parking and improves parking management.

If parking demand is reduced, land use planners will need to consider repurposing parking areas. In urban areas, this could mean reallocating curb-side space for pedestrians while allowing for safe passage, pick-ups, drop-offs, and deliveries by AVs. In suburban areas, it could mean redeveloping large surface parking lots and revisiting parking requirements.

The benefits of CAV technology are also likely to make longer commutes more attractive and increase urban sprawl unless local land use policy and regulations discourage this technology.

Big Data for Planning

Connected vehicle technology may provide valuable historical and real-time travel data for transportation planning. Privacy concerns and private-public coordination issues may limit data availability, but this data could allow for very detailed planning for vehicles, pedestrians, and other modes. In addition to traffic data, it could provide valuable origin-destination data.

Furthermore, as CAV technologies continue to develop and be implemented, they can be used to refine regional or state travel demand models. This can be accomplished by:

- Providing additional data that can be used for the calibration of existing travel characteristics.
- Analyzing the data, in before and after method, to understand the effect of pricing strategies on path choice and route assignment.
- Potentially developing long-distance travel data in statewide models since CAVs are continuously connected.
- Potentially providing large amounts of data on commercial vehicles and truck movements to develop freight elements.
- Identifying recurring congestion locations within a region or state.
- Supporting emission modeling by assisting with the development of local input values instead of using MOVES defaults.

3.4 Electric and Alternative Fuel Vehicles

There has been growing interest and investment in alternative fuel vehicle technologies in recent years, especially for electric vehicles. This renewed interest has also included the transit and freight industries.

Alternative Fuel Vehicles (AFVs) are defined as vehicles that are substantially non-petroleum, yielding high-energy security and environmental benefits. These include fuels such as:

- electricity
- hybrid fuels
- hydrogen
- liquefied petroleum gas (propane)
- Compressed Natural Gas (CNG)
- Liquefied Natural Gas (LNG)
- 85% and 100% Methanol (M85 and M100)
- 85% and 95% Ethanol (E85 and E95) (not to be confused with the more universal E10 and E15 fuels which have lower concentrations of ethanol)

Existing Stock of AFVs

The number of AFVs in use across the county continues to increase due to federal policies that encourage and incentivize the manufacture, sale, and use of vehicles that use non-petroleum fuels. According to the 2019 U.S. Energy Information Administration's *Annual Energy Outlook*, the most popular alternative fuel sources today for cars and light-duty trucks in the U.S. are E85 (flex-fuel vehicles) and electricity (hybrid electric vehicles and plug-in electric vehicles).

The U.S. Department of Energy's Alternative Fuels Data Center locator shows that there are seventeen (17) AFV stations in the MPA: twelve (12) electric stations five (5) propane stations.

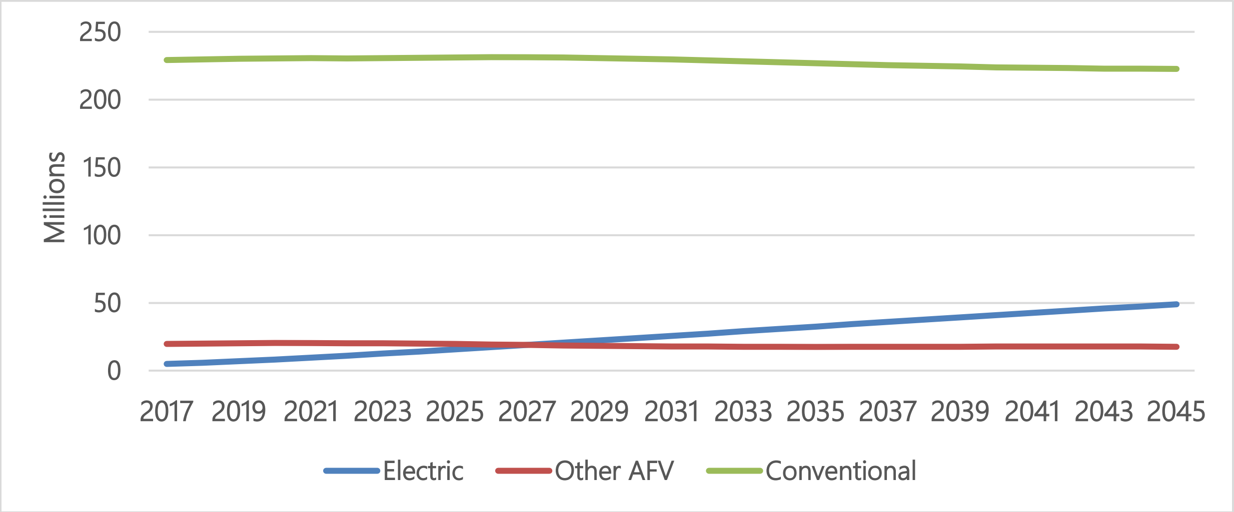
Growth Projections

Long-term projections for electric vehicle and other alternative fuels vary considerably. On the higher end, some projections estimate that electric vehicles will make up 30 percent of all cars in the United States by 2030.[10] The U.S. Energy Information Administration (USEIA) is more conservative, projecting that electric vehicles will make up approximately nine (9) percent of all light-duty vehicles by 2030 and approximately 17 percent by 2045. For freight vehicles, the USEIA projects only a two (2) percent market share for electric vehicles by 2045.

Outside of electric vehicles, which include full electric vehicles and hybrid electric vehicles powered by battery or fuel cell technology, the USEIA does not project other alternative fuels to grow significantly for light-duty vehicles. However, it does anticipate ethanol-flex fuel vehicles to grow significantly for light and medium freight vehicles.

In the United States, electric buses are becoming more common as transit agencies pursue long-term operations and maintenance savings in addition to environmental and rider benefits (less air and noise pollution). While electric buses have many challenges, upfront costs are anticipated to go down and utilization is likely to become more widespread. By 2030, it is anticipated that between 25 percent and 60 percent of new transit vehicles purchased will be electric.[11]

Figure 3.15: Light-Duty Vehicles on the Road by Fuel Type, 2017 to 2045



Source: U.S. Energy Information Administration, 2019 Annual Energy Outlook

[10] https://www.iea.org/publications/reports/globalevoutlook2019/

[11] https://www.reuters.com/article/us-transportation-buses-electric-analysi/u-s-transit-agencies-cautious-on-electric-buses-despite-bold-forecasts-idUSKBN1E60GS

Potential Impacts

Air Quality Improvement

Electric and other alternative fuel vehicles have the potential to drastically reduce automobile related emissions. While these fuels still have environmental impacts, they can reduce overall lifecycle emissions and reduce direct tailpipe emissions substantially.

Direct emissions are emitted through the tailpipe, through evaporation from the fuel system, and during the fueling process. Direct emissions include smog-forming pollutants (such as nitrogen oxides), other pollutants harmful to human health, and greenhouse gases (GHGs).

Infrastructure Needs

There may be a long-term need for public investment in vehicle charging stations to accommodate growth in electric vehicles.

Consumers and fleets considering Plug-in Hybrid Electric Vehicles (PHEVs) and all-electric vehicles (EVs) benefit from access to charging stations, also known as EVSE (Electric Vehicle Supply Equipment). For most drivers, this starts with charging at home or at fleet facilities. Charging stations at workplaces and public destinations may also bolster market acceptance.

Gas Tax Revenues

If adoption rates increase substantially, gas tax revenues will be impacted, and new user fees may need to be considered.

Because electric and other alternative fuel vehicles use less or no gasoline compared to their conventional counterparts, their operation does not generate as much revenue from a gas tax, which is one of the primary means that Mississippi uses to fund transportation projects. Because of this, many states have begun imposing fees on these vehicles to recoup lost transportation revenue.[12]

[12] http://www.ncsl.org/research/energy/new-fees-on-hybrid-and-electric-vehicles.aspx

4.0 Roadways and Bridges

4.1 Congestion Relief Needs

Given the population and employment growth forecasted to occur by 2045, the Travel Demand Model (TDM) indicates that the number of person trips in the MPA will increase from 1.61 million in 2018 to 1.98 million in 2045. Most of the trip types grow by the same rate. However, trips with one or both ends outside of the MPA are forecasted to grow at a faster rate. These changes are summarized in Table 4.1.

Table 4.1: Person Trips by Purpose, 2018 to 2045

Trip Purpose	2018	2045 (E+C)	Change	Percent Change
Home-Based Work	285,833	343,475	57,642	20.2%
Home-Based Other	630,930	759,607	128,678	20.4%
Non-Home Based	414,996	491,010	76,013	18.3%
Commercial Vehicle	118,204	140,104	21,899	18.5%
Truck	15,867	18,736	2,869	18.1%
Internal-External	144,951	222,553	77,602	53.5%
External-External	3,082	4,304	1,222	39.6%
Total	1,613,863	1,979,788	365,925	22.7%

22.7%

Growth in person trips in the MPA from 2018 to 2045

Notes: E+C is future scenario with only Existing and Committed transportation projects. Values do not include special generators.

Source: GRPC/MPO Travel Demand Model, NSI

Table 4.2 shows that if the transportation projects that currently have committed funding are constructed, the centerline miles of the roadway network will increase by less than half a percent. The table also shows the forecast change in Vehicle Miles Traveled (VMT), Vehicle Hours Traveled (VHT), and Vehicle Hours of Delay (VHD) if only those projects are constructed.

This data indicates that, by 2045, the VMT will increase by nearly 31 percent and the VHT by nearly 38 percent. However, during this same time period, the VHD will be almost double compared to the existing delay. These changes are the result of a large growth in person trips and comparatively slow growth of the roadway network.

Table 4.2: Travel Demand Impact of Growth and Existing and Committed Projects, 2018 to 2045

Centerline Miles of Roadways				
Classification	2018 (Existing)	2045 (E+C Projects)	Change	Percent Difference
Interstate	81.49	81.49	0	0.0%
Principal	201.79	202.60	0.81	0.4%
Minor Arterial	265.05	265.58	0.53	0.2%
Collector	809.43	811.8	2.37	0.3%
Total	1,357.76	1,361.47	3.71	0.3%
Daily Vehicle Miles Traveled (VMT)				
Classification	2018 (Existing)	2045 (E+C Projects)	Change	Percent Difference
Interstate	4,476,909	5,598,744	1,121,835	25.1%
Principal	4,082,219	5,359,807	1,277,589	31.3%
Minor Arterial	1,670,940	2,249,162	578,222	34.6%
Collector	2,240,958	3,080,979	840,021	37.5%
Total	12,471,026	16,288,692	3,817,666	30.6%
Daily Vehicle Hours Traveled (VHT)				
Classification	2018 (Existing)	2045 (E+C Projects)	Change	Percent Difference
Interstate	89,903	121,712	31,809	35.4%
Principal	98,325	134,505	36,181	36.8%
Minor Arterial	43,754	61,345	17,591	40.2%
Collector	62,251	88,113	25,862	41.5%
Total	294,233	405,676	111,443	37.9%
Daily Vehicle Hours of Delay (VHD)				
Classification	2018 (Existing)	2045 (E+C Projects)	Change	Percent Difference
Interstate	14,199	27,161	12,962	91.3%
Principal	11,455	21,948	10,493	91.6%
Minor Arterial	3,634	7,976	4,342	119.5%
Collector	4,411	9,114	4,703	106.6%
Total	33,700	66,198	32,499	96.4%

Note: E+C is future scenario with only Existing and Committed transportation projects.

Source: GRPC/MPO Travel Demand Model, NSI

Currently, congestion is concentrated mostly near intersections and interchanges in the MPA. By 2045, congestion continues to remain at these locations, but experienced to a greater degree and at more interchanges.

The number of roadway segments with a volume to capacity (V/C) ratio exceeding 1.0 would increase significantly by 2045, as shown in Table 4.3 and illustrated in Figure 4.1.

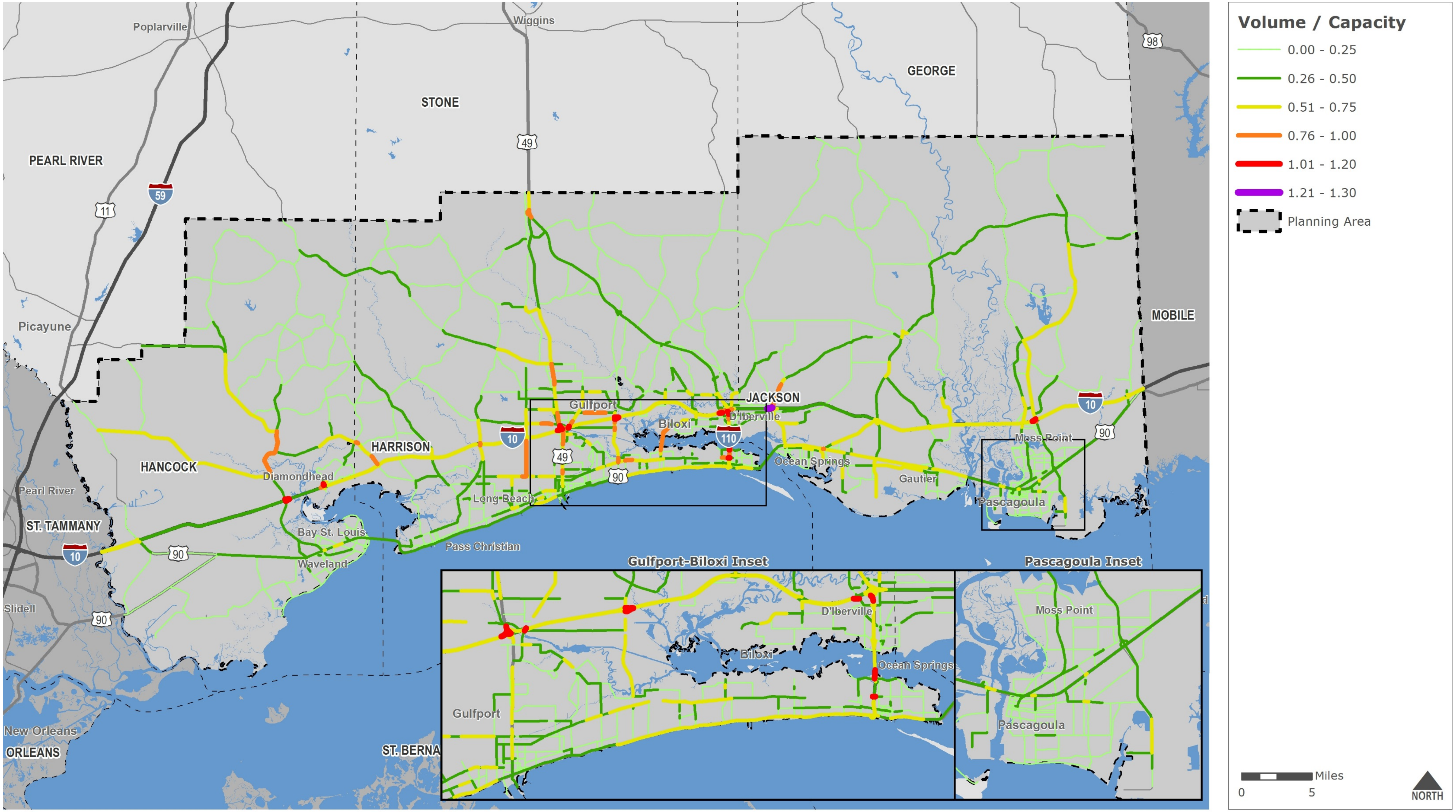
It is important to note that not all congested street and highway segments should be widened with additional through lanes or turning lanes. In urban settings, it may be more appropriate to consider ITS improvements or Travel Demand Management (TDM) strategies. Congestion may also be reduced by improving pedestrian, bicycle, and/or transit conditions that will encourage alternative means of transportation.

Table 4.3: Roadway Corridors with Volumes Exceeding Capacity, 2045

Roadway	Location	Length (miles)
I-10 WB Off Ramp	MS 43 to I-10 WB	0.27
I-10 EB On Ramp	MS 43 to I-10 EB	0.22
I-10 WB On Ramp	Old Hwy 49 to I-10 WB	0.44
I-10 WB Off Ramp	I-10 WB to Old Hwy 49	0.26
I-10 WB Off Ramp	MS 605 to I-10 WB	0.24
I-10 EB On Ramp	MS 605 to I-10 EB	0.29
I-10 EB Off Ramp	I-10 EB to Old Hwy 15	0.18
I-EB EB Off Ramp	I-10 WB Off Ramp to I-110	0.20
I-10 WB On Ramp	MS 609 to I-10 WB	0.36
I-10 EB Off Ramp	I-10 EB to MS 609	0.31
I-10 WB On Ramp	MS 63 to I-10 WB	0.28
I-110 SB Off Ramp	I-110 SB to Bayview Avenue	0.29
Division Street	I-110 SB Off Ramp to I-110 NB On Ramp	0.09
Three Rivers Road	Seaway Road to Crossroads Parkway	0.09
Gex Drive	I-10 WB Ramps to Kapalama Drive	0.09

Source: GRPC/MPO Travel Demand Model

Figure 4.1: Future Roadway Congestion, 2045 (Existing+Committed)



Data Sources: Travel Demand Model

Disclaimer: This map is for planning purposes only.

Public and Stakeholder Input

During the public and stakeholder involvement process, respondents were asked to identify the roadways and intersections they felt were most congested. The most often identified of these location types are described below.

US 49 Corridor, including:

- Between I-10 and MS 53
- Intersection at I-10
- Intersection at Creosote Rd

US 90 Corridor, including:

- Between Gautier and Ocean Springs
- Between I-110 and Veterans Ave
- Near Keesler Air Force Base
- Between Washington Ave and MS 43

I-10 Corridor, including:

- Interchange at US 49
- Interchange at MS 605
- Interchange at Diamondhead
- Interchange at MS 609

<u>Intersection and Corridor Recommendations</u>

Table 4.4 displays the locations identified through public involvement and engineering review, the observed issues, and recommendations to address the intersection needs.

Table 4.4: Recommended Intersection Improvement Projects

Location	Traffic Control Type	Observed Issues	Short-term Solution	Long-term Solution
I-10 and US 49	Cloverleaf	Traffic backs up along US 49 on either side of I-10	Adaptive Traffic Control System (ATCS) along US 49	Corridor Study from Dedeaux Rd to Martin Luther King Jr Blvd
US 49 and Creosote Rd	Signal	Traffic backs up on all approaches	Adaptive Traffic Control System (ATCS) along US 49	Corridor Study from Dedeaux Rd to Martin Luther King Jr Blvd
I-10 and MS 609	Signal	Traffic backs up along the NB and SB approaches at the ramp terminals. WB On Ramp traffic backs ups.	Adaptive Traffic Control System (ATCS) along the corridor	Corridor Study from Seaman Rd to Solomon Rd
I-10 and MS 609	Signal	Traffic backs up on the NB and WB Ramps	Adaptive Traffic Control System (ATCS) along the corridor	Corridor Study from Seaman Rd to Solomon Rd
I-10 and Cedar Lake Rd	Signal	Traffic backs up along the NB and SB approaches at the ramp terminals. EB off ramp traffic backs up to I-10.	Adaptive Traffic Control System (ATCS) along the corridor, left turn lane at mobile home if needed, possible access management improvements	Corridor Study from I-10 WB ramps to Cedar Lake Mobile Home Village Driveway
Three Rivers Rd and Seaway Rd	Signal	Traffic backs up along the NB and SB approaches	Adaptive Traffic Control System (ATCS) along Three Rivers Rd from Dedeaux Rd to Creosote Rd	Corridor study to add capacity with possible turn lane improvements and/or access management
I-10 WB Ramp and Lorraine Rd	Signal	Traffic backs up along the NB and SB approaches at the ramp terminals. WB off ramp traffic backs up to I-10.	Adaptive Traffic Control System (ATCS) from Reichold Rd to Dedeaux Rd	

Congestion Management Process

A Congestion Management Process (CMP) measures the operational effectiveness of major transportation facilities located within a Transportation Management Area (TMA), an urbanized area with a population greater than 200,000 people. Each roadway in the MPA received a CMP score based on travel time and Level of Service. Roadways with extensive congestion received a higher CMP score.

The roadways experiencing either existing (2018) of future (2045) congestion, based on the CMP score, are shown in Table 4.5. Many of these roadways also experience either existing or future congestion, based on the V/C ratios as shown in Figure 4.1 in this Technical Report and Figure 2.3 in *Technical Report #2: Existing Conditions*. Many of the roadways that experience existing congestion are projected to experience more extensive congestion by 2045.

Table 4.5: CMP Congested Segments

Roadway	Segment
I-110	Biloxi Bay Bridge
US 49	US 90 to MS 53
US 90	MS 43/MS 603 to 0.29 miles of Main St
	Broad Ave to US 49
	Pine Grove Ave to Oakmont Pl
	I-110 to Main St
	MS 609 to Ocean Springs Rd
	Telephone Rd to Chicot St
MS 15	I-10 to Old MS 67
MS 43	Texas Flat Rd to MS 603
MS 53	County Farm Rd to Indian Springs Rd
	Old Highway 49 to US 49
MS 57	Between I-10 Ramps
MS 63	I-10 to Old Saracennia Rd
MS 605	Pass Rd to I-10
MS 609	US 90 to Seaman Rd
MS 611	Wheeler Rd to Zollicoffer Rd
MS 613	Dutch Bayou Rd to Rosa Ln
28th St	73rd Ave to Canal Rd
Auto Mall Pkwy	D'Iberville Blvd to Brodie Rd
Canal Rd	Tillman Rd to I-10
Central Ave	Lamey Bridge Rd to Rodriguez St
County Farm Rd	Beatline Rd to I-10

Roadway	Segment
D'Iberville Blvd	Popps Ferry Rd to Lamey Bridge Rd
Dedeaux Rd	Wingate Dr to MS 605
Division St	Iroquois St to I-110
Gex Rd	I-10 to Aloha Dr
Kiln Delisle Rd	I-10 to Cuevas Rd
Pass Rd	Hewes Ave to Courthouse Rd
	Anniston Ave to Lindh Rd
	Eisenhower Dr to Popps Ferry Rd
Popps Ferry Rd	Bonne Terra Blvd to N Country Club Ln
Rodriguez St	Brodie Rd to Central Ave
Seaman Rd	Tucker Rd to Cox Rd
Three Rivers Rd	Seaway Rd to Dedeaux Rd

The CMP report also lists strategies that could be implemented to reduce congestion on these corridors. The CMP analysis can be found in *Technical Report #7: Congestion Management Process*.

4.2 Maintenance Needs

Pavement Maintenance

While less than three (3) percent of the MPA's roadways have poor pavement conditions, these roadway segments could eventually experience maintenance needs that will lead to decreased safety or emergency roadway repairs, both of which can increase congestion. Figure 2.5 in *Technical Report #2: Existing Conditions* displays the pavement conditions of the NHS monitored roadways within the MPA. Particular attention should be given to:

- US 49 between O'Neal Rd and Old Hwy 49 in Saucier
- MS 63 between Polktown Rd and 1.5 miles north of Polktown Rd
- US 90 throughout the entire study area

These roadways have continuous lengths of poor or fair pavement conditions and should be a priority for roadway maintenance and repaving.

Bridge Maintenance

The existing conditions analysis revealed that there are currently forty (40) bridges in Poor condition within the MPA; two (2) of which are on the National Highway System. Table 4.6 displays the MPA's bridges in Poor condition. Addressing the needs of these bridges will improve safety, reduce maintenance costs, and avoid future bridge shutdowns. Bridges are rated by the NBIS based on the conditions of the following categories:

- Decks
- Superstructure
- Substructure
- Stream Channel and Channel Protection.

A bridge is considered to be in Poor condition if any of the above categories are rated "Poor".

Some of these deficient bridges may be improved via the Metropolitan Transportation Plan (MTP) through other transportation projects, such as a roadway widening. Other bridges could instead be improved through line item funding for operations and maintenance. The MPO and MDOT should prioritize these bridges for improvements as funding becomes available.

Table 4.6: Bridges in Poor Condition

Structure ID	Roadway	Feature Intersecting	Year Built
210009002300010	US 90	East Pearl River	1934
SA2300000000032	Kiln-Delisle Rd	Over Bayou Laterre	1960
SA2300000000014	Rocky Hill Dedeaux	Bayou Leterre	1966
SA3000000000036	Wade-Vancleave Rd	Parkers Lk '	1955
SA2300000000061	La France Street	Bayou	1986
310061303001360	SR 613	Black Creek	1983
SA3000000000143	Graveline Road	Bayou Lamott	1987
SA2400000000169	Asmard Road	Bayou Portage Branch	1968
SA2300000000007	Caesar Necaise Rd	Hickory Creek	1971
SA3000000000115	Old Fort Bayou Rd	Bayou Talla	1970
SA3000000000125	Daisy Vestry Rd	Mill Creek	1991
SA2400000000168	North Clark Street	Bayou Portage	1960
SA2400000000035	McHenry Rd	Little Biloxi River	1930
SA3000000000124	Seamen Road	Mill Creek	1985
SA2400000000161	Cuevas Delisle Rd	Delisle Bayou	1971
SA2300000000049	S Railroad Ave	Mud Bayou	1962
SA2300000000001	Crane Creek Road	Crane Creek	1965
SA2300000000002	Necaise-Anna Road	Branch	1980
21000490240080A	US 49	Flat Branch	1938
SA2300000000010	East Cypress Lake	Lake	1983
SA3000000000200	Lilly Orchard Rd	Live Stream	1984
SA3000000000142	Hospital Street	Bayou Chico / Pasc.	1950
SA3000000000116	Hanshaw Road	Davis Bayou	1991
SA2400000000086	East Bayview Dr	Bay Bayou	1987
SA3000000000031	Big Point Road	Relief-Lake-Poll Control	1974
SA3000000000037	Big Point Road	Relief-Lake-Poll Control	1974
SA3000000000066	Poticaw Landing Rd	Live Stream	1984
SA3000000000147	Washington Avenue	Bayou-Relief	1965
SA3000000000094	Road to Boat Ramp	Relief Bridge	1991
SA3000000000134	Louise Street	West Prong Bayou Casotte	1960
SA3000000000177	Holder Road	Branch to Escatawpa River	2000
SA3000000000131	Old Mobile Hwy/Pas	Bayou Relief	1980

Structure ID	Roadway	Feature Intersecting	Year Built
SA2300000000022	Lott McCarty Rd	Mill Creek	1961
SA3000000000077	Seamen Road	Live Stream	1984
SA3000000000145	Tucker Avenue	Relief	1960
SA2400000000036	Bell Creek Road	Bell Creek	1968
SA2400000000141	Second Street	Coffee Creek	1985
SA2400000000182	Hiller Park Dr	Bayou La Porte	2002
SA2300000000023	Flat Top Road	Everett Branch	1966
SA2400000000028	Saucier Advance Rd	Bully Creek	1968

Source: National Bridge Inventory, 2018

4.3 Safety Needs

Within the MPA, over 55,000 crashes occurred between 2014 and 2018. During that timeframe, there were 293 fatal crashes and 245 life-threatening crashes. Another 15,651 crashes caused injuries or possible injuries.

The highest number of crashes in the MPA were rear-end collisions, followed by angle crashes and sideswipes. Recommendations for reducing these most common types of crashes are outlined below.

> *As traffic continues to increase from 2018 to 2045, historical trends predict that the number of crashes will also increase.*

Reducing Rear-End Collisions

The highest number of crashes in the MPA were rear-end collisions which can be attributed to a number of factors, such as:

- driver inattentiveness
- large turning volumes
- slippery pavement
- inadequate roadway lighting
- crossing pedestrians
- poor traffic signal visibility
- congestion
- inadequate signal timing, and/or
- an unwarranted signal

In general, the recommendations for reducing rear-end crashes include:

- Analyzing turning volumes to determine if a right-turn lane or left-turn lane is warranted. Providing a turning lane separates the turning vehicles from the through vehicles, preventing through vehicles from rear-ending turning vehicles. If a large right-turn volume exists, increasing the corner radius for right-turns is an option.
- Checking the pavement conditions. Rear-end collisions caused by slippery pavement can be reduced by lowering the speed limit with enforcement, providing overlay pavement, adequate drainage, groove pavement, or with the addition of a “Slippery When Wet” sign.
- Ensuring roadway lighting is sufficient for drivers to see the roadway and surroundings.
- Determining if there is a large amount of pedestrian traffic. Pedestrians crossing the roads may impede traffic and force drivers to stop suddenly. If crossing pedestrians are an issue, options include installing or improving crosswalk devices and providing pedestrian signal indications.

- Checking the visibility of the traffic signals at all approaches. In order to provide better visibility of the traffic signal, options include installing or improving warning signs, overhead signal heads, installing 12" signal lenses, visors, back plates, or relocating/adding signal heads.
- Verifying that the signal timing is adequate to serve the traffic volumes at the trouble intersections. Options include adjusting phase-change interval, providing or increasing a red-clearance interval, providing progression, and utilizing signal actuation with dilemma zone protection.
- Verifying that a signal is warranted at the given intersection.

Reducing Side Impact / Angle Crashes

Angle crashes were the second highest crash type within the MPA. These crashes can be caused by a number of factors, such as:

- restricted sight distance
- excessive speed
- inadequate roadway lighting
- poor traffic signal visibility
- inadequate signal timing
- inadequate advance warning signs
- running a red light
- large traffic volumes

In general, the recommendations for reducing side impact and angle collisions include:

- Verifying that the sight distance at all intersection approaches is not restricted. Options to alleviate restricted sight distance include removing the sight obstruction and/or installing or improving warning signs.
- Conducting speed studies to determine whether or not speed was a contributing factor. In order to reduce crashes caused by excessive speeding, the speed limit can be lowered with enforcement, the phase change interval can be adjusted, or rumble strips can be installed.
- Ensuring roadway lighting is sufficient for drivers to see the roadway and surrounding area.
- Checking the visibility of the traffic signal at all approaches. In order to provide better visibility of the traffic signal, options include installing or improving warning signs, overhead signal heads, installing 12" signal lenses, visors, back plates, and/or relocating or adding signal heads.
- Verifying that the signal timing is adequate to serve the traffic volumes. Options include adjusting phase change interval, providing or increasing a red-clearance interval, providing progression, and/or utilizing signal actuation with dilemma zone protection.
- Verifying that the intersection is designed to handle the traffic volume. If the traffic volumes are too large for the intersection's capacity, options include adding a lane(s) and retiming the signal.

Reducing Sideswipes

The third highest type of crashes in the MPA were sideswipes which are caused by factors such as:

- excessive speed
- inadequate roadway lighting
- poor pavement markings
- large traffic volumes
- driver inattentiveness

The recommendations for reducing sideswipes include:

- Checking for proper signage around the intersection, especially if the roadway geometry may be confusing for the driver. Verify that all one-way streets are marked "One-Way" and "No Turn" signs are placed at appropriate locations.
- Verifying that pavement markings are visible during day and night hours.
- Verifying that the roadway geometry can be easily maneuvered by drivers.
- Evaluating left and right turning volumes to determine if a right turn and/or left turn lane is warranted.
- Ensuring roadway lighting is sufficient for drivers to see roadway and surroundings.
- Verifying that lanes are marked properly and provide turning and through movement directions on lanes as well as signage that indicates lane configurations. This will prevent cars from dangerously switching lanes at the last minute.

Reducing Other Collision Types

The remaining representative crash types can be attributed to incidents involving animals, backing up, bicycle/pedestrian encounters, fixed objects, head on collisions, jackknife, rollovers, running off the road, and vehicle defects. Recommendations for increasing the safety and reducing the number of crashes for these crash types include:

- Determining if the speed limit is too high or if vehicles in the area are traveling over the speed limit. Reducing the speed can reduce the severity of crashes and make drivers more attentive to their surroundings.
- Verifying the clearance intervals for all signalized intersection approaches and ensure that there is an all red clearance. For larger intersections, it is particularly important to have a long enough clearance interval for vehicles to safely make it through the intersection before the light turns red.
- Checking for proper intersection signage, especially if the roadway geometry may be confusing for the driver. Verify that all one-way streets are marked "One-Way" and "No Turn" signs are placed at appropriate locations.
- Verifying that pavement markings are visible during day and night hours.

- Verifying that the roadway geometry can be easily maneuvered by drivers.
- Evaluating left and right turning volumes to determine if a right turn and/or left turn lane is warranted.
- Ensuring roadway lighting is sufficient for drivers to see roadway and surroundings.
- Checking the visibility of the traffic signals from all approaches.
- Verifying that lanes are marked properly and provide turning and through movement directions, as well as signage that indicates lane configurations. This will prevent cars from dangerously switching lanes at the last minute and reduces crash potential.

High Crash Frequency and High Crash Rate Needs

Technical Report #2: Existing Conditions identified high crash frequency and high crash rate locations within the MPA. These locations were identified in Tables 2.5 through 2.9. Each of these segments or intersections experience either a large amount of crashes in general, or a large amount of crashes for the roadway volume it carries.

The locations listed in those tables, and also shown in Table 4.7, should be high priority locations for the MPO to address in order to reduce congestion and increase safety within the MPA. The scope of the MTP does provide for a detailed analysis of the locations, but safety studies can be conducted by the MPO's safety partners for each location to determine the best site-specific crash countermeasures that can be employed.

Table 4.7: High Crash Frequency or Crash Rate Locations in the MPA

Route	Location	Type	Issue
US 49	Parkwood Blvd to 0.18 miles north of Orange Grove Blvd	Segment	Crash Frequency
US 49	Creosote Rd to 0.14 miles north of Airport Rd	Segment	Crash Frequency
I-10 WB	MS 613 (N Main St) On Ramp to Martin Bluff Rd	Segment	Crash Frequency
I-10 EB	Martin Bluff Rd to Exit 68	Segment	Crash Frequency
Jerry St. Pe Hwy	Homeport Rd (USS Vicksburg Way) to Litton Rd (Access Rd)	Segment	Crash Frequency
MS 605 (Lorraine Rd)	Brentwood Blvd to Magnolia St	Segment	Crash Frequency
Litton Rd (Access Rd)	Jerry St. Pe Hwy to Ingalls Shipyard	Segment	Crash Frequency
I-10 EB	US 49 On Ramps to MS 605 (Exit 38)	Segment	Crash Frequency
US 90 (Bienville Blvd)	MS 609/Washington Ave to Martin Luther King Jr Ave	Segment	Crash Frequency
US 90 (Bienville Blvd)	0.21 miles west to Hanshaw Rd	Segment	Crash Frequency
Dedeaux Rd	Wingate Dr to Lynn Ave	Segment	Crash Frequency
I-10 WB	Franklin Creek Rd On Ramp to MS 63 (Exit 69)	Segment	Crash Frequency
I-10 WB	MS 605 (Lorraine Rd) On Ramp to US 49 NB (Exit 34B)	Segment	Crash Frequency
I-10 EB	East of Old Fort Bayou Rd to MS 57 (Exit 57)	Segment	Crash Frequency
US 90 (Bienville Blvd)	0.42 miles west to Ocean Springs Rd	Segment	Crash Frequency
I-10 WB	Canal Rd On Ramp to County Farm Rd (Exit 28)	Segment	Crash Frequency
US 49	Community Rd to Landon Rd	Segment	Crash Frequency
I-110 SB (MS 15)	Rodriquez St On Ramp to Bayview Ave (Exit 1D)	Segment	Crash Frequency
US 90 (Bienville Blvd)	Hanley Rd to 0.35 miles west	Segment	Crash Frequency

Route	Location	Type	Issue
US 49	0.2 miles south of Wortham Rd to School Rd	Segment	Crash Frequency
Creosote Rd	US 49 to 0.14 miles west of US 49	Segment	Crash Rate
Eden St	Middle Ave to 0.12 miles south of Old Mobile Hwy	Segment	Crash Rate
Tucker Ave	Market St to 9th St	Segment	Crash Rate
Hospital Rd	Lt Majure Dr to 0.15 miles south of Lt Majure Dr	Segment	Crash Rate
Jackson Ave	Pascagoula St to 0.23 miles east of Pascagoula St	Segment	Crash Rate
Eden St	Boston Ave to Chicago Ave	Segment	Crash Rate
Government St	Kotzum Ave to Handy Ave	Segment	Crash Rate
Eden St	24th St to Middle Ave	Segment	Crash Rate
8th Ave	0.11 miles south of 34th St to 0.08 miles north of Pass Rd	Segment	Crash Rate
Davis Ave	E 2nd St to E Scenic Dr	Segment	Crash Rate
Chicot St	US 90 to 0.18 miles north of US 90	Segment	Crash Rate
Frederick St	Shortcut Rd to US 90	Segment	Crash Rate
13th St	29th Ave to 26th Ave	Segment	Crash Rate
Telephone Rd	Joe Ave to MS 613	Segment	Crash Rate
I-110 Southbound	Off Ramp to US 90 Westbound	Segment	Crash Rate
Community Dr	0.14 miles east of US 49 to 0.25 miles west of Klein Rd	Segment	Crash Rate
Jackson Ave	0.26 miles west of Market St to Market St	Segment	Crash Rate
Courthouse Rd	Victory St to Security Square	Segment	Crash Rate
Old Mobile Hwy	Market St to Francis St	Segment	Crash Rate
Macphelah Rd	Frederick St to 0.28 miles south of Frederick St	Segment	Crash Rate
US 49	Creosote Rd / Factory Shop Blvd	Intersection	Crash Frequency
Pass Rd	Cowan Rd	Intersection	Crash Frequency
US 49	Crossroads Pkwy / Landon Rd	Intersection	Crash Frequency
US 90 (Bienville Blvd)	MS 609 / Washington Ave	Intersection	Crash Frequency

Route	Location	Type	Issue
US 49	Dedeaux Rd	Intersection	Crash Frequency
US 90 (Terry Micheal Byrd Memorial Hwy)	Chicot St	Intersection	Crash Frequency
US 49	Community Rd	Intersection	Crash Frequency
MS 605 (Lorraine Rd)	Seaway Rd	Intersection	Crash Frequency
US 90 (Terry Micheal Byrd Memorial Hwy)	Hospital St	Intersection	Crash Frequency
US 49	MS 53 / N Swan Rd	Intersection	Crash Frequency
MS 605 (Lorraine Rd)	I-10 WB Ramps	Intersection	Crash Frequency
US 49 (25th Ave)	Pass Rd (25th St)	Intersection	Crash Frequency
US 90 (Bienville Blvd)	Hanshaw Rd	Intersection	Crash Frequency
US 49	Airport Rd	Intersection	Crash Frequency
MS 605	Dedeaux Rd	Intersection	Crash Frequency
US 49 (25th Ave)	28th St	Intersection	Crash Frequency
US 49	Orange Grove Blvd	Intersection	Crash Frequency
US 90 (Bienville Blvd)	Ocean Springs Rd / Guilford Rd	Intersection	Crash Frequency
US 90 (Scott Pruitt Memorial Hwy)	MS 57	Intersection	Crash Frequency
Courthouse Rd	Pass Rd	Intersection	Crash Frequency

Stakeholder and Public Input

During the public and stakeholder involvement process, respondents were asked to identify the roadways and intersections they perceived to have the most safety issues. The most often identified of these locations are described below:

US 49 Corridor, including:

- Between I-10 and US 90
- Intersection at Creosote Rd
- Intersection at Crossroads Pkwy
- Intersection at MS 53
- Intersection at US 90
- Intersection at O'Neal Rd

I-10 Corridor, including:

- Bridge between Gautier and Moss Point
- Between US 49 and Lorraine Rd
- Interchange at Diamondhead
- Pass Rd Corridor

5.0 Freight

Freight needs vary by mode (truck, rail, air, water, and pipeline) and can include mobility, safety, and asset conditions. Freight projections indicate that commerce and trade will continue to grow throughout the MPA from 2018 to 2045, which will lead to an increase in freight traffic on the MPA freight network. This increase in freight traffic will lead to an increase in congestion and a degrading of the freight network. However, projects in the MPA that address freight needs can improve safety and economic competitiveness in the MPA.

5.1 Freight Truck Needs

This section summarizes future freight truck movement and needs. Freight projections indicate that the truck mode will have the largest increases in freight tonnage and value between 2018 and 2045. This will have an impact on the freight highway network; including an increase in truck traffic and congestion, worsening roadway pavement and bridge conditions, and an increased chance of heavy vehicle involved crashes. Although all roadways in the MPA will be impacted due to the increases in freight truck traffic, the roadways with the largest increases in freight truck traffic are on the Mississippi Freight Network (MFN) highways, which include:

- I-10 Tier I Gulf Coast Corridor
- US 49 Tier I Jackson-Hattiesburg-Gulfport Corridor

Mobility

The FAF data can be used to understand the projected growth in freight truck commodity flows between 2016 and 2045. This projected growth will lead to an increase in freight truck traffic on MPA's roadways, resulting in an increase in roadway traffic congestion and subsequent decrease in travel time reliability.

Commodity Flow Growth

As shown in *Technical Report #2: Existing Conditions*, the truck mode accounts for 46 percent of the freight truck tonnage and 50 percent of freight value moved into, out of, and within the MPA in 2016. By 2045, the freight truck tonnage share is projected to increase to 52 percent, while the freight truck value share is projected to slightly decrease to 49 percent.

The changes in county ranks for freight truck commodity flows between 2016 and 2045 are summarized below:

- Hancock County is projected to increase from 49th to 46th in Mississippi by truck freight tonnage and remain at 57th by truck freight value.
- Harrison County is projected to decrease from 22nd to 30th in Mississippi by truck freight tonnage and increase from 16th to ninth by truck freight value.
- Jackson County is projected to increase from fourth to third in Mississippi by truck freight tonnage and increase from third to second by truck freight value.

Table 5.1 shows the growth in freight tonnage and freight value for trucks in the MPA between 2016 and 2045, as projected by the Freight Analysis Framework (FAF).[13] The following observations emerge in the MPA:

- The inbound intrastate movement tonnage is projected to be the largest tonnage increase, increasing by approximately 7.1 million tons.
- The inbound interstate movement value is the largest value increase, increasing by approximately $5.4 billion.
- The intrastate tonnage increase (12.0 million tons) is projected to be greater than the interstate freight tonnage increase (3.9 million tons). However, the interstate freight value increase ($8.9 billion) is projected to be greater than the intrastate freight value increase ($3.7 billion).
- Inbound tonnage and freight value are projected to be greater (increases of 9.6 million tons and $7.7 billion) than outbound tonnage and freight value (increases of 6.3 million tons and $4.9 billion).
- Outbound tonnage percent growth is projected to be larger (increase of 104 percent) than inbound tonnage percent growth (increase of 79 percent).
- Between 2016 and 2045, the total truck tonnage is projected to increase by 88 percent, and the total truck freight value is projected to increase by 79 percent.

[13] A disaggregated version of the Freight Analysis Framework (FAF) database was used to get the data to the county level.

Table 5.1: Changes in Commodity Flows by Truck, 2016 to 2045

Direction	Tons (Thousand)				Value ($ million)			
	2016	2045	Change	Percent Change	2016	2045	Change	Percent Change
Inbound (Interstate)	4,817	7,273	2,456	51%	$6,680	$12,116	$5,436	81%
Inbound (Intrastate)	7,243	14,347	7,104	98%	$3,476	$5,790	$2,313	67%
Outbound (Interstate)	1,783	3,217	1,434	80%	$3,987	$7,462	$3,475	87%
Outbound (Intrastate)	4,331	9,228	4,896	113%	$1,826	$3,229	$1,403	77%
Within MPA	371	785	414	112%	$225	$460	$235	105%
Total	18,544	34,849	16,305	88%	$16,195	$29,057	$12,862	79%

Source: Freight Analysis Framework 4

Table 5.2 and Table 5.3 show the top ten (10) inbound and outbound domestic trading partners in the MPA by truck tonnage increases between 2016 and 2045, respectively. Most of the partners with the largest increases are either Mississippi counties or in states bordering Mississippi. The partner with the largest tonnage increase is Lee County, Mississippi.

Table 5.2: Top Inbound Truck Trading Partners with Largest Increases in Trading Activity with MPA

Rank	Trading Partner	Tons (Thousand)		Change	Percent Change
		2016	2045		
1	Lee County, Mississippi	537	1,213	675	126%
2	Lowndes County, Mississippi	306	669	362	118%
3	Rest of Louisiana	709	1,068	359	51%
4	Rest of Texas	1,061	1,380	319	30%
5	Copiah County, Mississippi	303	599	296	98%
6	Rest of Alabama	497	752	256	52%
7	Tippah County, Mississippi	237	483	245	104%
8	Madison County, Mississippi	204	441	238	117%
9	Alcorn County, Mississippi	173	390	218	126%
10	Pike County, Mississippi	235	433	198	85%

Source: Freight Analysis Framework 4

Note: "Rest of Louisiana", "Rest of Texas", and "Rest of Alabama" refer to those areas of those states that are outside the FAF 4 designated metropolitan areas.

Table 5.3: Top Outbound Truck Trading Partners with Largest Increases in Trading Activity with MPA

Rank	Trading Partner	Tons (Thousand)		Change	Percent Change
		2016	2045		
1	Lee County, Mississippi	454	1,034	580	128%
2	Rest of Louisiana	330	659	329	100%
3	Lowndes County, Mississippi	239	540	301	126%
4	Madison County, Mississippi	160	353	194	121%
5	Alcorn County, Mississippi	149	341	191	128%
6	Copiah County, Mississippi	129	283	154	119%
7	Prentiss County, Mississippi	126	278	152	121%
8	Rest of Arkansas	188	339	151	80%
9	Winston County, Mississippi	112	255	143	127%
10	Grenada County, Mississippi	112	254	142	126%

Source: Freight Analysis Framework 4

Note: "Rest of Louisiana" and "Rest of Arkansas" refer to those areas of those states that are outside the FAF 4 designated metropolitan areas.

Table 5.4 and Table 5.5 show the top commodities by tonnage and value increases between 2016 and 2045, respectively. By tonnage, the largest increase is coal n.e.c. By value, the largest increase is motorized vehicles.

Table 5.4: Top Commodities by Truck Tonnage Increase

Rank	Commodity	Tons (thousand)		Change	Percent Change
		2016	2045		
1	Coal n.e.c	5,728	14,580	8,853	155%
2	Gravel	1,525	2,797	1,272	83%
3	Motorized vehicles	1,417	2,251	834	59%
4	Waste and scrap	980	1,770	790	81%
5	Agricultural products	909	1,698	789	87%
6	Mon-metallic products	946	1,565	619	65%
7	Logs	872	1,255	383	44%
8	Other foodstuffs	489	796	308	63%
9	Mixed freight	725	998	273	38%
10	Fuel oils	470	671	201	43%

Source: Freight Analysis Framework 4

Table 5.5: Top Commodities by Truck Value Increase

Rank	Commodity	Value ($ million)		Change	Percent Change
		2016	2045		
1	Motorized vehicles	$3,411	$7,117	$3,707	109%
2	Electronics	$1,130	$2,491	$1,361	120%
3	Coal n.e.c	$959	$2,296	$1,337	140%
4	Mixed freight	$2,222	$3,073	$850	38%
5	Machinery	$779	$1,503	$724	93%
6	Pharmaceuticals	$493	$1,082	$589	119%
7	Transportation equipment	$279	$841	$562	201%
8	Furniture	$371	$794	$423	114%
9	Other foodstuffs	$515	$878	$362	70%
10	Precision instruments	$175	$532	$357	204%

Source: Freight Analysis Framework 4

Roadway Capacity

Roadways that have the highest freight truck traffic in 2018 are shown in *Technical Report #2: Existing Conditions*. These roadways are expected to see an increase in truck traffic between 2018 and 2045. Figure 5.1 illustrates where growth in freight truck traffic is anticipated to be the highest while Figure 5.2 shows the estimated 2045 truck volumes on the MPA's roadway network. The roadways with the highest freight truck traffic growth between 2018 and 2045, as well as roadways with the highest truck traffic volume, are on the MFN. Other roadways that are projected to have the highest truck traffic volumes are on segments of US 90, MS 605, MS 607, and MS 619.

The largest increases in freight truck traffic are on:

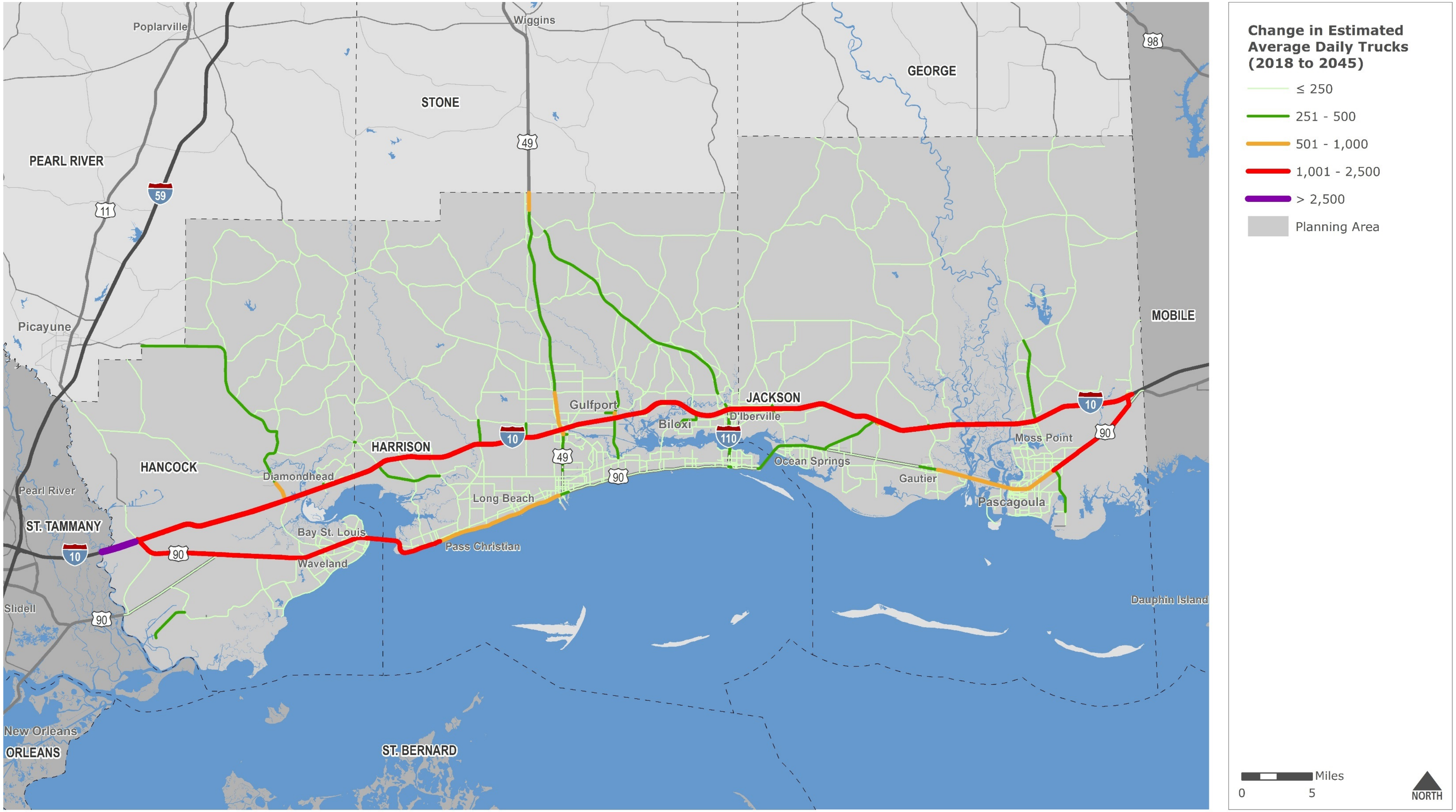
- I-10 through the entire study area
- US 90 from MS 607 to Pass Christian
- US 90 from MS 63 to Franklin Creek Rd
- MS 607 from I-10 to US 90
- Franklin Creek Rd from US 90 to I-10

Figure 5.3 shows the roadway segments that accommodate a large number of daily truck trips (500 trucks or more) and experience peak period and/or daily congestion in the base year. These segments possess the greatest need for capacity/reliability improvements to improve future freight conditions in the short-term. Figure 5.4 displays the roadway segments that are anticipated to have greater than 500 truck trips per day and experience a volume to capacity ratio of 1.0 or greater.

<u>Reliability</u>

The Truck Travel Time Reliability (TTTR) index for Interstates in the MPA are summarized in *Technical Report #2: Existing Conditions*. Although future TTTR cannot be measured, the Interstates that currently experience existing reliability issues are projected to experience more significant reliability issues in the future. Additionally, Interstates that may not currently experience reliability issues may experience future reliability issues as truck traffic volumes and congestion continue to increase.

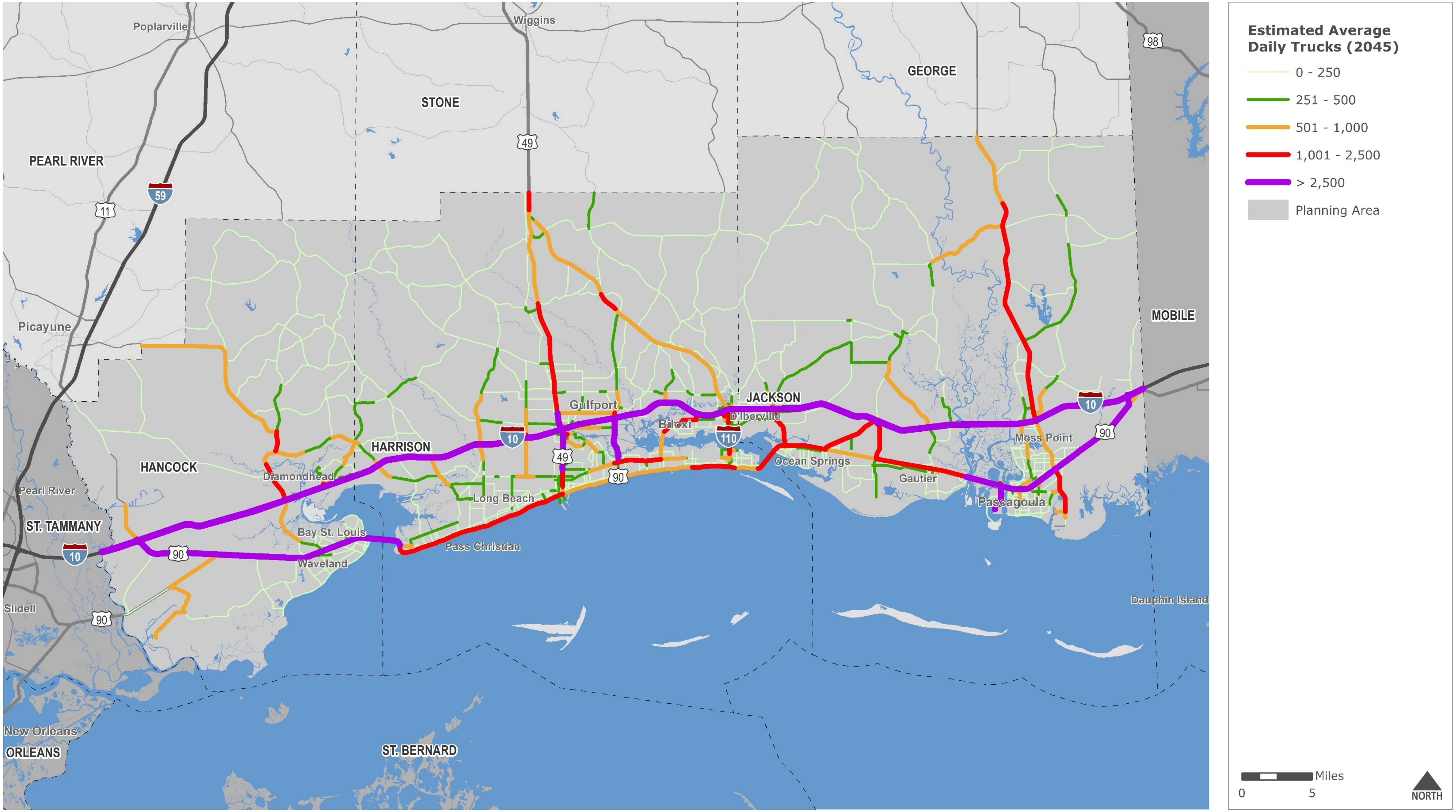
Figure 5.1: Freight Truck Growth, 2018 to 2045



Data Sources: Travel Demand Model

Disclaimer: This map is for planning purposes only.

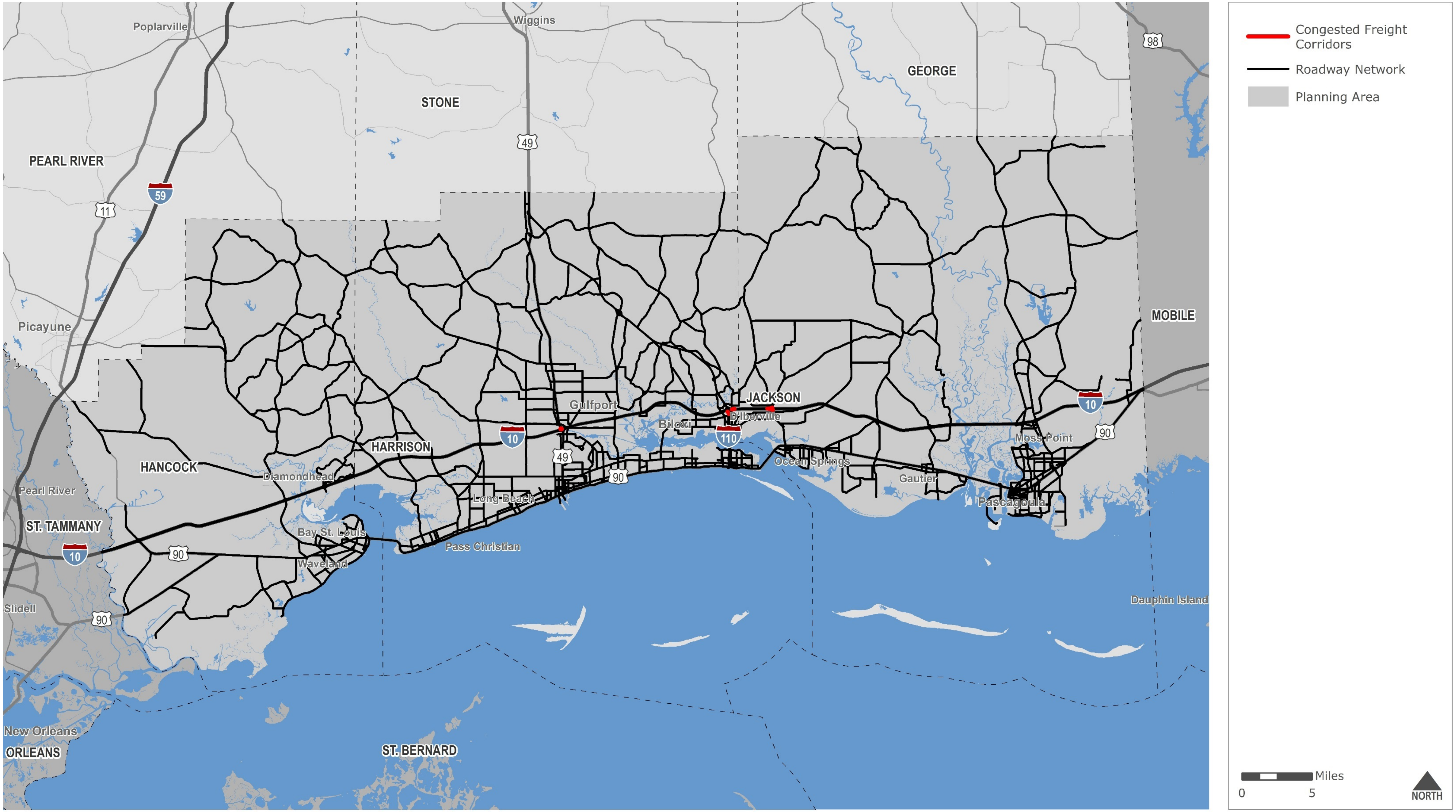
Figure 5.2: Freight Truck Traffic, 2045



Data Sources: Travel Demand Model

Disclaimer: This map is for planning purposes only.

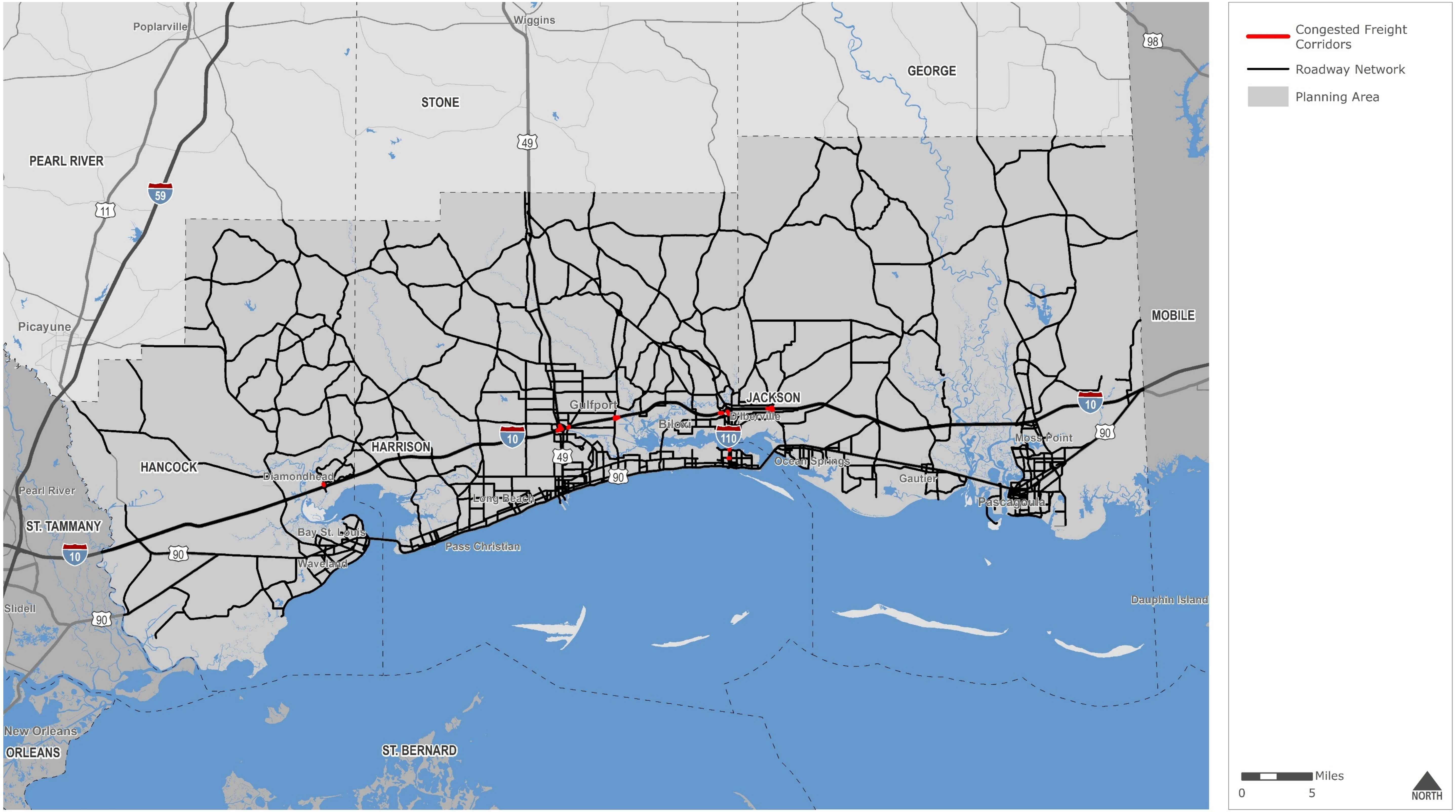
Figure 5.3: Congested Freight Truck Corridors, 2018



Data Sources: Travel Demand Model

Disclaimer: This map is for planning purposes only.

Figure 5.4: Congested Freight Truck Corridors, 2045



Data Sources: Travel Demand Model

Disclaimer: This map is for planning purposes only.

Non-Capacity Freight Truck Implications

Increases in freight truck traffic can adversely impact bridges, pavement, and safety. Those impacts can include, but are not limited to, increased vehicle wear and tear, increased operating costs, and an increased chance of heavy vehicle related crashes.

Bridge Condition

The existing bridge conditions are summarized in Section 2.6 of *Technical Report #2: Existing Conditions* and in Section 4.2 of this report. One (1) of these bridges in "Poor" condition are on the MFN. Additionally, the bridge conditions should be monitored to ensure that bridges can handle the increases in freight traffic.

Bridges that have vertical clearances can also have an impact on freight truck conditions since trucks must detour to avoid low vertical clearance bridges. There is also a risk of trucks striking low vertical clearance bridges, which can result in bridge and road closures, leading to an increase in freight operating costs. The *MDOT Bridge Design Manual* specifies that the minimum vertical clearance for bridges to be 16.5 feet.[14] There are currently 43 bridges in the MPA that have a vertical clearance of less than 16.5 feet, most of which are on roadways that cross MFN roadways.

Pavement Condition

Poor pavement conditions can result in increased wear and tear and operating costs for freight truck traffic. The existing pavement conditions are summarized in Section 2.5 of *Technical Report #2: Existing Conditions* and in Section 4.2 of this report. The MFN roadways in the MPA with "Poor" pavement conditions include US 49 between 0.28 miles north of O'Neal Rd and 0.21 miles north of Old Hwy 49 in Saucier. Pavement conditions should be monitored to ensure that pavements can handle the increases in freight traffic.

Safety

The increases in truck traffic will potentially increase heavy vehicle crashes. All crashes can result in delays, and thus increased operating costs, for freight truck traffic. However, crashes involving heavy vehicles, especially those that involve hazardous chemicals, can result in extended delays. The heavy vehicle crashes are summarized in *Technical Report #2: Existing Conditions*. Two (2) intersections and eight (8) segments experienced at least five (5) heavy vehicle crashes between 2014 and 2018; both intersections seven (7) of the intersections were on the MFN.

[14] Mississippi Department of Transportation Bridge Design Manual

5.2 Freight Rail Needs

This section summarizes future freight rail movement and needs. Freight projections indicate that the rail mode will have the third largest increase in freight tonnage and fifth largest increase in freight value between 2016 and 2045. This increase in freight rail commodity flows will lead to an increase in rail traffic on railroads. The majority of railroads in the MPA are on the MFN, which include the following Tier I railroads:

- the CSX Transportation (CSXT) Railroad paralleling I-10
- the Kansas City Southern (KCS) Railroad paralleling US 49

Mobility

The FAF data can be used to understand the projected growth in freight rail commodity flows between 2016 and 2045. This growth in commodity flows, as well as the existing rail infrastructure, can have an impact on future railroad conditions.

Commodity Flow Growth

As shown in *Technical Report #2: Existing Conditions*, the rail mode accounts for 4.4 percent of freight tonnage and approximately two (2) percent of freight value in the MPA in 2016. By 2045, the freight truck tonnage share is increase to 2.3 percent.

The changes in county ranks for freight rail commodity flows between 2016 and 2045 are summarized below:

- Hancock County is projected to increase from 37th to 35th in Mississippi by rail freight tonnage and decrease from 35th to 45th by rail freight value.
- Harrison County is projected to remain at second in Mississippi by rail freight tonnage and decrease from fifth to seventh by rail freight value.
- Jackson County is projected to decrease from third to ninth in Mississippi by rail freight tonnage and increase from fourth to second by rail freight value.

Table 5.6 shows the growth in freight tonnage and freight value for rail in the MPA between 2016 and 2045, as projected by the Freight Analysis Framework. The following observations emerge in the MPA:

- The outbound interstate movement is projected to be the largest tonnage and value increase, increasing by approximately 294,000 tons and $427 million.
- The interstate tonnage and value increases are projected to be greater (552,000 tons and $696 million) than the intrastate tonnage and value increases (25,000 tons and $8 million).
- The outbound tonnage and value increase are projected to be greater (increase of 306,000 tons and $431 million) than inbound tonnage and value (increase of 269,000 tons and $273 million).
- Between 2016 and 2045, the truck tonnage is projected to increase by 33 percent, and the truck freight value is projected to increase by 109 percent.

Table 5.6: Changes in Commodity Flows by Rail, 2016 to 2045

Direction	Tons (Thousand)				Value ($ million)			
	2016	2045	Change	Percent Change	2016	2045	Change	Percent Change
Inbound (Interstate)	1,265	1,520	256	20%	$330	$599	$269	82%
Inbound (Intrastate)	65	79	13	21%	$34	$37	$4	12%
Outbound (Interstate)	409	703	294	72%	$275	$703	$427	155%
Outbound (Intrastate)	21	33	12	57%	$9	$13	$4	45%
Within MPA	3	4	2	59%	$1	$2	$1	44%
Total	1,763	2,339	577	33%	$649	$1,354	$705	109%

Source: Freight Analysis Framework 4

Table 5.7 and Table 5.8 show the top ten (10) inbound and outbound domestic trading partners in the MPA by rail tonnage increases between 2016 and 2045, respectively. Most of these partners are located in the Southern or Midwestern United States.

Table 5.7: Top Inbound Rail Trading Partners with Largest Increases in Trading Activity with MPA

Rank	Trading Partner	Tons (Thousand)		Change	Percent Change
		2016	2045		
1	Rest of Illinois	157	225	68	44%
2	Rest of Tennessee	47	94	46	98%
3	New Orleans, Louisiana	64	107	44	69%
4	Rest of Alabama	67	109	42	62%
5	Rest of Louisiana	35	76	41	116%
6	Dallas-Fort Worth, Texas	14	35	22	159%
7	Rest of Oklahoma	9	30	21	236%
8	Rest of Iowa	19	39	21	110%
9	Baton Rouge, Louisiana	38	55	17	45%
10	Tulsa, Oklahoma	6	23	17	277%

Source: Freight Analysis Framework 4 (FAF4)

Note: "Rest of Illinois", "Rest of Tennessee", "Rest of Alabama", "Rest of Louisiana", "Rest of Oklahoma", and "Rest of Iowa" refer to those areas of those states that are outside the FAF 4 designated metropolitan areas.

Table 5.8: Top Outbound Rail Trading Partners with Largest Increases in Trading Activity with MPA

Rank	Trading Partner	Tons (Thousand)		Change	Percent Change
		2016	2045		
1	Rest of Kentucky	51	132	81	159%
2	Rest of Georgia	55	85	30	55%
3	Detroit, Michigan	10	38	28	267%
4	Rest of Tennessee	8	24	15	185%
5	Memphis, Tennessee	4	13	10	260%
6	Rest of Illinois	12	20	7	61%
7	Rest of Missouri	7	13	6	85%
8	Rest of Indiana	9	13	5	54%
9	Rest of Alabama	44	49	5	10%
10	Tampa, Florida	3	8	4	130%

Source: Freight Analysis Framework 4 (FAF4)

Note: "Rest of Kentucky", "Rest of Georgia", "Rest of Tennessee", "Rest of Illinois", "Rest of Missouri", "Rest of Indiana", and "Rest of Alabama" refer to those areas of those states that are outside the FAF 4 designated metropolitan areas.

Table 5.9 and Table 5.10 show the top rail freight commodities by tonnage and value increases between 2016 and 2045, respectively. By tonnage, the largest increase is basic chemicals. By value, the largest increase is motorized vehicles.

Table 5.9: Top Commodities by Rail Tonnage Increase

Rank	Commodity	Tons (thousand)		Change	Percent Change
		2016	2045		
1	Basic chemicals	446	660	215	48%
2	Waste and scrap	96	216	120	126%
3	Fertilizers	112	213	101	90%
4	Other foodstuffs	171	249	78	46%
5	Coal n.e.c.	20	63	43	216%
6	Motorized vehicles	16	56	40	252%
7	Crude petroleum	8	46	38	482%
8	Non-metallic minerals	11	41	29	262%
9	Cereal grains	58	84	25	43%
10	Transportation equipment	6	31	25	433%

Source: Freight Analysis Framework 4

Table 5.10: Top Commodities by Rail Value Increase

Rank	Commodity	Value ($ million)		Change	Percent Change
		2016	2045		
1	Motorized vehicles	$134	$472	$338	253%
2	Basic chemicals	$195	$295	$100	51%
3	Waste and scrap	$36	$79	$42	115%
4	Other foodstuffs	$75	$108	$33	44%
5	Coal n.e.c.	$20	$49	$30	152%
6	Fertilizers	$33	$62	$29	87%
7	Plastics and rubber	$32	$58	$26	81%
8	Other chemical products	$13	$38	$26	203%
9	Crude petroleum	$5	$31	$25	485%
10	Transportation equipment	$4	$21	$17	422%

Source: Freight Analysis Framework 4

Rail Capacity and Asset Management

Future rail capacity and needs can be measured in many ways. However, actual volumes and capacities are not known for all rail segments in the Gulf Coast MPA. This makes it difficult to forecast future capacity utilization rates and needs by segment.

The use of rail as a means of freight transportation is becoming a more popular alternative due to increasing roadway congestion. The *Mississippi Statewide Freight Plan* outlines the future efforts anticipated by the State of Mississippi.

The elements that are assessed to determine physical rail capacity include the number of tracks (single track, double track, etc.), rail line operating speed, and terminal and yard capacity.

Number of tracks

Within the MPA, 150 miles of railroad are single track while the remaining 20 miles are double track. The primary areas with double track or greater are near railroad yards. Single track railroads limit the number of shipments on railroads since passing or overtaking can only take place in areas where there is a siding or double-track section for one train to pull over. Although there has been no Amtrak service in the MPA since Hurricane Katrina (*Sunset Limited*), this problem would be exacerbated on the CSXT railroad should this service be restored since passenger trains must adhere to a stricter schedule, and the difference between operating speeds for freight and passenger service is larger.

Rail Line Operating Speed

The average speed trains move on a corridor impacts capacity and effects the railroad's ability to move higher value, time-sensitive goods. The Mississippi Statewide Freight Plan (MSFP) recommends that all MFN Tier I main line tracks meet or exceed FRA Class 4 standards for freight (greater than 40 MPH). The MSFP also recommends that all MFN Tier II main line tracks meet or exceed FRA Class 3 standards for freight (greater than 25 MPH). There are no MFN Tier II railroads in the MPA. Therefore, every crossing in the MPA is either on an MFN Tier I railroad or along a branch line.

Table 5.11 displays the total railroad crossings by maximum speed. Figure 5.5 illustrates the operating speeds at each crossing within the MPA.

Table 5.11: Maximum Operating Speed at Railroad Crossings in the MPA, 2018

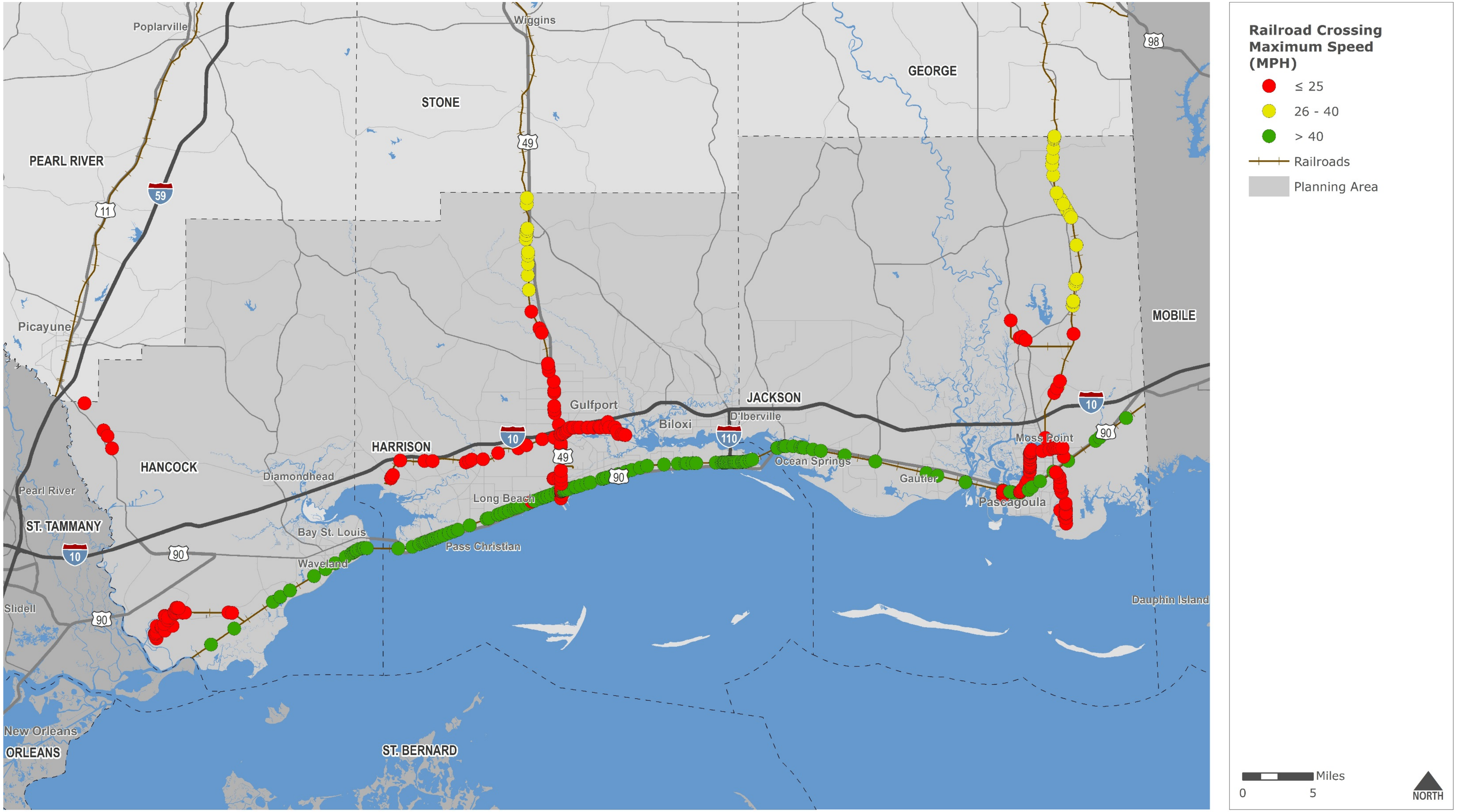
Maximum Operating Speed	Number	Percentage
Less than or equal to 25 MPH	181	52%
26 – 40 MPH	35	10%
Greater than 40 MPH	134	38%
Total	350	100%

Source: Federal Rail Administration

Terminal and yard capacity

Information on terminal and yard capacities were not available for the MPA.

Figure 5.5: Railroad Crossing Speeds



Data Sources: 2015 National Transportation Atlas; USDOT; MDOT; Travel Demand Model

Disclaimer: This map is for planning purposes only.

Rail assets can also have an impact on rail capacity. Rail assets include vertical clearances of railroad overpasses, railroad weight limits, and railroad traffic control and signaling.

Vertical clearances

With the projected increases in rail commodity flow traffic, removing height restrictions is a critical concern. The *MDOT Bridge Design Manual* has specified that the minimum vertical clearance for bridges crossing over railroads to be 23.5 feet.[14] This clearance allows for unrestricted access for all standard rail car configurations, including double-stacked intermodal cars and trilevel auto carriers. According to data from the NBI, there are five (5) bridges crossing over railroads in the MPA that had a vertical clearance that was less than 23.5 feet. One (1) of these bridges is in "fair" condition. As the conditions of these bridges continue to degrade and become more in need of replacement, adequate vertical clearances need to be considered in any future bridge replacements.

Weight limits

Consistent railroad weight capacity is important to maintaining freight rail movement efficiency and cost advantage. Shippers on rail lines that cannot handle standard 286,000-pound gross carloads may either be forced to use trucks or to break loads inefficiently. The mainline railroads in the MPA accommodate the industry standard of 286,000 pounds. No information is available for branch lines off of the main lines.

Traffic control and signaling

A new traffic control system, Positive Train Control (PTC), is designed to automatically stop a train before certain incidents occur. The PTC systems are integrated command, control, communications, and information systems for controlling train movements with safety, security, precision, and efficiency. PTC must be designed to prevent the following:

- Train to train collisions
- Derailments caused by excessive speed
- Unauthorized movements by trains onto sections of track where maintenance activities are taking place
- Movement of a train through a track switch left in the wrong position

According to the *Mississippi State Rail Plan*, PTC will be required on the following MPA railroads:

- Any portions of the CSX Transportation (CSXT) and Kansas City Southern (KCS) main lines that carry poisonous inhalation hazard materials

The Rail Safety Improvement Act of 2008 (RSIA) mandated that PTC be implemented across a significant portion of the Nation's rail industry by December 31, 2015.[15] However, this deadline was extended from 2015 to December 31, 2018. As of Q4 2018, CSXT and KCS have completed PTC equipment on its locomotives and tracks.[16]

Safety

As shown in *Technical Report #2: Existing Conditions*, there were 35 crashes in the MPA that involved an automobile and a train between 2014 and 2018; three (3) crashes resulted in a fatality, and four (4) crashes resulted in moderate injuries. Also, there was one (1) train derailment in the MPA between 2014 and 2018. In addition to injuries and fatalities that can result from these safety issues, these incidents can result in significant delays for all road and rail users and increased operational costs for freight. The MPO should work with its local rail partners to improve railroad safety in the MPA.

Highway-Railroad Crossings

Technical Report #2: Existing Conditions shows that there are 279 public highway-rail grade crossings within the MPA. Slightly more than a third (101) of those crossings possess only passive warning devices. These include cross bucks, warning signs, regulatory signs, and pavement markings. Among the locations that contain only passive warning devices, three (3) are on the MFN:

- CSXT at S Lang Ave in Long Beach
- CSXT at Old Mobile Ave in Pascagoula
- KCS at Old Hwy 49 in Saucier

The MPA should work with its local rail partners to add active crossing devices to these locations to improve safety.

Section 202 of the Rail Safety Improvement Act of 2008 (RSIA08), Public Law 110-432 (H.R.2095 / S.1889), that was signed into law on October 16, 2008, required the U.S. Secretary of Transportation to identify the ten (10) States with the most highway-rail grade crossing collisions, on average, over the past three (3) years. Those states are required to develop state highway-rail grade crossing action plans.

Section 202 further states that the plans must identify specific solutions for improving safety at crossings, including highway-rail grade crossing closures or grade separations, and must focus on crossings that have experienced multiple collisions, or are at high risk for such collisions.

Mississippi was not one of the ten states that was required to develop state highway-rail grade action plans. However, Mississippi was one of the states that was targeted in the National Highway Traffic

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[15] https://railroads.dot.gov/train-control/ptc/positive-train-control-ptc-information-rd
[16] https://www.fra.dot.gov/app/ptc/Q4%20Oct.%201%E2%80%94Dec.%2031,%202018

Safety Administration's "Stop, Trains Can't" safety ad since one of the nation's most dangerous crossings during the last decade was in Mississippi.[17, 18]

<u>Derailments</u>

There was one (1) derailment in the MPA between 2014 and 2018; this derailment did not result in injuries. The primary cause of the derailment was improper instruction to the train or yard crew. The rail partners should ensure proper instructions to their crews. Also, the rail partners should work to ensure that the rail infrastructure is in good condition.

[17] https://railroads.dot.gov/elibrary/fra-releases-list-railroad-crossings-most-incidents-over-last-decade
[18] https://www.transportation.gov/highlights/stop-trains-can%E2%80%99t-campaign-sends-strong-message-motorists-railroad-crossings

5.3 Air Network Needs

This section summarizes future air freight conditions. Although the amount of freight shipped by air is small, the commodities transported by air tend to be high-value and time-sensitive.

The air freight network is summarized in *Technical Report #2: Existing Conditions*. The airports in the MPA are:

- Stennis International Airport in Kiln
- Gulfport-Biloxi International Airport in Gulfport
- Trent Lott International Airport in Moss Point

Gulfport-Biloxi International Airport had the most based aircraft in the MPA, and this airport also serves as the MPA's commercial airport. Stennis International Airport had the most daily aircraft operations in the MPA.

Capacity Needs

The FAF data can be used to understand the projected growth in freight air commodity flows between 2016 and 2045. This growth in commodity flows, as well as the existing air infrastructure, can have an impact on future airport conditions.

Commodity Flow Growth

As shown in *Technical Report #2: Existing Conditions*, the air mode accounts for approximately 0.01 percent of freight tonnage and 2.3 percent of freight value in the MPA in 2016. By 2045, the tonnage of freight shipped by air is projected to increase to 0.03 percent of all freight in the MPA in 2045. However, the mode is projected to increase by over 200 percent between 2016 and 2045. The value share of air freight is projected to be approximately 3.8 percent in 2045, and the value is projected to increase by over 200 percent between 2016 and 2045.

The following trading partners with the largest increases in inbound and outbound air tonnage being traded with the MPA between 2016 and 2045 are:

Inbound

1. Massachusetts
2. California
3. Pennsylvania
4. South Carolina
5. Georgia

Outbound

1. Pennsylvania
2. Connecticut
3. Florida
4. California
5. New York

Table 5.12 and Table 5.13 show the top air freight commodities by tonnage and value increases between 2016 and 2045, respectively. By tonnage and by value, the largest increase is electronics.

Table 5.12: Top Commodities by Air Tonnage Increase

Rank	Commodity	Tons (hundred)		Change	Percent Change
		2016	2045		
1	Electronics	14	84	70	262%
2	Precision instruments	22	57	35	188%
3	Machinery	3	10	7	441%
4	Pharmaceuticals	1	8	7	371%
5	Furniture	1	7	5	505%
6	Transportation equipment	4	9	5	75%
7	Motorized vehicles	7	11	5	100%
8	Printed products	1	3	2	312%
9	Base materials	1	3	2	182%
10	Misc. manufactured products	1	3	1	52%

Source: Freight Analysis Framework 4

Table 5.13: Top Commodities by Air Value Increase

Rank	Commodity	Value ($ million)		Change	Percent Change
		2016	2045		
1	Electronics	$323	$1,170	$847	262%
2	Precision instruments	$164	$473	$308	188%
3	Transportation equipment	$196	$342	$146	75%
4	Machinery	$15	$81	$66	441%
5	Pharmaceuticals	$15	$71	$56	371%
6	Furniture	$9	$54	$45	505%
7	Motorized vehicles	$22	$44	$22	100%
8	Base materials	$4	$10	$7	182%
9	Printed products	$2	$7	$5	312%
10	Waste and scrap	$0	$5	$4	1657%

Source: Freight Analysis Framework 4

Airport Conditions

Adequate airport runway conditions are important in handling large cargo planes; runway conditions include runway dimensions and pavement condition. The all-cargo carriers use planes such as Airbus (A310 and A320), Boeing (747, 757, and 767), and McDonell Douglas (MD 10 and MD 11) planes. These planes require several thousand feet of runway to land and take off. Additionally, the runway pavement needs to be able to handle the cargo planes' weight. Table 5.14 shows the runway information for the MPA's airports.

Table 5.14: MPA Airport Runway Information

Airport	Runway	Dimensions		Pavement Condition
		Length (feet)	Width (feet)	
Stennis International Airport	18/36	8,497	150	Good
Gulfport-Biloxi International Airport	14/32	9,002	150	Good
	18/36	4,935	150	Excellent
Trent Lott International Airport	17/35	6,500	100	Fair

Source: AirNav

Airport Projects

There is no information available for any planned updates for any of the MPA's airports.

5.4 Waterway Network Needs

This section summarizes future freight port movement and needs. Freight projections indicate that the port mode will have the third largest increase in freight tonnage and the second largest increase in freight value between 2016 and 2045. This increase in freight water commodity flows will lead to an increase in not only port traffic at the ports, but also in truck and rail traffic. There are four ports in the MPA, as summarized in *Technical Report #2: Existing Conditions*, and are listed below.

- Port Bienville in Bay St Louis
- Port of Gulfport in Gulfport
- Port of Biloxi in Biloxi
- Port of Pascagoula in Pascagoula

All four (4) ports are located along the Mississippi Sound, a component of the Gulf Intracoastal Waterway (GIWW). The GIWW is part of the USDOT Marine Administration's (MARAD) Marine Highway Program and is designated as Marine Highway 10 (M-10). Also, the Port of Gulfport and Port of Pascagoula, along with the GIWW and the waterways that connect to these two (2) ports, are part of the National Multimodal Freight Network (NMFN).

Future Capacity

The United States Army Corps of Engineers (USACE) does not provide waterborne commodity forecasts. However, the FAF data can be used to understand the projected growth in freight water commodity flows between 2016 and 2045, and then apply the growth in commodity flows to the existing USACE waterborne commodity flows to develop forecasted 2045 waterborne commodity flows. This projected growth will lead to an increase in port traffic as well as truck and rail traffic.

Commodity Flow Growth

As shown in *Technical Report #2: Existing Conditions*, the FAF data indicates that the water mode accounts for approximately four (4) percent of freight tonnage, but nearly twenty-two (22) percent of freight value in the MPA in 2016. By 2045, the tonnage share of freight shipped by water is projected to decrease to slightly more than three (3) percent of all freight in the MPA in 2045, but the value share of water freight is projected to increase to more than twenty-five (25) percent in 2045. Also, according to FAF predictions, the tonnage shipped by the ports is projected to grow 39 percent between 2016 and 2045, and the value of freight shipped by the ports is projected to grow 114 percent between 2016 and 2045.

The USACE collects commodity flow data for ports ranked in the Top 150 in the U.S. in terms of total tonnage, which includes the Port of Gulfport and Port of Pascagoula. The changes commodity flows for these two ports are summarized on the next page. Port Bienville and the Port of Biloxi are not shown since those ports were outside the Top 150 ports in the U.S. in terms of tonnage.

Port of Gulfport

The freight tonnage at the Port of Gulfport is projected to increase from 2.3 million tons in 2017 to nearly 3.3 million tons in 2045. The changes in tonnage by movement is summarized in Table 5.15. Most of the increases in tonnage at the Port of Gulfport are Exports.

Table 5.15: Trade Tonnage Changes at the Port of Gulfport, 2017 - 2045

Movement	2017 Tons	2045 Tons	Tons Change	Percent Change
Domestic	20,039	34,349	14,310	71%
Exports	509,724	1,406,481	896,757	176%
Imports	1,782,295	1,845,043	62,748	4%
Total	2,312,058	3,285,872	973,814	42%

Source: Freight Analysis Framework 4 and USACE Navigation Data Center, Waterborne Commerce Statistics Center

At the Port of Gulfport, the top five origins for imported freight are projected to account for 83 percent of all imported tonnage in 2045, and the top five destinations for exported freight are projected to account for all exported tonnage; these percentages are the same as in 2017, as shown in *Technical Report #2: Existing Conditions*. The top five origins and destinations, by increases in tonnage between 2017 and 2045, are:

<u>Origins (Imports)</u>

1. Honduras
2. Guatemala
3. Mexico
4. Mozambique
5. Australia

<u>Destinations (Exports)</u>

1. Honduras
2. Guatemala
3. Peru
4. Colombia
5. Japan

Table 5.16 shows the top (10) commodities at the Port of Gulfport, by tonnage increases between 2017 and 2045. The top ten (10) commodities account for 95 percent of all tonnage at the Port of Gulfport in 2017, which is projected to slightly decrease to 94 percent in 2045. Between 2017 and 2045, the inbound movement percentage is projected to decrease from 78 percent to 57 percent, while outbound movements are projected to increase from 22 percent to 43 percent. As mentioned in *Technical Report #2: Existing Conditions*, there were no Intraport tons at the Port of Gulfport in 2017.

Table 5.16: Top Ten Commodities by Tonnage Increases at Port of Gulfport, 2017 - 2045

Commodity Group	2017 Tons	2045 Tons	Tons Change	Percent Change
Textile Products	247,594	544,398	296,804	120%
Paper & Paperboard	204,359	462,272	257,913	126%
Manufac. Prod. NEC	54,964	300,518	245,554	447%
Machinery (Not Elec)	23,201	75,741	52,540	226%
Bananas & Plantains	627,382	660,597	33,215	5%
Food Products NEC	7,576	29,382	21,806	288%
Petroleum Coke	9,621	23,931	14,310	149%
Cotton	11,256	23,525	12,269	109%
Plastics	9,124	20,698	11,574	127%
Limestone	196,840	207,070	10,230	5%

Source: Freight Analysis Framework 4 and USACE Navigation Data Center, Waterborne Commerce Statistics Center

Table 5.17 shows the top five (5) import and export commodities at the Port of Gulfport, by tonnage increases between 2017 and 2045. The top five (5) exported commodities are projected to account for 89 percent of all tonnage in 2045, which is up from 83 percent of all tonnage in 2017. The top five (5) imported commodities are projected to account for 96 percent of all tonnage in 2045, which is the same percentage in 2017.

Table 5.17: Top Commodities for Exports and Imports by Tonnage Increases, Port of Gulfport, 2017 - 2045

Exports				
Commodity	2017 Tons	2045 Tons	Tons Change	Percent Change
Textile Products	112,907	403,530	290,623	257%
Paper & Paperboard	204,326	462,239	257,913	126%
Manufac. Prod. NEC	38,584	283,260	244,676	634%
Machinery (Not Elec)	23,069	75,607	52,538	228%
Food Products NEC	7,074	28,837	21,763	308%
Imports				
Commodity	2017 Tons	2045 Tons	Tons Change	Percent Change
Bananas & Plantains	626,579	658,761	32,182	5%
Limestone	196,840	207,070	10,230	5%
Non-Ferrous Ores NEC	696,145	704,755	8,610	1%
Textile Products	134,687	140,869	6,182	5%
Fruit & Nuts NEC	59,660	62,724	3,064	5%

Source: Freight Analysis Framework 4 and USACE Navigation Data Center, Waterborne Commerce Statistics Center

Port of Pascagoula

The freight tonnage at the Port of Pascagoula is projected to decrease from 25.6 million tons in 2017 to 22.0 million tons in 2045. The changes in tonnage by movement is summarized in Table 5.18. The export tonnage is projected to increase slightly, but the domestic and import tonnages are projected to decrease.

Table 5.18: Trade Tonnage Changes at the Port of Pascagoula, 2017 - 2045

Movement	2017 Tons	2045 Tons	Tons Change	Percent Change
Domestic	8,640,845	8,466,201	-174,644	-2%
Exports	7,944,705	8,195,541	250,836	3%
Imports	9,059,018	5,357,981	-3,701,037	-41%
Total	25,644,568	22,019,723	-3,624,845	-14%

Source: Freight Analysis Framework 4 and USACE Navigation Data Center, Waterborne Commerce Statistics Center

At the Port of Pascagoula, the top five origins for imported freight are projected to account for 74 percent of all imported tonnage in 2045, which is a decrease from 70 percent in 2017; the top five destinations for exported freight are projected to account for 56 percent of all exported tonnage in 2045, which is a decrease from 63 percent in 2017. Although the total tonnage is projected to decrease between 2017 and 2045, the tonnage between the Port and some origins and destinations are projected to increase. The top five origins and destinations, by increases in tonnage between 2017 and 2045, are:

Origins (Imports)

1. Trinidad
2. Guatemala
3. Chile
4. Nicaragua
5. China

Destinations (Exports)

1. Belgium
2. Gibraltar
3. Guatemala
4. Netherlands
5. Brazil

Table 5.19 shows the top (10) commodities at the Port of Pascagoula, by tonnage increases between 2017 and 2045. The top ten (10) commodities account for 95 percent of all tonnage at the Port of Pascagoula in 2017, which is projected to decrease to 90 percent in 2045. Between 2017 and 2045, the inbound movement percentage is projected to decrease from 41 percent to 30 percent, while outbound movements are projected to increase from 59 percent to 69 percent. As mentioned in *Technical Report #2: Existing Conditions*, less than one (1) percent of tonnage at the Port of Pascagoula was Intraport in 2017; Intraport tonnage is projected to remain at less than one (1) percent of the total tonnage in 2045.

Table 5.19: Top Ten Commodities by Tonnage Increases at Port of Pascagoula, 2017 - 2045

Commodity Group	2017 Tons	2045 Tons	Tons Change	Percent Change
Distillate Fuel Oil	5,219,966	5,967,736	747,770	14%
Lube Oil & Greases	1,082,219	1,619,695	537,476	50%
Vegetable Oils	77,384	553,964	476,580	616%
I&S Primary Forms	42,267	295,435	253,168	599%
Sodium Hydroxide	21,922	217,214	195,292	891%
Hydrocarbon & Petrol Gases, Liquefied and Gaseous	137,033	310,966	173,933	127%
Other Hydrocarbons	155,277	239,945	84,668	55%
Petro. Products NEC	36,921	88,976	52,055	141%
I&S Plates & Sheets	6,373	44,546	38,173	599%
Paper & Paperboard	29,644	64,381	34,737	117%

Source: Freight Analysis Framework 4 and USACE Navigation Data Center, Waterborne Commerce Statistics Center

Table 5.20 shows the top five (5) import and export commodities at the Port of Pascagoula, by tonnage increases between 2017 and 2045. The top five (5) import and export commodities at the Port of Pascagoula are projected to account for 95 percent of all tonnage in 2045, which is the same percentage in 2017. The top five (5) imported commodities are projected to account for 97 percent of all tonnage in 2045, which is a decrease from 99 percent in 2017.

Table 5.20: Top Commodities for Exports and Imports by Tonnage Increases, Port of Pascagoula, 2017 - 2045

Exports				
Commodity	2017 Tons	2045 Tons	Tons Change	Percent Change
Distillate Fuel Oil	2,948,738	4,682,464	1,733,726	59%
I&S Primary Forms	42,267	295,435	253,168	599%
I&S Plates & Sheets	6,373	44,546	38,173	599%
Paper & Paperboard	29,644	64,381	34,737	117%
Food Products NEC	13,822	46,615	32,793	237%
Imports				
Commodity	2017 Tons	2045 Tons	Tons Change	Percent Change
Vegetable Oils	77,384	553,964	476,580	616%
Sodium Hydroxide	11,023	202,986	191,963	1,741%
Manufac. Prod. NEC	6,347	27,327	20,980	331%
Naphtha & Solvents	379	6,979	6,600	1,741%
Alcoholic Beverages	128	1,554	1,426	1,114%

Source: Freight Analysis Framework 4 and USACE Navigation Data Center, Waterborne Commerce Statistics Center

Port Conditions

The MPA ports' descriptions are shown in *Technical Report #2: Existing Conditions*. The MPA port capacities are summarized in Table 5.21. Port capacities can be measured by a variety of methods, including channel depth, available square footage of warehouse and dock space, and the total acreage of the port.

Channel depths must be at least 47 feet in order to consistently provide service to larger ships that will travel through the Panama Canal widening. The Port of Pascagoula has the largest channel depth at 42 feet, followed by the Port of Gulfport at 36 feet; the remaining two (2) ports have a channel depth of twelve (12) feet.

Table 5.21: MPA Port Capacity

Port	Acreage	Channel Depth (feet)	Warehouse and Dock Space Square Footage
Port Bienville	25	12	610,780
Port of Gulfport	300	36	5,191,600
Port of Biloxi	2	12	20,000
Port of Pascagoula	214	42	1,996,643

Future Port Projects

There are several planned projects at the MPA's ports, which will increase future capacity and potentially lead to higher volumes of waterborne commodities. Some of these port projects are summarized below.

Port Bienville

Port Bienville has received funding for facility investments from MDOT's Port Multi-modal Transportation Improvement Program to fund four projects:

- Construction of two heavy lift areas on its existing main dock structure
- Adding bumpers on a bulkhead and removed wooden dolphin clusters
- Constructing an additional roadway to serve an unused 43-acre development plot
- Installing dolphins for barge mooring

Port of Gulfport

The Port of Gulfport has received funding from MDOT's Port Multi-modal Transportation Improvement Program for an inland port development.

Biloxi Port Division

There are no planned projects planned by the Biloxi Port Division.

Port of Pascagoula

Port Bienville has received funding for facility investments from MDOT's Port Multi-modal Transportation Improvement Program to fund three projects:

- Dock repair at Terminal A-1
- Relocating a benzene and sulfur pipeline to clear a new rail line
- Grading and paving

5.5 Pipeline Network Needs

This section summarizes future freight pipeline commodity flow movement and needs. Freight projections indicate that the pipeline mode will have the second largest increase in freight tonnage and fourth largest increase in freight value between 2016 and 2045. As shown in *Technical Report #2: Existing Conditions*, the MPA's pipeline network currently consists of approximately 413 miles of pipelines; most of the pipelines by length are natural gas pipelines, and the remainder are hydrocarbon gas liquids and refined petroleum product pipelines.

Capacity

Although information on needs and pipeline conditions are not publicly available, the FAF data can be used to understand the projected growth in pipeline commodity flow between 2016 and 2045.

<u>Commodity Flow Growth</u>

The tonnage shipped by pipelines is projected to grow 53 percent between 2016 and 2045. The value of freight shipped by pipelines is projected to grow 38 percent between 2016 and 2045. The pipeline is projected to rank second in tonnage in 2045, and the value share is projected rank third in 2045.

The area of Arkansas that is outside the FAF designated metropolitan areas ("Rest of Arkansas") is the trading partner with the projected largest inbound tonnage increase, and the area of Alabama that is outside the FAF designated metropolitan areas ("Rest of Alabama") is the trading partner with the projected largest outbound tonnage increase. Coal n.e.c. is projected to be the commodity with the largest tonnage and value increase.

<u>Pipeline Conditions and Needs</u>

Pipelines are typically private investments, and pipeline needs and conditions are not publicly available. Nonetheless, pipelines provide additional freight capacity since they handle liquid bulk, such as crude oil and natural gas, that would need to use other surface transportation modes if pipelines did not carry these commodities.

6.0 Bicycle/Pedestrian

6.1 Infrastructure/Facility Needs

Existing and Future Gaps

Figure 6.1 shows existing bicycle facilities and pedestrian facilities. Figure 6.2 shows existing demand for biking and walking based on land use, demographic, and built environment conditions. Methodology details can be found in *Technical Report #2: Existing Conditions*.

Figure 6.3 identifies areas that are anticipated to experience high growth or development over the next 25 years - enough growth to significantly increase biking and walking demand. While it is difficult to forecast exactly how growth will impact demand, areas that are likely to experience increased demand for biking and walking are Downtown Biloxi, D'Iberville, Orange Grove, Downtown Pascagoula, and many areas along US 90.

Based on the existing facilities and both existing demand and future growth, many major "gaps" emerge between demand and supply. These gaps are shown in Table 6.1.

Table 6.1: Major Bicycle and Pedestrian Gap Areas

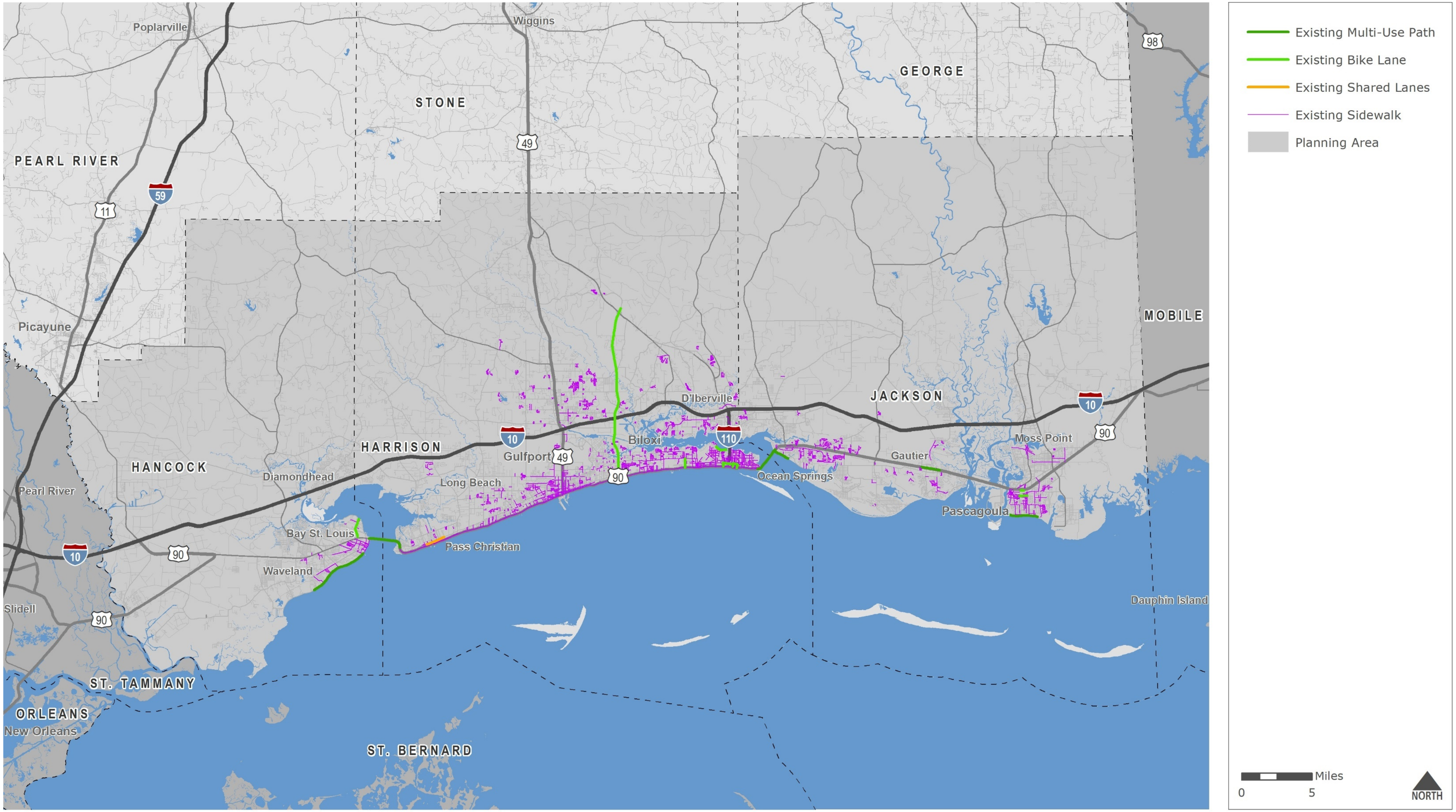
Gap Area	Pedestrian or Bicycle
Downtown Biloxi	Bicycle
Downtown Gulfport and Naval Facility/Hospital area	Bicycle and Pedestrian
US-90 (Long Beach to Ocean Springs)	Bicycle
US-90 (Bay St. Louis to Waveland)	Bicycle and Pedestrian
Pass Road	Bicycle and Pedestrian
Orange Grove	Bicycle and Pedestrian
Pascagoula/Moss Point	Bicycle and Pedestrian
Gautier	Bicycle and Pedestrian
Ocean Springs	Bicycle and Pedestrian
D'Iberville	Bicycle and Pedestrian

Public and Stakeholder Input

During outreach, the public and stakeholders frequently mentioned the need for better walking and biking conditions. While there were no specific improvements that were frequently mentioned, the following types of input were the most common:

- Improve sidewalks.
- Add more pedestrian paths.
- Make communities more walkable.
- Improve pedestrian infrastructure along US 90 by filling in boardwalk gaps and adding crosswalks or overhead bridges.

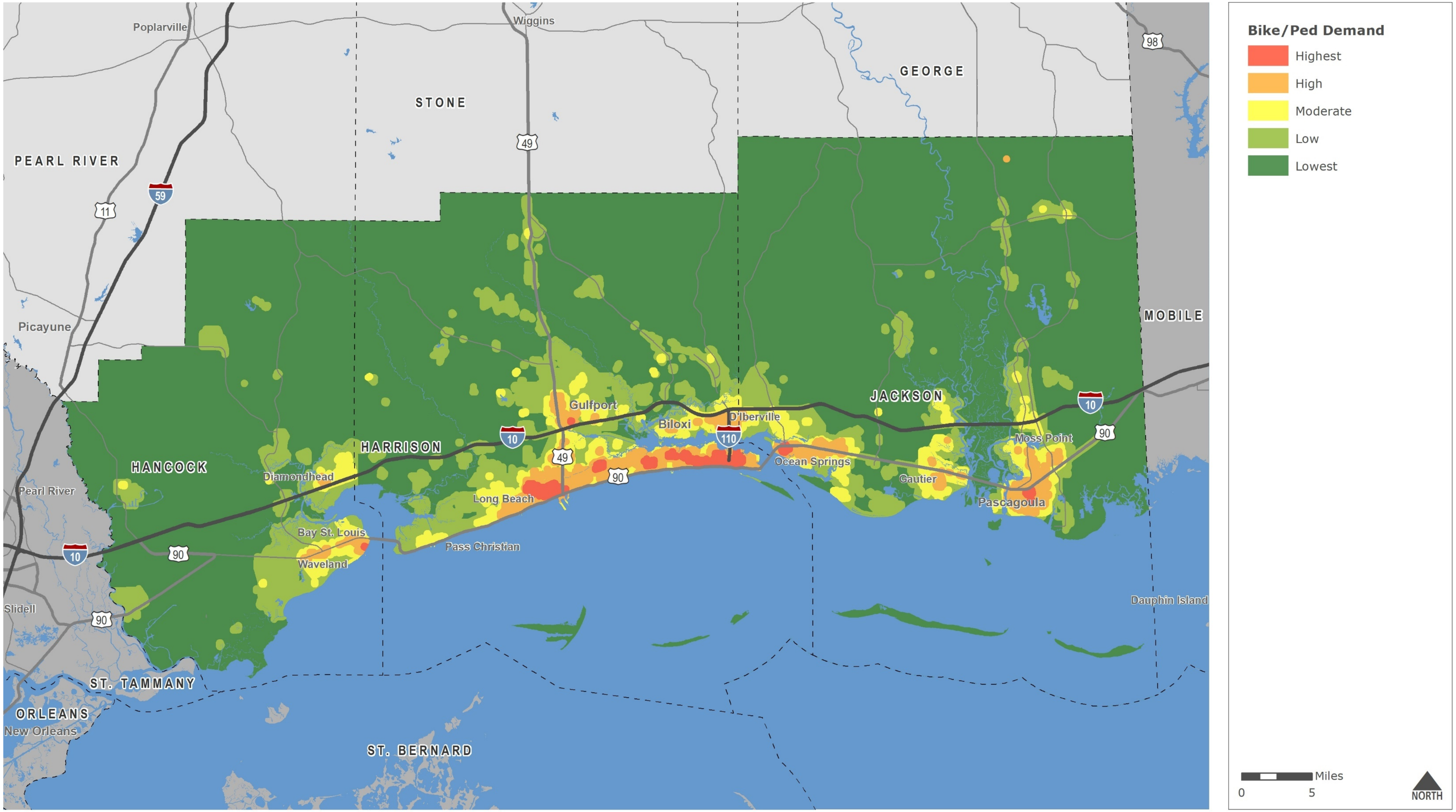
Figure 6.1: Existing Bicycle and Pedestrian Facilities



Data Sources: MPO Staff; Neel-Schaffer

Disclaimer: This map is for planning purposes only.

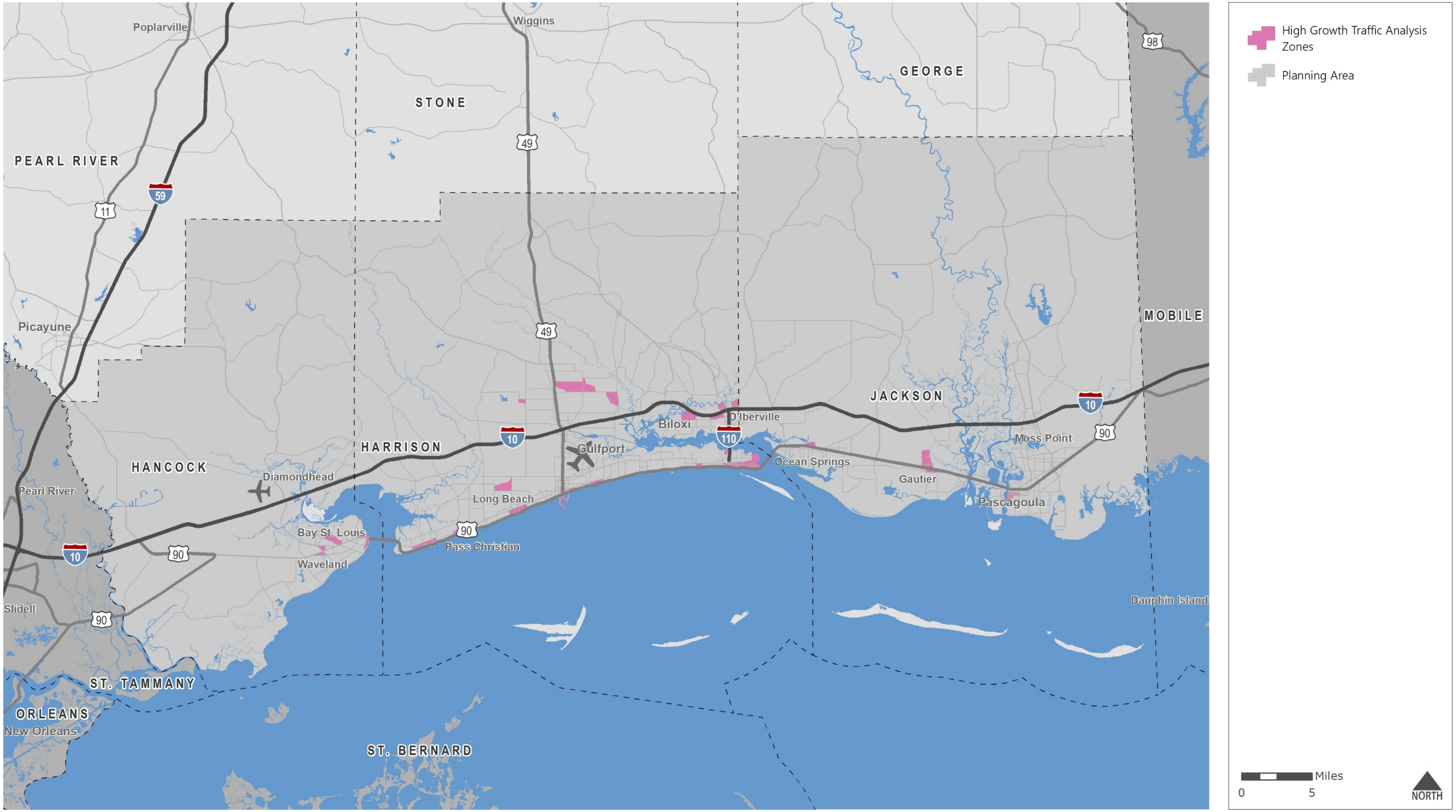
Figure 6.2: Existing Bicycle and Pedestrian Demand



Data Sources: Census Bureau; InfoUSA; MPO Staff; Neel-Schaffer

Disclaimer: This map is for planning purposes only.

Figure 6.3: Future High Growth Areas



Data Sources: Neel-Schaffer

Disclaimer: This map is for planning purposes only.

6.2 Maintenance Needs

Bicyclists and pedestrians are very sensitive to maintenance issues. Many bicycles lack suspension systems and they travel closer to the edges of roadways where pavement conditions deteriorate more rapidly, and debris may accumulate. Pedestrians are also more sensitive to pavement conditions, either on sidewalks, along crosswalks, or elsewhere. Furthermore, bicyclists and pedestrians are also highly sensitive to well-maintained signage, markings, and lighting due to their existing safety vulnerabilities.

Therefore, maintenance of existing bicycle and pedestrian facilities is necessary to keep facilities safe and attractive for users. This is true not only for maintaining smooth surfaces and ramps but also for signage, facility markings, lighting, and vegetation management.

While public input did not indicate a major need for improved maintenance, the MPO should work with local governments and agencies and MDOT to periodically assess maintenance needs for bicycling and pedestrian facilities in the region.

6.3 Safety and Security Needs

Based on available crash data, there are about 50 bicycle crashes per year in the MPO area and these crashes result in at least one pedestrian fatality each year. For pedestrians, there are about 35 pedestrian-related crashes per year and these crashes result in at least two (2) pedestrian fatalities each year. It is unusual for an area to have more bicycle crashes than pedestrian crashes, and this indicates that bicycle safety is a major need for the MPO.

In order to better understand safety needs, the MPO should work with MDOT and local police departments to obtain detailed crash records for analysis, where feasible.

7.0 Public Transit

7.1 Service Needs

As documented in *Technical Report #2: Existing Conditions*, transit service in the region is generally on par with that of peer regions. This section discusses high-level service needs identified in the planning process that should be addressed to improve upon existing transit service.

Existing and Future Regional Transit Demand

Figure 7.1 shows existing demand for public transit in the region based on land use, demographic, and built environment conditions. Methodology details can be found in *Technical Report #2: Existing Conditions*.

In addition to existing demand, future demand must also be considered. Figure 7.2 highlights areas forecasted to experience high rates of population and/or employment growth over the next 25 years. In these areas, there will be increased demand for public transit services.

In addition to identifying the concentration of high demand areas, travel flows should also be considered when assessing transit demand. Travel flows, which represent the "route" between trip origins and destinations, can help determine where transit should prioritize direct service or easy connections. Figure 7.3 shows travel flows between Traffic Analysis Districts in the region, for all trip purposes (e.g. work, shopping, school, etc.) and modes of transportation (driving, carpooling, transit, etc.).

Based on existing demand and travel flows, the existing transit system provided by Coast Transit Authority (CTA) covers many of the needs in the central part of the region and provides service in a hub-and-spoke system that mirrors overall travel flows in the region. However, the following high-level unmet needs still emerge:

- There is a high unmet need for fixed route public transit in the Pascagoula/Moss Point area. Travel flows suggest the highest need is for locally-oriented service, but there is also a need for connections to the core of the region (Biloxi/Gulfport).
- There is some unmet need for fixed route public transit in the Bay St. Louis area. Travel flows suggest that this is primarily for locally-oriented service, with little demand for connections to the core of the region (Biloxi/Gulfport).
- There are also other areas without fixed route transit service that could support some level of fixed route service. These areas include: northern Orange Grove, Long Beach, Gautier, and the Pass Road corridor.
- For regional transit service, the highest demand parallels the US 90 corridor from Long Beach to Pascagoula.

Public and Stakeholder Input

During outreach, the general public and stakeholders mentioned the need for better public transit. The following needs were most commonly mentioned:

- Increased service that covers more of the region and that runs more frequently. Extending transit to Pascagoula and more parts of Jackson County was frequently mentioned.
- Intercity connections, primarily to New Orleans, LA, but also to Baton Rouge, LA, Jackson, MS, Mobile, AL, and Jacksonville, FL.
- Increased accessibility for disabled riders, specifically for accommodating wheelchairs or walkers on all vehicles.
- Adding stops and routes close to where low-income residents live, work, and shop.

Existing Plans

Coordinated Public Human Service Transportation Plan (2016)

The purpose of this plan, which focused on Hancock, Harrison, and Jackson counties, was to identify the transportation needs of individuals with disabilities, older adults, and those with lower incomes, and to identify and prioritize strategies for meeting those needs. This planning effort is required for transit providers receiving funding through the Federal Transit Administration's Section 5310 - Enhanced Mobility of Seniors & People with Disabilities program.

The goals of this plan included:

- Goal 1: To increase and expand on current service hours.
- Goal 2: To more effectively engage the local elected officials in supporting transit growth on the Gulf Coast
- Goal 3: To improve and expand the availability of transportation services to include more of the traditionally underserved populations such as the disabled and elderly.
- Goal 4: To develop and implement and education and awareness program. Specifically, to identify and secure the assistance of a mobility manager, and to increase community awareness and support of coordinated transportation efforts
- Goal 5: To better coordinate services to improve operation of transportation services.

Priorities were focused on the following issues: acquiring of additional buses and vans to increase Demand Response Transportation Services; increasing operational funding for increased Demand Response Service for weekend and evening hours; and increasing coverage of Demand Response services in areas that fixed route transit service is unavailable.

The East West Multimodal Corridor Plan

This project is a proposed new 12.6-mile parkway that would parallel an existing railroad corridor between Gulfport and Biloxi. It is envisioned as a multimodal corridor, including a new shared use path and rapid transit, as well as a catalyst for new development in targeted areas.

The purpose of this project is to:

- Provide an interconnected multimodal corridor to accommodate automobiles, transit, bicycles, pedestrians and light rail (future)
- Grow economic development opportunities by supporting community revitalization and attracting new opportunities
- improve Harrison County emergency/disaster response and recovery operations
- improve mobility and access to employment, education, and healthcare.

Planners envision this project addressing the needs to:

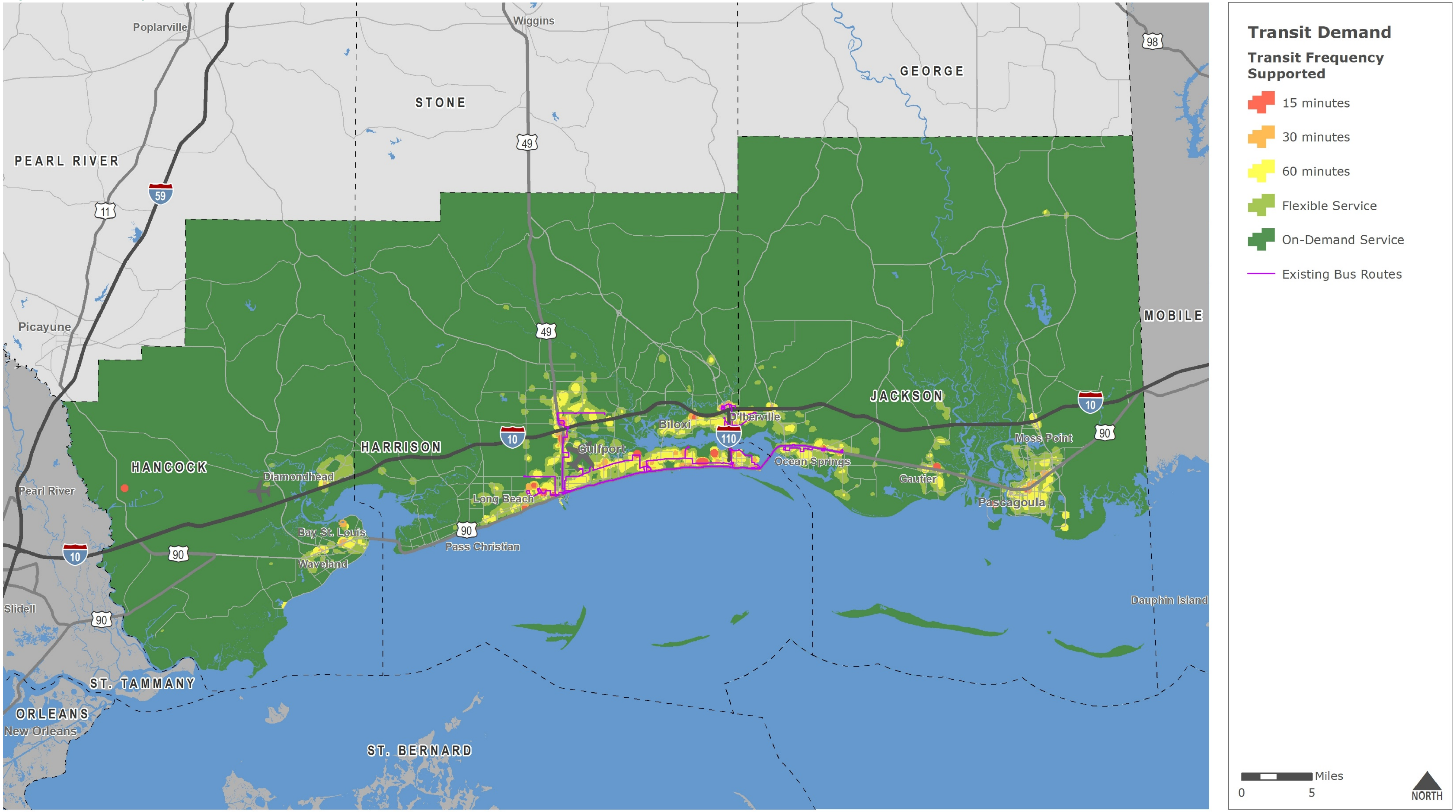
- Disperse traffic congestion with interconnected roadway network
- Support regional economic development; sustain area population and job growth
- Improve safety and emergency response operations.

Transit Development Plan

The CTA maintains a Transit Development Plan, which has been updated in tandem with this 2045 Metropolitan Transportation Plan. This plan is more detailed in nature than the Metropolitan Transportation and provides the following for CTA and the region:

- Detailed analysis of existing conditions and needs
- Identification and evaluation of potential service expansion concepts
- Development of a long-term strategic service plan
- Additional recommendations, such as technology and marketing related recommendations.

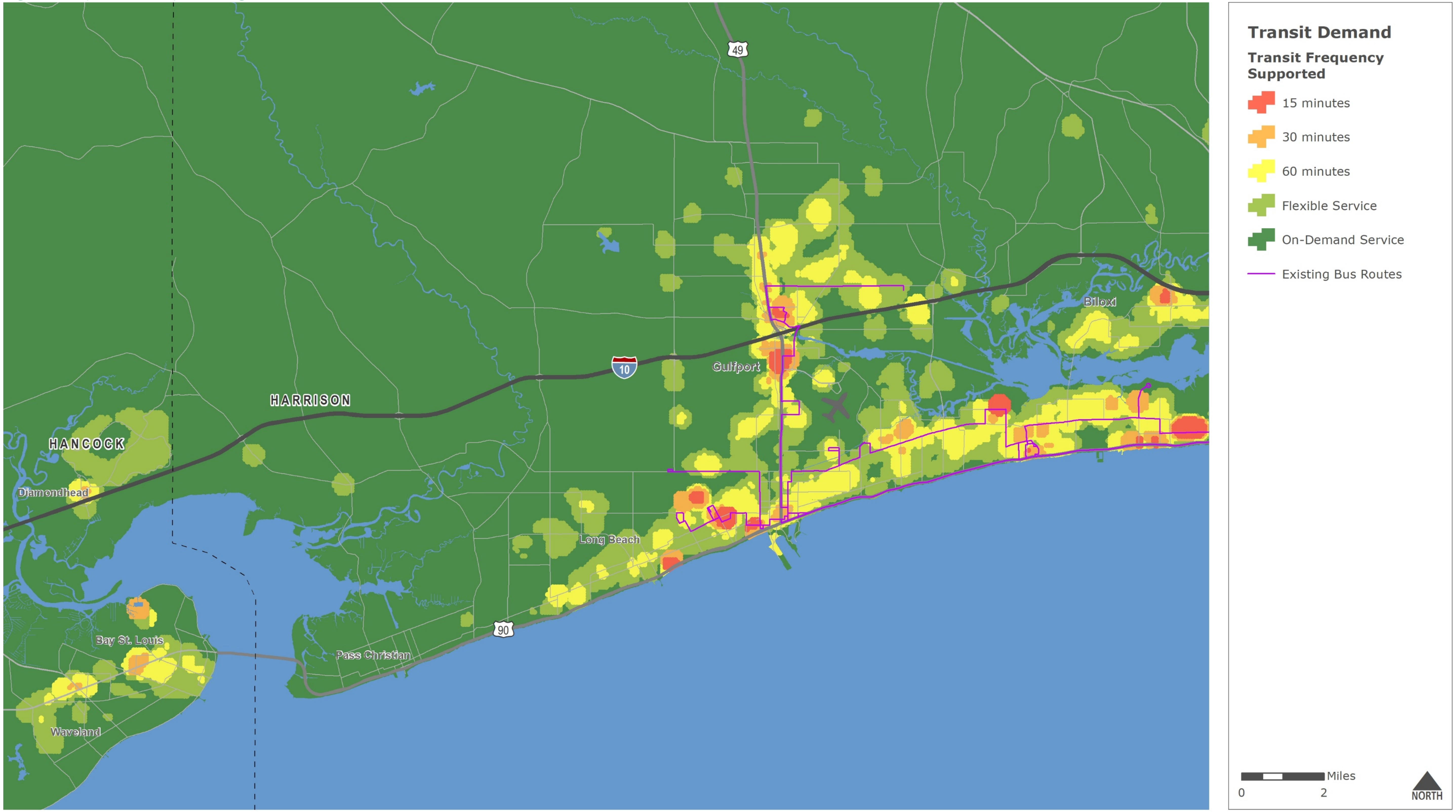
Figure 7.1: Existing Transit Demand



Data Sources: Neel-Schaffer

Disclaimer: This map is for planning purposes only.

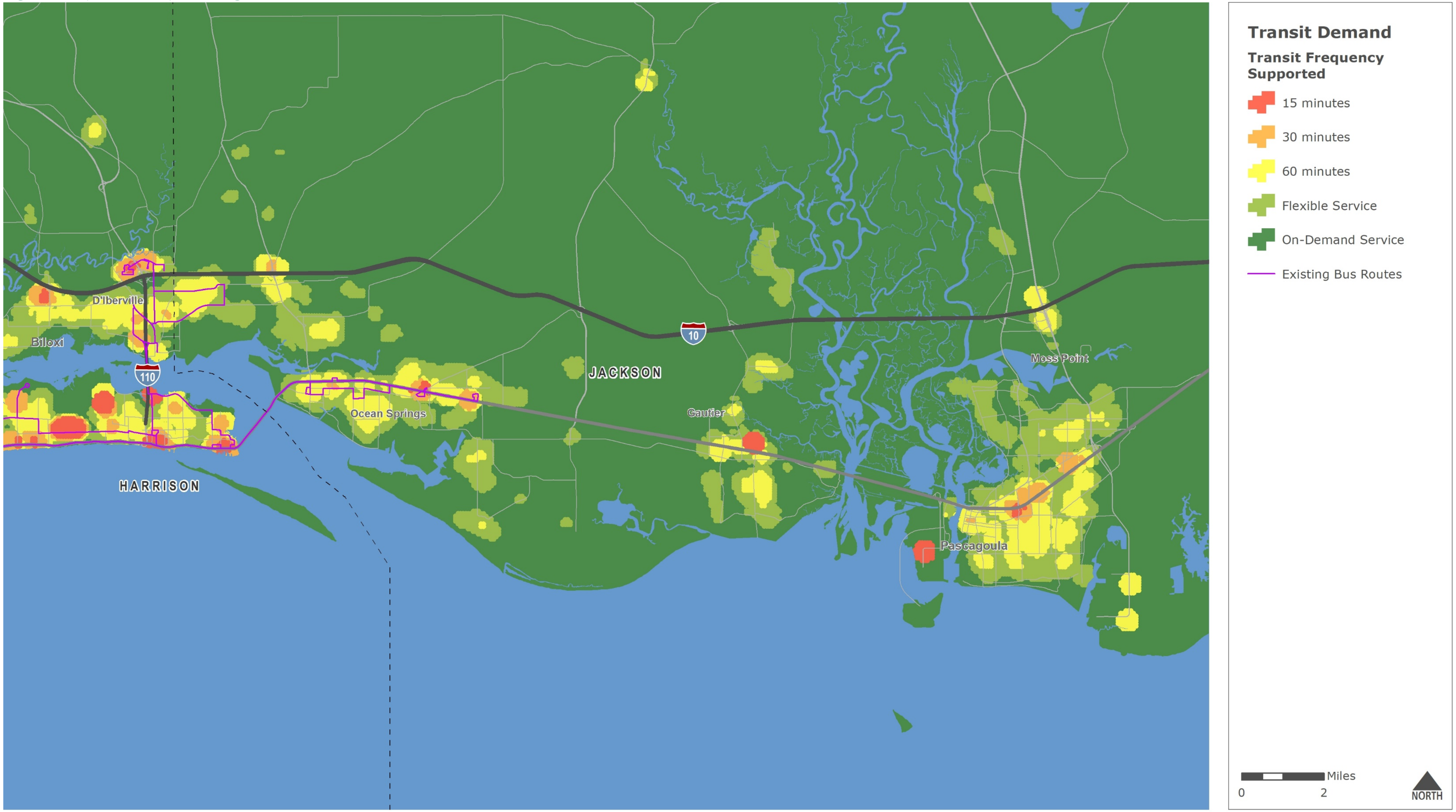
Figure 7.1 (zoom west): Existing Transit Demand



Data Sources: Neel-Schaffer

Disclaimer: This map is for planning purposes only.

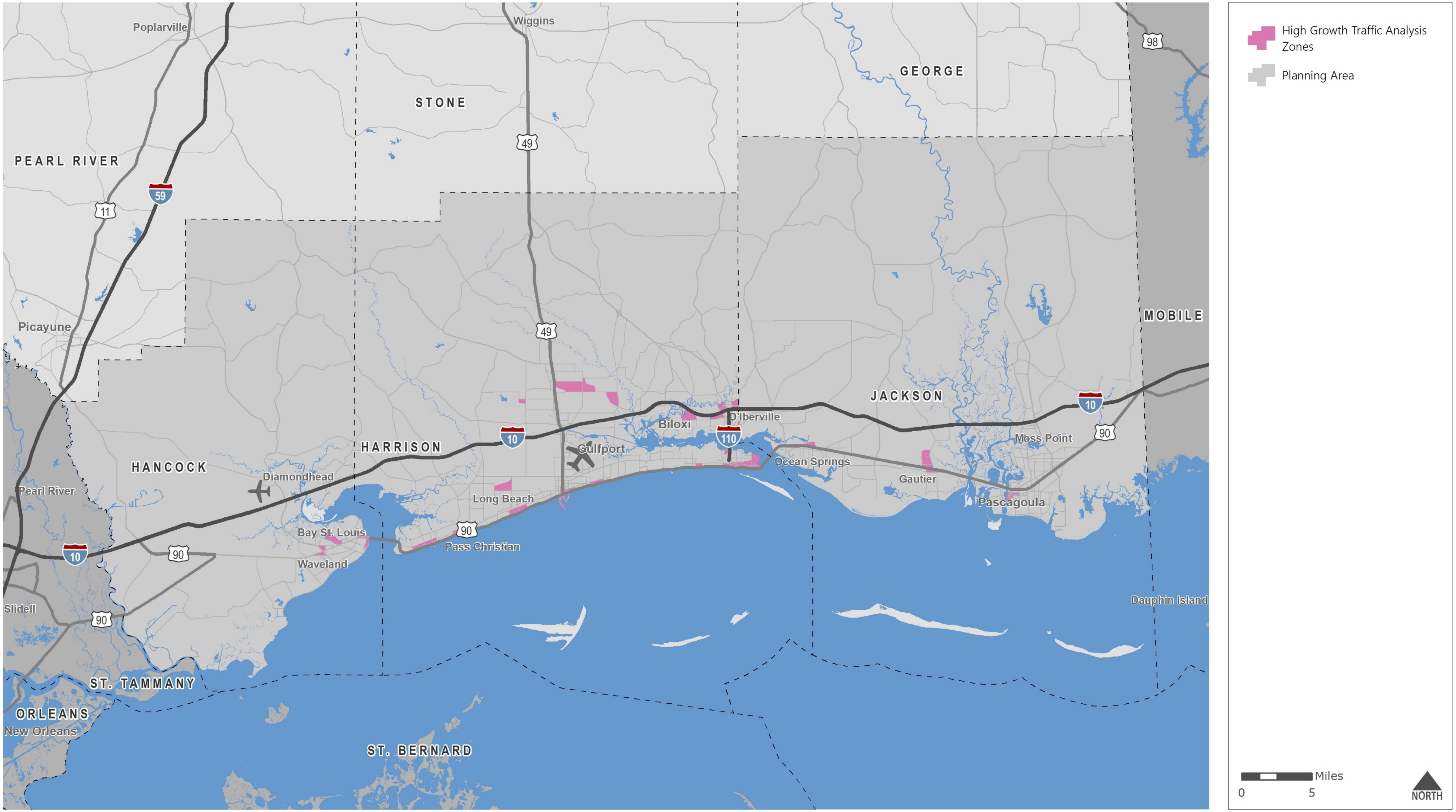
Figure 7.1 (zoom east): Existing Transit Demand



Data Sources: Neel-Schaffer

Disclaimer: This map is for planning purposes only.

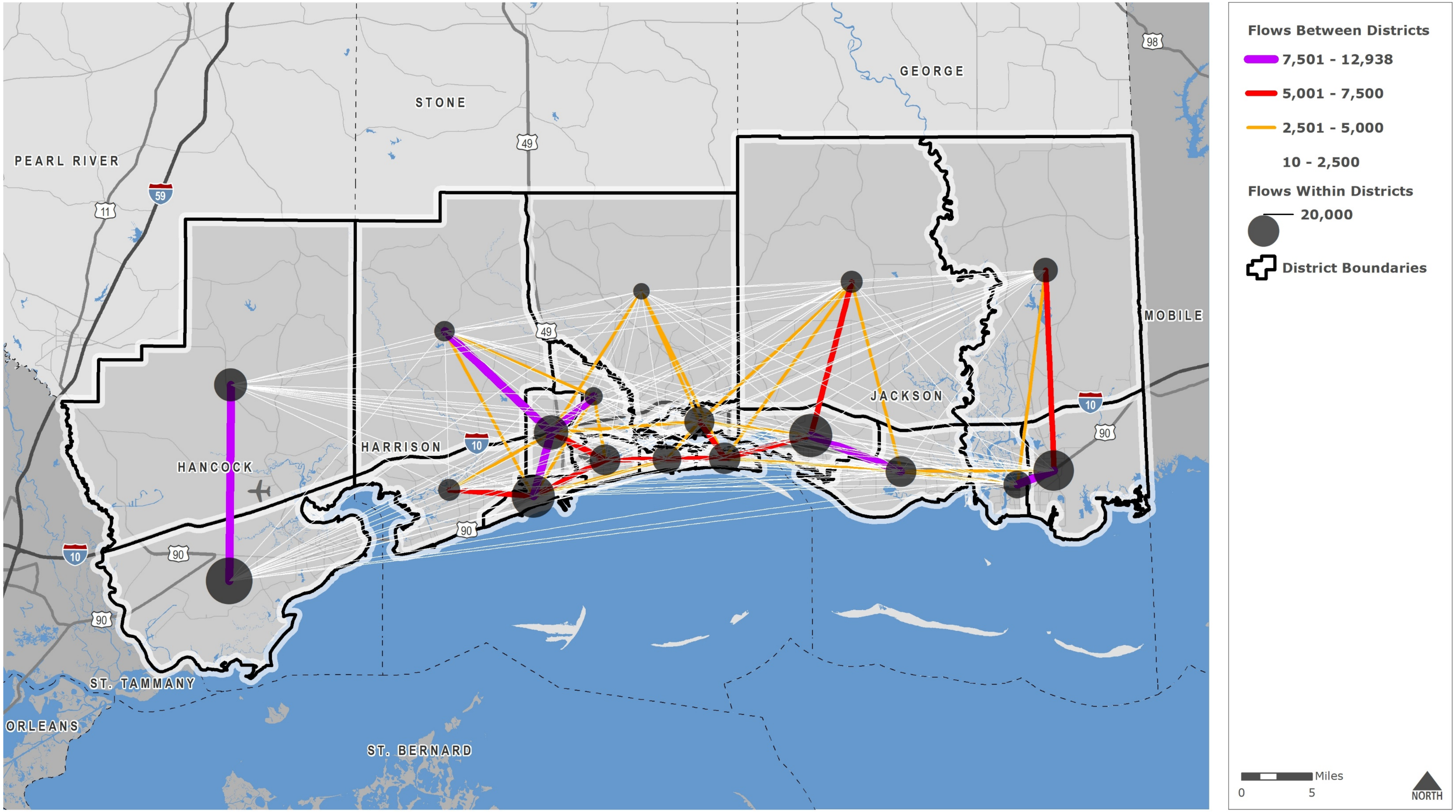
Figure 7.2: Future High Growth Areas



Data Sources: Neel-Schaffer

Disclaimer: This map is for planning purposes only.

Figure 7.3: Regional Travel Flows by District



Data Sources: Neel-Schaffer

Disclaimer: This map is for planning purposes only.

7.2 Maintenance and Capital Needs

Maintaining Existing Assets

The existing fleet for CTA has many vehicles, particularly its smaller cutaway buses, that are past their Useful Life Benchmark (ULB), as defined by their age and the default ULB established by the Federal Transit Administration. While actual vehicle lifespans may extend beyond the default ULB based on local roadway and environmental conditions, older vehicles will still need to be replaced on a regular basis over the next 25 years. Efforts should also be made to extend vehicle lifespans beyond their ULB through preventative maintenance.

While all existing facilities (administrative, parking, and passenger facilities) are in an "adequate" or better state of repair, CTA should continue to carefully monitor maintenance of facilities.

New Assets

As CTA expands its services and upgrades its stop amenities, new capital assets will be required. CTA should ensure that the acquisition of these new assets is done in a sustainable manner so that they may be maintained in a state of good repair in the future.

7.3 Safety Needs

While no specific safety or security needs are identified, CTA has a slightly lower rate of safety and security events than other urban transit systems in the state or country. Furthermore, in the last five (5) years, no fatalities were reported by CTA.

CTA should continue to measure and monitor its safety performance, per its standard operating procedures for operations and maintenance. This will ensure that any safety needs are identified and that mitigation measures are implemented as needed. It should also continue to develop an Agency Safety Plan in coordination with MDOT and implement recommendations from this plan.