SPACE COAST SUPER-REGIONAL FREIGHT STUDY

January 2022

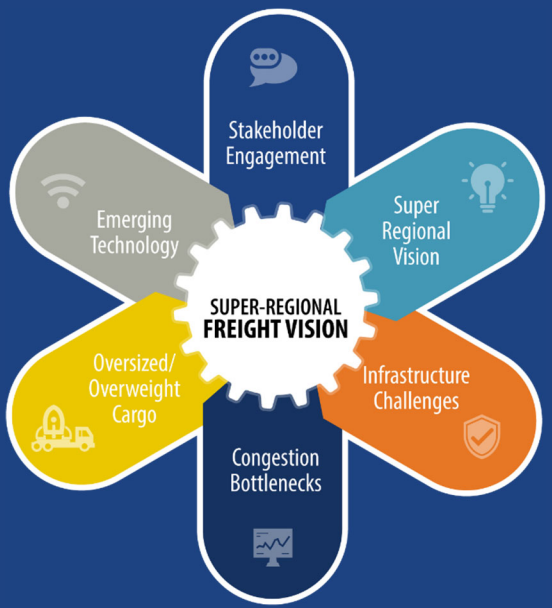
EXECUTIVE SUMMARY

Space Coast's private sector has experienced strong economic growth with high paying jobs, high-tech industries, and improved quality of life, which is expected to further accelerate in the future. To support this growth, the existing transportation corridors need to be connected with the region, the state, and the nation; not only to improve freight mobility, but also to better serve local residents and visitors. The Space Coast/East Central Florida Freight & Logistics Subarea Study (Phase I Study) was conducted to initiate "beyond the fence" strategic engagement and planning in the area, and a set of recommendations was developed in collaboration with the freight stakeholders in the region. The Phase II Study (Space Coast Super-Regional Freight Study) builds on the previous effort while expanding the focus to Space Coast and River to Sea TPO areas.

Study Approach

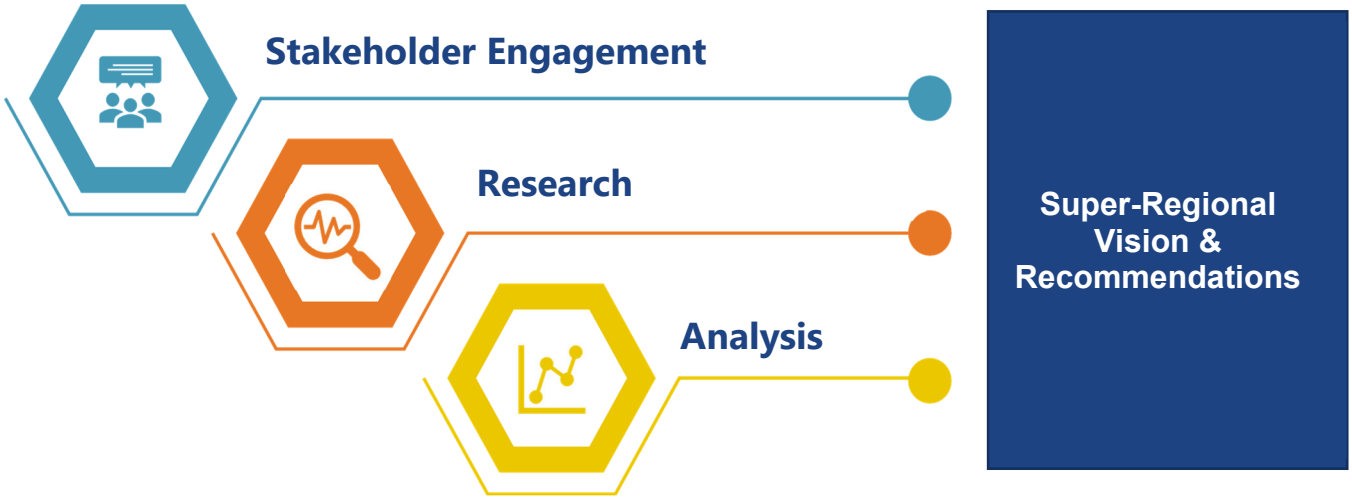
The Phase II Study approach involved:

- Stakeholder engagement
- Development of super-regional vision
- Exploring infrastructure challenges
- Analyzing congestion bottlenecks and oversize/overweight cargo issues
- Investigating emerging technology solutions
- Developing recommendations for implementation



The Phase II approach was heavily based on feedback from the study stakeholders. This was obtained through one-on-one interviews, online surveys, and group discussions. These activities helped identify regional opportunities and challenges for freight movement and shed light on industry growth projections.

Research and analysis, guided by stakeholder insights, included exploring infrastructure challenges, identifying crash hotspots, understanding recurring and non-recurring congestion, and evaluating oversized/overweight (OS/OW) cargo movement. Finally, a super-regional growth vision was developed along with a set of recommendations that can be advanced by the study stakeholders.



Issues and Challenges

Through analysis and feedback from area stakeholders several key issues were identified including:

- *Non-Recurring Congestion*
- *Recurring Congestion*
- *Truck Crash Hotspots*
- *Oversized Overweight Cargo*
- *Limited East - West River Crossings*
- *Bridge Height & Weight Restrictions*

Trends and Drivers

Super-regional vision development necessitated a scenario planning exercise. To develop scenarios, feedback from stakeholders was used as a foundation for micro-scenario formation. The micro-scenarios were based off the top six industries for the region, as identified in Phase I. Research was conducted on what projected industry growth and trends may ensue. Some highlights from this review include:

Aerospace: Transporting Worlds to Space

Industry will evolve to regularly ship workforce, visitors, and industry materials to space to explore and colonize Mars and beyond.

Maritime: Bigger, More Diverse Ships and Cargo

Larger, uniquely shaped, and more frequent cruises are anticipated along with a diverse influx of cargo, like fuel, and other materials to support area space industry.

Tourism: Space Tourism Growing

The region transforms to support tourism-based land use (more retail/hotels) driven by an increase in space tourism, outside recreation, and cruise activity.

Transportation Warehousing: Larger Demand for Just-In-Time Delivery

Same day, same hour delivery increases demand for faster shipments in more urban areas. Meeting demand with innovative modes is anticipated.

Healthcare: Growing, Connected Device Industry

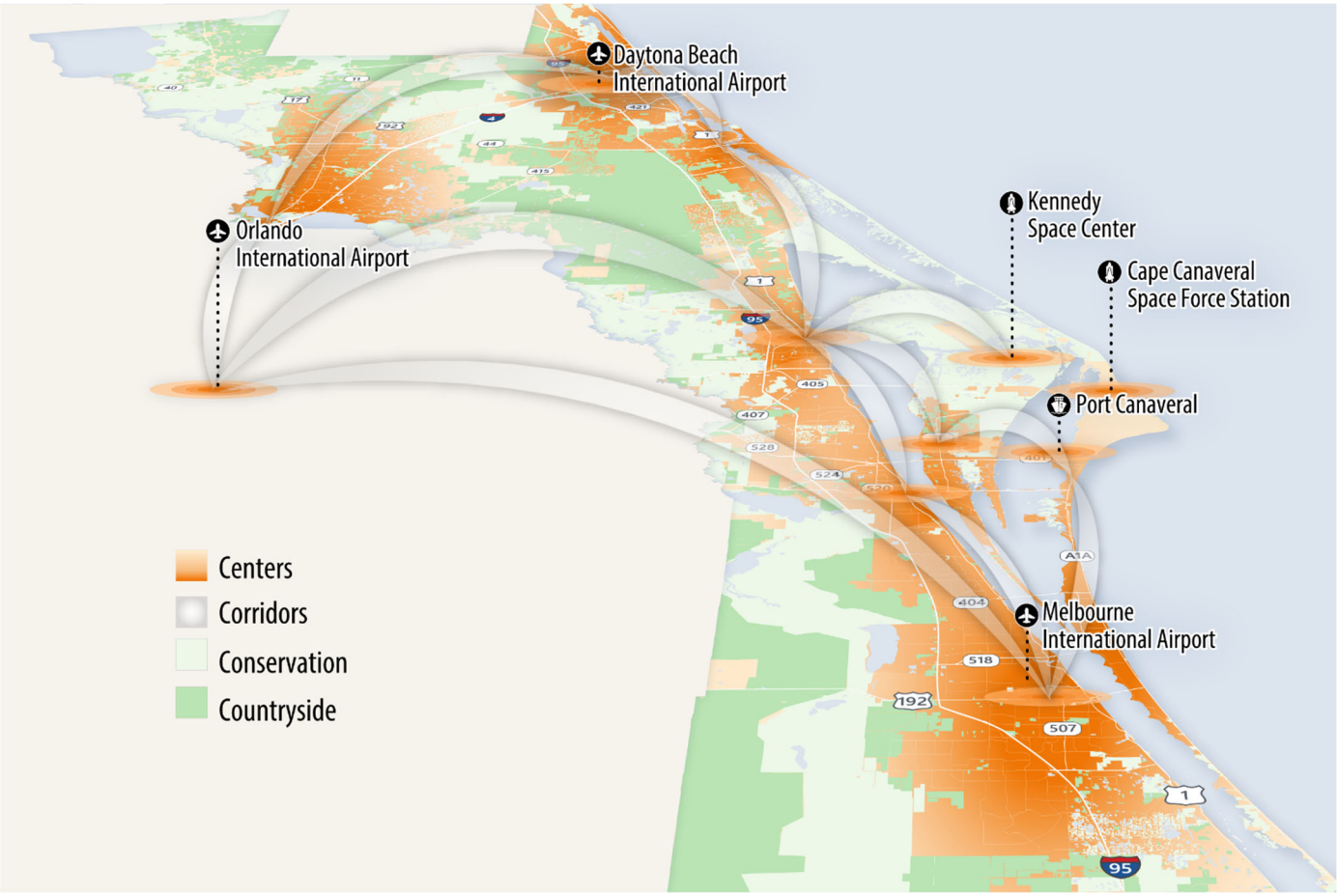
Healthcare becomes driven by personalized tele-medicine and medical devices. Decreasing medical trips on roadways and increasing medical delivery trips.

Boat Manufacturing: Increasing Lighter, Faster, and More Efficient, Manufacturing

To meet water recreation demand, manufacturers will employ new technologies to evolve products.

Regional Planning Vision

The anticipated growth in private industries was integrated with the long-range transportation plans of the Transportation Planning Organizations to develop a super-regional growth vision. Emphasis was placed on identification of the 4Cs - Centers, Corridors, Conservation, and Countryside.



The super-regional vision supports the Central Florida How Shall we Grow concept of creating centers or activity areas to live, work, learn, and play; developing corridors to connect the centers while providing choices for moving people and goods; conserving precious natural resources; and supporting agricultural activities in the countryside.

Short-Term Recommendations

Address Non-Recurring Congestion from Space Launch Activities

Space launches impact area travel by creating congestion, parking shortages, and safety concerns on roadways close to the spaceport facilities.

- Use Intelligent Transportation Systems (ITS) to coordinate event travel between I-95 and launch viewing locations. Install dynamic message signage (DMS) and parking occupancy sensors at designated parking sites and along SR 520, SR 528/SR A1A, SR 407/SR 405, and US 1. Incorporate into current *SR 528 Widening and Indian River Bridge/Space Commerce Way Replacement & Improvements.*
- To reduce event traffic impacts on local roads, identify a remote parking site (west of I-95 for visitors and within Cocoa Beach/Titusville for locals) and provide shuttle services to and from launch viewing areas. Prioritize enforcement to address safety and prevent parking in a hazardous manner along SR 528, SR A1A, US 1, and the NASA Causeway/SR 405. Add mobility hubs near popular launch viewing areas, cruise terminals, and airports for local access to alternative modes.

Improve Recurring Congestion in Region causing Truck Bottlenecks

Truck bottlenecks occur around the region's airports, along US 1 in New Smyrna Beach, Cocoa, and Viera, and along I-95, especially at the interchanges of I-4, SR 40, SR 421, SR 44, US 192, and SR 514.

- Incorporate freight signal priority into current projects: *Ellis Rd Widening, Indian River Bridge Replacement/ Space Commerce Way Widening & Improvements, and SR 528 Widening.* Evaluate key east-west corridors (SR 520 east of I-95, and US 192 east of I-95) and facilities close to ports (SR 3, SR A1A, SR 401) for implementation.
- Reduce personal automobile traffic through travel demand management (TDM) incentives activating carpool, vanpool, transit, rideshare, and active transportation along freight corridors and implementation of proposed Bus Rapid Transit (BRT) routes: US 1, SR 528, SR 520, SR A1A, and Wickham Rd.

Improve Safety Conditions at Truck Crash Hotspots

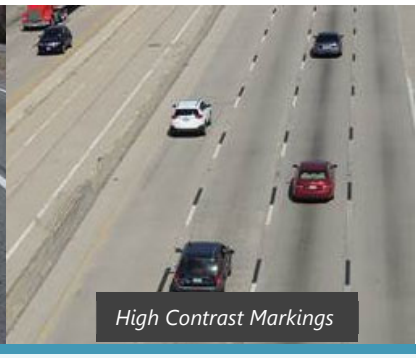
Truck crash hotspots are located along key space industry routes including I-95 and SR 528/ SR A1A. Other high crash locations near freight activity centers include I-4 at I-95 interchange, I-95 at US 1 interchange, and SR 528 at SR 3 interchange.

- Incorporate freight safety countermeasures into current projects: *SR 528 Widening, I-95 at US 1 PD&E, SR A1A – Misc./Intersection Realignment/New 2-lane Rd/Curb Gutter/Safety/Signal improvements.*
- Intersection mobility and safety applications can be used on the following corridors: SR 528/SR A1A east of I-95, SR 520 east of I-95 and SR 192 east of I-95; SR 3 at SR A1A and SR 405 (crossovers specifically noted as an issue) at US 1.

Static Warning Signs

Dynamic Warning Signs

Horizontal Signs


High Contrast Markings

Designate Oversize/Overweight (OS/OW) Routes

To reach Space Coast destinations, OS/OW transporters are forced into out of the way routes due to height and weight movement restrictions.

- Designate Super Haul Routes/Corridors with flexible features like swivel mast arms, removable/flexible signage, truck aprons, flexible median/zipper barriers, etc. Candidates include: SR 405, SR 528, US 1, and SR 3. The stakeholders should study OS/OW restrictions to eliminate circuitous routing. Areas of concern for study include Port. St. John Parkway and Citrus Boulevard overpasses. As key freight corridors are reconstructed in the future, ensure they are designed to handle the oversize/overweight needs of the region.
- Incorporate OS/OW freight needs into the following projects and advance *SR A1A – Misc./Intersection Realignment/ New 2 lane Rd/Curb Gutter / Safety/Signal improvements. SR 528 Widening, SR 401 Bridge Replacement, and I-95 Widening.*
- Support secondary route for Cape Canaveral launches, specifically improving Roy Bridges Jr. Bridge to accommodate OS/OW movements to the base.
- Improve access to maritime facilities (on the land and water side) to allow oversized moves that could be completed by barge to shift from highways.

Advance Regionally Significant Priority Projects by Identifying Construction Funding

With the availability of additional formula and discretionary funding opportunities through the Infrastructure Investment and Jobs Act, the regional partners should collaborate to secure construction funding for regionally significant priority projects.

Space Coast TPO

- Ellis Road Widening
- Babcock St. Widening
- Malabar Road Widening
- SR 528 Widening
- SR 401 Bridge Replacement over Canaveral Barge Canal
- SR A1A Multimodal Corridor Improvements
- Rail-highway crossing safety projects

**Note: refer to TPO list of priority projects for details*

River to Sea TPO

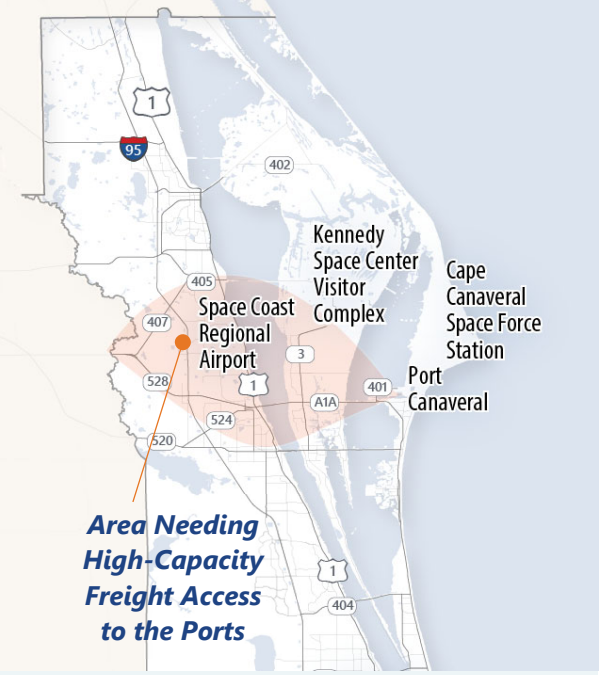
- I-4 BtU
- Widening of SR15, SR40, and SR100
- I-95 Interchanges at LPGA, US1, Pioneer Trail, and SR44

Long-Term Recommendations

Provide a Direct, High Capacity, Freight Super Corridor Facility to the Ports

With future acceleration in launch activities, reliable and direct transport of cargo to the ports is vital to maintain region's prominent aerospace industry.

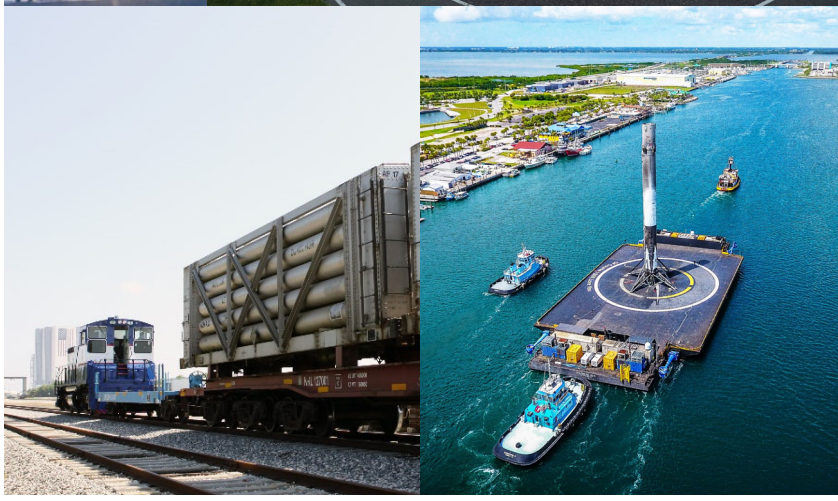
- Conduct a feasibility study to identify direct, high capacity, limited access facilities from I-95/SR 528 to the ports.
  - *Facility should be freight focused while accommodating passenger vehicles.*
  - *Use time of day freight priority treatments (e.g., movable medians and freight signal priority) to facilitate fast, off-peak deliveries (both standard shipments and OS/OW cargo).*
  - *Incorporate waterside and landside connectivity for cargo to come off of barges, or other vessels and go to the launch facilities directly.*
  - *Separate freight and passenger traffic closer to the ports and equip with technology enabled infrastructure.*



Enhance and leverage multimodal freight infrastructure including water, air, and rail

Private industry partners should have more choices into and out of the ports other than just highway.

- Conduct a study to develop a multimodal freight network that can improve goods movement in and out of the region. This may include the use of NASA railway and area waterways and should also consider future modes like vertiports and space point-to-point cargo transport. Additionally, consider transport connecting to offshore launch facilities.
  - *Review tradeoffs and potential constraints, for example, use of drawbridges impacting roadway congestion across the Canaveral barge canal.*



Near-Source Rocket and Satellite Manufacturing and Assembly

The demand for faster delivery of space components can be addressed if they are manufactured and assembled closer to launch operations.

- Space Florida can continue to attract industry partners and incentivize near-source rocket and satellite manufacturing and assembly targeting development sites in the area that allow for streamlined connections to the ports. This includes the undeveloped acres in the Spaceport Commerce Business Park and the utility corridor around Cape Canaveral, which recently signed Terran Orbital as the first tenant.
  - *Work with educational institutions within the Central Florida High-Tech Corridor like Embry Riddle, University of Central Florida, and area state and private colleges to develop workforce of the future.*

Develop Automated Freight Corridors between Major Freight Origin and Destination Centers

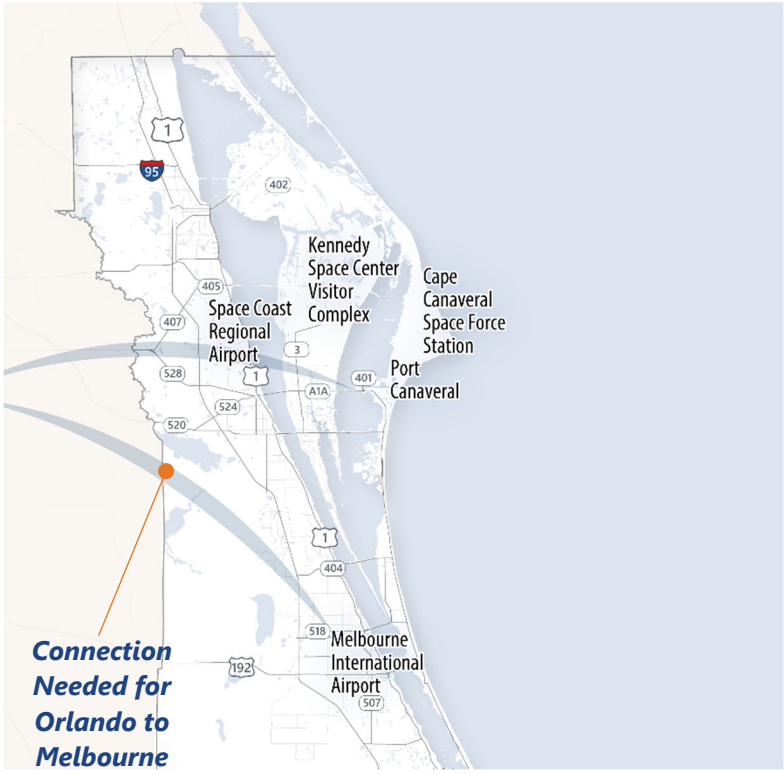
Movement of cargo can be automated and accomplished through innovative, flexible alternatives to avoid congestion.

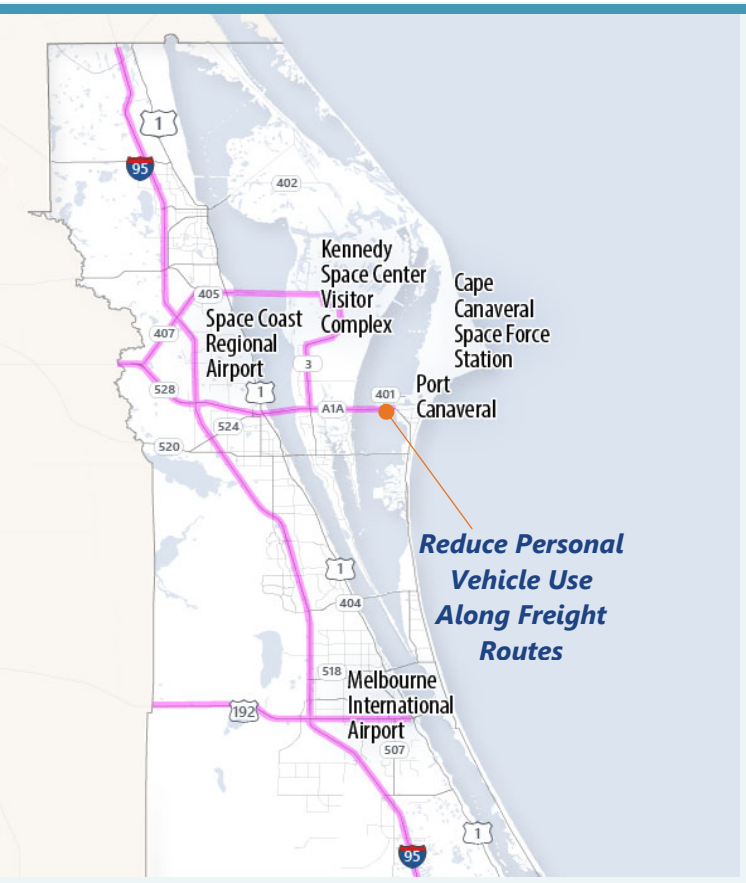
- As freight activities in the area grow and new freight activity centers emerge, automated corridors between major activity centers can offer improved efficiency of the system.
  - *Technology considerations may include freight shuttle express, hyperloop freight, and automated freight highways.*

Establish Direct Corridors between Activity Centers to Enhance System Connectivity and Accessibility for both Passenger and Freight

Lack of direct connections between major activity centers creates longer trips and congestion bottlenecks.

- To improve congestion and travel time between the Space Coast and Central Florida, consider developing a new corridor between Orlando and Melbourne.





Reduce Personal Vehicle Traffic Along Major Freight Routes Leading to the Ports

Develop strategies to prioritize cargo movement while shifting personal travel to other modes of transportation along freight routes.

- Identify a package of mobility solutions to encourage mode shift including transit, land use controls, incentives, strategic/controlled parking, etc.

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Transport of Rockets Near ULA (Source: Visit Space Coast)

INTRODUCTION

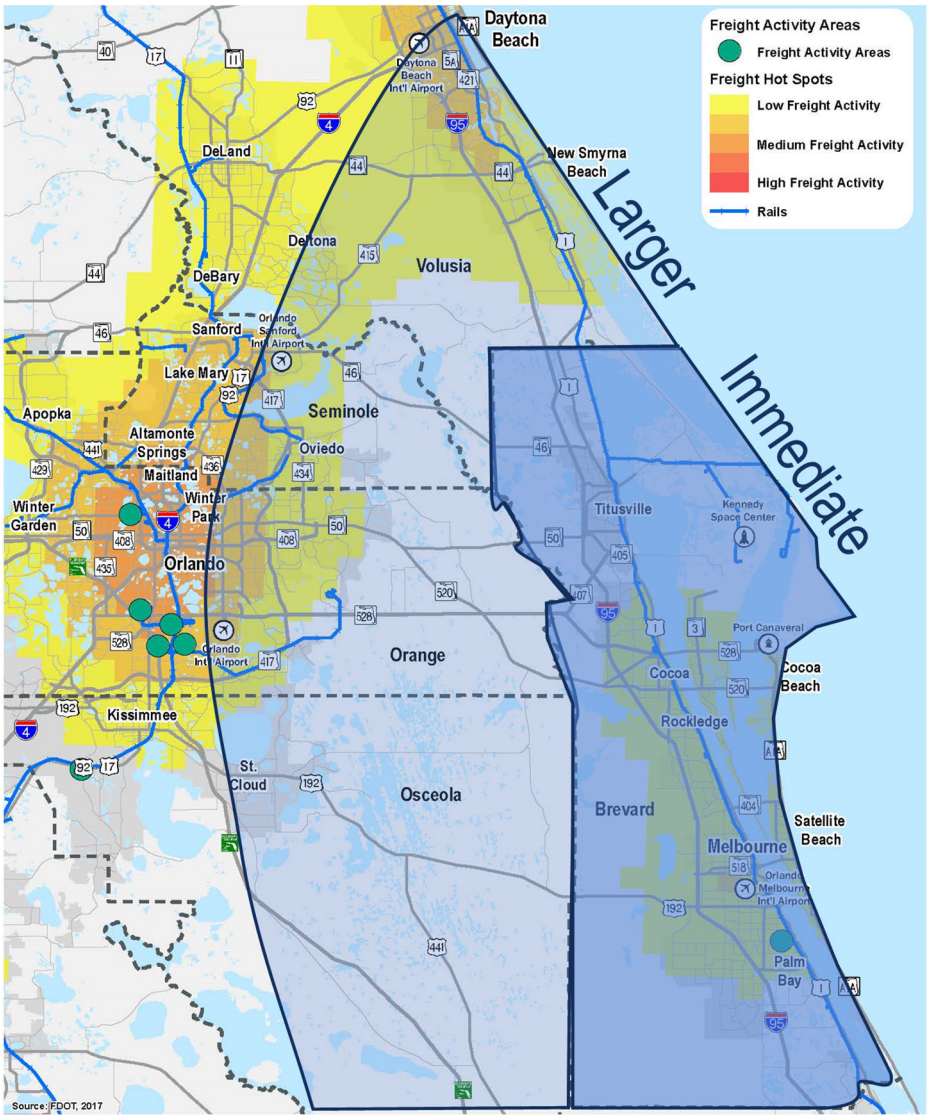
The Phase II Study (Space Coast Super-Regional Freight Study) explores freight transportation needs beyond the immediate influence of the Cape Canaveral Spaceport (CCS), which includes the Kennedy Space Center (KSC), Patrick Air Force Base, and Cape Canaveral Air Force Station (CCAFS). While NASA and USAF maintain a presence at the CCS, the area has transformed to serve private sector space activities. Major private industry companies, like SpaceX and Blue Origin, have been attracted to the region and are helping to spur growth. This study considers the unique needs of the aerospace industry and transportation corridors connecting the CCS with the region and beyond.

Purpose

While private sector industry growth has fueled a new era for the Space Coast, it has also impacted the movement of freight. The purpose of this study is to provide better understanding of these impacts, explore issues and opportunities, and identify low-cost solutions that prepare the area to accommodate future movements of freight.

Phase I of the study provided a foundation for assessing the "Immediate Subarea," **Figure 1**, including major industries impacting the area's economy. Phase II builds upon this work, expanding the focus to the "Larger Subarea" to understand the relationship and impacts to the greater region. The goal of Phase II is to take feedback from stakeholders and analysis of regional freight movements and develop a super-regional (encompassing both the immediate and larger areas) vision for freight.

***Figure 1** | Study Area Super Region*



Methodology

Phase II encompasses a range of tasks. This includes continued stakeholder engagement; exploration of industry micro-scenarios; synthesis of regional visions and scenario planning; analysis of infrastructure and oversized/overweight (OS/OW) cargo challenges; identification of congestion bottlenecks; and a review of applicable emerging technology solutions.



Transportation of Orion Crew Module (Source: NASA)

Report Structure

This report follows the methodology structure already outlined and provides findings in the following:

- Stakeholder Engagement & Micro-Scenarios describes the stakeholder engagement approach including the development of micro-scenarios.
- Long-Range Vision identifies the process of synthesizing the visions from area TPOs, findings from the micro-scenarios, and scenario planning in the development of a long-range vision for freight for the super region.
- Infrastructure Challenges reviews infrastructure challenges including state of good repair, weight and height limits, and accessibility.
- Congestion Bottlenecks provides information on recurring and non-recurring bottlenecks and unauthorized parking issues during launch events.
- Oversized and Overweight Cargo explores OS/OW cargo issues in and outside of the region including designation of routes and geometric/flexible design solutions.
- Emerging Technologies highlights emerging technologies such as connected and automated vehicles as well as alternative fuels. Also, this chapter looks at signal and technology infrastructure.
- Recommendations provides the actionable recommendations, including the coordination approach with stakeholders for implementing the super-regional freight vision.

STAKEHOLDER ENGAGEMENT & MICRO-SCENARIOS

Stakeholder Engagement

Phase I stakeholder engagement was conducted to understand the baseline conditions and concerns for freight in the Space Coast. This was done through three technical and executive committee meetings with public and private industry leaders. This committee membership included:

- FDOT
- River to Sea TPO
- Canaveral Port Authority
- Naval Ordnance
- Space Florida
- Blue Origin
- Office of Space Launch
- Boeing
- Space Coast TPO
- Port Canaveral
- United Launch Alliance
- Astrotech

In addition, a survey was distributed to these representatives for further insight on specific issues. The feedback from this included bridge issues, congestion, direct access to the spaceport from the highway, and connectivity with the regional airports. Opportunities and improvements were also discussed.

Phase II stakeholder engagement builds off insights gained from Phase I and fosters deeper discussions with some of the technical committee stakeholders to develop major industry micro-scenarios. Once developed, these scenarios were shared with committee stakeholders.

The goal of Phase II is the development of a super-regional vision that addresses the needs of freight throughout the Space Coast region, aligning themes from each of the major stakeholder's visions. To inform such a vision, the micro-scenarios provide insights on what to expect from other industries for the near- and long-term future. A series of one-on-one interviews was conducted with some of the area's stakeholders, and key feedback was incorporated into the development of these scenarios.

Micro-scenarios

Micro-scenarios were developed based on a review of the current state of the regional economy (the immediate and larger study area) and consideration of long-term trends and impacts. The following six industries are important for growth in the super region based on higher employment and payroll in the "Economic Profile" of the "Space Coast/East Central Florida Freight & Logistics (Subarea Study Phase I)" Report:

General themes or highlights for each of the scenarios are included in **Table 1.** Each of the six industries in the area is, in turn, further described in the pages that follow.

Table 1 | *Industry Highlights*

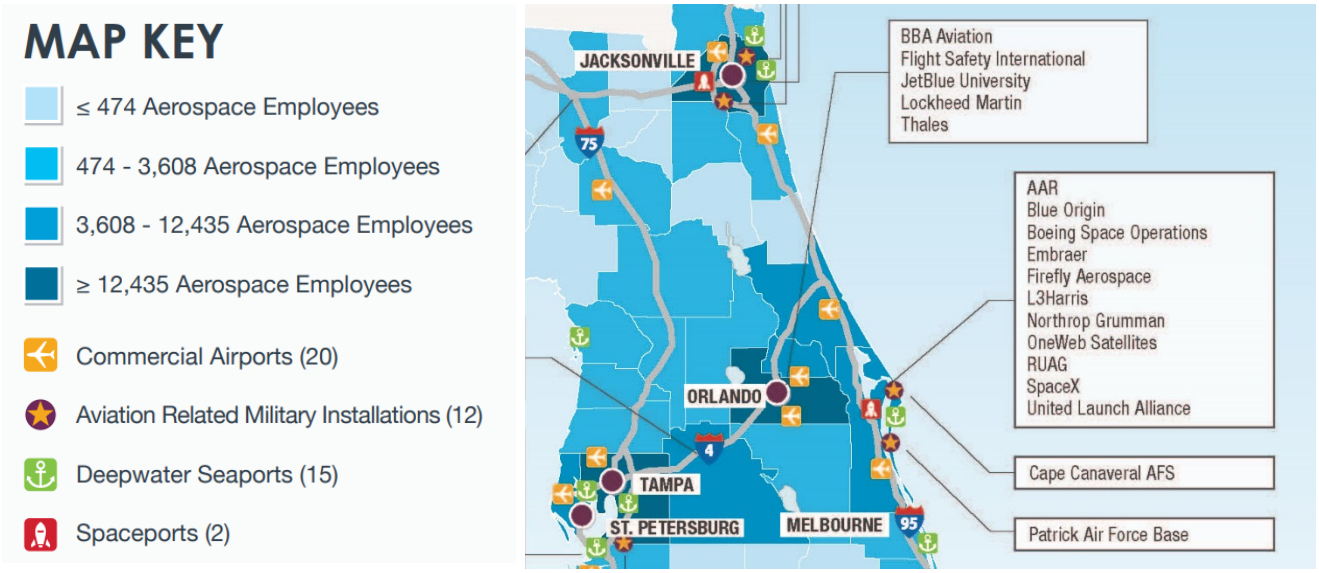
Industry	Highlights
Aerospace/ Space	▪ The space industry will continue to grow in the region with more commercial space operations (e.g., SpaceX, and Blue Origin) and public sector investments (NASA, USAF, FDOT). With this growth, more heavy, unusually shaped loads will navigate through the area network and other modes may be used via air, rail, and water. Demand and supply of fuel for this industry will also grow. ▪ Land uses may evolve with more visitors to the area from the related industries including defense, commercial space, researchers, etc. As this industry grows, accommodations will also be needed to support the needs of this population such as housing, hotel, restaurants, shopping, etc. ▪ The sensitive nature of instruments being transported for the spaceport will need to be considered in terms of interaction with intelligent transportation systems (ITS).

Industry	Highlights
Maritime (Passenger & Cargo)	▪ Demands for personal transportation vehicles (in any form; e.g., gasoline, hybrid, or electric) will continue to support growth of the new roll-on roll-off (Ro-Ro) facility at Port Canaveral. ▪ Port Canaveral will continue to diversify its services, remaining a viable option for services offered by Jaxport, Port Everglades, and PortMiami. ▪ Larger cruise vessels increase the number of passengers. ▪ Smart port infrastructure for logistics and autonomous technologies will need reliable ITS/broadband infrastructure.
Tourism	▪ Regional tourism will increase due to a growing number of rocket launches and proximity to popular attractions, such as beaches, theme parks, and cruises. ▪ The desire to have visitors, such as cruise passengers, stay longer before and after embarkation will increase demand for attractions and land uses (hotels, shopping, restaurants) in the area.
Transportation & Warehousing	▪ New investment in the Melbourne International Airport near the NASA Causeway Bridge will continue to support growth. ▪ E-commerce growth, especially for same day/same hour delivery increases demand and constraints on last mile delivery; demand for fulfillment centers/distribution centers also increases.
Healthcare	▪ HealthFirst is one of the largest health care networks in Brevard County, and is anticipated to continue to grow with the new Health Villages being developed. ▪ The aging population in Florida and the region will continue to support the need for healthcare industry expansion. ▪ Advances with medical devices and pharmaceutical distribution may result in smaller shipments and more sent directly to consumers instead of retailers.
Boat Manufacturing	▪ Public outdoor recreation, specifically for motorized water vehicles, will continue to grow. ▪ Changes in boat manufacturing may impact the type of materials delivered to factories.

Aerospace/Space Industry

Florida is home to two of nine active spaceports in the U.S.: CCS and the Cecil Field Spaceport. The state is the leader in active launch licenses held by private industry — eight of 17 licenses permitting a rocket launch into space are authorized from sites in Florida.[1] The Space Coast is an anchor for this industry, with major employment clusters shown in **Figure 2.** There were 3,858 people employed in aerospace manufacturing in the Palm Bay-Melbourne-Titusville Metropolitan Statistical Area (MSA), and 107 people employed in the Deltona-Daytona Beach-Ormond Beach MSA in 2018.[2] Some major Brevard County employers in 2019 included the Harris Corporation: 5,890; Department of Defense: 2,170; NASA: 2,067; Rockwell Collins Inc: 1,410; Northrop Grumman Corporation: 1,345; Florida Institute of Technology: 1,280; and Embry-Riddle Aeronautical University – 1,326 in Volusia County.[3]

Figure 2 | *Aerospace and Aviation Industries (Source: Enterprise Florida)*



[1] https://fedconline.org/top-5-industries-in-florida-which-parts-of-the-economy-are-strongest/#:~:text=Aerospace%20and%20Aviation&text=And%20the%20state%20is%20the,second%20with%20four%20launch%20licenses.
[2]https://data.census.gov/cedsci/table?g=310M500US19660,37340&d=ANN%20Business%20Patterns%20County%20Business%20Patterns&n=3364&tid=CBP2018.CB1800CBP&hidePreview=true
[3] https://business.ucf.edu/wp-content/uploads/sites/4/2020/11/UCF_FLMetro_Forecast-Q3-2020_red.pdf

Transport of Rockets, 1960s (Source: NASA)

Background

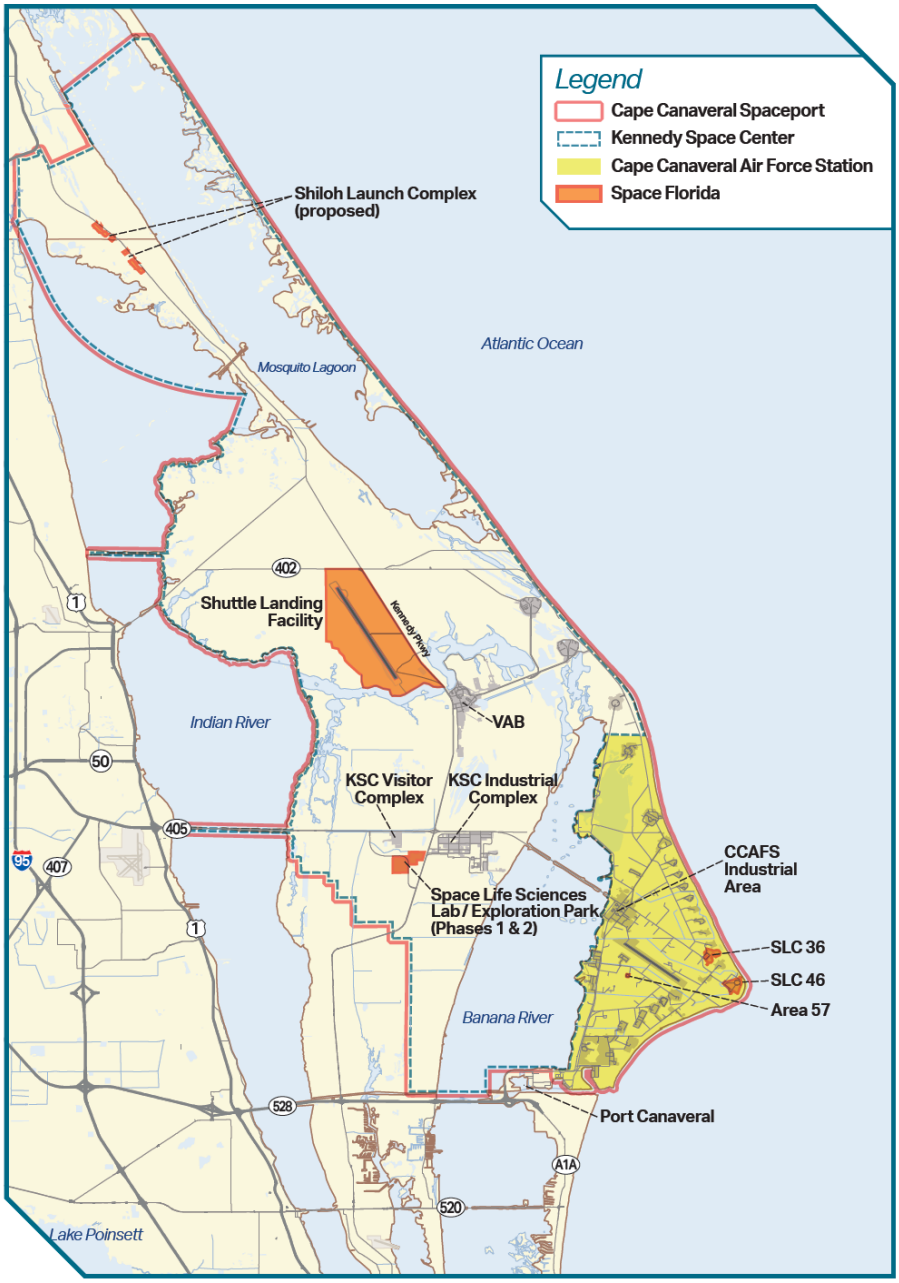
Cape Canaveral has been identified with the U.S. space industry since the nation's missile development programs of the 1950s. Transport of humans into space and the Moon in the 1960s elevated the area's position with space exploration. As shown in **Figure 3**, the spaceport has grown with built infrastructure encompassing NASA's KSC, and the CCAFS – collectively known as the CCS.

Why Cape Canaveral?

A 15,000-acre site at Cape Canaveral was selected for the Joint Long-Range Proving Ground in 1949. The site was isolated, mostly uninhabited, undeveloped, and with portions already government owned making it an ideal location. In 1961, the area expanded to support operations for landing humans on the Moon. At that time, government officials secured additional land north and west of the Cape for the manned lunar program.[4]

[4] https://www.spaceflorida.gov/wp-content/uploads/2018/12/sf-bod-approved-ccs-master-plan-02-01-17.pdf

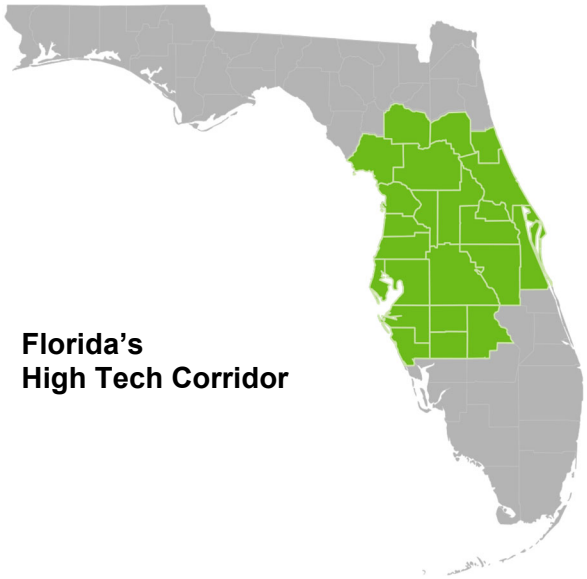
Figure 3 | *Cape Canaveral Spaceport (Source: CSS Master Plan)*



Since then, Cape Canaveral has launched **more cargo tonnage and humans into space than from anywhere else on earth**. The location is supported by Florida's statewide transportation network, advanced universities, and economic infrastructure. Florida's High-Tech Corridor and more specifically the Cape Canaveral Spaceport Technologies Triangle are clustered within a 50-mile radius of CCS, (left side of **Figure 4)**. At each point of this geography there is an international airport and aerospace university.[5]

The CCS supports the full range of launch vehicle classes including small, medium, and heavy, allowing orbit lift capability for most payload types. Launch providers can support the needs and market of the Department of Defense (DoD), commercial operators and markets, and U.S. civilian science agencies.

Figure 4 | *Spaceport Technologies Triangle & Florida's High-Tech Corridor (Source: CCS Master Plan)*



[5] https://www.spaceflorida.gov/wp-content/uploads/2018/12/sf-bod-approved-ccs-master-plan-02-01-17.pdf

Evolving Governance

During the 1960s, governance of Cape Canaveral was split between NASA, for land jurisdiction of the KSC, and USAF which retained management and operation of the Eastern Range and land jurisdiction for CCAFS. In 1989, Florida established the nation's first state-chartered space transportation authority with Spaceport Florida Authority. The first formalized use of CCS was with Spaceport Florida Authority's commercial site license for Space Launch Complex (SLC) 46. Its application to the land boundaries of KSC and CCFS was recognized as an unofficial designation in the joint 2002 CCS Master Plan conducted by NASA, USAF, and Spaceport Florida Authority. The three agencies agreed that as the spaceport evolves, so too must its management. Currently, Space Florida carries out the planning and operations for CSS.

Currently there is consensus that the governance of CCS must adapt to the future of the spaceport. **Figure 5** shows the current roles at the spaceport between government and private entities. Space Florida's Vision 2025 promotes an independent authority for the operation of CCS as part of an integrated, multi-sector spaceport. CCS stakeholders desire the creation of space commerce zones and possibly a transitional council. Ultimately it is envisioned that just as the Canaveral Port Authority manages port commercial enterprises, this model can inform CCS as an independent spaceport authority.[6]

***Figure 5** | CSS Governance*

[6] https://www.spaceflorida.gov/wp-content/uploads/2018/12/sf-bod-approved-ccs-master-plan-02-01-17.pdf

CCS Current Roles

Various federal, state, and commercial enterprises make up "the players" in defining, managing, and operating the CCS. As illustrated in **Figure 6**, the principal roles at CCS include:

- **Spaceport Landowners** - The entities that own the land. The owners of the land within CCS are State of Florida, NASA, and USAF.
- **Spaceport Land Managers** - The entities that manage the use, development, and operations on a parcel of land via a mutual agreement with the landowners.
- **Spaceport Developers and Operators** - The private and commercial partners of the aerospace and defense industries that conduct business operations at the CCS.
- **Spaceport Approval Authorities** - The entities/agencies responsible for exercising autonomous authority for the mission or the betterment of humanity, the environment, and endangered species.[7]

Figure 6 | *CCS Governance and Roles (Source: Space Florida)*

	ROLE			
THE "PLAYERS"	LAND MANAGERS	LAND OWNERS	APPROVAL AUTHORITIES	DEVELOPERS AND OPERATORS
Space Florida	●			●
SpaceX	●			●
United Launch Alliance	●			●
Boeing	●			●
Blue Origin	●			●
Moon Express	●			●
OneWeb / Airbus	●			●
NASA	●	●	●	●
FDOT	●		●	
USAF 45th Space Wing	●	●	●	●
State of Florida	●	●	●	
US Fish and Wildlife Service	●		●	
National Park Service	●		●	
FAA			●	
USACE			●	
Florida DEP			●	
SJRWMD			●	
US. Navy (NOTU)	●			●
AstroTech				●
Other Commercial Entities				●

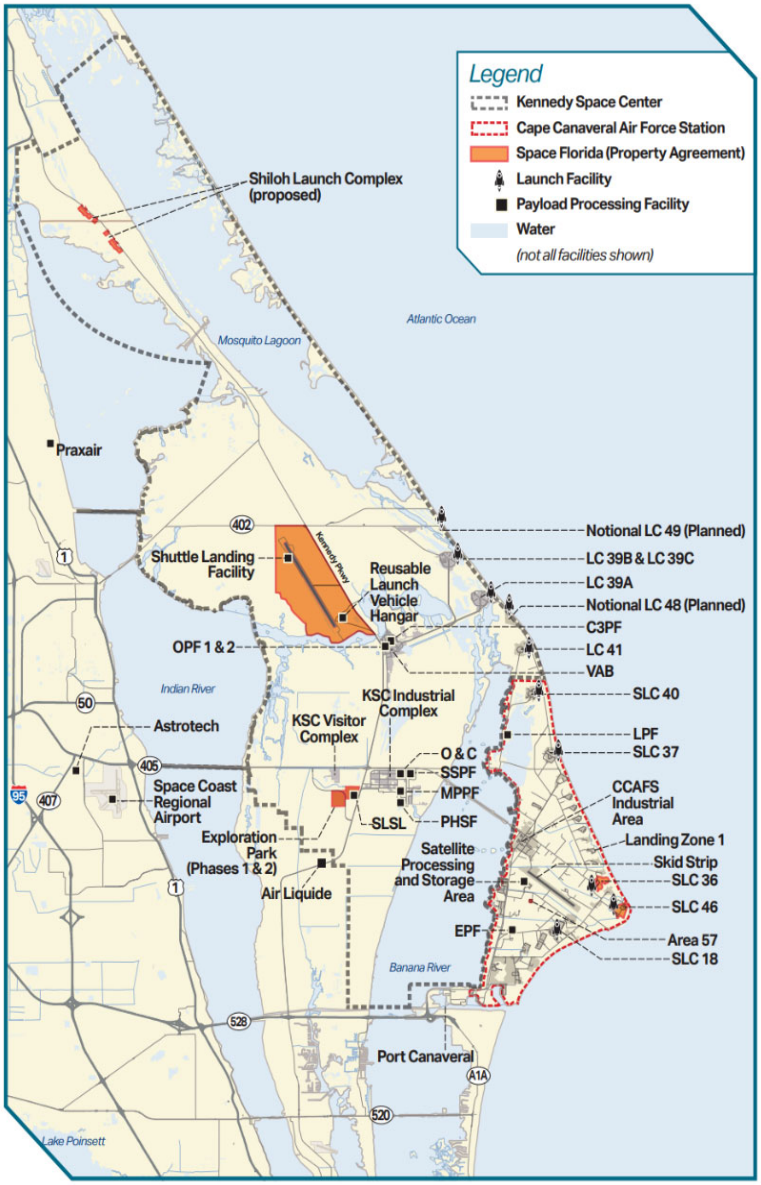
[7] https://www.spaceflorida.gov/wp-content/uploads/2018/12/FSSP18_FINAL__03-06-2018__Low-Res.pdf

Current CCS Operations

The CCS comprises two properties: 1) KSC and 2) CCAFS (**Figure 7**). KSC makes up the largest portion of CCS and is NASA's only launch site for human spaceflight. It is located on Merritt Island and covers 219 square miles; the remaining area is managed by the Merritt Island National Wildlife Refuge and the Canaveral National Seashore. After the cancellation of the NASA Space Shuttle program in 2011, KSC has evolved into a multi-use spaceport serving government and commercial customers.

The CCAFS is part of the Air Force Space Command's 45th Space Wing, headquartered at Patrick Air Force Base. It is the launch site of the Eastern Range covering over 15 million square miles to the Indian Ocean. The CCAFS directs launch operations and support for military, civil, and commercial launches. CCAFS offers a variety of facilities including five orbital SLCs, and a 10,000-foot runway for horizontal launch. There are also vehicle re-entry corridors, an operations control center, and processing facilities.

***Figure 7** | Cape Canaveral Spaceport Map (Source: Space Florida)*



CCS services commercial and diversified carrier systems using the following payload and processing facilities (mapped in **Figure 7):**

- Armstrong Operations and Checkout (O&C) Building;
- Orbiter Processing Facility (OPF) 1;
- Orbiter Processing Facility (OPF) 2;
- Commercial Crew and Cargo Processing Facility (C3PF);
- Multi-Payload Processing Facility (MPPF);
- Payload Hazardous Servicing Facility (PHSF);
- Space Station Processing Facility (SSPF);
- SpaceX Payload Encapsulation and Integration Facility;
- Large Processing Facility (LPF);
- Eastern Processing Facility (EPF);
- CCAFS Satellite Processing and Storage Area (Area 59);
- Space Life Sciences Laboratory (SLSL); and
- Astrotech Space Operations (ASO).

Astrotech Space Operations is the only major payload processing establishment in Florida not located on CCS. Astrotech serves multiple DOD civil and commercial customers with satellite processing. Astrotech manages ten buildings dedicated to payload processing.

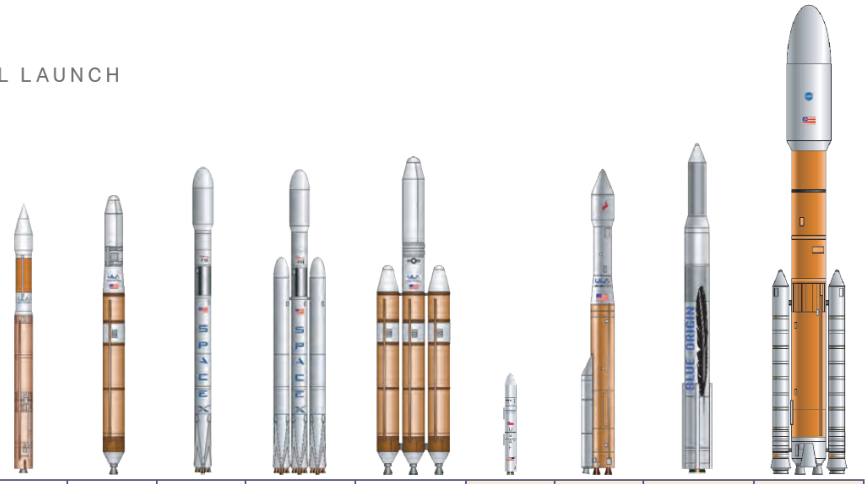
Launch Vehicles

In the United States, there has been an average of 18 orbital launches per year since 2008, mostly supporting government missions.[8] Recent private industry activity in Florida successfully conducted 31 orbital launches in 2020, doubling 2019 launches (15).[9] The majority, 12 per year, are launched from CCS. Launch vehicles are categorized as expendable launch vehicle (ELVs) or reusable launch vehicles (RLVs). Due to high investment and decreased infrastructure needs, companies are developing RLVs for suborbital and orbital missions. **Figure 8** illustrates the main orbital launch vehicles and spacecraft currently operating, or are expected to operate, at CCS.[10]

[8] https://www.spaceflorida.gov/wp-content/uploads/2018/12/FSSP18_FINAL__03-06-2018__Low-Res.pdf
[9] https://www.floridatoday.com/story/tech/science/space/2021/01/01/florida-just-had-its-busiest-orbital-rocket-launch-year-decades-spacex-ula/3923066001/
[10] https://www.spaceflorida.gov/wp-content/uploads/2018/12/FSSP18_FINAL__03-06-2018__Low-Res.pdf

***Figure 8** | Launch Vehicles (Source: FAA)*

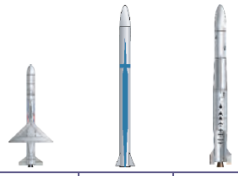
VERTICAL LAUNCH



Vehicle	Atlas V	Delta IV	Falcon 9	Falcon Heavy	Delta IV Heavy	Minotaur IV	Vulcan	New Glenn	SLS
Lift Class	Medium	Medium	Medium	Heavy	Heavy	Small	Medium	Medium-Heavy	Super Heavy
Operator	ULA	ULA	SpaceX	SpaceX	ULA	Orbital ATK	ULA	Blue Origin	NASA

Expected 2017-2020

HORIZONTAL LAUNCH



Vehicle	Pegasus XL	GOLauncher-2	LauncherOne
Lift Class	Small	Small	Small
Operator	Horizontal ATK	Generation Orbit	Virgin Galactic

Area Airports Background

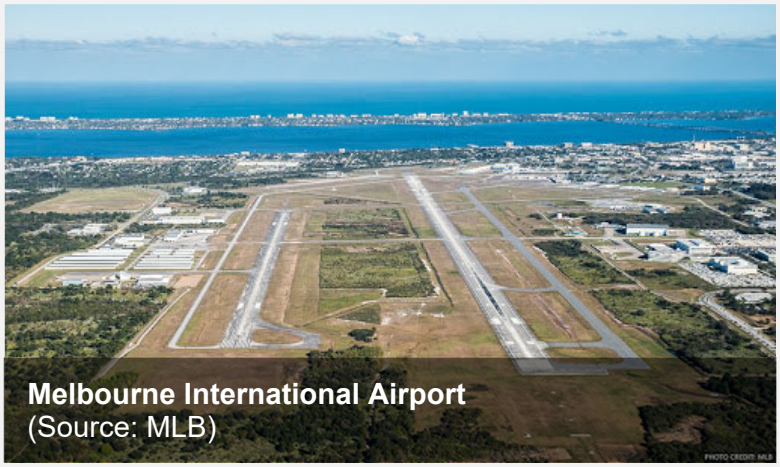
As shown in **Figure 9,** East Central Florida has four commercial service and 19 general aviation airports, including five FAA-designated relievers. Orlando International Airport, Orlando Sanford International Airport, Daytona Beach International Airport, and Melbourne International Airport are an important link for regional tourism, leisure travel, and business convention industries. Additionally, the region's intermodal connectivity offers an advantage for transportation of people and goods.[11]

Figure 9 | *Florida East Central Florida Airports (Source: FDOT FASP 2035)*

[11] https://www.fdot.gov/aviation/FASP2035

Melbourne International Airport

In 1933, the City of Melbourne acquired 160 acres west of the Indian River for a new municipal airport. This facility supported World War II operations as a temporary Naval Air Station, which trained pilots and housed German prisoners of war. The city resumed control over the airport in 1946 as a municipal airport. Scheduled commercial air service began in 1952 and has been running ever since.[12]



Melbourne International Airport
(Source: MLB)

The Melbourne International Airport (MLB) is a commercial service and general aviation facility, about two miles north of downtown Melbourne accommodating both commercial and general aviation.[13] The facility mainly supports tourism, business activity, and recreational flying with 2,000 weekly operations and with 20,000 daily employees and visitors. Also, the airport is a top employer with the site supporting multiple aviation manufacturers, maintenance and repair firms, and defense contractors.[14] Some major tenants include: Northrop-Grumman, Embraer Executive Jets, Harris Corporation, Rockwell Collins, and the Florida Institute of Technology.[15]

[12] http://mlbair.com/EconomicOpportunities.aspx/BusinessOpportunities/FutureLandUsePlan.aspx
[13] http://mlbair.com/EconomicOpportunities.aspx/BusinessOpportunities/FutureLandUsePlan.aspx
[14] https://www.fdot.gov/aviation/economicimpact.shtm
[15] https://www.fdot.gov/aviation/FASP2035

Daytona International Airport

Aviation in Daytona Beach began on the beach with daredevil pilots providing entertainment to shoreline hotel guests. This prompted Volusia County to consider Daytona Beach as a site for its first airport, including airmail deliveries. In 1928, the City of Daytona Beach moved its airport from the beach to the Bethune Point location along the Halifax River.[16]

Daytona International Airport
(Source: Daytona International Airport)

Daytona Beach International Airport is a commercial service and general aviation facility in Volusia County, located three miles west of downtown Daytona Beach. The airport accommodates a full range of commercial and general aviation aircraft. The airport supports business activity, recreational flying, and flight training.[17]

Space Coast Regional Airport

The Titusville-Cocoa Airport was developed by the United States in 1943 as a supplementary airfield to the Sanford Naval Air Station during World War II. Under the “Development of Landing Areas for National Defense” program, the airport was meant to relieve other area military bases. The airport was deeded to the cities of Titusville and Cocoa Beach in 1947, and the "Titusville-Cocoa Airport District Act of 1963" created the Titusville-Cocoa Airport District and the Titusville-Cocoa Airport Authority ("Authority") to govern operations of airport facilities. This legislation enabled the Authority to govern the Airport District, which includes the Space Coast Regional Airport, Arthur Dunn Airpark, and Merritt Island Airport.[18]

Space Coast Regional Airport
(Source: Space Coast Regional Airport)

[16] http://www.flydaytonafirst.com/about-dab/historical-information.stml
[17] https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/aviation/daytona-beach-erau_update.pdf?sfvrsn=f9bfc326_2
[18] http://www.ticoairportauthority.com/tix-history.html

Space Coast Regional Airport is in Brevard County approximately seven miles south of downtown Titusville. The airport accommodates most general aviation aircraft and general aviation activities. The airport mainly supports business activity and flight training. The Space Coast Regional Airport is also the closest airport to the KSC. This allows it to accommodate the travel needs of KSC visitors and stakeholders. The airport provides aircraft maintenance and two full service fixed-based operators (FBOs) to serve local and transient users.[19] Also, this airport is currently in the process of securing a spaceport license. [20]

Future Trends

Historically, Florida has been recognized as the home of United States human aerospace operations and will continue to support space industry growth. Space Florida aims to leverage this leadership role and focus efforts on 11 market segments (listed below):

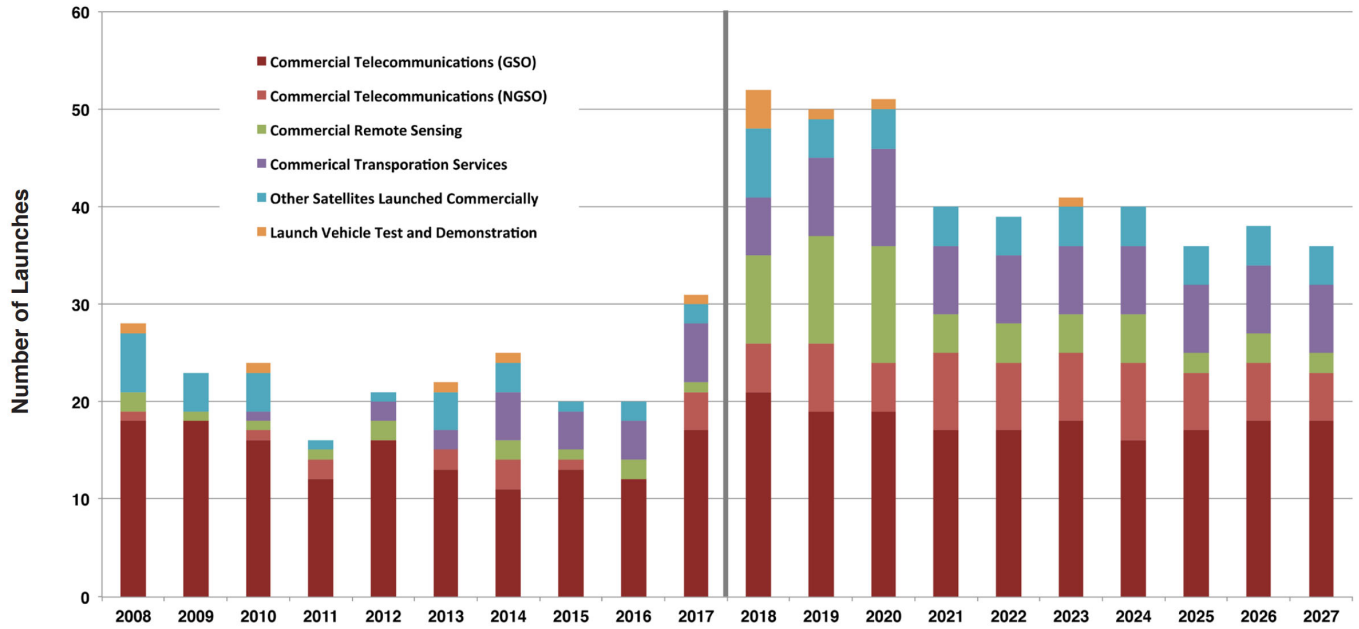
- Space transportation and technologies support systems;
- Satellite systems and payloads;
- Ground and operations support systems;
- Advanced materials and new products;
- Agriculture, climate and environmental monitoring;
- Civil protection and emergency management;
- International Space Station (ISS) and human life sciences;
- Cis-lunar space;
- Communications, cybersecurity, and robotics;
- Adventure tourism; and
- Clean energy.

[19] https://www.fdot.gov/aviation/economicimpact.shtm
[20] http://www.ticoairportauthority.com/spaceport-license.html

Orbital

Figure 10 summarizes global commercial launches by industry segments through 2027. Overall, **423 launches are forecast for the 2018-2027 decade**, averaging 42 commercial launches per year. Fostering growth will be new commercial cargo services and crewed flights to ISS beginning 2020/2021. NASA selected Boeing and SpaceX to provide commercial crew transportation services. United Launch Alliance (ULA) will continue to support the government market with its Atlas V and Delta IV rockets and SpaceX, Blue Origin, and Orbital ATK are marketing to international customers.[21]

***Figure 10** | Historical and Projected Global Launches (Source: FAA)*



[21] https://www.spaceflorida.gov/wp-content/uploads/2018/12/FSSP18_FINAL__03-06-2018__Low-Res.pdf

According to Space Florida, 152 Florida orbital launches were conducted between 2006 and 2017, an average of about 13 per year; 36 of these were commercial. **During the next ten years, the average number of CCS orbital launches is expected to increase to over 30 annually (130%)** as compared with previous activity. This is due to commercial cargo and crew services to the ISS that began in 2012.[22]

Over the next ten years the orbital launch industry may evolve due to new launch vehicles. NASA will rely more on commercial vehicles to resupply the ISS. **Of the 41 launches listed in the SpaceX manifest, 29 are planned for launch from CCS**.[23] However, the majority of KSC's infrastructure will support NASA's Space Launch System (SLS) and Orion Multi-Purpose Crew Vehicle. LC-39C (completed in 2015) supports a fleet of small class launch vehicles. SLC-18 was was-purposed in 2018-2019 to support Moon Express's mission of mining the Moon for natural resources. SLC-36/SLC-11 will accommodate Blue Origin's New Glenn and New Shepard Launch Vehicles.[24]

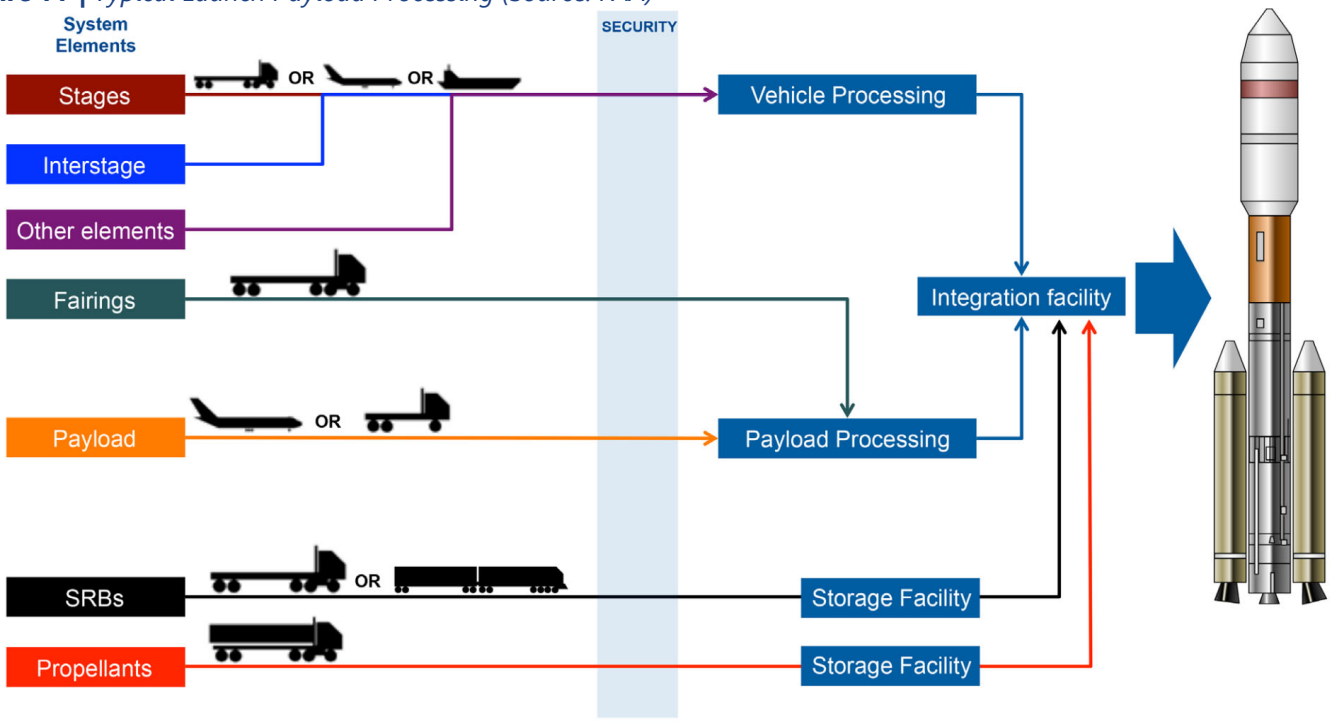
Suborbital

Deploying RLVs during the next ten years may increase suborbital launches. There are nine RLVs in active planning, development, or operation with **payload capacities ranging from tens of kilograms to hundreds, with the largest being about 700 kilograms (1,543 pounds).** RLVs can address at least six markets including commercial human spaceflight, basic and applied research, aerospace technology test and demonstration, media and public relations, education, and satellite deployment. Many RLVs carry humans, with current designs supporting about eight individuals.[25] Florida RLV operations may use leased assets at CCS and Cecil Spaceport. Other Florida launch and re-entry sites are being considered including the Space Coast Regional Airport in Titusville.[26]

[22] https://www.spaceflorida.gov/wp-content/uploads/2018/12/FSSP18_FINAL__03-06-2018__Low-Res.pdf
[23] https://www.spaceflorida.gov/wp-content/uploads/2018/12/FSSP18_FINAL__03-06-2018__Low-Res.pdf
[24] https://www.spaceflorida.gov/wp-content/uploads/2018/12/FSSP18_FINAL__03-06-2018__Low-Res.pdf
[25] https://www.spaceflorida.gov/wp-content/uploads/2018/12/FSSP18_FINAL__03-06-2018__Low-Res.pdf
[26] https://www.spaceflorida.gov/wp-content/uploads/2018/12/FSSP18_FINAL__03-06-2018__Low-Res.pdf

Florida has substantial infrastructure to support existing and forecast launch activity for these missions. Each orbital mission requires unique procedures for vehicle component transport from the manufacturing site to launch site, component receipt at the launch process for space launch, and reentry operations. **Figure 11** illustrates the infrastructure required to support an orbital launch.[27]

Figure 11 | *Typical Launch Payload Processing (Source: FAA)*



[27] https://www.spaceflorida.gov/wp-content/uploads/2018/12/FSSP18_FINAL__03-06-2018__Low-Res.pdf

Major Future Project: NASA's Lunar Operations

NASA Moon Mission & SLS Rocket for Artemis Program (Source: NASA)

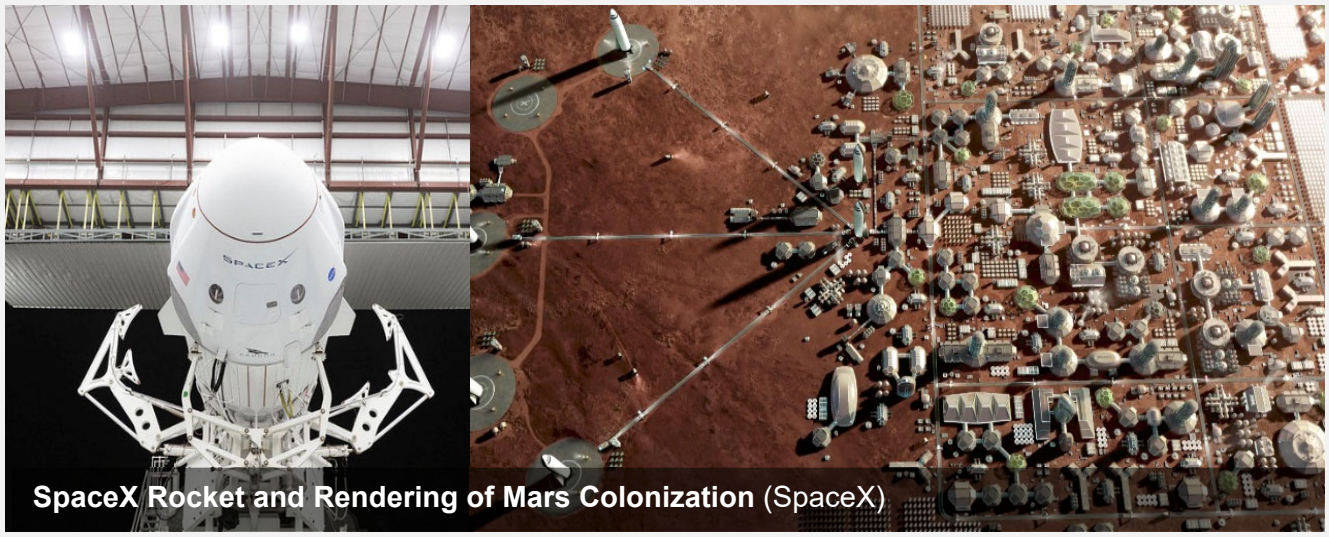
NASA has several plans for space exploration with the biggest being its Moon to Mars program. This is under the Artemis program that aims to send the first woman and next man to Moon's surface by 2024. Companies will supply scientific instruments and technology demonstrations to the Moon's surface (beginning 2021), followed by the spaceship Gateway orbiting the Moon, supporting the Moon's intermediary stop mission. The SLS rocket and the Orion spacecraft will support building and transporting the Gateway and astronauts into and from space. Orion missions will launch from NASA's KSC spaceport. The Gateway will operate autonomously as a deep space science outpost without crew and built to internationally agreed-upon standards. Eventually the Gateway will transform into a way station for refueling depots, serving platforms, and a processing facility for scientific research and commerce.[28]

In preparation, NASA will work with companies to address living in space challenges. Missions to the Moon are about 1,000 times farther from Earth than missions to the ISS. These systems must be reliable enough to operate far from home, support the needs of human life, and still be light enough to launch. These missions will foster development of the 34-million-mile trip to Mars.[29] NASA will

[28] https://www.nasa.gov/topics/moon-to-mars/overview
[29] https://www.nasa.gov/topics/moon-to-mars/overview

collaborate with commercial and international partners to establish sustainable missions by 2028 and use this model for sending astronauts to Mars.[30]

Major Future Project: SpaceX Mission to Mars



SpaceX Rocket and Rendering of Mars Colonization (SpaceX)

SpaceX has helped accelerate commercial space exploration, including being the first private company capable of returning a spacecraft from low Earth orbit, deliver cargo to and from the ISS, and transport astronauts in 2020. SpaceX uses the CCSFS Space Launch Complex 40 for low- and medium-inclination orbits of communications and Earth observing satellites, and supply missions to the ISS The KSC Launch Complex 39A launches satellites and space station supply missions and crew launches of the Dragon spacecraft. [31]

[30] https://www.nasa.gov/what-is-artemis
[31] https://www.spacex.com/

In addition to supplying cargo, SpaceX is focused on providing global high-speed internet access through its Starlink program. It intends near global coverage of the populated world by 2021.[32]

SpaceX Starship (Source: SpaceX)

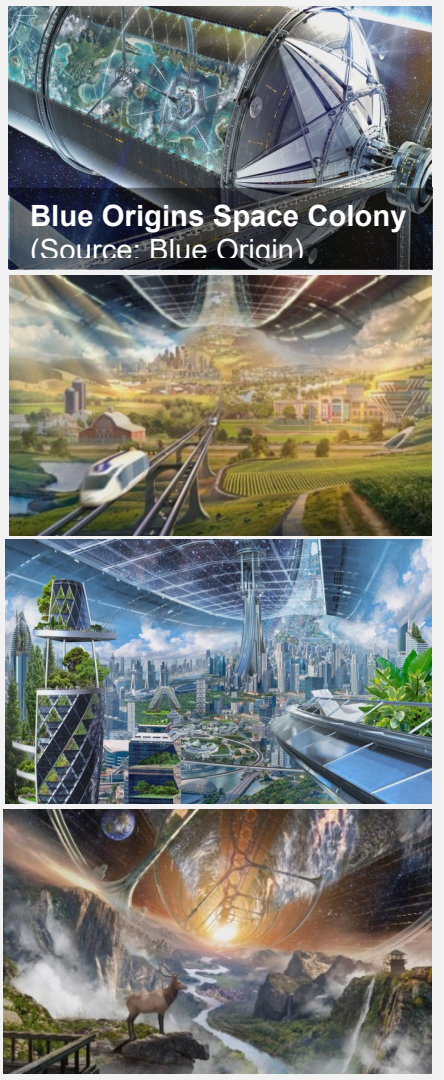
SpaceX's Starship spacecraft and Super Heavy rocket (together known as Starship) is a reusable system for the transport of cargo and crew from Earth to Moon, Mars, and beyond. This powerful launch vehicle can carry more than 100 metric tons to Earth orbit. Starship currently delivers satellites and has a payload compartment larger than any fairing currently operated, with possibilities of delivering large telescopes and other materials. [33]

In addition to colonization of Mars, SpaceX's Starship has other initiatives planned closer to Earth including providing the first private passenger to fly around the Moon by 2023. The Dragon spacecraft carries up to seven passengers to and from the Earth's orbit and will be a space tourism experience where passengers can view large sites like the Great Pyramids. Additionally, international point-to-point travel can be completed with Starship where hours long journeys may now take only 30 minutes or less.[34] Starship will also assist NASA with transporting crew and materials to the orbit and surface of the Moon supporting Artemis. Additionally, Starship will use tanker vessels to refuel vehicles in space helping to reach Mars with up to 100 tons. The vehicle will be designed for the Martian environment and help with the colonization.[35]

[32] https://www.starlink.com/
[33] https://www.spacex.com/
[34] https://www.spacex.com/
[35] https://www.spacex.com/

Major Future Project: Blue Origin's Manufactured Worlds

A company with equally ambitious space goals is Blue Origin. However, a primary motivating factor behind its plans is not to leave Earth, but to preserve it through promoting industrial space efforts. The company aims to keep harmful industries (such as resource mining and energy) away from the atmosphere and sustain the Earth for future generations. Blue Origin envisions manufactured worlds rotating in space creating artificial gravity and supporting up to one trillion people where cities, even wildlife preserves, can endure.[36]

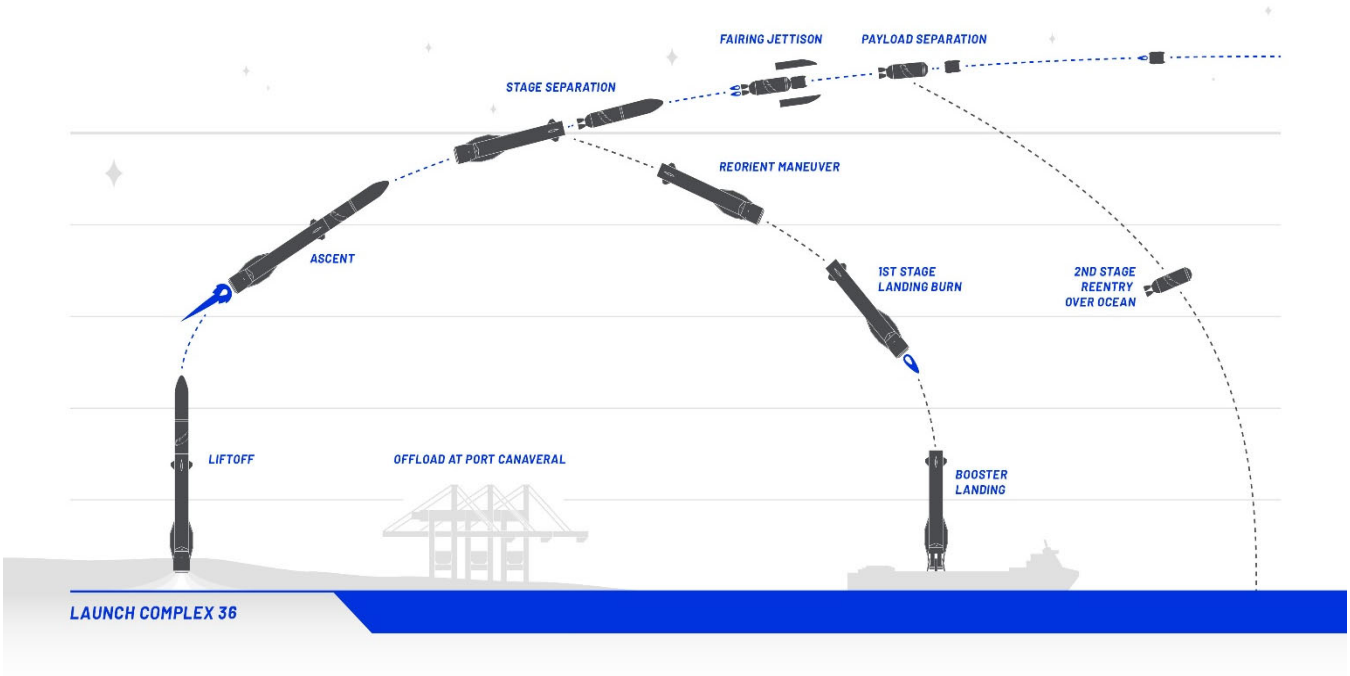

Blue Origins Space Colony
(Source: Blue Origin)

Blue Origin's New Shepard is a reusable suborbital rocket system intended to take crew and research payloads into space, past the internationally recognized boundary of space, in about 11 minutes. The missions of this spacecraft involve academic research, entrepreneurship, and technological development.[37]

Another spacecraft launching from Cape Canaveral, is the New Glenn heavy lift launch vehicle, which will carry people and payloads routinely to Earth's orbit and beyond. It will have a reusable first stage supporting civil, commercial, and national security customers. It is a seven-meter fairing with two times the payload volume of any vehicle. It has room for satellites and is capable to launch in 95 percent of weather conditions for optimum reliability. New Glenn will use BE-4, which is a liquid oxygen/liquefied natural gas engine that allows payloads of over 13 metric tons to geostationary transfer orbit and 45 metric tons to low Earth orbit beginning in 2021. The launch is illustrated in **Figure 12.**[38]

[36] https://www.nbcnews.com/mach/science/jeff-bezos-foresees-trillion-people-living-millions-space-colonies-here-ncna1006036
[37] https://www.blueorigin.com/new-shepard/
[38] https://www.blueorigin.com/our-mission

Figure 12 | *New Glen's Launch (Source: Blue Origin)*



Other Future Trends

Aviation Activity

Melbourne International Airport

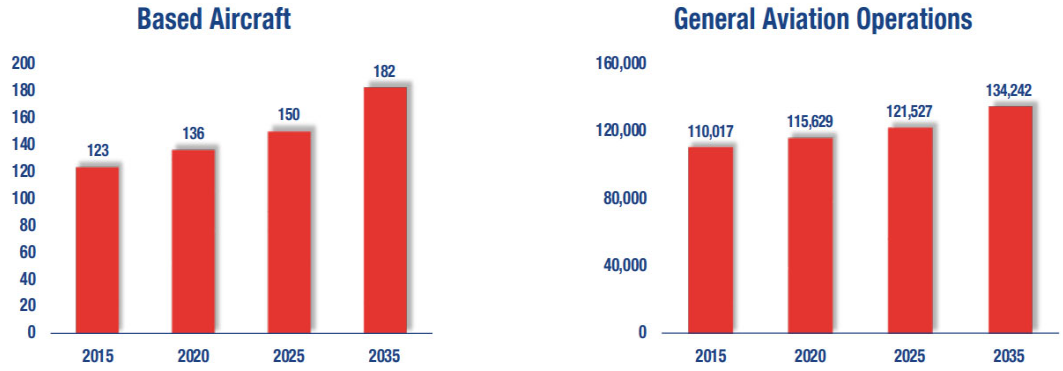
The MLB is considered America's fastest growing aviation and aerospace manufacturing center and is anticipated to grow significantly in the coming years.[39] Planning and design of major terminal renovation and expansion is underway to accommodate growth anticipated from projects such as TUI UK, an airline carrier, which will bring 158,000 visitors in 2022.[40] Also, Aerion Supersonic selected MLB for the site of the AS2 supersonic jet with plans to create at least 675 new jobs by 2026 as part of a multi-year $300 million investment.[41] The recommended growth forecast for domestic passenger enplanements from the 2018 MLB Masterplan Update is a 5.5 percent annual average change resulting in 693,100 passenger enplanements by 2035. The recommended annual average change for cargo is 0.6 percent coming through passenger air and 2.1 percent for all cargo operations.[42]

Space Coast Regional Airport

According to FDOT's 2016 Air Cargo Study, the Space Coast Regional Airport is forecasted to experience an all-cargo carrier domestic RTMs CAGR of 0.52 percent between 2016 and 2034 resulting in growth from 7,680 pounds in 2016 to 8,914 pounds in 2034.[43] The Florida Aviation System Plan (FASP) 2035 provides aircraft and operations projections for the airport as shown in **Figure 13**.

[39] http://mlbair.com/EconomicOpportunities.aspx/BusinessOpportunities/FutureLandUsePlan.aspx
[40] http://mlbair.com/EconomicOpportunities.aspx/BusinessOpportunities/FutureLandUsePlan.aspx
[41] http://mlbair.com/Default.aspx?tabid=142&Article=187
[42] http://mlbair.com/EconomicOpportunities.aspx/BusinessOpportunities/FutureLandUsePlan.aspx
[43] https://www.fdot.gov/aviation/cargo.shtm

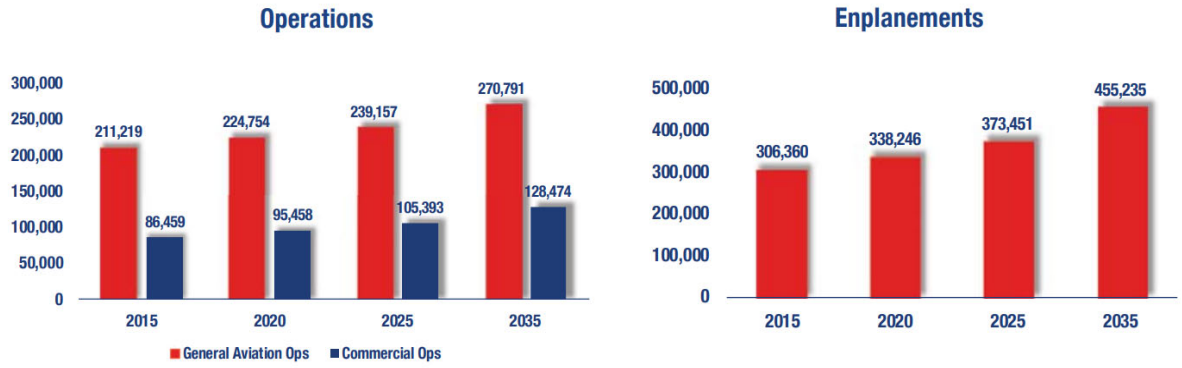
***Figure 13** | 2035 Projections for Space Coast Regional Airport (FASP)*



Daytona Beach International Airport

According to FDOT's 2016 Air Cargo Study, the Daytona International Airport will have a CAGR of 2.1 percent between 2014 and 2034 resulting in growth from 146 short tons in 2014 to 220 short tons in 2034.[44] The Florida Aviation System Plan 2035 provides operations and enplanements forecasts as displayed in **Figure 14.**

***Figure 14** | Daytona International Airport (FASP)*



[44] https://www.fdot.gov/aviation/cargo.shtm

Urban Air Mobility

According to the FAA, urban air mobility (UAM) is an aviation transportation system that uses automated aircraft transporting cargo and passengers at lower altitudes within urban and suburban environments.[45] The vehicles can be vertical takeoff and landing (VTOL) aircraft or Unmanned Aircraft Systems (UAS). These systems hold potential for future short-range transport of package delivery, search and rescue missions, and personal air mobility. The FAA anticipates a low average growth rate for commercial Small Unmanned Aircraft Systems (sUAS) at around nine percent by 2024 (17-35 percent high).[46] Additionally, the FAA anticipates UAM systems to evolve into air metros transporting 750 million annual passenger trips in 15 metro areas by 2028/2030. For cargo, last mile deliveries using UAS can be profitable by 2030 with 500 million deliveries annually and a fleet of 40,000.[47]

Key to UAM is the existence of vertiports or areas where vertical launch of electric aircraft is possible. Several companies have started to conceptualize and build UAM vertiport infrastructure in Florida. Archer Aviation is building a UAM network for the Miami Metro area with various vertiports in operation by 2024 using four seat and two seat aircrafts. These eVTOLs can travel up to 97 kilometers (60 miles) enabling convenient transport between downtown Miami and suburban areas. The service is anticipated to be on-demand where riders can book rides through smartphones.[48]

[45] https://www.faa.gov/uas/advanced_operations/urban_air_mobility/
[46] https://www.faa.gov/data_research/aviation/aerospace_forecasts/media/FY2020-40_FAA_Aerospace_Forecast.pdf
[47] https://www.faa.gov/data_research/aviation/aerospace_forecasts/media/FY2020-40_FAA_Aerospace_Forecast.pdf
[48] https://aerospaceamerica.aiaa.org/features/building-vertiport-cities/

Another effort is by Lilium of Germany/Ferrovial of Spain, the company behind the Lake Nona vertiport plan. This is part of a planned network of 11 U.S. vertiports, including Lake Nona and Palm Beach International Airport, with the latter leasing a five-acre vacant lot to the company. Up to six passengers can board Lilium jets for trips up to 300 kilometers (186 miles). As shown in **Figure 15**, that range will connect every major city in Florida by eVTOL and allow 20 million Florida residents vertiport access within a 30-minute drive. [49] Lilium plans to operate its Florida hubs with seven-to-twelve-minute wait times for passengers.

***Figure 15** | Cities Reachable from Lake Nona Vertiport (Source: Lilium)*

Both companies target price tags low enough to attract a wide range of passengers: Archer plans to charge between $3 and $4 per passenger mile, and Lilium is aiming for $2.20 per passenger mile — comparable to an Uber or Lyft ride. [50]

While Lilium is planning new vertiport infrastructure, other companies are retrofitting existing infrastructure. For example, Joby Aviation of California is working with parking garage operator REEF Technology on landing pads, charging stations, and other infrastructure for vertiports on top of REEF garages, which number around 5,000 across North America and Europe. Parking garages in high-demand locations need little new infrastructure to build on the roofs. The company is targeting a few U.S. cities for eVTOL flights starting in 2024, including Miami. [51]

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[49] https://aerospaceamerica.aiaa.org/features/building-vertiport-cities/
[50] https://aerospaceamerica.aiaa.org/features/building-vertiport-cities/
[51] https://aerospaceamerica.aiaa.org/features/building-vertiport-cities/

Regional Air Mobility

The U.S. has over 5,000 public airports and only 30 serve over 70 percent of all travelers. Most are underutilized due to air transportation services consolidation putting more people into fewer, larger aircraft on popular routes. Also, these large aircraft can only take off from and land on longer airstrips.[52]

To address this constraint, in 2021 NASA suggested existing smaller, local airports can be used as a catalyst for change in travel. Regional Air Mobility (RAM) seeks to transform travel by bringing the convenience, speed, and safety of air travel closer to more of the public. NASA is advocating RAM technology investment to complement and accelerate Advanced Air Mobility (AAM) and other related initiatives. Through targeted advanced technology investments, including aircraft automation, enhanced operational models, more efficient aircraft and propulsion systems, and expanded airport renewable energy generation, RAM will increase the effectiveness of regional travel while leveraging underutilized federal, state, and local investment in local airports.[53]

For next steps, NASA will support aeronautics-related technology development including systems analysis, critical air-vehicle technologies, investigation of novel aircraft configurations suitable for RAM missions, autonomous operations and associated safety assurance methods, and airspace technology and integration approaches. NASA will also support efforts by other federal agencies, like the FAA and DoE on activities that range from assuring that RAM aircraft and operations are safe, to determining opportunities for renewable energy generation. Industry partners will advance technology for RAM, develop a seamless, enhanced user experience, and continue the operation and integration of RAM into business cases.[54]

Military Space Operations

The United States Space Force (USSF) was established in 2019 with enactment of the Fiscal Year 2020 National Defense Authorization Act. The USSF military service will protect U.S. and allied space interests and provide space capabilities to the joint force. The USSF responsibilities include developing

[52] https://sacd.larc.nasa.gov/ram/
[53] https://www.nasa.gov/feature/langley/nasa-seeks-to-increase-accessibility-of-regional-air-travel
[54] https://www.nasa.gov/feature/langley/nasa-seeks-to-increase-accessibility-of-regional-air-travel

Guardians, acquiring military space systems, building the military doctrine for space power, and organizing space forces for the Combatant Commands.[55]

The CCAFS and Patrick Air Force Base were formally re-designated in 2020 as facilities central to the mission of the USSF. The CCAFS was renamed Cape Canaveral Space Force Station, and Patrick Air Force Base was renamed Patrick Space Force Base. The re-designation affects the names only and are not official installations for the USSF.[56] Space Force operations at Cape Canaveral will be influenced by the Space Force Range of the Future, a plan to modernize infrastructure and processes to prepare for daily space launches.[57]

Range of the Future

The Eastern Range in Florida and the Western Range in California have been the military's primary space launch sites for over 60 years. The USSF is pursuing upgrades to the infrastructure and system in general through the Range of the Future. This strategic planning effort intends to address imminent issues including:

- Infrastructure renovation and replacement;
- Streamlined and improved scheduling of launches; and
- Development of innovative approaches including reusable launch vehicles, recoverable payload fairings, flyback boosters, and autonomous flight safety systems.

The Range of the Future is intended to help with lowering costs and enhancing the ability for industry to move at the "speed of business." The USSF is using the Range of the Future to see how to commercialize management of the Ranges, while still ensuring that national security needs can be met.[58]

National Spaceport Network

Recently, several commercial spaceports have been established by state and local governments, or by private companies, to participate in the growing space economy. These spaceports are intended to

[55] https://www.spaceforce.mil/About-Us/About-Space-Force/Mission/
[56] https://www.spaceforce.mil/News/Article/2441804/2-famed-bases-re-designated-to-highlight-space-force-connection/
[57] https://www.airforcemag.com/article/building-the-space-range-of-the-future/
[58] https://www.faa.gov/about/office_org/headquarters_offices/ast/advisory_committee/meeting_news/media/2020/june/National_Spaceport_Network_Development_Plan.pdf

alleviate federal regulation and expand civil and commercial launch opportunities. The FAA and the U.S. Spaceports are planning a National Spaceport Network to better leverage these developments. This consists of current and prospective commercial spaceports, government-owned-and-operated launch and landing sites, and privately-owned-and-operated launch and landing sites. This new network offers an opportunity to increase the safety, capacity, efficiency, and resiliency of space operations. This network supports a framework for formal or informal public-private partnerships between federal, state, and local governments; the aerospace industry; and academia. The FAA and the U.S. Spaceports have developed a National Spaceport Network Development Plan to provide the information needed to assist in the development of this network.[59]

Point-to-Point Space Travel

The USSF is leading an experimental program to promote point-to-point space travel called Rocket Cargo. Point-to-point space travel is a form of space transportation involving a rocket launching into space and then returning at another location. The rocket could be bringing supplies, industrial or commercial materials or people from one side of the Earth to the other in under an hour. The program will research and help develop capabilities like landing a rocket on various surfaces, creating a cargo bay for rapid unloading and loading, and airdropping cargo to service locations where landing is not possible.[60]

The Air Force's 2022 budget proposal requested almost $50 million for Rocket Cargo to continue the study concept work began in 2020 with small contracts to SpaceX and Exploration Architecture Corporation (XArc). Rocket Cargo will explore using ships like SpaceX Starship and look at fully reusable private rockets capable of between 30 and 100 tons. Currently, Starship is the only rocket with plans to be reused and can launch that much mass.[61]

Off-Shore Launches

SpaceX is developing floating spaceports to support missions to mars, the moon, and hypersonic travel around Earth. The company acquired two offshore oil rigs in 2020, classified as ultra-deepwater semi-submersible. This is an offshore drilling platform capable of being moved from place to place, while

[59] www.faa.gov/about/office_org/headquarters_offices/ast/advisory_committee/meeting_news/media/2020/june/National_Spaceport_Network_Development_Plan.pdf
[60] https://www.cnbc.com/2021/06/04/us-military-rocket-cargo-program-for-spacexs-starship-and-others.html
[61] https://www.cnbc.com/2021/06/04/us-military-rocket-cargo-program-for-spacexs-starship-and-others.html

most of it floats above the water's surface. It can be anchored using pontoon-type columns submerged under water. SpaceX has named the rigs Phobos and Deimos and have located them off the Port of Brownsville in southern Texas near SpaceX's Starship development facility in Boca Chica.[62]

Space Manufacturing

The Space Coast advanced manufacturing industry to support the space industry has ramped up and will continue to experience future growth. Space Florida has secured the first tenant for a 400-acre industrial park close to Cape Canaveral's former space shuttle runway. Terran Orbital will build a satellite factory and employ 2,100 people producing up to 1,000 satellites a year. It hopes to be the largest satellite manufacturing facility in the world at 660,000 square feet. Titled the Space Florida Launch and Landing Facility industrial park, the facility follows the development of other industrial parks including Exploration Park where Blue Origins and Firefly Aerospace have factories. Other tenants include SpaceX, Boeing, Relativity Space, Lockheed Martin, and Made In Space, Inc.[63]

Potential Impacts and Challenges

The vision for Florida's spaceport system is to be the premier transportation hub for global space commerce. Based on the anticipated demand for both suborbital and orbital launches, Florida's existing spaceport system can support launch and land operations for the next ten years and beyond. Despite this, there may be freight and supply chain impacts and challenges to consider.

Air Traffic Demand and Transportation Logistics: Continued increases in air traffic and the introduction of new spacecraft, launch vehicles, and technologies will continue to present challenges and opportunities to the system. The FAA has worked on NextGen, which is a plan using satellite technology instead of ground radars for managing improved aviation and aerospace capacity. Even with this program, some anticipated issues will need to be addressed including:

- Prioritization of air and space flights including UAS flight;
- Accommodating increased demand;
- Designation (size, location, time frame) of restricted areas;

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[62] https://singularityhub.com/2021/06/03/spacex-will-have-an-offshore-spaceport-ready-for-launches-as-soon-as-next-year/
[63] https://www.thecentersquare.com/florida/florida-s-aerospace-industry-booming-but-faces-competition-capacity-challenges/article_3a0d9f8c-2245-11ec-b5ae-833390608348.html?web=1&wdLOR=c354F8142-07F4-48CC-94BB-BE908A3ED709

- Assessment of “re-routing” impacts (costs and schedule);
- Control of UAV flights;
- Payload processing with larger processing centers, smaller centers for small cube satellite payloads, and support facilities for space tourism;
- Introduction of mobile processing units that could be moved around and between spaceports as needed; and
- New commercial and university-based processing facilities.

The transportation of cargo is influenced by these impacts and will need to be coordinated efficiently to ensure reliability for launch schedules. Current transportation routes for this cargo, specifically OS/OW cargo, are limited and can lead to frequent re-routing of the cargo. Also, limited direct routes to key facilities, such as launch pads, will continue to be problematic in maintaining increased launch schedules. Continued review of these routes, including bridges, will be important for future planning.

Intermodal Facilities: Highway, waterway, and railway facilities are essential to the spaceport system, specifically for developing and constructing spacecraft. The existing infrastructure is adequate to support all projected demand. However, scheduled maintenance, rehabilitation, or reconstruction of infrastructure should be a top priority for either the Florida government or the applicable responsible regulatory agencies. Additional considerations include:

- Future new Florida spaceports and intermodal connections should be examined during the planning phase. Increasing intermodal freight and logistics volume to the spaceports will drive studies and implementation plans for public-to-public (federal to state, or state to authority) infrastructure transfers to enable increased commercial commerce;
- An evaluation of routes for transport of spacecraft and launch vehicles from northwest Florida to CCS will be needed; and
- Feasibility studies of routes from future landing sites on the west coast to launch sites on the east coast is also recommended.

Protection of Cargo: CCS will support several industries in transporting sensitive cargo into space. The sensitivity of this cargo will need to be considered in the transportation to the spaceport itself. As the region implements new technologies for improving local transportation such as traffic management and broadband or 5G, routes to CCS will need to ensure limited to no electronic interference with

cargo. Additionally, some cargo may require maximum discretion and specialized surveillance protocols with little to no camera visibility. Finally, special attention to protection of cargo from potential highway construction sites and traffic safety in general will need to be considered.

Space Component Manufacturing: There is significant potential for many companies supporting the industry to relocate the manufacturing of certain components to the Space Coast. As launch events increase, especially for satellite/communications, companies may want to be closer to the launch facilitates.

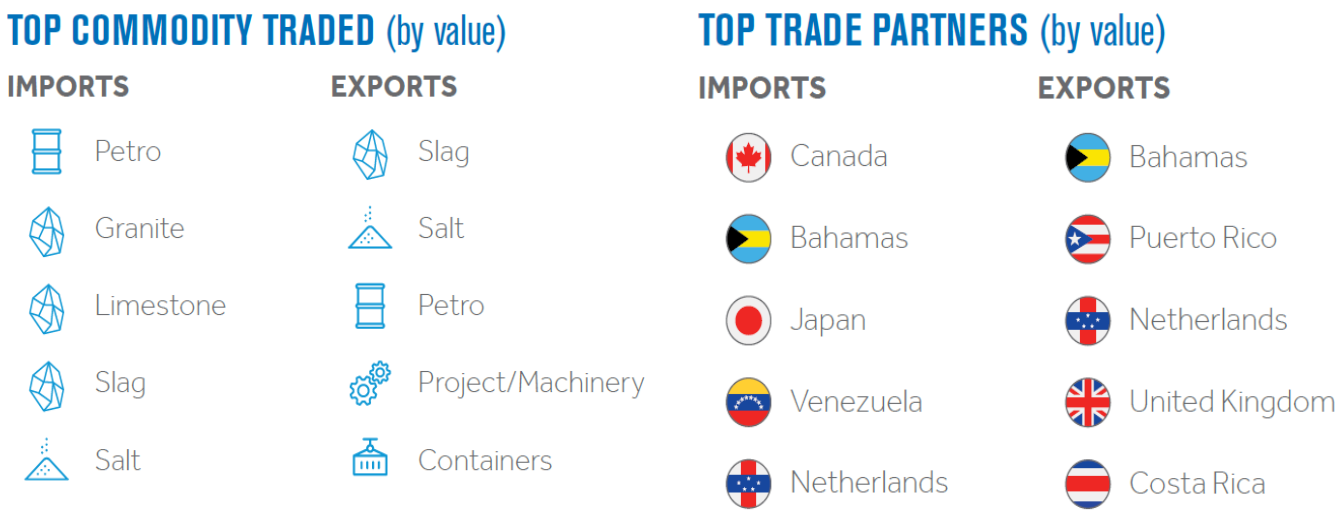
Maintaining Transportation Infrastructure in State of Good Repair: While the current infrastructure is prepared to support the launch schedule for the next ten years, looking at the major projects and their needs will need to be considered. Regular transport of heavy cargo will need to keep up with the pace of the commercial industries launch expectations for CCS to remain competitive. Additionally, a major movement of fuel will be needed not only to transport the vehicles into space but also to provide fuel for fuel tanker vehicles in space. What the current movement of fuel looks like to CCS and how this may change to support this in the future will need to be considered.

Ownership of Land: The ownership of the land for the spaceport may limit solutions. As the future of the spaceport advances, this will continue to evolve with NASA potentially changing its ownership and private industries along with USAF also having considerable influence.

Maritime – Passenger and Cargo

Port Canaveral is a strategic gateway for Central Florida, which in 2018 reached $103.8 million in total revenue– the highest in Port's history. Recently, the Port entered a long-term, 25-year agreement with Carnival Cruise Line involving homeporting Carnival's largest and newest class of ships, including the first LNG powered cruise ship in North America and building $163 million 188,000 sq. ft. cruise terminal and adjacent 1,800 vehicle parking garage. More than six million tons of cargo moved in 2018. This was due to diversification of cargo, including new auto imports arriving on Post-Panamax RO/RO vessels; transportation fuels; lumber and aggregate imports for the Orlando/Central Florida market. The Port's major commodities and partners are listed in **Figure 16**.[64] In 2019 the Port supported 32,650 jobs, and $1.3 billion in wage income.[65]

***Figure 16** | Port Canaveral Trading Highlights (Source: Port Canaveral)*



[64] https://www.portcanaveral.com/PortCanaveral/media/Recreation/JPC/PORT-CANAVERAL-30-YEAR-VISION-PLAN_1.pdf
[65] https://www.bizjournals.com/orlando/news/2019/10/28/new-report-details-port-canaverals-economic-impact.html

Background

Port Canaveral was officially dedicated in 1953 with commercial fishing. Cargo came after with oil, newsprint, and tanker vessels transporting Florida orange juice to New York. By 1966 one million tons per year was moved through the Port, including materials supporting the nearby space program. The cruise industry started in the 1970's, and homeported its first ship in 1990, followed by Disney in 1998, and Royal Caribbean in 2000.[66] Now Port Canaveral is one of the world's busiest cruise ports with 4.6 million revenue passengers in 2018 and the most port-of-call ship visits of any Florida home port. Additionally, six million tons of cargo moved through the Port supporting a major petroleum terminal and tank farm.[67]

Early Photo of Port Canaveral
(Source: Port Canaveral)

Port Canaveral Current Activity

The Port is located at the intersection of Florida's main north-south and east-west corridors creating opportunities for trade and tourism to serve Brevard County, Central Florida, and the state.[68] This location is convenient for shippers interested in close proximity to major markets with efficient transportation links. Recent harbor improvements including new cruise and cargo terminals, a new auto facility, and an inland warehouse and logistics center in nearby Titusville make this an ideal location.[69] The Port is a unique quadrimodal transportation hub, linking sea, land, air, and space. This offers the benefits of a first-class seaport including easy highway access, unrestricted air draft, 43-foot deep-water sea access, and uncongested multipurpose berthing.[70]

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[66] https://www.portcanaveral.com/About/History
[67] https://flaports.org/ports/port-canaveral/
[68] https://www.portcanaveral.com/PortCanaveral/media/Recreation/JPC/PORT-CANAVERAL-30-YEAR-VISION-PLAN_1.pdf
[69] https://www.portcanaveral.com/About/History
[70] https://flaports.org/ports/port-canaveral/

The Port's major businesses include cruise, cargo, fishing, parks and recreation, marine recreation and commercial development, and the new commercial space industry.

Port Canaveral (Source: Port Canaveral)

Cruise Operations

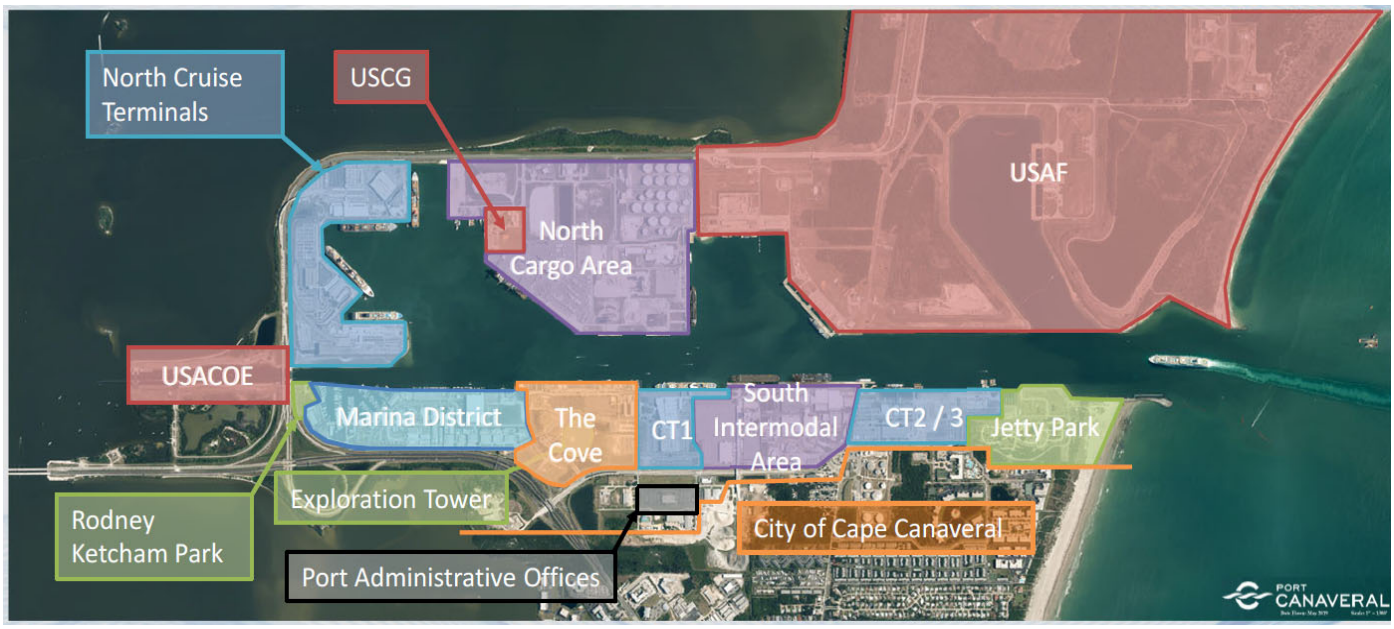
Port Canaveral is presently the second largest cruise port in the world, and cruise activity accounts for 80 percent of its revenue.[71] The link between Central Florida theme parks and the cruise industry has fostered the Port's growth. The increase of passengers driving to the Port has spurred a boom in local hotel and associated industries. Presently, major cruise lines operate some of the world's largest cruise ships and each cruise line has increased in size and number. The cruise lines not currently operating at Port Canaveral have considered the Port for increased business.[72] The Port Canaveral 30-Year Vision Plan includes additional improvements to cruise operations including a new eastern cruise terminal and redevelopment of the west cruise center.[73]

[71] https://www.portcanaveral.com/About
[72] https://www.portcanaveral.com/PortCanaveral/media/Recreation/JPC/PORT-CANAVERAL-30-YEAR-VISION-PLAN_1.pdf
[73] https://www.portcanaveral.com/PortCanaveral/media/Recreation/JPC/PORT-CANAVERAL-30-YEAR-VISION-PLAN_1.pdf

Cargo Operations

Bulk and general cargo have historically supported Port Canaveral. The Port serves the energy needs of Central Florida with a large petroleum operation, aggregate, rock, and citrus among other commodities. Recently, cargo opportunities expanded at the Port to include new auto imports/exports. The Port supports seven types of cargo including, liquid bulk, dry bulk, break-bulk, RoRo, containerized, heavy lift and project, and space. As shown in **Figure 17**, cargo is supported by ten cargo piers, three tanker berths, storage facilities for cement, petroleum, slag and salt, a 16-acre auto and RoRo facility, and a 20-acre container yard with two STS cranes. The Port houses the largest mobile harbor crane in the United States, the Liebherr LMH 600 and provides 280,000 sq. ft of refrigerated storage.[74]

Figure 17 | *Port Canaveral Aerial (Source: Port Canaveral)*

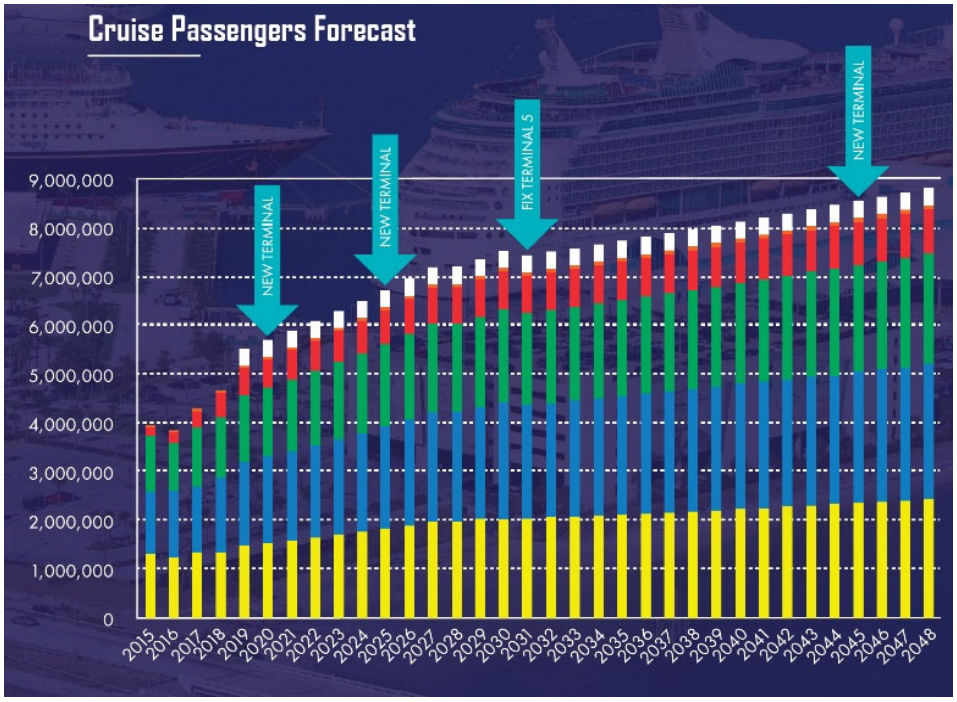


[74] https://www.portcanaveral.com/PortCanaveral/media/Recreation/JPC/PORT-CANAVERAL-30-YEAR-VISION-PLAN_1.pdf

Future Trends

Port Canaveral is unique as a major homeport and port of call for ships that are homeported in the northeastern United States. This combination produces higher volumes and higher terminal utilization as evidenced by the Port's highest average passenger per terminal use than any port in the world. As shown in **Figure 18**, the Vision Plan presents the potential of exceeding eight million passengers over the 30-year planning horizon.[75]

Figure 18 | *Future Port Passengers (Source: Port Canaveral)*

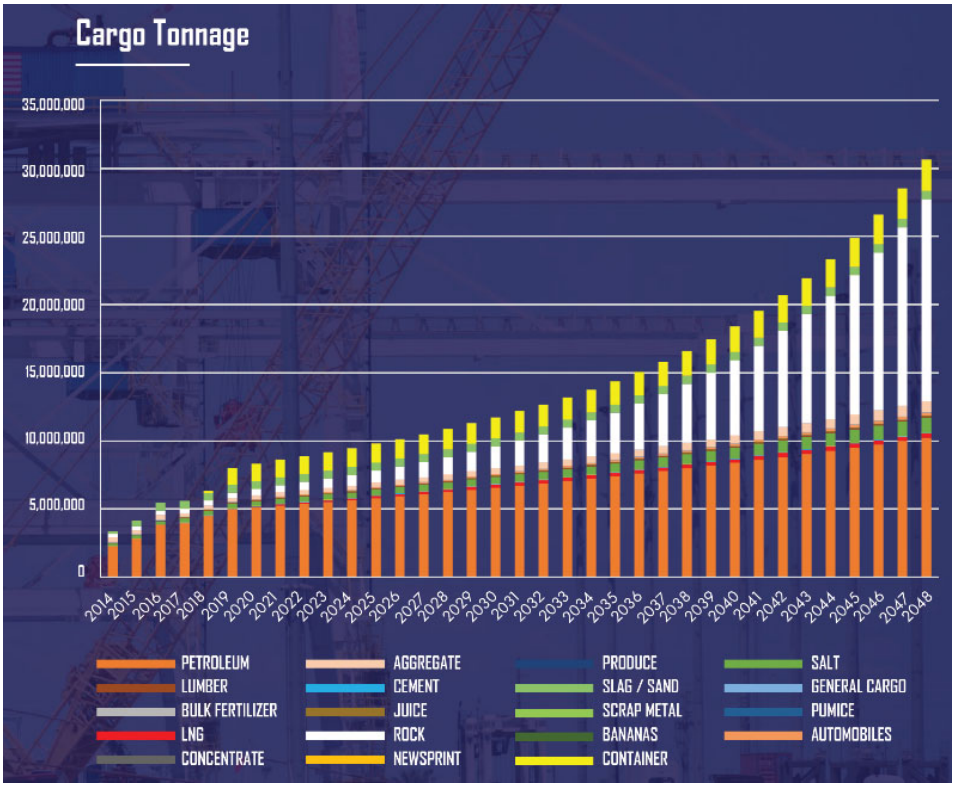


Port Canaveral has the highest growth potential of any Florida port, and this is driving infrastructure development.[76] The Port currently has five cruise terminals and future demand indicates that the Port will need to add another three terminals and update an existing berth. As part of the cruise program, the Vision Plan includes "Port Central," an integrated transportation center creating space for a consolidated rental car facility and additional parking.[77]

[75] https://www.portcanaveral.com/PortCanaveral/media/Recreation/JPC/PORT-CANAVERAL-30-YEAR-VISION-PLAN_1.pdf
[76] https://www.portcanaveral.com/PortCanaveral/media/Recreation/JPC/PORT-CANAVERAL-30-YEAR-VISION-PLAN_1.pdf
[77] https://www.portcanaveral.com/PortCanaveral/media/Recreation/JPC/PORT-CANAVERAL-30-YEAR-VISION-PLAN_1.pdf

Bulk and general cargo have historically supported Port Canaveral with a large petroleum operation, aggregate, rock, and citrus among other commodities. Recently, cargo opportunities expanded at the Port to include new auto imports and exports. As shown in **Figure 19**, future cargo tonnage is projected to more than triple to over 30 million tons by 2048. This expansion will continue as long population and economic growth are maintained in Florida. Petroleum traffic may level off or decline as the United States transitions to renewable energy sources.[78]

***Figure 19** | Future Cargo Tonnage Projection (Source: Port Canaveral)*



The Port Canaveral 30-Year Vision Plan identifies future cargo growth improvements including dividing the north sector of the Port into three areas to handle cargo. The north side cargo area is for bulk with expansion possibilities to accommodate LNG, important for both rockets and cruise ships. The central north supports general cargo, container, and auto facilities. The western end serves spaceport operations. There may be more demand for land on north side of the Port than what is available, leading to maximization of existing cargo sites.[79]

[78] https://www.portcanaveral.com/PortCanaveral/media/Recreation/JPC/PORT-CANAVERAL-30-YEAR-VISION-PLAN_1.pdf
[79] https://www.portcanaveral.com/PortCanaveral/media/Recreation/JPC/PORT-CANAVERAL-30-YEAR-VISION-PLAN_1.pdf

Other Future Trends

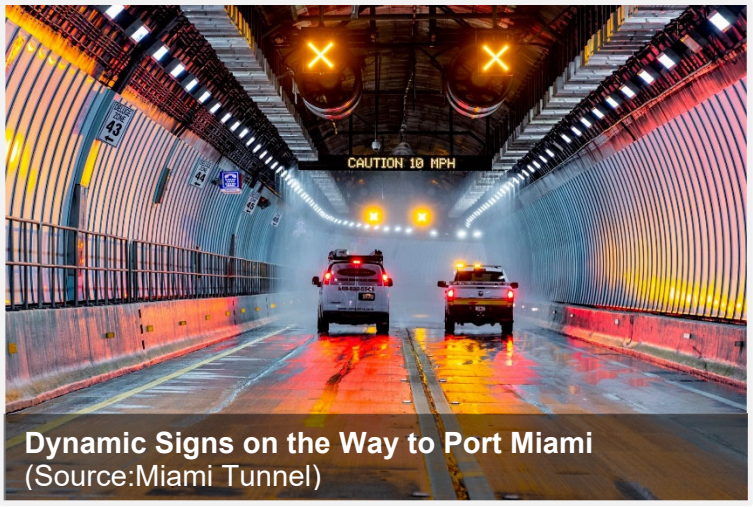
Smart Ports

For future efficiency, ports will likely adopt connected, smart waterfront and intermodal advancements. Such technologies modernize supply chains advancing efficiency, reliability, safety, and security. To address shipper demands for efficient global supply chains ports and logistics partners will rely on this technology to limit costs as much as possible.[80]

Some smart port technologies will:

- Predict pricing and book cargo, reset inventories and reroute trucks, and replace manual transportation and logistics processes;
- Deploy drones helping to survey site enhancements;
- Integrate software platforms connecting ITS and increasing road capacity without construction while reducing accidents. Ports interact with thousands of trucks per day and expedited road traffic will be important; and
- Artificial intelligence.

Additionally, ITS will integrate wireless communications into transportation infrastructure and vehicles to process and share information facilitating improved traffic flow and operations at the port. An example is already occurring in Florida with dynamic messaging signs for port truck traffic and adaptive traffic signal controls.[81]



Dynamic Signs on the Way to Port Miami
(Source:Miami Tunnel)

[80] https://www.portcanaveral.com/getattachment/Publications/Florida-Ports-Council-5-Year-Florida-Mission-Plan.pdf?lang=en-US
[81] https://www.portcanaveral.com/getattachment/Publications/Florida-Ports-Council-5-Year-Florida-Mission-Plan.pdf?lang=en-US

Ship Design and Fuel

The future cruise and cargo ship industry will likely increase sustainability of vessels and limit carbon footprints. This includes efficiency in operations and design as well as sustainable fuel types. Many vessels now use LNG and some future designs include infrastructure for alternative fuels like wind and solar energy. Additionally, autonomous cargo ships can add to this efficiency.

Cruise ship designs will also change as tourism needs evolve. Ships may get larger or even change in shape. These vessels may be floating hotels, with increasingly diverse amenities attracting and accommodating more numbers of tourists than previously designed.

Renderings of Future Passenger/Cargo Vessels (Source: Cruise.com/Oceanbird)

Potential Impacts and Challenges

Increased Traffic: The increase in cruise activity with more vessels and increase in ship capacity will bring more vehicles on the road, competing with the supply chain traffic to reach Port Canaveral.

Changing Land Use: The interest in convincing visitors to stay in the cruise area before and after embarkation will lead to changes in surrounding land uses with more hotels, restaurants, and shopping areas. This may further urbanize street designs to accommodate pedestrian activity and potentially impact continuity in routes for freight to the Port.

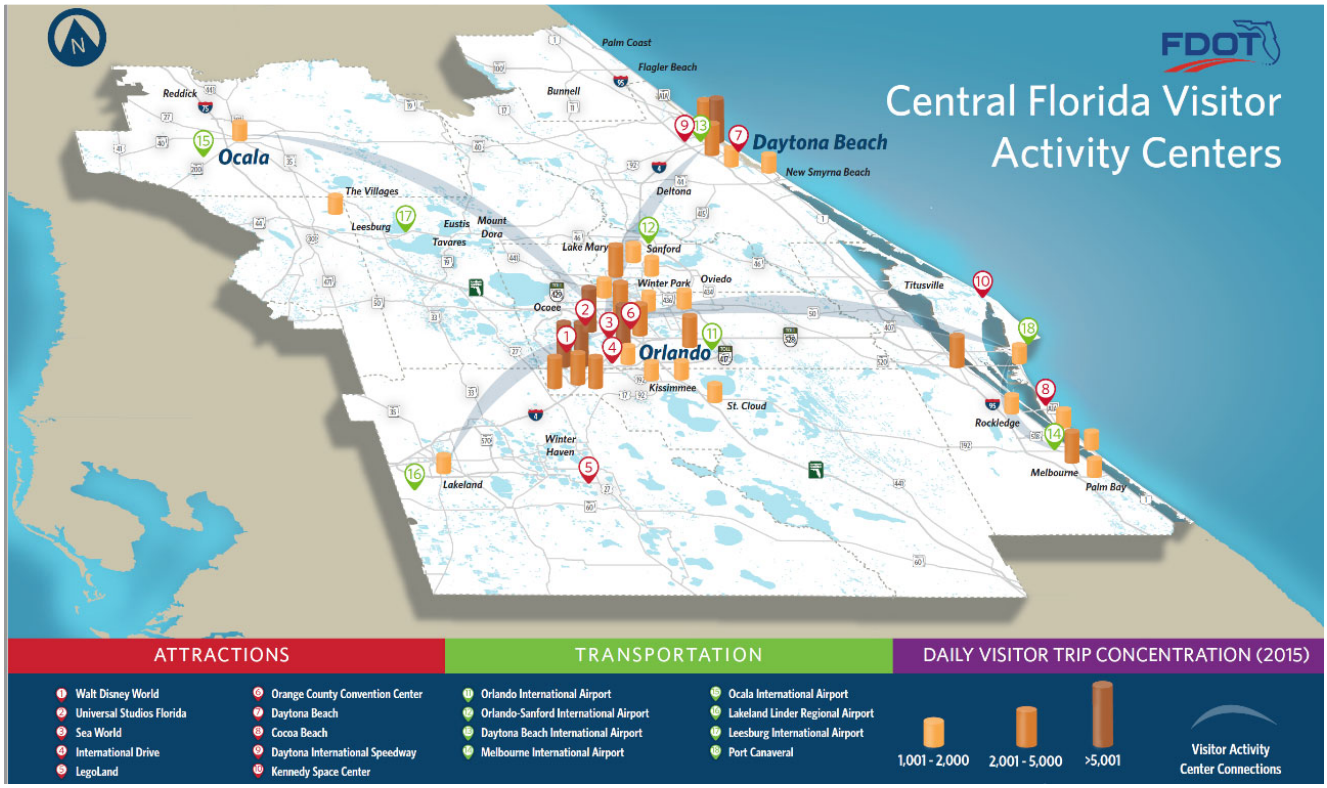
Technology: The potential for smart port enhancements and the need for infrastructure connectivity to ensure uninterrupted communications will be increasingly important, especially along key freight routes to and from the Port.

Sea Level Rise: Future climate conditions such as sea level rise and weather patterns like increased flooding will require the Port to harden infrastructure to be more resilient.

Tourism

Tourism is the region's largest economic cluster comprising various industries, such as theme parks, accommodations, transportation (air and ground), travel arrangement services, and others. The epicenter of tourist activity is Metro Orlando, which became the nation's most visited destination with 75 million visitors in 2019.[82] Space Coast attractions are a draw for Central Florida tourists as viewed in **Figure 20.** Leisure and Hospitality employees totaled 28,324 (2019) increasing by 36.9 percent compared to 2009, more than the U.S. average of 26.5 percent.[83]

***Figure 20** | Central Florida Visitor Activity Centers (Source: Central Florida Visitor Study, 2019)*

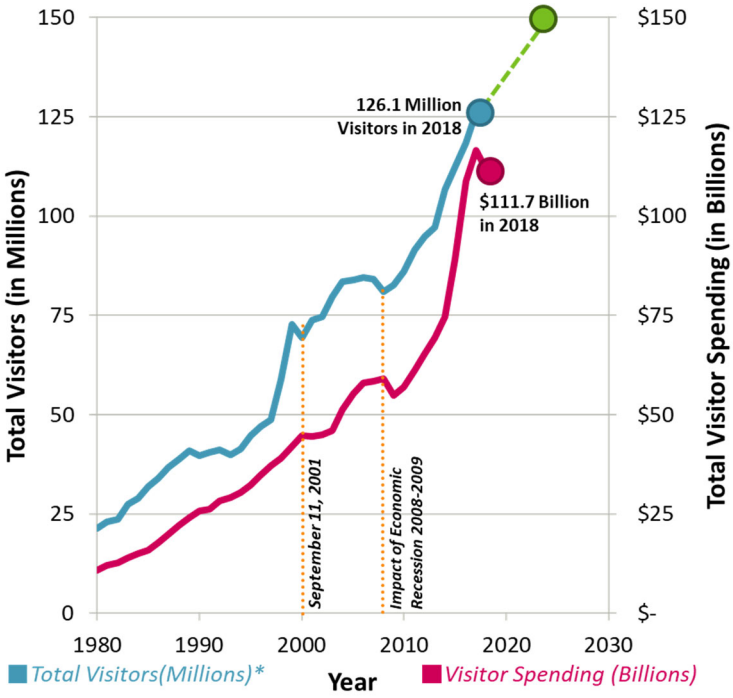


[82] http://cfgis.org/FDOT-Resources/Central-Florida-Visitor-Study.aspx; https://www.globenewswire.com/news-release/2019/05/10/1821626/0/en/Orlando-Announces-Record-75-Million-Visitors-Solidifies-Ranking-as-No-1-U-S-Travel-Destination.html
[83] https://www.Space Coastheadlight.com/headlight/empind

Background

Florida visitor growth has been steadily increasing. **Figure 21** illustrates this trend based on total visitors and total visitor spending, including future projections. As shown in **Figure** 22, the Space Coast and Daytona Beach areas offer popular attractions including the beaches, KSC, Port Canaveral, and the Daytona International Speedway.[84]

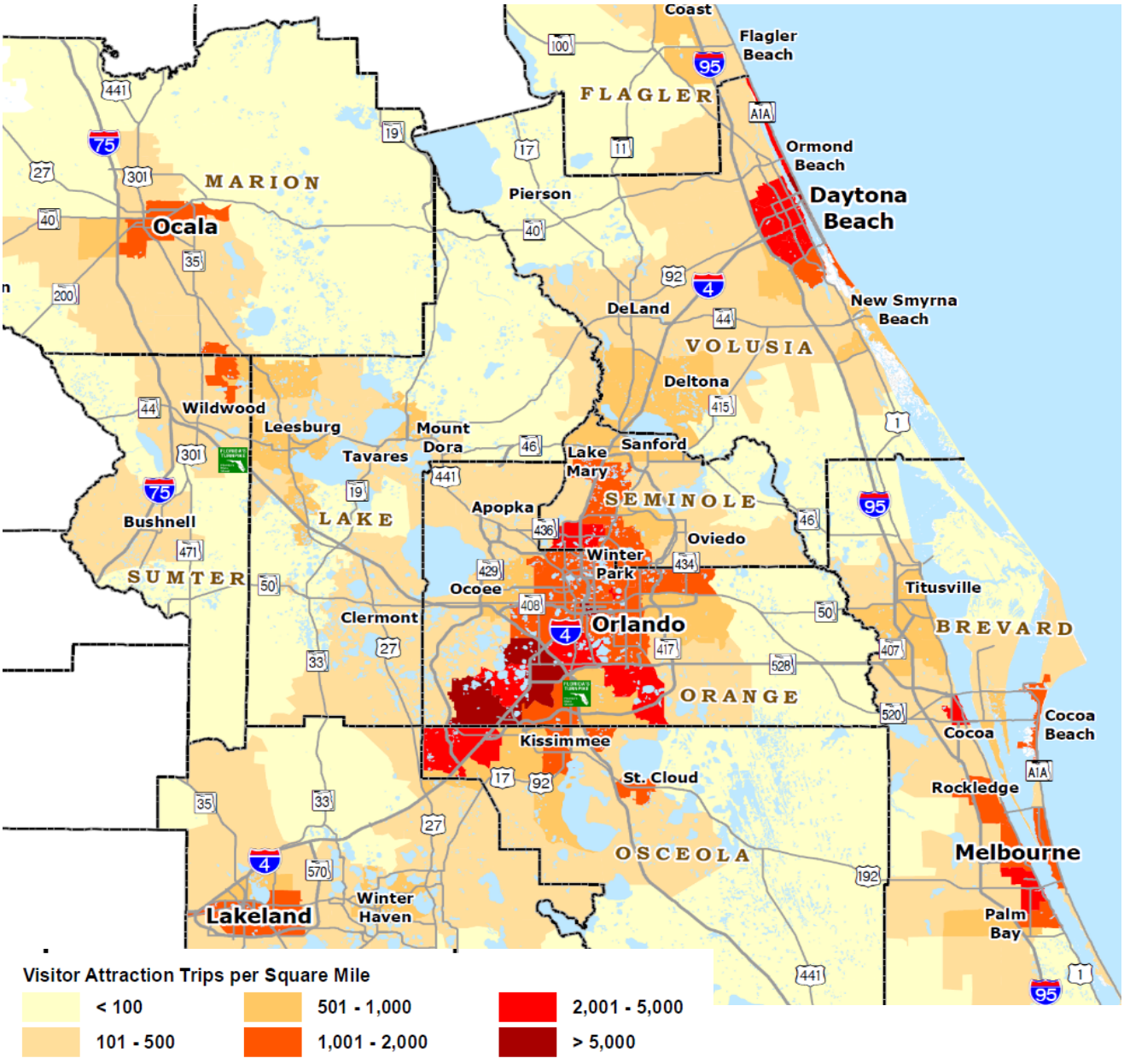
Figure 21 | *Florida Visitor Projections (Central Florida Visitor Study, 2019)*



In Brevard County, space-related tourism has a significant impact. The KSC is a premier tourist destination with unique interstellar exhibits, displays of historic spacecraft and memorabilia, and various tours throughout the spaceport. The visitor complex hosts 1.5 million visitors annually.[85] Additionally, launches attract large crowds of visitors, up to 100,000 per event, as evidenced by the SpaceX Arabsat-6A mission in April 2019.[86] The financial impacts from this can be seen through the collection of bed tax from Titusville, the city closest to KSC, which increased by 40 percent between 2016-2019.[87]

[84] http://cfgis.org/FDOT-Resources/Central-Florida-Visitor-Study.aspx
[85] http://media.kennedyspacecenter.com/kennedy/quick-facts/
[86] https://issuu.com/spacecoast/docs/20fall_fscot_digital
[87] https://issuu.com/spacecoast/docs/20fall_fscot_digital

***Figure 22** | Visitor Attraction Trips per Square Mile (Source: Central Florida Visitor Study, 2019)*



For a summary of other popular attractions in Brevard County, **Figure 23** shows results from a visitor survey conducted by the Space Coast Office of Tourism for 2018 and 2019. While only 2,079 visitors were surveyed, it shows popular activities including the beach, Brevard Zoo, Eau Gallie Arts Districts, some local downtowns and villages and various recreational sports. Also, important to note, at the time of the survey over 50 percent of respondents visited the Space Coast two to four times in the past 24 months with 19 percent visiting five or more times. These repeat visitors come mostly from other Florida communities, driving to the area.[88]

Similarly, statistics can be shown for the Daytona Beach area tourism. In 2019, Volusia County accommodated ten million visitors, contributing $6.2 billion to the local community in 2019.[89] According to visitor surveys, the most popular attractions include the beaches and the Daytona Beach International Speedway. For this area, 65 percent of visitors come from out of state or abroad and of the 35 percent of Florida origin, most traveled from Central and West Florida.[90]

***Figure 23** | Activity Participation Rates and Satisfaction (Source: Space Coast Office of Tourism)*

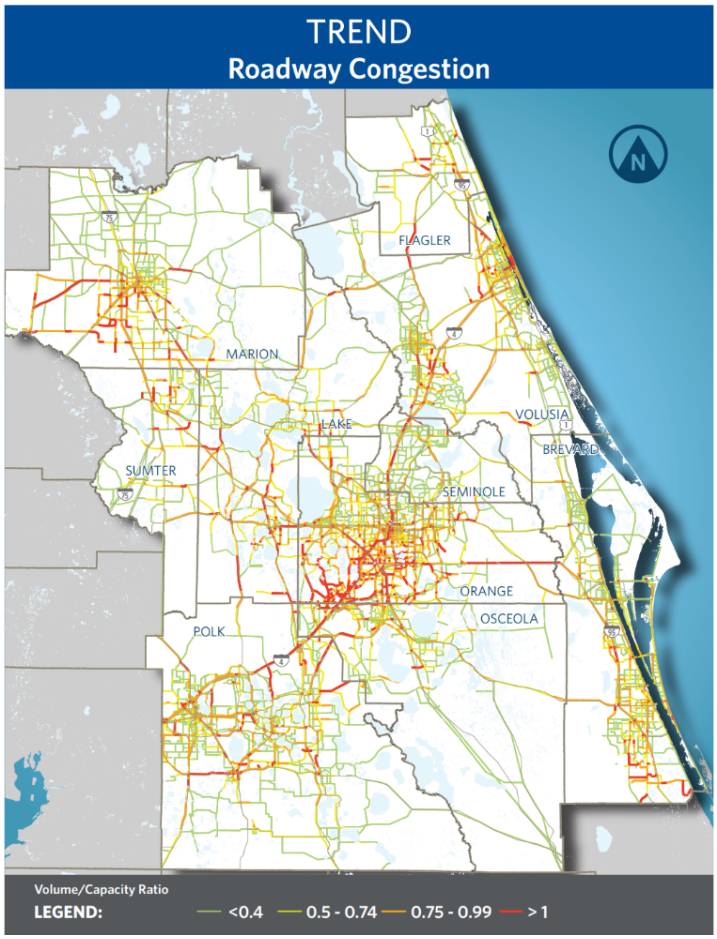
	Participation Rate		Satisfaction (5-point Scale)	
	2018	2019	2018	2019
Average	52.6%	49.7%	4.40	4.41
Beach Activities	87.7%	85.1%	4.44	4.47
Bicycling	39.0%	34.5%	4.41	4.37
Brevard Zoo	35.6%	32.5%	4.51	4.41
(Brevard Zoo) Treetop Trek	na	10.1%	na	4.13
Eau Gallie Arts District	30.5%	27.5%	4.26	4.36
Cocoa Village	52.7%	48.9%	4.38	4.34
Downtown Melbourne	45.5%	43.3%	4.35	4.44
Kennedy Space Center	59.8%	60.7%	4.59	4.63
Nature & Wildlife Viewing	56.7%	56.1%	4.41	4.47
Orlando Theme Parks	37.1%	28.1%	4.47	4.35
Ron Jon Surf Shop; Cocoa Beach Surf Company	57.0%	54.0%	4.35	4.34
Space Coast Stadium	17.5%	12.3%	4.09	4.18
The Cove	39.3%	32.4%	4.38	4.43
Westgate Cocoa Beach Pier	49.5%	44.3%	4.27	4.28

[88] https://issuu.com/spacecoast/docs/20fall_fscot_digital
[89] https://assets.simpleviewinc.com/simpleview/image/upload/v1/clients/daytonabeach/2019_EconomicImpactofTourismVolusiaCountyFInal_sm_78b0a90f-3b5e-44b8-88bc-64b27ac770a1.pdf
[90] https://assets.simpleviewinc.com/simpleview/image/upload/v1/clients/daytonabeach/JUN_2019_Visitor_Profile__69d0e5de-ae45-4bcd-9076-47e63795e1b1.pdf

Future Trends

According to the 2019 Central Florida Visitor Study, visitor growth is forecasted to average 3.15 percent annually until 2045 resulting in 171 million visitors to the region.[91] The east coast of Central Florida including Brevard and Volusia counties are poised to receive much of this future traffic. Shown in **Figure 24,** various roadway segments will see significant congestion in this region, specifically around the major highways and related intersections of I-95, SR 528, and I-4.

***Figure 24** | Visitor Study Trend Scenario Roadway Congestion 2045 (Source: Central Florida Visitor Study, 2019)*



Attractions

As indicated in the Central Florida Visitor Study, visitors continue to visit theme parks, beaches, cruises, and racing entertainment. However, the increase in attendance creates congested parks and overloaded infrastructure, influencing visitors to consider alternative attractions to better use time. Therefore, the entertainment industry companies may acquire more areas of property to help increase capacity. For example, Carnival Cruise selected Port Canaveral for the homeport of an XL-class ship for 6,500 passengers. Port Canaveral has also tried to attract cruise passengers to stay longer in the area before and after cruise embarkations. This will lead to more attractions being created, more land uses to support longer stays and ultimately more congestion.[92]

[91] http://cfgis.org/FDOT-Resources/Central-Florida-Visitor-Study/DocumentLibrary.aspx
[92] https://www.portcanaveral.com/PortCanaveral/media/Recreation/JPC/PORT-CANAVERAL-30-YEAR-VISION-PLAN_1.pdf

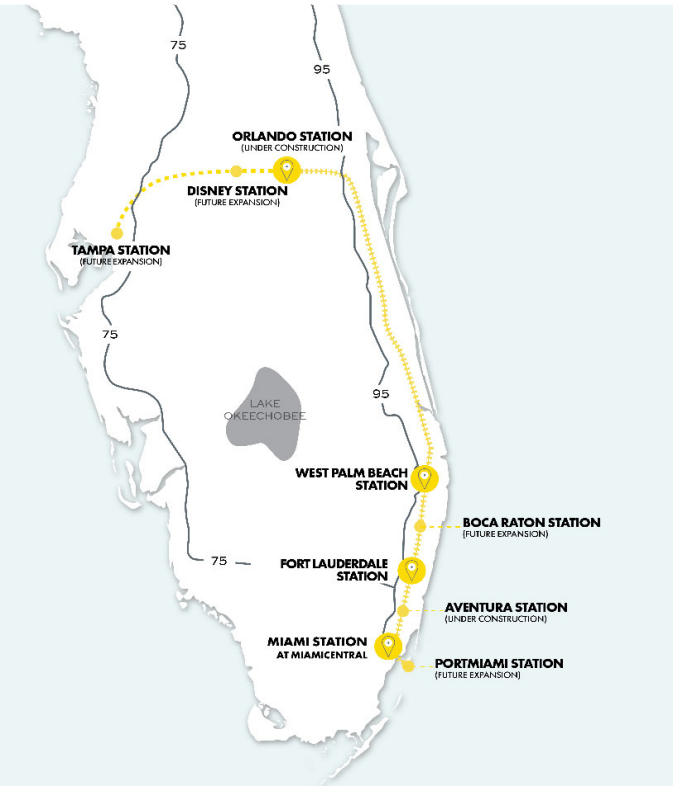
Space Tourism

Cape Canaveral is anticipated to become like the Silicon Valley of the space tourism industry with up to 48 launches per year by 2021.[93] Space tourism is an emerging phenomenon with several companies developing options including Virgin Galactic, SpaceX, and Blue Origin. Trips may be suborbital, orbital, or beyond. However, while this will be a growing trend, it may not be available for the masses due to the space constraints and costs.

High Speed Intercity Rail

The Brightline system, shown in **Figure 25,** will also increase visitors traveling in from the west and the south areas of Florida. Brightline has already been promoting these trips using taglines such as "carefree and car-free way to explore Florida's most popular theme parks." The Orlando service extension is anticipated to open in 2022.[94] The service will offer 32 trips a day, 16 each way, from 6 a.m. to 9 p.m. In Brevard County, the route passes through several areas including Melbourne, Cocoa, Rockledge, Grant-Valkaria, and Palm Bay. However, there are currently no plans for a station in the area. The company is open to consider a station in the area after reviewing initial ridership numbers from the current route.[95] If this occurs, more visitors would be able to conveniently access the Space Coast from around the state, increasing pressure on transportation and land use to accommodate travelers.

***Figure 25** | Brightline Florida Route (Source: Brightline)*



[93] http://cfgis.org/FDOT-Resources/Central-Florida-Visitor-Study/DocumentLibrary.aspx
[94] https://www.gobrightline.com/florida-expansion
[95] https://www.vieravoice.com/senior-life/news/brightline-trains-skip-brevard-on-track-for-late-2022/article_a2c8ef20-7e7d-52b6-b9fd-7ca009e9d440.html

Hyperloop

Another potential carrier of tourists to Central Florida is the Hyperloop. Initially, Hyperloop One proposed a route from the Miami International Airport to the Orlando International Airport, **Figure 26**. Hyperloop is an elevated tube that would swiftly transport people through the middle of the state, powered by solar panels on top of the tube. This concept also considered a connection at Port Miami as another phase of the project. The 257-mile route, which is three hours by car, would turn into only 26 minutes.[96] Additional visitors to Central Florida via Hyperloop may lead to more trips to the Space Coast.

***Figure 26** | Potential Route for VirginOne Hyperloop (Source: VirginOne Hyperloop)*

Potential Impacts and Challenges

Increased Traffic: Greater volumes of visitors to the area will increase traffic from personal vehicle use or even ridesharing. These visitors would compete for use of the facilities shared with freight transport.

Changing Land Use: Land uses related to hotels, restaurants, and shopping would increase around popular attractions areas, including around the spaceport. Additionally, these same changes could happen around potential new regional transportation stations such as Brightline.

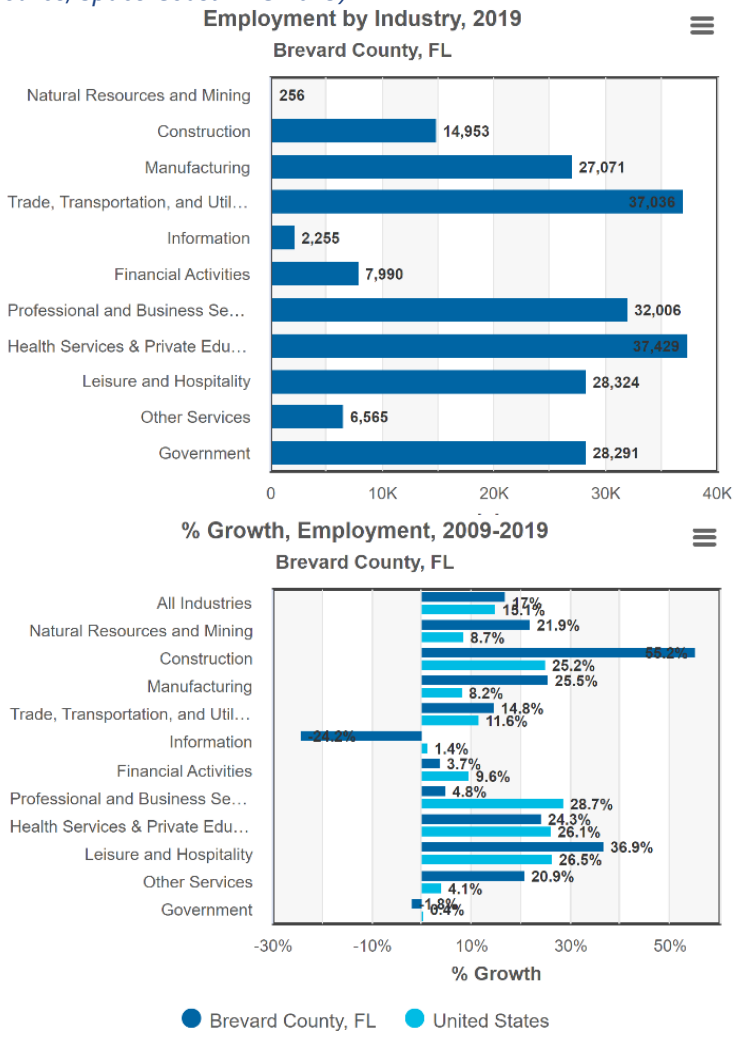
[96] https://wsvn.com/news/local/miami-to-orlando-in-26-minutes-plans-for-proposed-hyperloop-train-moving-forward/#:~:text=In%20September%2C%20Hyperloop%20One%20selected,to%20about%2026%20minutes%2C%20the

Transportation and Warehousing

According to the Bureau of Labor Statistics, the transportation and warehousing sector includes industries providing transportation of passengers and cargo, warehousing and storage for goods, scenic and sightseeing transportation, and support activities related to modes of transportation.[97] In Florida, this sector is part of a larger logistics, distribution, and manufacturing network where transportation and warehousing maintain close linkages.[98] Brevard County employment in these related industries is shown in **Figure 27**.

The Space Coast is the second leading "producer" of goods in the Central Florida region, with 20 percent of total imports and exports combined, and 23 percent of total outbound tonnage. Brevard County is also home to the only deep-water port in the region, handling over six million tons of freight annually.[99] Businesses related to transportation and warehousing have grown, with more than 500 manufacturers in the area. A segment of manufacturing is the defense and semiconductor industry in Palm Bay, which has recently grown faster than any other Florida

***Figure 27** | Employment in Brevard County (Source, Space Coast EDC 2019)*



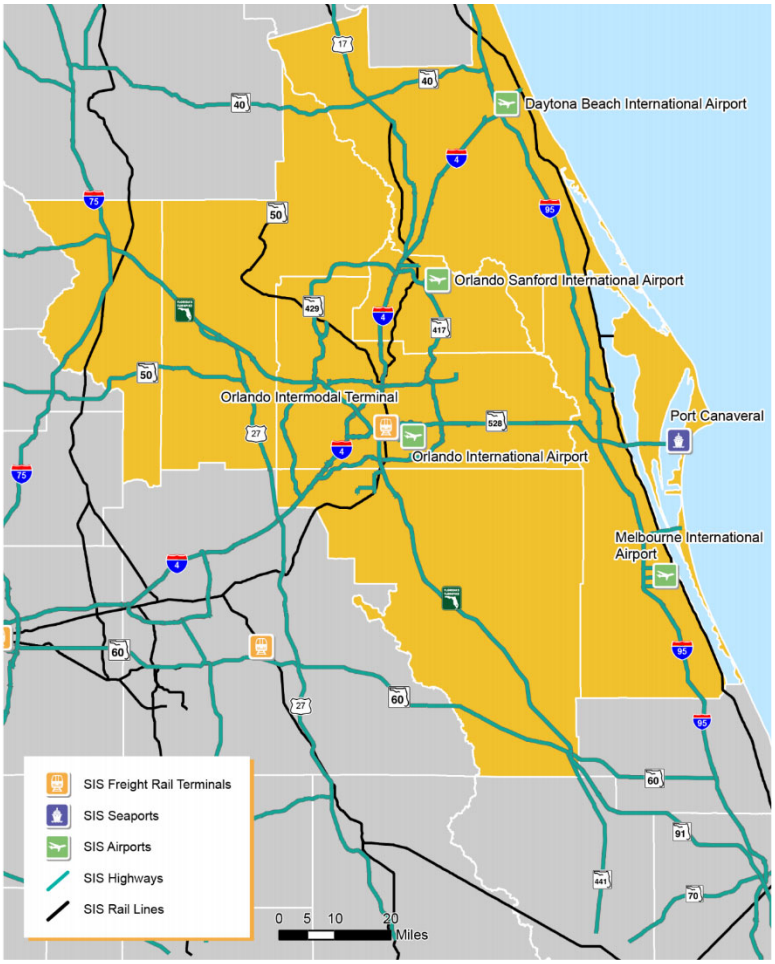
[97] https://www.bls.gov/iag/tgs/iag48-49.htm#:~:text=The%20Transportation%20and%20Warehousing%20sector%20includes%20industries%20providing%20transportation%20of,related%20to%20modes%20of%20transportation.
[98] https://www.enterpriseflorida.com/wp-content/uploads/Logistics_Distribution_Wage_Data_Sheet.pdf
[99] https://Space Coasttpo.com/plans-programs/long-range-transportation-plan/

city.[100] In the north, Volusia County provides easy access to the entire I-4 High Tech Corridor, coastal Florida, and the entire eastern seaboard. There are over 450 local manufacturers based in the area.[101]

Background

To support transportation and associated logistics sectors, this area of Central Florida has multiple freight resources. There are eight railroads (Central Florida Rail Corridor - SunRail, CSX, Florida Central Railroad, Florida East Coast Railway, Florida Midland Railroad, Florida Northern Railroad, Orlando Utilities Commission, and United States Government), one deep water seaport, Port Canaveral, that is a Strategic Intermodal System (SIS) hub with highway and rail connections, 25 public use and 135 private use airports and a spaceport, which operates the Shuttle Landing Facility. However, most freight travels by highway and, as shown in **Figure 28**, the region offers many SIS facilities to support this movement.[102]

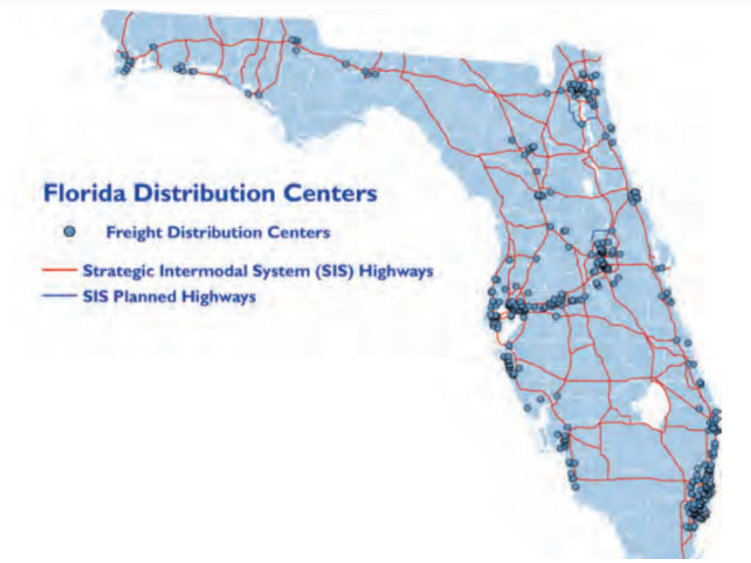
***Figure 28** | SIS Facilities in FDOT District 5*
(Source: FDOT Economic Profile)



[100] https://www.globaltrademag.com/made-in-america-20-top-u-s-cities-for-manufacturers/
[101] https://www.teamvolusiaedc.com/Logistics---Distribution-10-116.html
[102] https://www.fdot.gov/rail/publications.shtm/D5freight

To support transportation and distribution facilities, 708,681 people were employed in logistics and distribution, and transportation and warehousing in 2018.[103] **Figure 29** illustrates Florida freight distribution centers. Enterprise Florida, Inc. has identified distribution and logistics as a statewide targeted industry supporting domestic and international freight flows, with global trade fueling this sector. [104]

***Figure 29** | Florida Distribution Centers (Source: FDOT, FL Chamber)*



Trucking is the principal way goods are delivered, relying on local roads, which also carry heavy flows of commuters. Sometimes these facilities are not designed to accommodate large trucks. For long-distance movements, trucks operate on the Interstate Highway System, Florida's Turnpike, and other major corridors such as US 27. Given Florida growth projections, many of these roadways, including rural segments, are expected to have future peak period congestion. An alternative is freight rail provided in some parts of the state. Florida's major highway and rail corridors must identify how to best accommodate growth in both freight and passenger traffic over the next 50 years.[105]

[103] https://www.enterpriseflorida.com/wp-content/uploads/Logistics_Distribution_Wage_Data_Sheet.pdf
[104] http://www.flchamber.com/wp-content/uploads/2016/06/Florida_Made-for-Trade_Trade-and-Logistics-Study2.0.pdf
[105] http://www.flchamber.com/wp-content/uploads/2016/06/Florida_Made-for-Trade_Trade-and-Logistics-Study2.0.pdf

Future Trends

Demand for movement of goods has been steadily increasing and will continue to grow significantly by 2045. Movement by truck is projected to increase more rapidly than other modes of freight, growing 1.5 percent annually or by 35 percent by 2040, as shown in **Figure 30** and **Figure 31.**[106]

***Figure 30** | Historical and Forecast Total Freight Tonnage in Millions of Tons (Source: US DOT)*

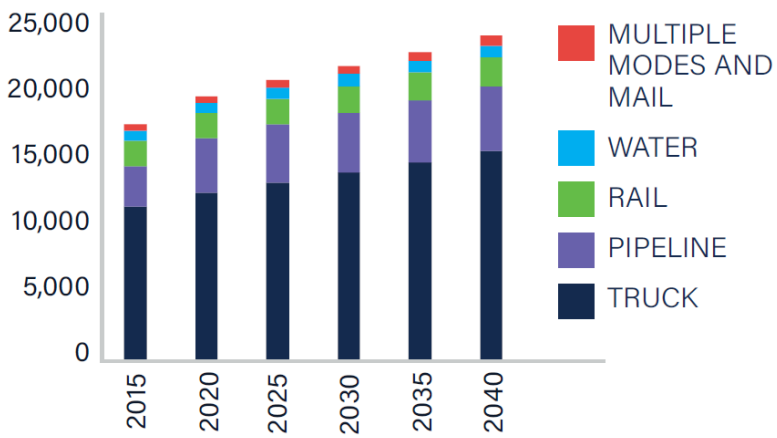


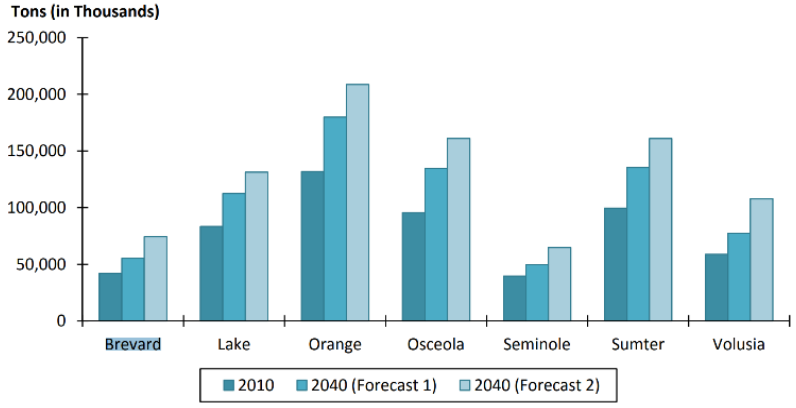
***Figure 31** | Forecasted Goods Movement by Mode in Thousands of Tons (Source: US DOT)*

OVERALL	2020	2025	2030	2035	2040	2045
Truck	12,417,523	13,132,935	13,840,459	14,572,969	15,474,235	16,414,977
Rail	1,795,948	1,866,043	1,939,856	2,021,716	2,135,560	2,250,033
Water	780,553	819,228	839,389	864,383	903,684	942,244
Air (include truck-air)	9,703	11,887	14,300	17,397	22,129	26,211
Multiple modes/mail	478,272	522,850	572,596	630,243	711,698	799,761
Pipeline	3,976,704	4,266,485	4,419,310	4,554,760	4,637,816	4,766,228
Other and unknown	32,402	32,019	29,824	29,900	30,568	31,688

[106] https://www.transportation.gov/freight/NFSP

Similar growth is anticipated locally according to the 2013 Central Florida Regional Freight Plan, illustrated in **Figure 32**. By 2040 the freight volume is anticipated to grow between 35 and 61 percent with every one million tons of freight moved in this region providing 155 direct transportation jobs and $7 million in direct income.[107]

***Figure 32** | Inbound, Outbound, Intra-county, and Through Freight Tonnage by County 2010-2040*



The manufacturing industry movement (**Figure 33**) is also anticipated to increase significantly (close to 50 percent) by 2045. This will also be mostly supported by the trucking mode or multiple/combination of modes.[108] In Brevard County, a manufacturing sector segment anticipated to

***Figure 33** | Forecasted Manufacturing Goods Movement by Mode Thousands of Tons (Source: US DOT)*

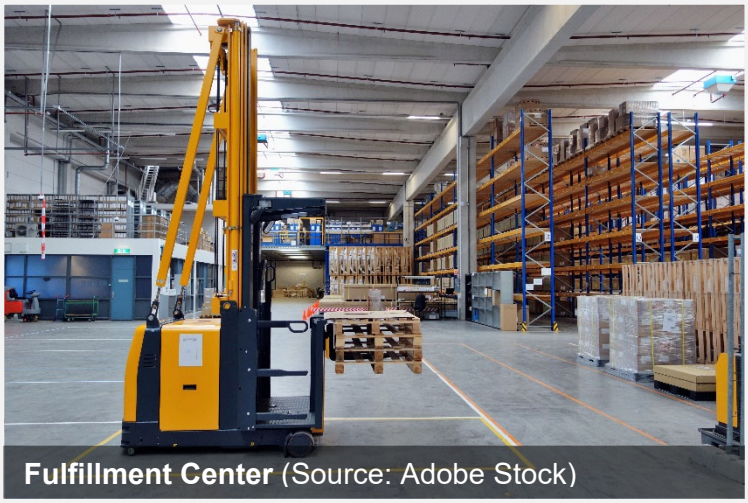
MANUFACTURING	2020	2025	2030	2035	2040	2045
Truck	3,530,732	3,799,251	4,084,292	4,407,952	4,793,941	5,210,084
Rail	197,799	214,852	233,340	255,489	283,082	310,270
Water	41,125	47,389	54,207	62,836	75,200	86,002
Air	7,248	8,917	10,790	13,219	16,950	20,155
Multiple modes/mail	161,981	182,581	205,849	235,171	275,318	323,238
Other and unknown	4,650	5,778	7,087	8,764	11,176	13,788

[107] https://metroplanorlando.org/plans/regional-freight-plan/#:~:text=Preparing%20for%20freight%20growth%20will,between%2035%25%20and%2061%25.&text=For%20every%201%20million%20tons,in%20direct%20income%20are%20created.
[108] https://www.transportation.gov/freight/NFSP

grow 20 percent by 2028 is leather and allied product manufacturing.[109] In Volusia County, transportation and warehousing is anticipated to grow 17.3 percent.[110]

Other Future Trends

E-commerce


Fulfillment Center (Source: Adobe Stock)

E-commerce has rapidly grown, influencing supply chains, and exploding demand for deliveries in congested urban areas. This trend directly impacts transportation and warehousing and associated industries. Items bought online bypass brick-and-mortar stores and go directly to the consumer, becoming a customer-preferred way of shopping. This direct relationship is a growing trend, increasing 16.9 percent between 2018 and 2019, compared to total retail sales growth of four percent. **E-commerce sales are anticipated to increase at a CAGR of 12 percent between 2019 and 2024**.[111]

Same-day delivery is also a growing trend, becoming the fastest growing service type for e-commerce deliveries. The transportation and warehousing industry is pressured by this phenomenon in trying to provide shorter delivery windows and just-in-time inventory management, forcing even more focus on truck travel time reliability. Rapid delivery increases demand on air cargo with the need for larger, more efficient terminal and processing facilities. Related, is the increase in package returns where between 13 and 30 percent of all online orders are returned, further pressuring freight transportation systems.[112]

Retailers will need to move inventory closer to population centers, closer to consumers. Companies have invested in **moving distribution and fulfillment centers closer to Interstate highways** near

[109] https://floridajobs.org/economic-data/employment-projections/fastest-growing-industries
[110] https://floridajobs.org/economic-data/employment-projections/fastest-growing-industries
[111] https://www.transportation.gov/freight/NFSP
[112] https://www.transportation.gov/freight/NFSP

metropolitan areas, increasing costs for warehousing space and inventory. Also, regional distribution hubs are developing in secondary markets within 250 miles of large transportation and population centers. [113]

As a result of e-commerce trends, **shorter, intra-regional truck deliveries will increase in urban areas and with higher frequency** as compared to longer, inter-regional trips. Truck traffic in urban areas has already grown by more than 17 percent since 2010.[114] This creates challenges as urban truck traffic increases and exacerbates last-mile logistics issues. Greater competition continues for already congested urban roadways and curb space, especially in the urban cores.[115]

Technology

Supply chain industries look to integrate **automated technologies into processes** to cut costs and increase efficiency. Ports have made investments to automate and become efficient to keep up with international competition. The same is true for warehouse and distribution centers to meet consumer expectations, compete, and address labor costs. Some of this automation includes automated cranes and forklifts to handle inventory.[116]

Connected Technologies (Source: Adobe Stock)

In addition to distribution and warehouse, related technologies have been incorporated into delivery vehicles. One example is **truck platooning,** which uses wireless connectivity to enable automated communications between a line of vehicles keeping them in sync with acceleration and deceleration and reducing following distance. This improves safety, reduces operating costs, and enhances fuel efficiency for long-haul deliveries, with fuel savings of 5.2 to 7.8 percent. Truck automation will likely

[113] https://www.transportation.gov/freight/NFSP
[114] https://www.transportation.gov/freight/NFSP
[115] https://www.transportation.gov/freight/NFSP
[116] https://www.transportation.gov/freight/NFSP

increase over the coming decades, allowing trucks to reduce human intervention for significant portions of long-haul deliveries.[117]

Another element of automation is the increase in **Internet of Things (IoT) infrastructure and increased amounts of real-time data** available from supply chain freight brokers, carriers, shippers, and receivers. This allows industry stakeholders to analyze freight data and optimize supply chains through real-time information on vehicle locations, traffic conditions, and intermodal facility capacity.[118]

These trends will further eliminate manual processes impacting the current pace of freight transactions. Other improvements include services such as digital shipping marketplaces, where carriers connect directly with shippers with minimal brokerage costs. The use of **digital ledger technology, or blockchain**, will also influence how firms track freight transportation.[119]

Future Delivery Systems

The future of goods system delivery will be transformed by other innovations starting to develop including crowd-sourced delivery drivers **(on-demand like Uber Freight), cargo bikes or scooters, and delivery robots.** Increases of in-store pick up lockers for “click and carry” customers also expands and leads to last-mile challenges. Also, refueling systems and infrastructure for sustainable sources will have impacts on future trucking fleets.[120]

As discussed previously, **unmanned aircraft systems technologies** will likely be incorporated into distribution and warehousing processes. UAS, or drones, could be used for last-mile deliveries of a range of goods. Currently many retailers, delivery companies, and technology firms are piloting the potential to use drones to deliver parcels to residents.[121]

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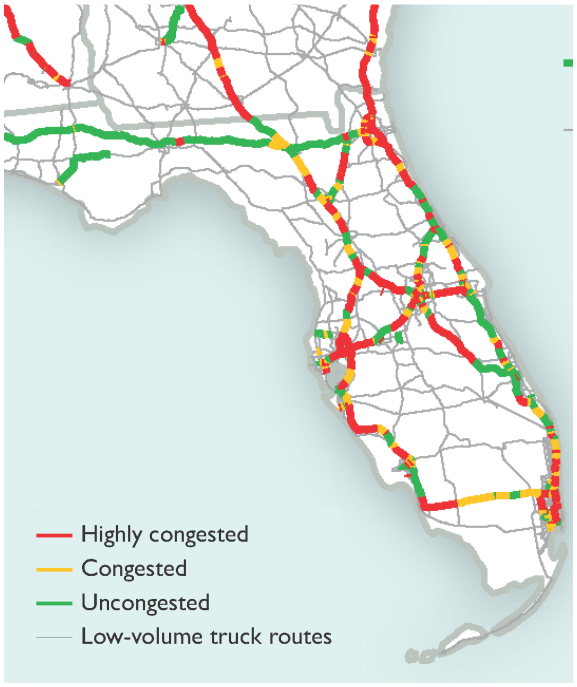
[117] https://www.transportation.gov/freight/NFSP
[118] https://www.transportation.gov/freight/NFSP
[119] https://www.transportation.gov/freight/NFSP
[120] https://www.transportation.gov/freight/NFSP
[121] https://www.transportation.gov/freight/NFSP

Potential Impacts and Challenges

According to the 2040 Space Coast Long Range Transportation Plan (LRTP), the county's population is anticipated to grow to over 750,000 in 2040, increasing 40 percent. Also, jobs are expected to grow by 41 percent.[122] In Volusia County, population will increase by 39 percent and employment by 49 percent. While this growth is positive, it will lead to increased cars on the roads and increased challenges with land uses. **Figure 34** illustrates U.S. DOT's 2045 congested roadways forecast with several segments in the area facing challenges. Transportation and warehousing, and related industries, face challenges navigating this increasingly dense environment to make deliveries to ports and distribution centers.[123]

***Figure 34** | 2045 Congested Roadways (Source: US DOT)*



Some specific issues to consider for the future include:

Last Mile Deliveries and Congestion in Urban Areas. Last-mile deliveries already account for 41 percent of overall supply chain costs. Urban areas have infrastructure difficult for trucks to navigate, and with higher levels of congestion from increased population and employment growth, freight and passenger traffic will compete for use of infrastructure. Physical and operational constraints such as street widths, roadway design, time of day restrictions, etc. make it difficult for larger freight to access routes or certain neighborhoods.[124]

Bottlenecks – Freight bottlenecks occur at major highway interchanges. Trucks moving through urban areas deal with increased traffic and network deficiencies due to peak period traffic volumes, special

[122] https://Space Coasttpo.com/plans-programs/long-range-transportation-plan/
[123] https://Space Coasttpo.com/plans-programs/long-range-transportation-plan/
[124] https://www.transportation.gov/freight/NFSP

event traffic, work zones, crashes, and other incidents.[125] Delays from these bottlenecks may prove costly for industries expecting and promising on-time deliveries.

Deliveries and Parking – On-street and off-street deliveries can be difficult for drivers to access in increasingly-congested urban areas.[126] Truck parking is also in limited supply as indicated in the 2020 Statewide Truck Parking Study.[127] The full range of truck parking space demand for 2016 was 843 to 6,648 spaces, while in 2025 the minimum range increases to between 1,133 to 4,118 spaces; and in 2040, 1,360 to 10,005 truck parking spaces will be needed in the FDOT District 5 area.[128]

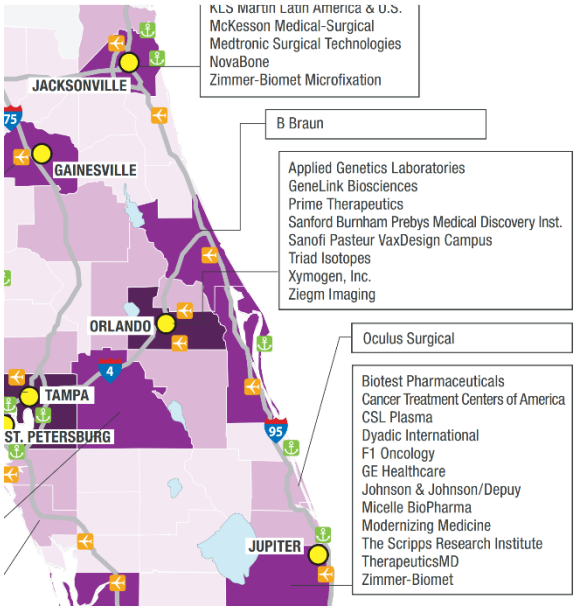
Truck Travel Time – Urban areas where manufacturing production and distribution could occur may encounter impacts to travel times for logistics, timing of shipments, just-in-time manufacturing, and other ripple effects in the production process.[129]

[125] https://www.transportation.gov/freight/NFSP
[126] https://www.transportation.gov/freight/NFSP
[127] https://www.fdot.gov/rail/studies/truck-parking
[128] https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/rail/publications/d5/truckparkingstudy_tr5_futuredemand_feb2018.pdf?sfvrsn=bd549449_2
[129] https://www.transportation.gov/freight/NFSP

Healthcare

East Central Florida supports multiple health and life sciences businesses. **Figure 35** identifies the life sciences industry employers in the area. Life sciences includes health related industries. With 37,429 employees in 2019, the health services and private education sector employed more people than any other sector in Brevard County.[130] It consists of operations in the provision of education and health services, including private schools, colleges, training centers, hospitals, doctors' offices, social work, and childcare. From 2009 to 2019 this sector grew 24 percent, which is just below the U.S. average of 26 percent.[131]

***Figure 35** | Life Sciences Employment and Companies (Source: Enterprise Florida)*

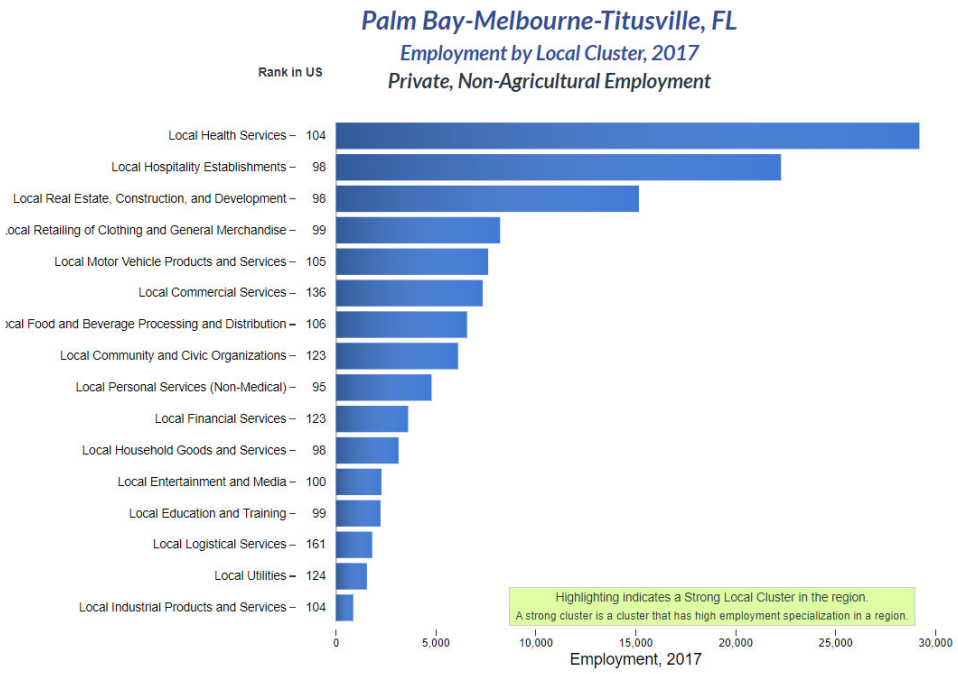


[130] https://www.SpaceCoastheadlight.com/headlight/empind
[131] https://www.SpaceCoastheadlight.com/headlight/empind

Background

Healthcare has many industry clusters and related segments. As discussed, life sciences is a related segment, which is a Florida targeted industry with many supporting companies in Brevard and Volusia counties. Another segment is the local health services industry cluster (concentrations of related industries), and in the Palm Bay-Melbourne-Titusville Metro area this is the top local cluster. Local clusters mean the industry sells products and services primarily for the local market compared to what is called a traded cluster, which is where the industry serves other regions or nations. According to U.S. Cluster Mapping, the area's top local industry clusters are shown in **Figure 36,** with local health services as the top industry with over 29,000 employed in 2017. Local health services refer to healthcare provider offices, home and residential care, hospitals, drug stores, medical laboratories, funeral services and crematories, optical goods retailing, and medical equipment distribution and rental.[132]

Figure 36 | *Local Employment Clusters (Source: U.S. Cluster Mapping)*



[132] http://www.clustermapping.us/region/msa/palm_bay_melbourne_titusville_fl/cluster-portfolio

The Deltona-Daytona Beach-Ormond Beach Metro area has a similar local industry make up with local health services supporting 28,932 employees in 2017, the top employed local industry. Also, this metro area has a related traded cluster serving other regional and national markets - medical devices, which ranks this area 70th in the U.S.[133]

Major Area Employer: Health First


Health First Brevard County
(Source: Space Coastdaily.com)

Founded in 1995, Health First is Central Florida's only fully integrated delivery network (IDN) and employs over 9,000 associates in the region. This company operates four hospitals in Brevard County, including Health First's Cape Canaveral Hospital (opened in 1962), Holmes Regional Medical Center (opened as Brevard Hospital in 1937 and serves as Brevard County's only Trauma Center), Palm Bay Hospital (opened in 1992), and Viera Hospital (opened in 2011). Health First Medical Group is the largest multi-specialty physician group on the Space Coast. Health First operates various outpatient and wellness services, including Health First Aging Services, three Health First Pro-Health & Fitness Centers, Home Care and Hospice of Health First.[134] Health First is a top employer in the Palm Bay-Melbourne-Titusville Metro area, employing 7,800 employees, second only to the Brevard County Schools.[135]

Major Area Employer: AdventHealth (Florida Hospital)

AdventHealth was founded in 1973, with its roots tracing back to 1866 with a team of Seventh-day Adventist medical pioneers in Battle Creek, Michigan.[136] In the Deltona-Daytona Beach-Ormond Beach Metro area AdventHealth (Florida Hospital Volusia Flagler) employs 5,510, second only to Volusia County Schools.[137] Its facilities are located throughout Volusia and Flagler counties including AdventHealth DeLand, AdventHealth Fish Memorial in Orange City, AdventHealth Palm Coast,

[133] http://www.clustermapping.us/region/msa/deltona_daytona_beach_ormond_beach_fl/cluster-portfolio
[134] https://hf.org/about_us/index.cfm
[135] https://business.ucf.edu/wp-content/uploads/sites/4/2020/11/UCF_FLMetro_Forecast-Q3-2020_red.pdf
[136] https://www.adventhealth.com/mission-and-history
[137] https://business.ucf.edu/wp-content/uploads/sites/4/2020/11/UCF_FLMetro_Forecast-Q3-2020_red.pdf

AdventHealth Daytona Beach, and AdventHealth New Smyrna Beach. Additionally, specialists, surgeons, and primary care physicians also serve patients in Palm Coast, Flagler Beach, Deltona, Debary, Ormond Beach, Ormond-by-the-Sea, Holly Hill, and Port Orange. These facilities are all part of the larger AdventHealth system known as the East Florida Region.[138]

Advent Health Volusia County (Source:AdventHealth)

Future Trends

While the future of the health care industry is challenging to anticipate, there are certain segments for which insight can be gleaned, especially the medical device industry and pharmaceutical distributors.

Medical Devices

The medical device industry is anticipated to steadily grow with global annual sales increasing five percent each year, reaching $800 billion by 2030. This is apparent through the lens of an increasingly older population facing growing health challenges coupled with the rising demand for innovative new devices and services to address these challenges.[139]

Governments try to reduce the cost of healthcare, especially in hospitals. A potential avenue for such cost savings lies in using medical devices and data analytics. Medical device companies try to get increasingly closer to patients and customers. New innovations in this supply chain may lead to shorter, less expensive, and fewer hospital visits and lower costs.[140]

[138] https://www.adventhealthmedicalgroup.com/east-florida/adventhealth-medical-group-volusia-county
[139] https://assets.kpmg/content/dam/kpmg/xx/pdf/2017/12/medical-devices-2030.pdf
[140] https://assets.kpmg/content/dam/kpmg/xx/pdf/2017/12/medical-devices-2030.pdf

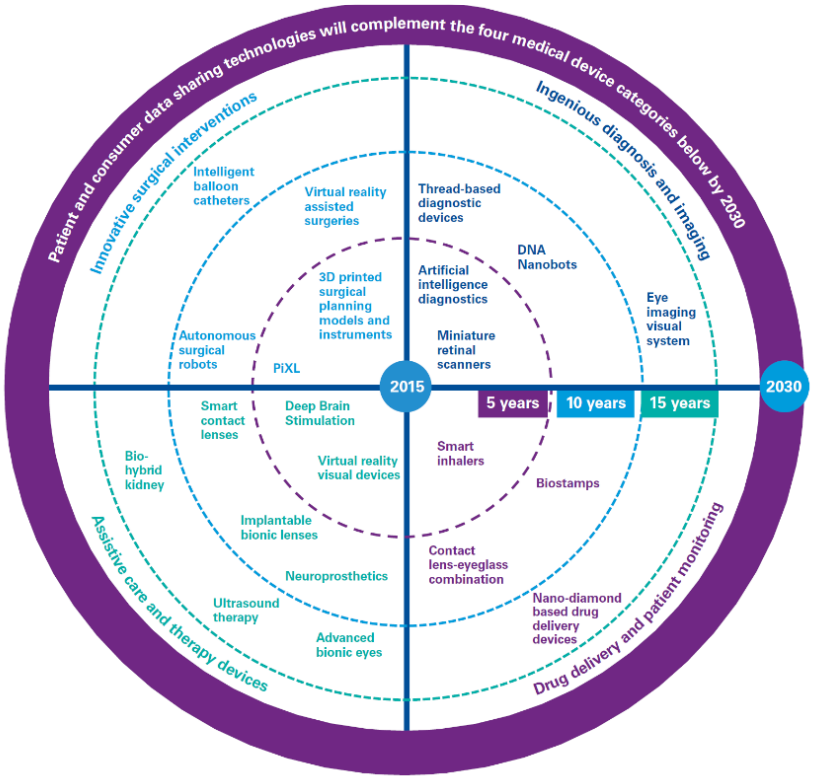
Customer Customization

Using wearable devices and connected phone apps, patients connect their vitals to a health platform or directly to physicians that can monitor them, reducing the need for various in-person exams. This will be amplified by connected devices, such as smart inhalers or smart eye lenses, which can wirelessly transmit data to physicians and providers. In 2016, remote monitoring of patients grew by 44 percent, and is anticipated to keep growing to 50 million in the U.S. by this year (2021). The global market for these devices is anticipated to reach $1.9 billion by 2025.[141]

Advanced Devices

As shown in **Figure 37**, many advances are anticipated in the medical device market. Specifically, technology impacts can be seen with 3D printing and artificial intelligence to manufacture devices and further reduce costs. Examples include Johnson and Johnson using a 3D printer to create orthopaedic products, or Google and Ethicon collaborating to use robotic surgical devices with artificial intelligence. Artificial intelligence has the potential to greatly speed up diagnosis and care decisions. Additionally, the use of artificial organs may increase.[142]

Figure 37 | *Medical Devices Technology Evolution (Source: KPMG)*

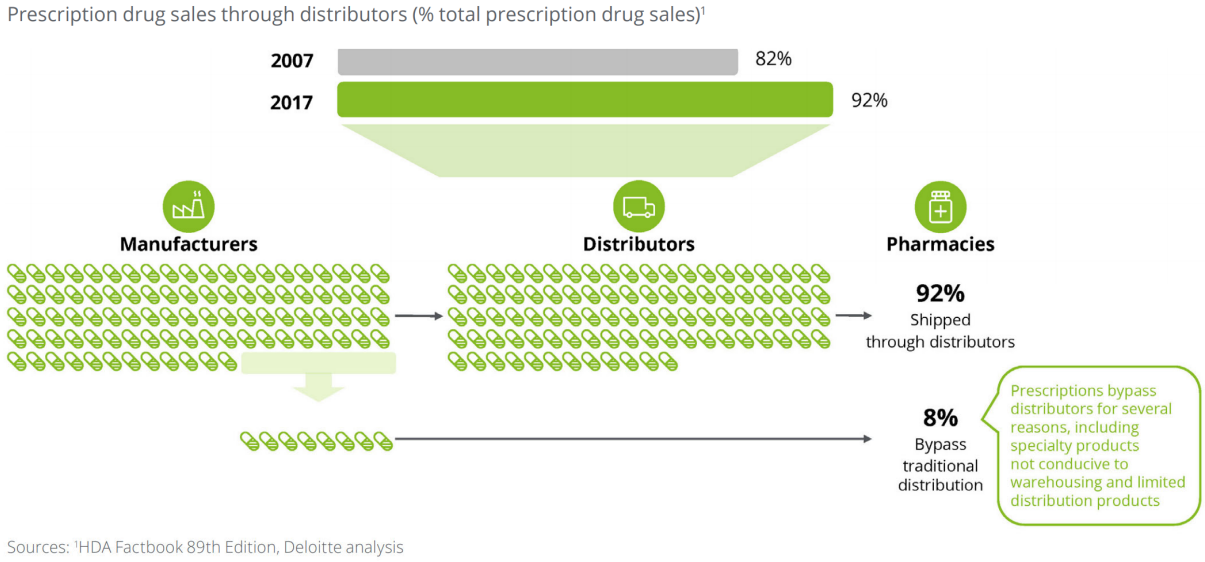


[141] https://assets.kpmg/content/dam/kpmg/xx/pdf/2017/12/medical-devices-2030.pdf
[142] https://assets.kpmg/content/dam/kpmg/xx/pdf/2017/12/medical-devices-2030.pdf

Pharmaceutical Distributors

Pharmaceutical distributors are integral in the complex healthcare industry. Supply chain elements include patients, providers, pharmacies, distributors, group purchasing organizations, manufacturers, pharmacy services administration, pharmacy benefit managers and payers.[143] This supply chain is shown in Figure 38.

***Figure 38** | Pharmaceutical Ecosystem (Source: HDA)*



Distributors currently meet customer and patient demands with daily shipments to pharmacy locations. This is done through self-warehousing where the distributor is responsible for delivering products to a retailer's warehouse. Another approach is the direct-to-store model where the products are delivered directly to retailer stores. In 2017, 93 percent of sales were attributed to the direct-to-store model.[144]

[143] https://www.hda.org/~/media/pdfs/publications/hda-role-of-distributors-in-the-us-health-care-industry.ashx
[144] https://www.hda.org/~/media/pdfs/publications/hda-role-of-distributors-in-the-us-health-care-industry.ashx

Personalized Medicine & Technology

Future personalized medicine may lead to smaller shipments delivered directly to patients. In general, personalized medicine is projected to have a 11 percent CAGR between 2017 to 2024. Additionally, the type of last-mile deliveries for same-day packages may involve advanced modes such as robots and drones.[145]

Another impact for distributors is the proliferation of IoT technologies providing real-time data on deliveries to pharmacies and patients. Such technologies will likely improve delivery routes, helping to find the best route and avoid any unexpected delays for critical medical needs.[146]

Potential Impacts and Challenges

Land Use and Traffic – As the need for regular in-person medical care decreases, this will likely impact land use approaches for related facilities, potentially with smaller building footprints or fewer locations. Additionally, traffic may be decreased from personal vehicles needing to make these trips and become replaced by more delivery vehicles in the transport of medical supplies and goods.

Transport of Sensitive Devices – Technological advances in medical devices may require additional precautions for protection of cargo; for example, in the transportation of hybrid organs or life saving devices. It will be important to keep these devices in mind and how they may be impacted by ITS technologies. Additionally, time sensitivity may also be a factor.

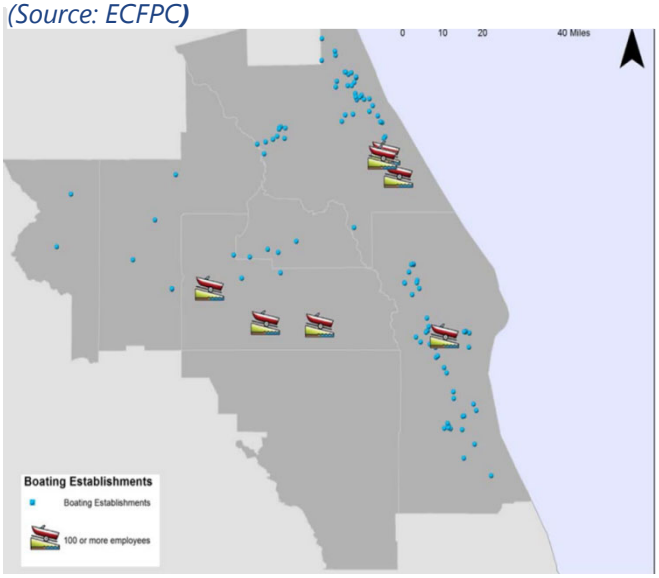
Smaller and Increased First/Last Mile Deliveries – With the increase in more personalized medicine, packages or shipments may become smaller and more direct to consumer as opposed to distribution warehouses or retailers. Additionally, the ability for distributors to accomplish these deliveries, navigating first/last mile within congested urban areas may be a challenge.

[145] https://www.hda.org/~/media/pdfs/publications/hda-role-of-distributors-in-the-us-health-care-industry.ashx
[146] https://www.hda.org/~/media/pdfs/publications/hda-role-of-distributors-in-the-us-health-care-industry.ashx

Boat Manufacturing

According to the National Marine Manufacturers Association, 100 million people in the United States do recreational boating each year.[147] Supporting this activity is the recreational boat manufacturing industry. In East Central Florida the boats and other vessels industry cluster is one of the region's largest agglomerations, with a heavy concentration in Brevard and Volusia counties, as shown in **Figure 39**. These boating establishments include boat manufacturers, machine shops and other makers of boat parts and accessories, product suppliers, and marinas that provide repair services, among others.[148]

***Figure 39** | Distribution of Boating Companies (Source: ECFPC)*



In 2018, there were 249 related businesses supporting 3,055 jobs. Moreover, there are 45,662 registered boats in this area.[149] Volusia County is home to three of the region's largest boat manufacturers: Boston Whaler, Everglades Boats, and Edgewater Power Boats. Other large industry employers include Sea Ray Boats in Brevard County and Regal Marine Industries and Nautique in Orange County.[150]

[147] National Marine Manufacturers Association https://www.nmma.org/press/article/22428
[148] East Central Florida Comprehensive Economic Development Strategy 2017
[149] National Marine Manufacturers Association https://www.nmma.org/statistics/publications/economic-impact-infographics
[150] East Central Florida Comprehensive Economic Development Strategy 2017

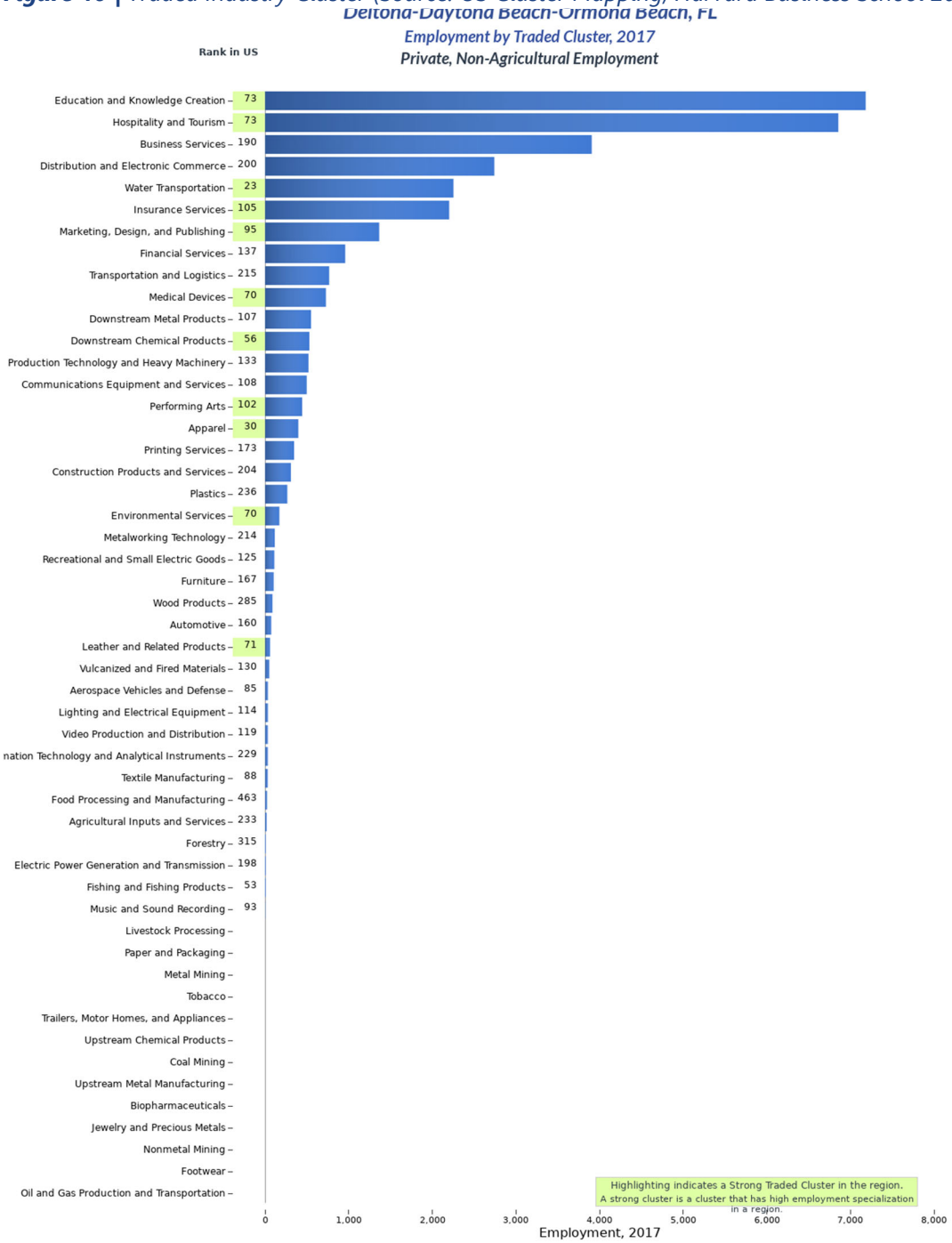
SeaDek Marine Products Facility in Rockledge
(Source: SeaDek)

Background

The boat manufacturing industry has a few regional industry clusters with the Deltona-Daytona Beach-Ormond Beach Metro area having significant specialization. As shown in **Figure 40**, water transportation is ranked as a top industry for serving regional and national markets. Additionally, this area's industry is ranked 23rd nationally.[151] Within the water transportation industry, (which also includes marine transportation services and water passenger transportation) the ship and boat building segment was the largest with 2,642 employees in 2018; 2,141 in the Deltona-Daytona Beach-Ormond Beach Metro area, and 501 in the Palm Bay-Melbourne-Titusville Metro area.[152]

[151] http://clustermapping.us/region/msa/deltona_daytona_beach_ormond_beach_fl/cluster-portfolio
[152]https://data.census.gov/cedsci/table?g=310M500US19660,37340&d=ANN%20Business%20Patterns%20County%20Business%20Patterns&n=3366&tid=CBP2018.CB1800CBP&hidePreview=true

Figure 40 | *Traded Industry Cluster (Source: US Cluster Mapping, Harvard Business School 2020)*



Major Boat Manufacturer - Boston Whaler

Boston Whaler is major boat manufacturer in Volusia County, specifically in Edgewater. The company was founded by Richard Fisher, who patented a foam injected hull process for boat durability in 1957. In 1987, Boston Whaler opened a factory in Volusia County's Edgewater community. Several boat models are produced at this facility including the Whaler 25, 27, and 31.[153]

Boston Whaler Facility Edge Water
(Source: Boston Whaler)

In 2017, the company announced acquisition of 60 additional acres of land adjacent to its Edgewater headquarters. The company leadership indicated that it would grow manufacturing, job creation, and product innovation in the area.[154] The plant reopened in 2021 and is expected to create 300 to 400 jobs over the next 18 to 24 months. Those jobs will be in addition to the 1,200 workers Boston Whaler employs at its main plant.[155]

153 https://www.bostonwhaler.com/about-boston-whaler.html
154 https://www.bostonwhaler.com/about-boston-whaler.html
155 https://www.news-journalonline.com/story/business/real-estate/2021/01/25/boston-whaler-add-300-400-jobs-reopening-plant-palm-coast/4249959001/

Future Trends

Outdoor recreation is anticipated to grow, and motorized water use is a significant part of this trend. According to the U.S. Department of Agriculture, motorized water use has the highest anticipated participation growth of all outdoor motorized activities. It is the only motorized activity with positive percentage increases in both participation rate and days per participant for 2030. Both total participants and total days will grow by about 30 percent between 2008 and 2030.[156] It is unclear what trends may appear with this growth, but some possibilities are explored here.

Future Recreational Water Vessels

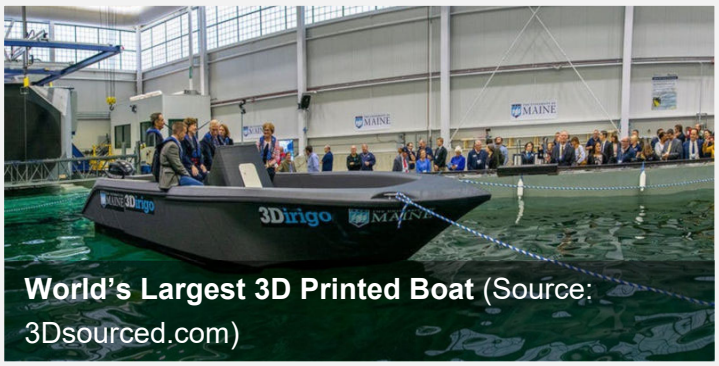
Recreational water vessels are anticipated to change, get larger and more complex, and serve a range of recreational functions. Various shapes are being designed, including floating, building-type structures. These range from thatched beach cottages on top of a catamaran hull to an entire floating city generating its own power and food. For example, Finnish companies have built a temporary accommodation floating structure off the coast of Qatar in anticipation of the 2022 soccer World Cup. It is four floors with a lounging area and a restaurant, capable of being towed to a new location after the tournament. Another design entitled the Oceanix concept uses hexagonal clusters of floating homes linking up to become towns with net zero emissions. A final concept is the Nomadia, a multi-deck craft for 3,000 guests. It has an internal marina capable of berthing ten 100-ft yachts, manmade beaches, 12 decks moving at up to five knots, along with lecture halls, meeting rooms, restaurants, and shops.[157] These types of boats may not replace smaller vessels, but as these concepts come to life, the demand for the manufacturing of different parts and resources to stock may impact this industry.

Future Leisure Boating Designs (Source: Yachtingworld.com)

[156] https://www.fs.fed.us/pnw/pubs/pnw_gtr945.pdf
[157] https://www.yachtingworld.com/features/extreme-multihull-concepts-future-catamaran-design-128038

3D Printing of Boats

The boating industry is working on how to be more sustainable, especially in use of alternative fuels. Another aspect is the manufacturing process itself, and this is where 3D printing may hold promise.



World's Largest 3D Printed Boat (Source: 3Dsourced.com)

The production of a 3D printed boat is faster and cheaper than traditional methods. This manufacturing method offers more efficient military boats, more environmentally friendly private yachts, and even autonomous boats. In a typical shipyard there will be 15 to 20 percent raw material waste. With 3D printing, waste is decreased to only two percent, providing savings in material and labor. The world's largest 3D printed boat was created in 2019, with the 3Dirigo, a model created by a team of researchers at the University of Maine. The 3Dirigo is a patrol boat weighing 2.2 tons and measuring 7.62 meters in length. The printer produced the boat in just 72 hours, using a blend of plastic and cellulose derived from wood resources.[158]

[158] https://3dsourced.com/feature-stories/3d-printed-boats-future/

Potential Impacts and Challenges

The United States boating industry has recently had a significant increase in popularity with a 13-year high of boat sales in 2020.[159] This interest will continue, and some potential challenges may be related to how the boats are manufactured and what impacts may come from climate change.

Changing Manufacturing Technologies: If boat manufacturers utilize advanced technologies such as 3D printing, perhaps on site, this may reduce the demand for hauling of parts. Instead, demand may increase for materials used in the 3D printing process such as plastic and cellulose derived from wood.

Climate Change: Sea level rise changes and warming climate may impact the areas where recreational boat users embark. Additionally, changing environmental conditions such as increased existence of red tide may also force recreational boaters to visit areas where this phenomenon does not exist. This may potentially reduce the demand in the study area.

[159] https://www.nmma.org/press/article/23527

Summary

Six industries in the Space Coast region are considered critical for the economic sustainability of the region. **Table 2** provides a summary of the expected growth estimates for the future.

***Table 2** | Space Coast Industries Growth Forecasts*

Aerospace	*Average of 42-50 launches a year until 2027* *5.5% annual increase in passengers at MLB by 2035* *9% growth in UAS by 2024*
Transportation & Warehousing	*35% growth by 2040 for movement of goods by truck* *30%-60% growth in freight tonnage for Central Florida by 2040*
Maritime	*8 million cruise passengers by 2048* *30 million cargo tonnage by 2048*
Healthcare	*11% CAGR in personalized medicine between 2017 and 2024* *5% global annual sales increase for medical devices, reaching $800 billion by 2030*
Boat Manufacturing	*30% increase in total participants and total days in motorized water recreation between 2008 and 2030*
Tourism	*3.2% annual tourism growth in Central Florida through 2045* *171 million visitors to Central Florida by 2045*

LONG-RANGE VISION

A key exercise in this study is the development of a long-range, regional vision for freight. This is based on planning partners' efforts, what the data revealed in combination with the micro-scenario projections, and what that looks like when synthesized for the region. This section describes this process and the resulting vision.

Regional Planning Visions and Frameworks

Space Coast TPO

As part of the 2040 LRTP, the Space Coast TPO developed a vision based on scenario planning with community members and stakeholders. The focus of the vision was continued with the 2045 LRTP effort and includes the following elements for the 2060 vision:

- Continued investment in ports (space, sea, air);
- Continue high tech focus;
- More walkable communities;
- Lower reliance on automobiles;
- Wider variety of housing; and
- More travel options for users (transit, rail, rideshare, walk, bike, trails).

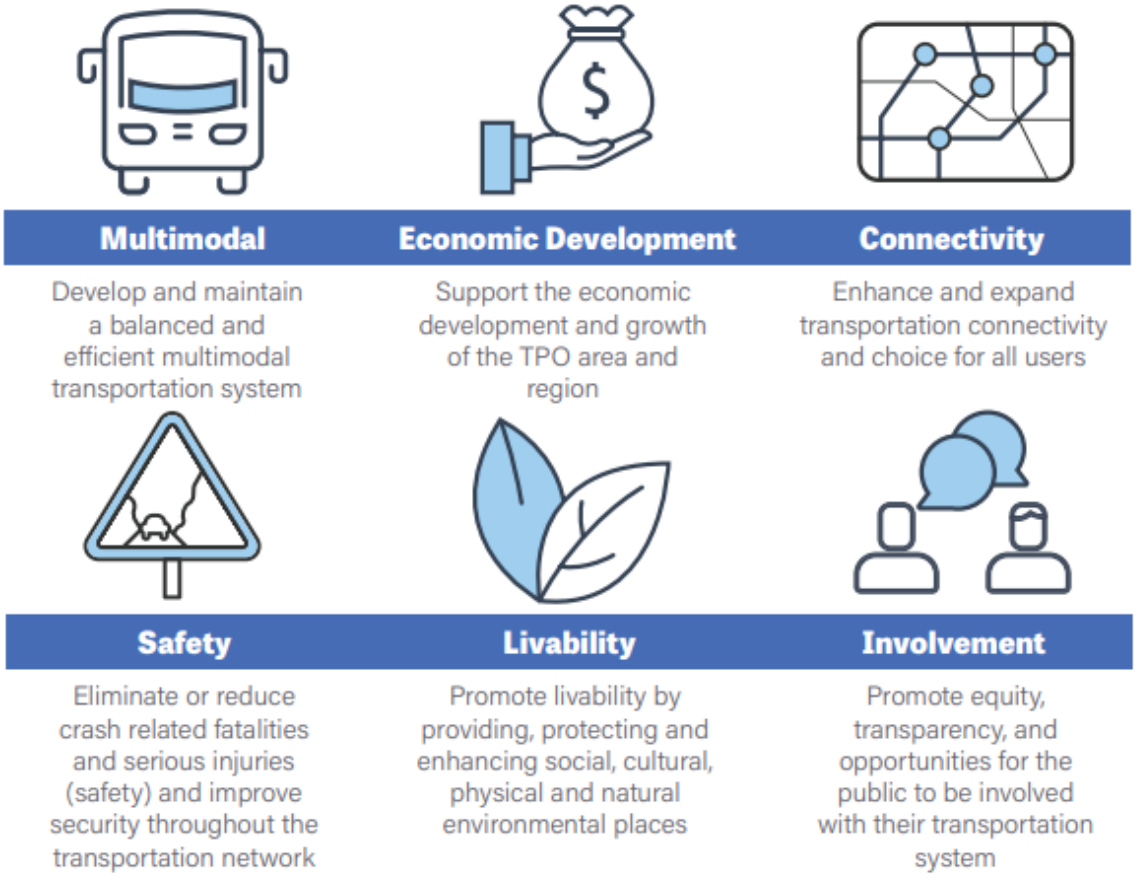
River to Sea TPO LRTP

The 2040 River to Sea TPO LRTP has the following vision:

"Our transportation system will provide a safe and accessible range of options that enhances existing communities while providing mobility in a fiscally responsible, energy efficient, and environmentally compatible manner. This integrated system will support economic development, allowing for the effective movement of all people, goods, and services necessary to maintain and enhance our quality of life."

The 2045 River to Sea TPO LRTP does not have a specific vision statement. Rather, the LRTP lists goals which it claims reflect the vision, as illustrated in **Figure 41**. The overall goals are organized by multimodal, economic development, connectivity, safety, livability, and involvement.

***Figure 41** | 2045 River to Sea LRTP Goals*



East Central Florida Regional Planning Council

In 2006, Central Florida started the large-scale planning effort “How Shall We Grow." This was a regional visioning project engaging 20,000 residents in a shared growth vision. Emphasis was on the Four Cs process, which included Conservation, Centers, Countryside, and Corridors. Through this process, two potential regional growth outcomes were developed for the year 2050 including *Continuing the Trend* and *Implementing the Shared Growth Vision*.

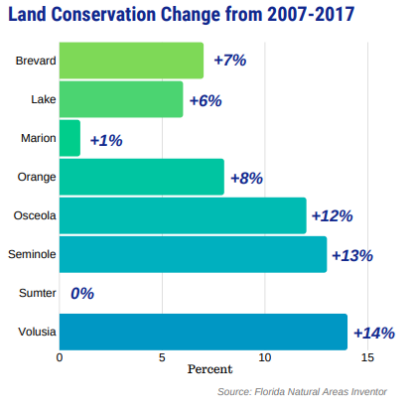
The Four Cs are described below:

- **Conservation:** Enjoying Central Florida's most precious resources - lands, waters, air, and wildlife.
- **Centers:** Hamlets, villages, towns, and cities - a variety of places to live, work, and play.
- **Countryside:** Maintaining Central Florida's heritage of agriculture and small villages.
- **Corridors:** Connecting our region with more choices for people and freight to move.

In 2020 an update was created for this plan, reviewing the growth that occurred between 2007 and 2017. Some results from this review, organized by the Four C’s, are illustrated in **Figure 42** through **Figure 45.** As illustrated in these figures, both Brevard and Volusia counties have experienced considerable change with conservation land, agricultural lands, land consumption, and commute time.

Conservation

***Figure 42** | Land Conservation (Source: How Did We Grow?)*



Countryside

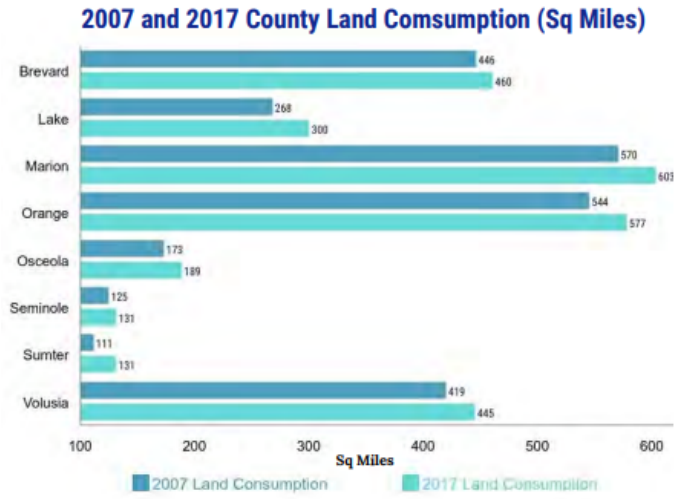
***Figure 43** | Agricultural Growth (Source: How Did We Grow?)*

	Farms	Value of Products Sold (2017)	Change in Value 2012-17
Brevard	522	$58,974,000	+ 28%
Lake	1,703	$215,711,000	+ 52%
Marion	3,985	$145,458,000	- 23%
Orange	622	$231,964,000	- 11%
Osceola	392	$85,449,000	- 21%
Seminole	403	$21,345,000	- 22%
Sumter	1,307	$54,457,000	+ 29%
Volusia	1,575	$196,391,000	+ 76%

Source: U.S. Department of Agriculture (2017)

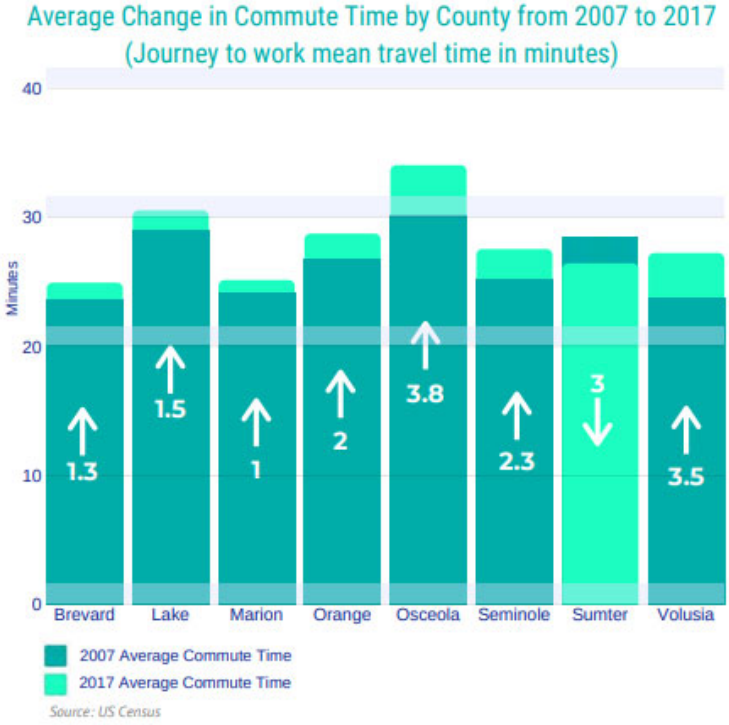
Centers

***Figure 44** | Land Consumption (Source: How Did We Grow?)*



Corridors

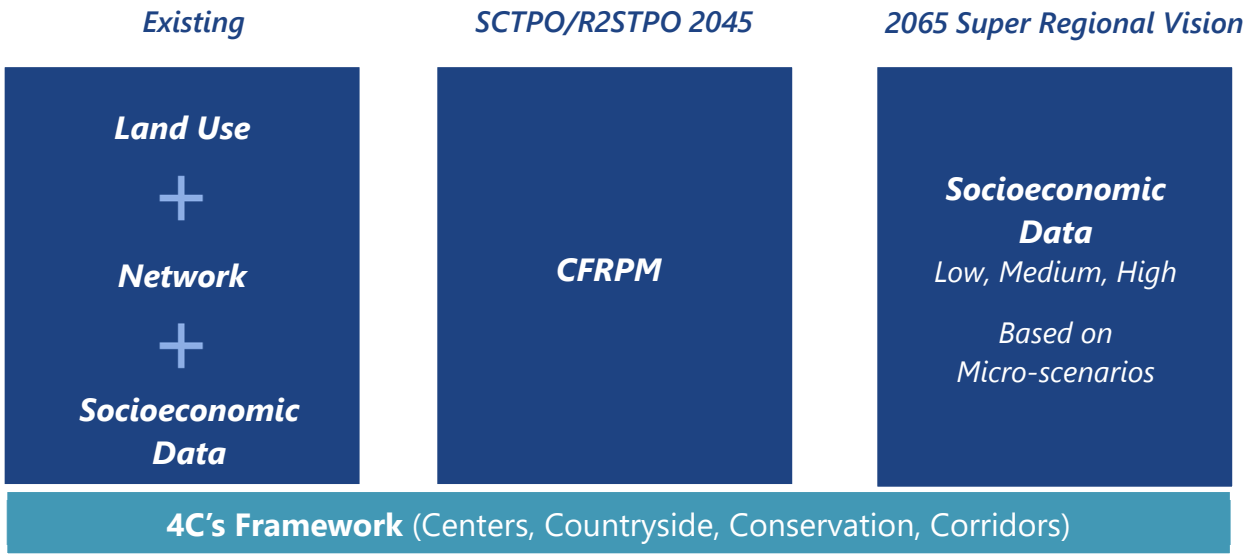
***Figure 45** | Change in Commute Time (Source: How Did We Grow?)*



Developing a Long-Term Vision

The regional visions provide the foundation for the development of a long-term framework or super-regional vision for freight. To get to this final vision, socioeconomic data analysis was applied, and micro-scenarios were incorporated and turned into macro-scenarios. This process is outlined in **Figure 46**.

Figure 46 | *Long-Term Vision Development Process*



Data Analysis Methodology

This section documents the methodology used to perform travel demand forecasting for the Space Coast micro-scenarios. Modeling was performed using the Central Florida Regional Planning Model (CFRPM) version 7.0.

Growth Estimates

The industry growth rates for the six micro-scenarios were estimated from the data listed in **Table 3**, plus other growth estimates listed in the *Space Coast Super-Regional Freight Study Phase II*. Using Geographic Information Systems (GIS) and the CFRPM Transportation Analysis Zones (TAZ) shapefile, TAZs were selected as representative zones for each of the micro-scenarios. **Figure 47** shows the locations of the TAZ areas chosen with the assigned industry label.

Table 3 | *Micro-Scenario Growth Projections*

Aerospace	*Average of 42-50 launches a year until 2027* *5.5% annual increase in passengers at MLB by 2035* *9% growth in UAS by 2024*
Transportation & Warehousing	*35% growth by 2040 for movement of goods by truck* *30%-60% growth in freight tonnage for Central Florida by 2040*
Maritime	*8 million cruise passengers by 2048* *30 million cargo tonnage by 2048*
Healthcare	*11% CAGR in personalized medicine between 2017 and 2024* *5% global annual sales increase for medical devices, reaching $800 billion by 2030*
Boat Manufacturing	*30% increase in total participants and total days in motorized water recreation between 2008 and 2030*
Tourism	*3.2% annual tourism growth in Central Florida through 2045* *171 million visitors to Central Florida by 2045*

***Figure 47** | TAZ selected for the Micro-Scenarios*

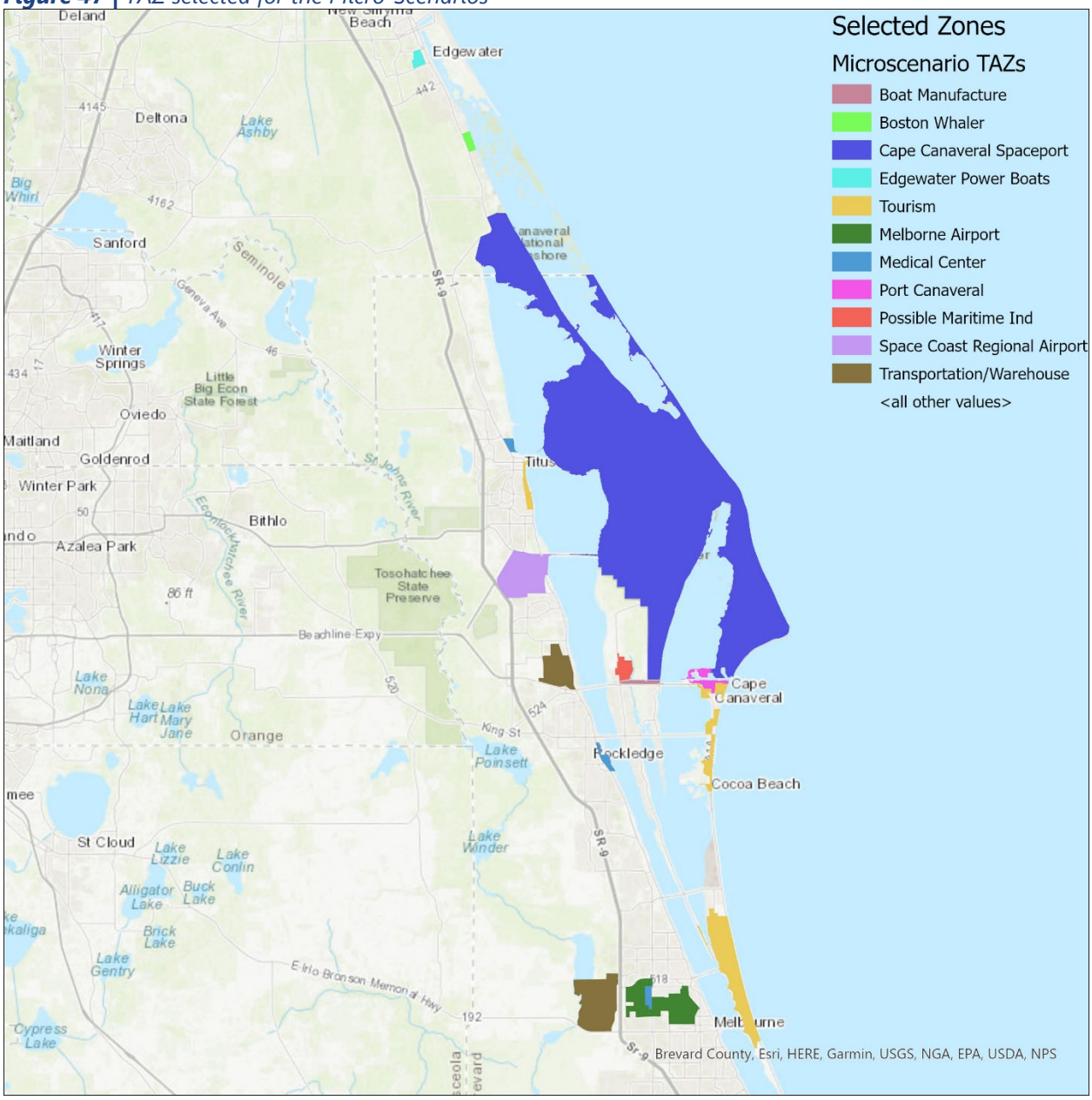


Table 4 lists the chosen industry areas, along with their micro-scenario designation and estimated growth rate. These estimated growth rates were used as a basis to create high, medium, and low growth rates for each industry area by employment category.

Table 4 | *Micro-Scenario Industry Areas and Estimated Growth Rates*

Industry Areas	Micro-Scenario	Estimated Growth Rate
Cape Canaveral Spaceport	Aerospace	15-25 before 2016, 42 launches/year forecast to 2027
Melbourne International Airport	Aerospace	5.5% annual passenger growth, 2.1% cargo growth
Space Coast Regional Airport	Aerospace	0.52% annual growth
Daytona Beach International Airport	Aerospace	2.1% annual growth
Port Canaveral	Tourism Maritime	8m cruise passengers, 30m cargo ton by 2048 (2.34% CAGR pass., 6% Cargo)
Transportation/ Warehouse	Transportation & Warehouse	35% growth by 2040
Tourism	Tourism	3.2% annual growth
Medical Center	Healthcare	11% annual growth
Boat Manufacture	Boat Manufacturer	30% increase (2008-2030)
Possible Maritime Ind	Maritime	35% growth by 2040

Table 5 lists the employment growth rates. For employment categories that do not have a scenario growth rate listed, the no-build model growth rate was assumed. Some of the TAZs selected for the industry areas are included in the CFRPM special generators table. **Table 6** lists the scenario growth rates used for those special generator trips.

***Table 5** | Average Annual Employment Growth Rates*

	2045 No-Build Model			2045 High Scenario			2045 Medium Scenario			2045 Low Scenario		
Industry Areas	**Ind Emp**	**Com Emp**	**Svc Emp**	**Ind Emp**	**Com Emp**	**Svc Emp**	**Ind Emp**	**Com Emp**	**Svc Emp**	**Ind Emp**	**Com Emp**	**Svc Emp**
Cape Canaveral Spaceport	1.03%	0.00%	15.37%	7.18%	7.18%		4.50%	4.50%		2.00%	2.00%	
Melbourne International Airport	0.96%	1.44%	1.88%	5.50%	5.50%	5.50%	3.50%	3.50%	3.50%	2.00%	2.00%	2.00%
Space Coast Regional Airport	4.56%	1.05%	1.22%	7.18%	7.18%	5.00%	4.50%	4.50%	3.00%	2.00%	2.00%	1.50%
Daytona Beach International Airport	0.30%	0.37%	0.51%	3.00%	3.00%	3.00%	2.10%	2.10%	2.10%	1.00%	1.00%	1.00%
Port Canaveral	3.58%	0.61%	1.07%	6.00%	4.00%	4.00%	4.00%	2.34%	2.34%	3.60%	1.50%	1.50%
Transportation/Warehouse	4.12%	1.84%	3.92%	6.00%	4.00%	6.00%	4.12%	1.84%	3.92%	3.09%	1.38%	2.94%
Tourism	0.08%	0.33%	0.32%			3.50%			2.25%			1.00%
Medical Center	4.65%	4.20%	0.64%			5.00%			3.00%			1.00%
Boat Manufacture	0.24%	0.38%	6.53%	2.40%			1.20%			0.60%		
Possible Maritime Ind	2.46%	1.95%	2.43%	1.21%								

***Table 6** | Growth Rates for Model Special Generators*

Model Special Generators	2015 Trips	2045 Trips	Model Growth	High Scenario	Med Scenario	Low Scenario
Kennedy Space Center	9,315	13,166	1.16%	7.18%	4.50%	2.00%
Port Canaveral Cruise Terminal	23,178	40,562	1.88%	4.00%	2.34%	1.50%

Once the added employment was computed, additional population was included at the model average rate of 2.01 persons per employment. The added population was then distributed to surrounding residential TAZs in Brevard and Volusia counties. This distribution was performed using the CFRPM trip distribution routine using the HBW friction factor parameters and the TAZ population in the gravity routine. **Figure 48** shows the location and magnitude of the added employment and population for the high scenario. The distribution of the medium and low scenarios is similar, but of a lower magnitude.

After updating the model input files for the high, medium, and low growth scenarios, the scenarios were modeled in CFRPM. The highway assignment results are illustrated in **Figure 49**, showing a significant increase in congested roads because of the additional population and employment.

2065 Scenario Development

Extrapolations of the CFRPM scenarios out to 2065 were also created to examine possible impacts of continued growth beyond 2045.

***Figure 48** | High Scenario Population and Employment*

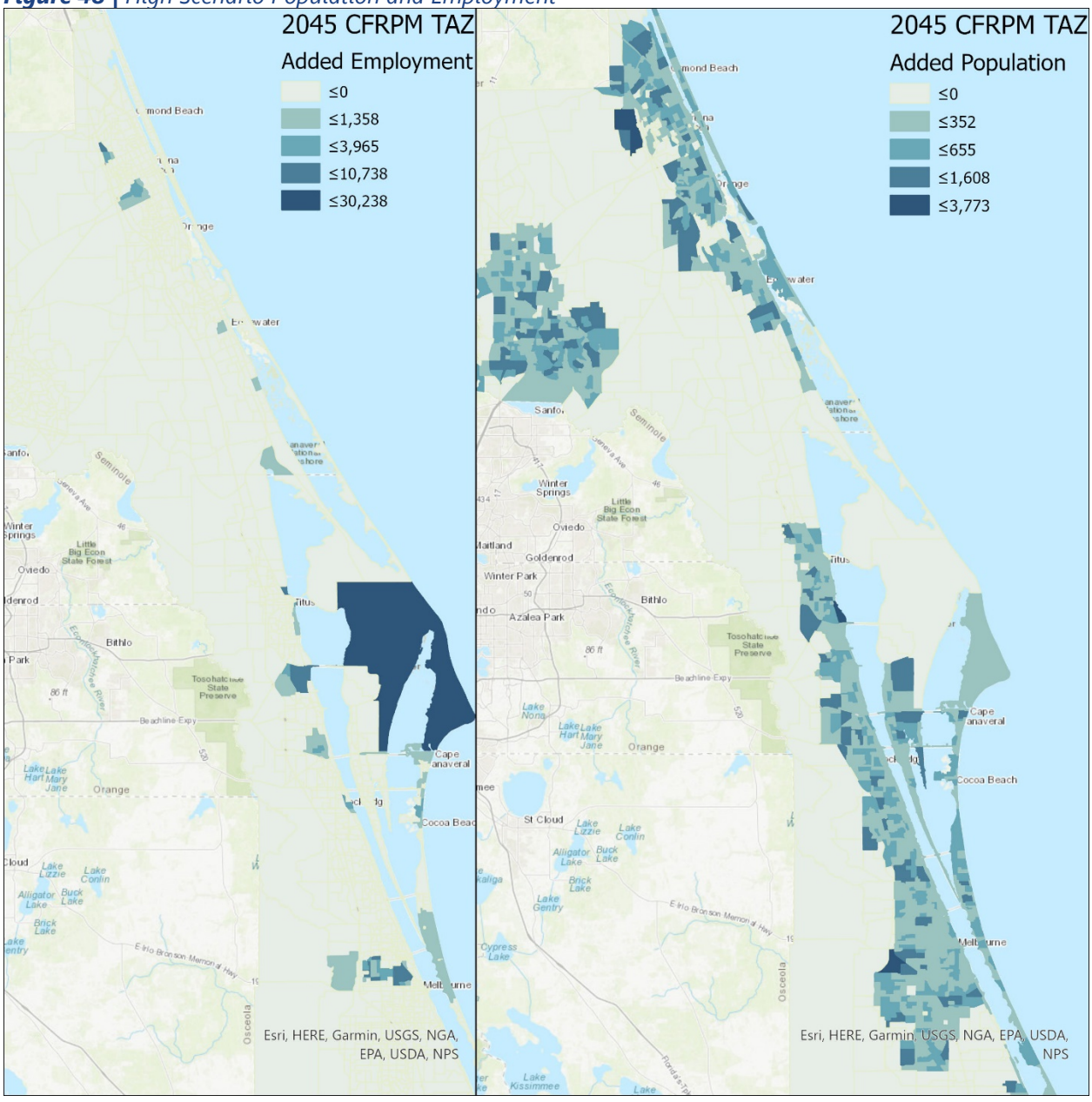
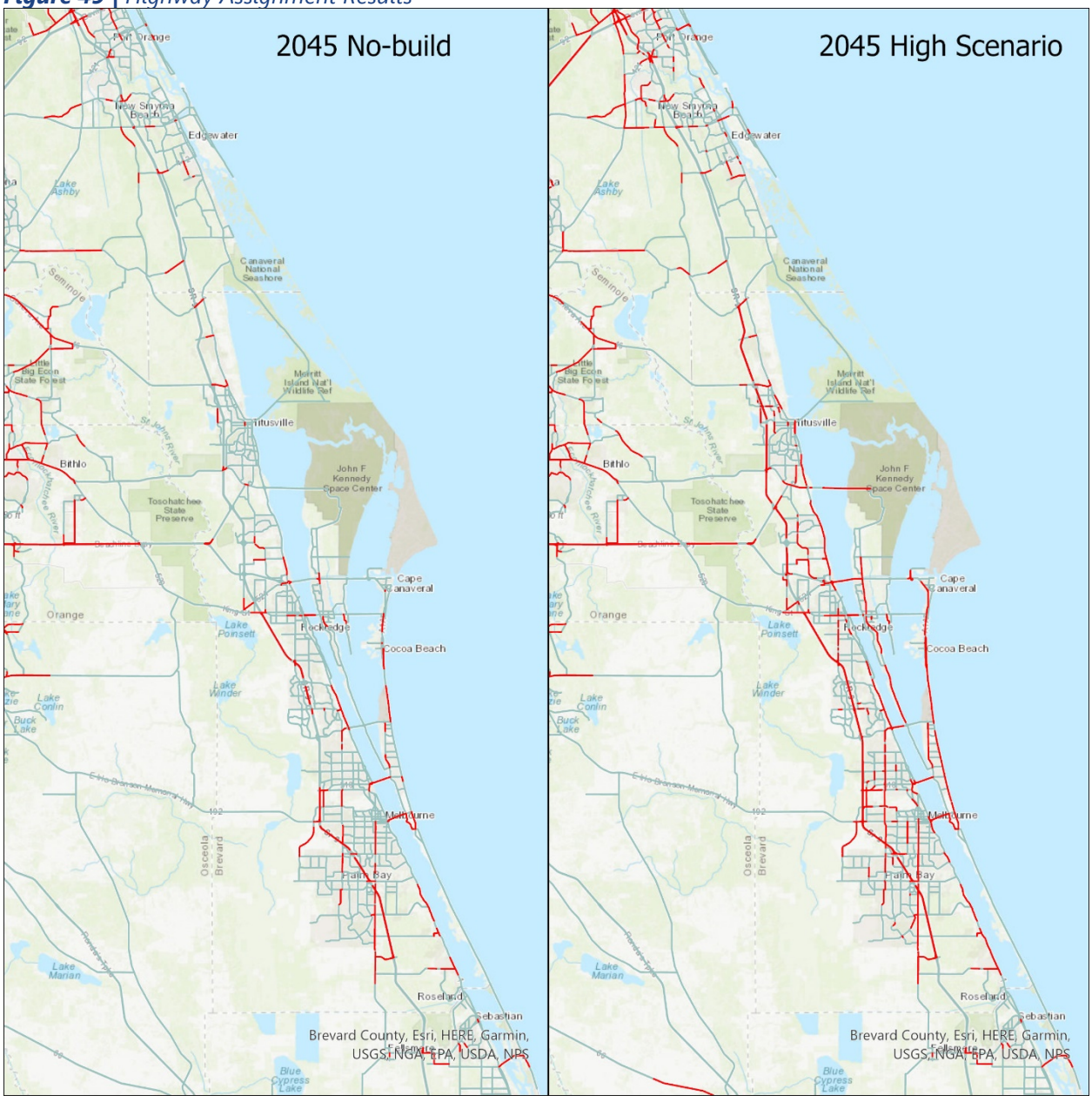


***Figure 49** | Highway Assignment Results*



2045 Scenario Results

Volume-to-capacity (V/C) is based on traffic volume and the number of travel lanes. It is used to understand how close travel demand is to reaching the roadway's physical capacity. A V/C ratio of 1 indicates that the roadway is operating at 100 percent capacity. The 2045 no-build scenario, illustrated in **Figure 50**, shows a significant number of roadways with a V/C ratio greater than 1. **Figure 51** through **Figure 53** show the congested roadways for the low, medium, and high growth scenarios. The high growth scenario, in particular shows a significant increase in congested roadways.

***Figure 50** | 2045 Base Congestion*

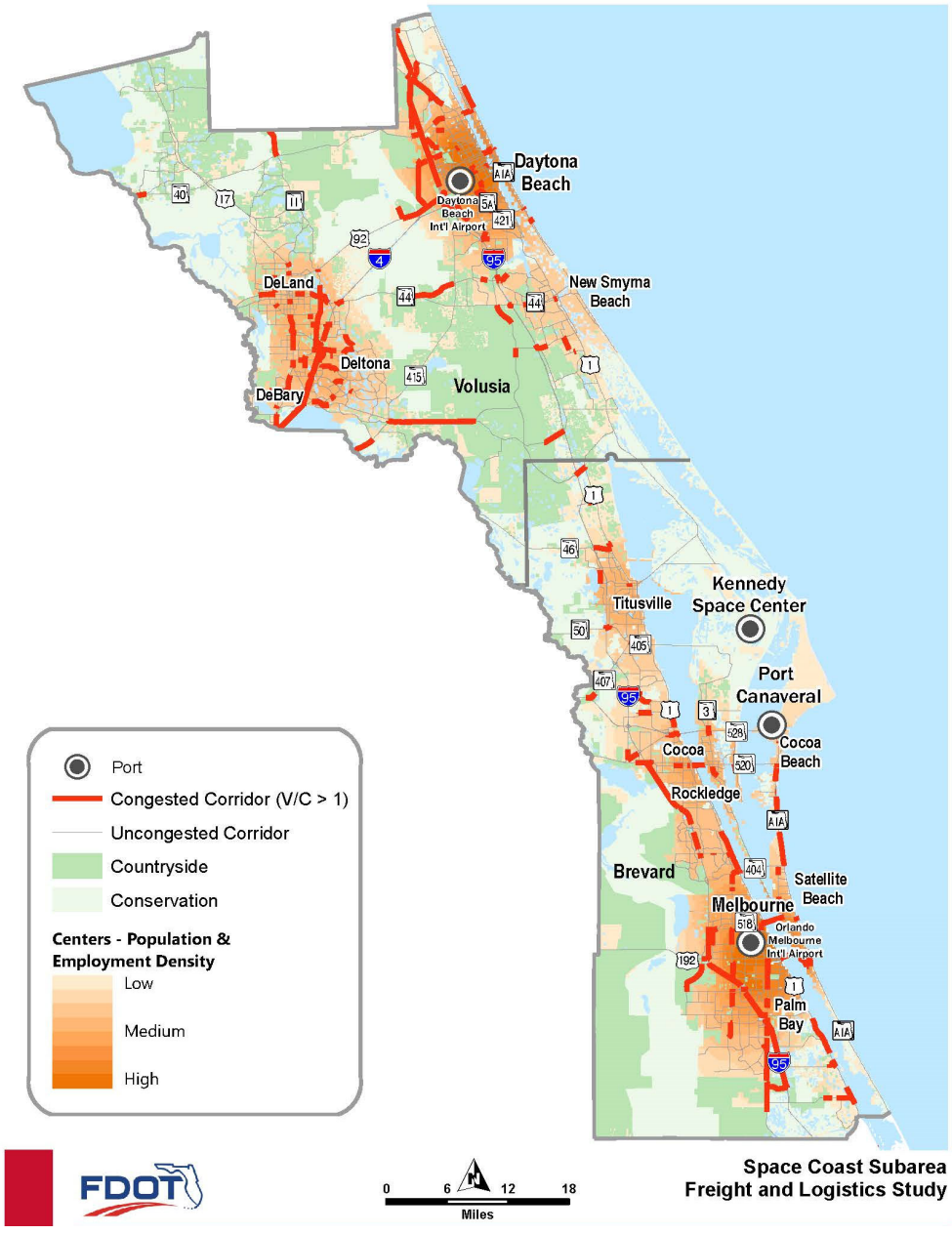


***Figure 51** | 2045 Low Scenario*

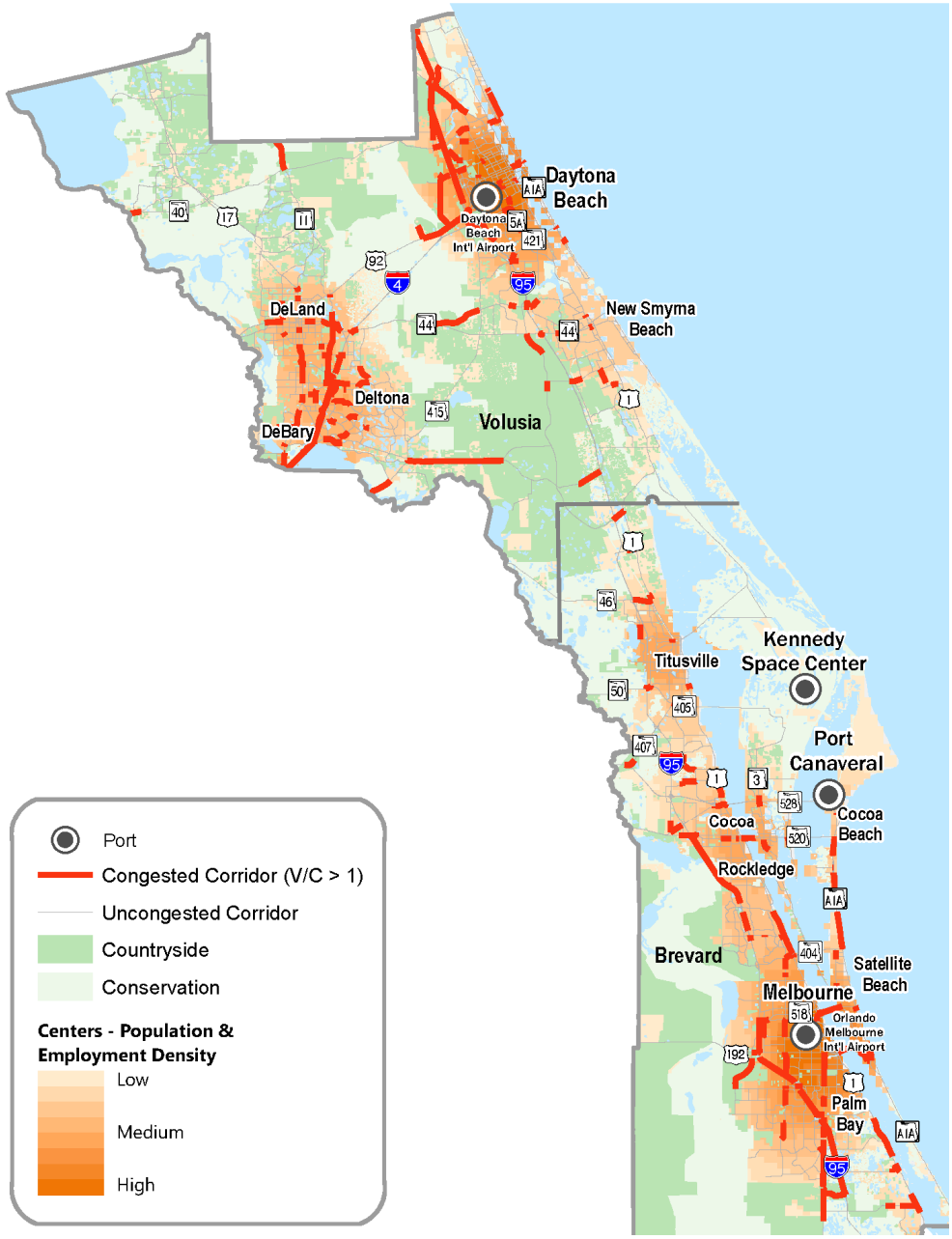


***Figure 52** | 2045 Medium Scenario*

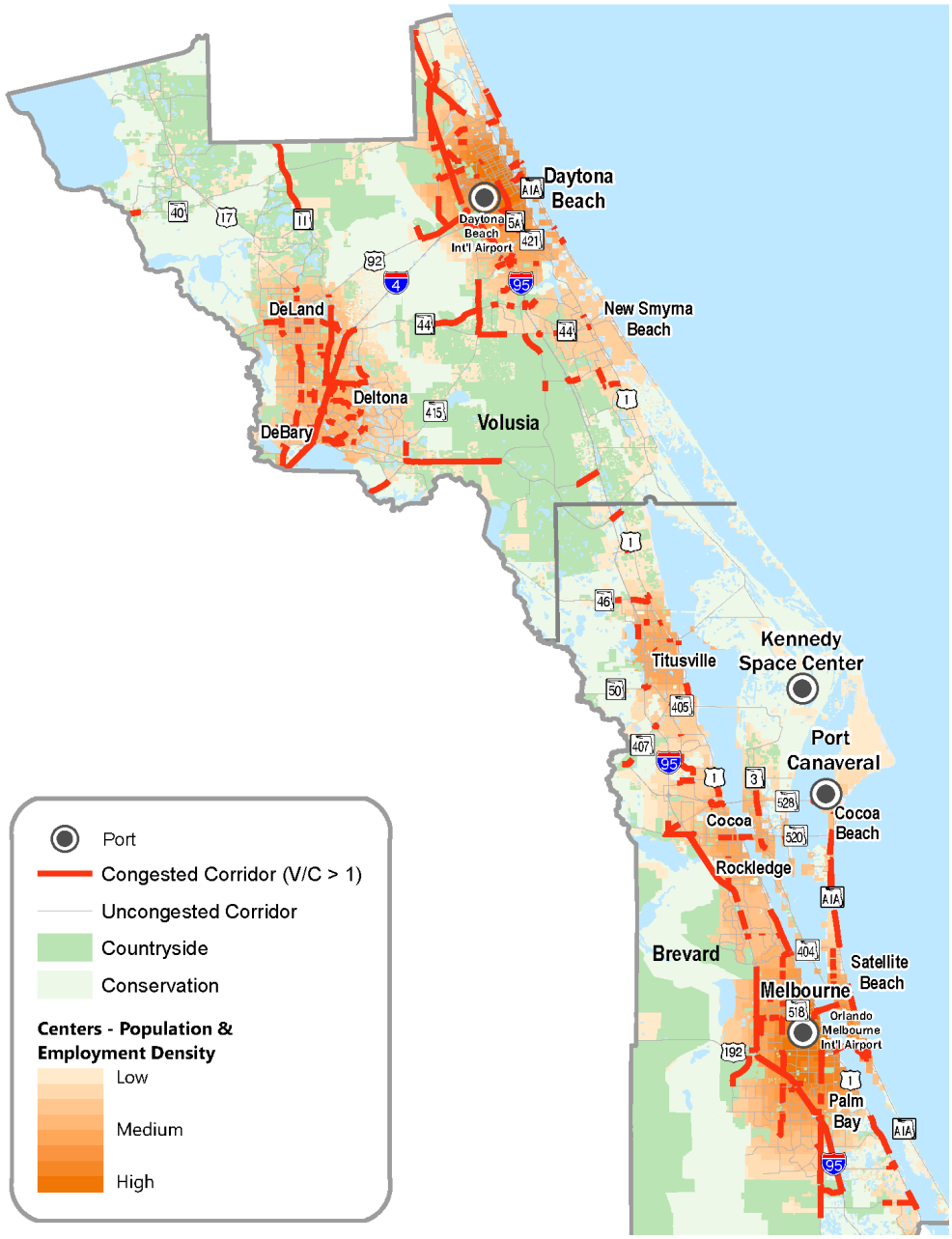
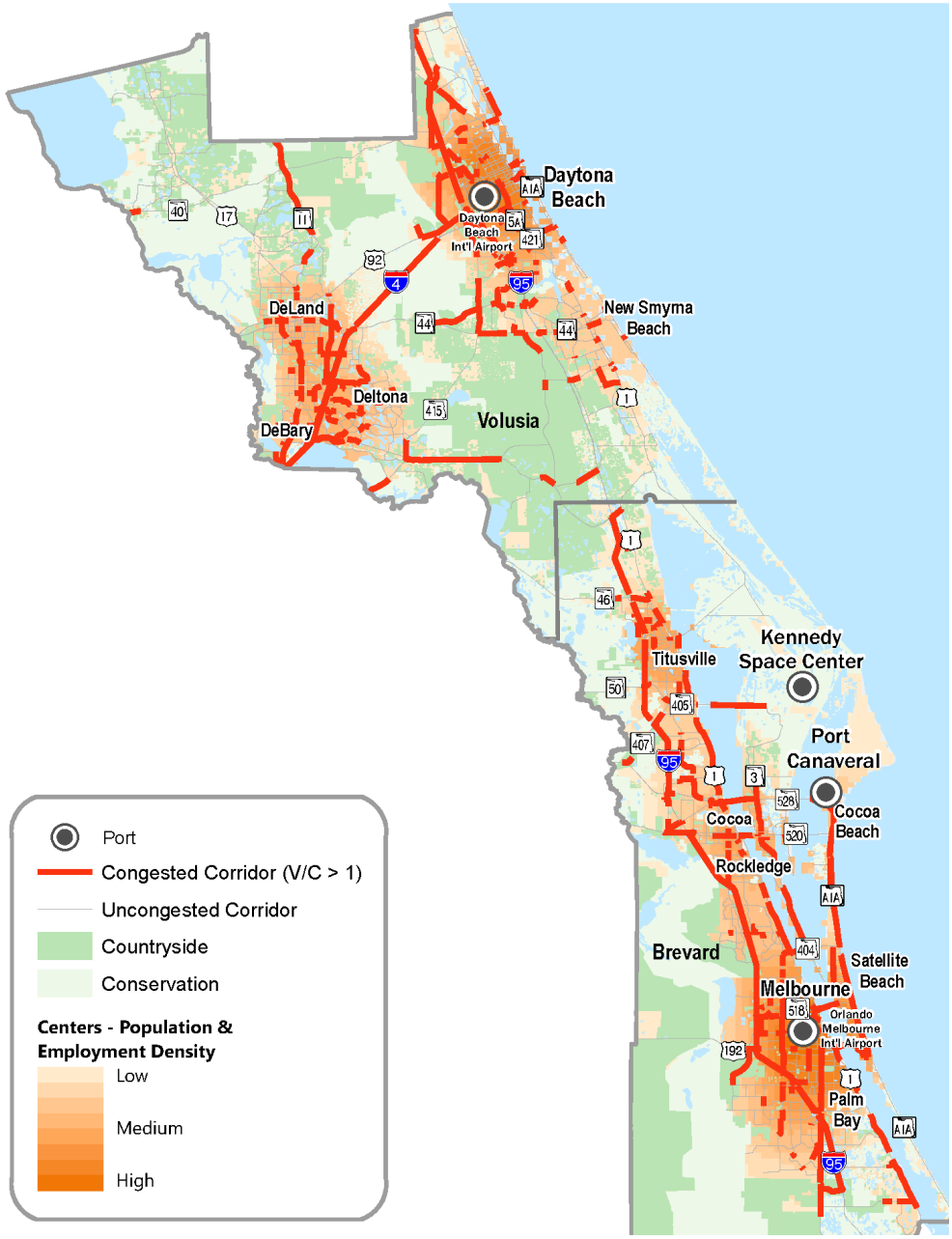


***Figure 53** | 2045 High Scenario*



2065 Scenario Results

The 2065 no-build scenario, illustrated in **Figure 54,** shows an even greater number of roadways with a V/C ratio greater than 1 compared to 2045. This is because the model scenario assumes continued population and employment growth without increased roadway capacity. **Figure 55** through **Figure 57** shows the congested roadways for the low, medium, and high growth scenarios in 2065. The high growth scenario again shows a significant increase in congested roadways over the no-build scenario.

***Figure 54** | 2065 Base Congestion*

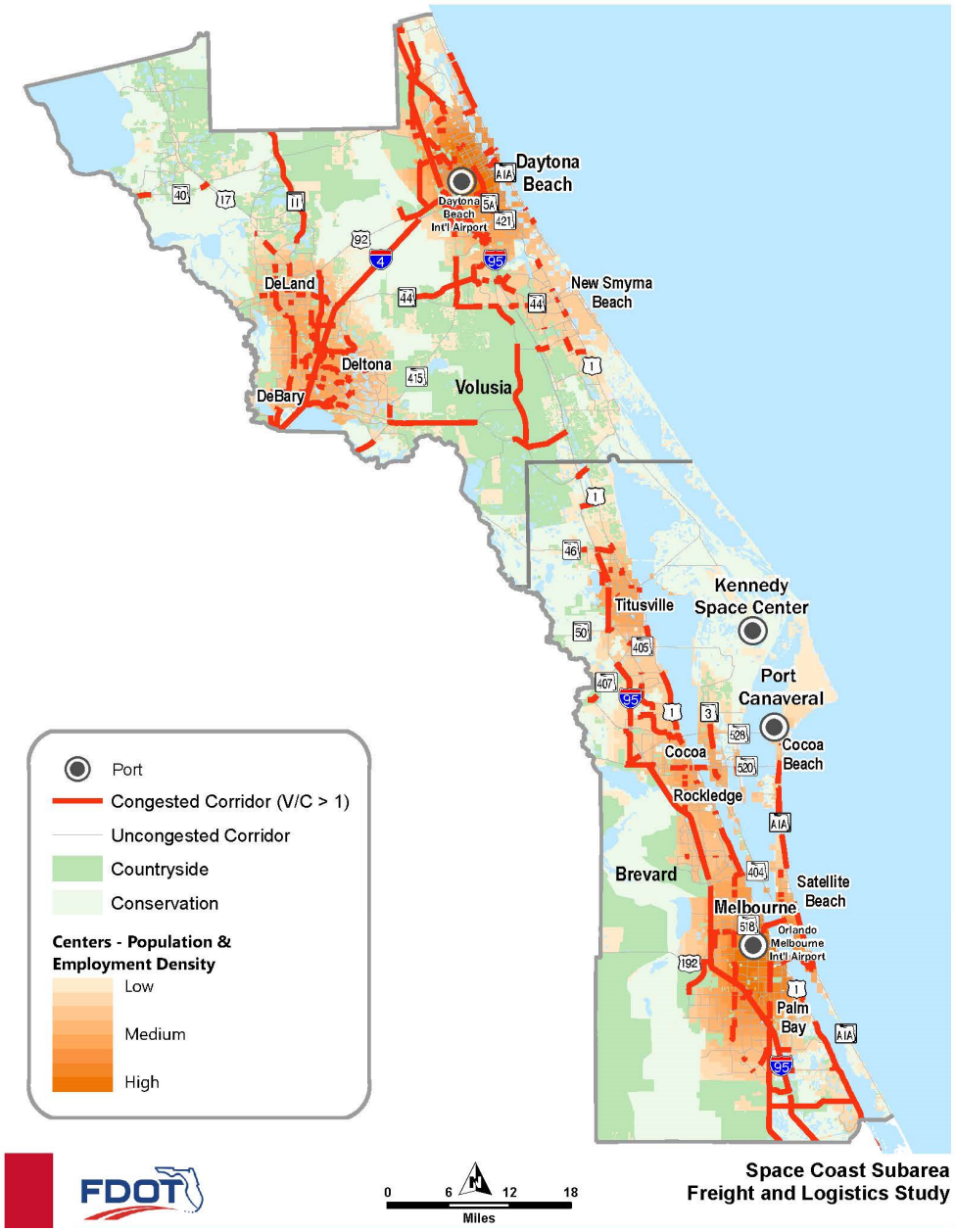


***Figure 55** | 2065 Low Scenario*

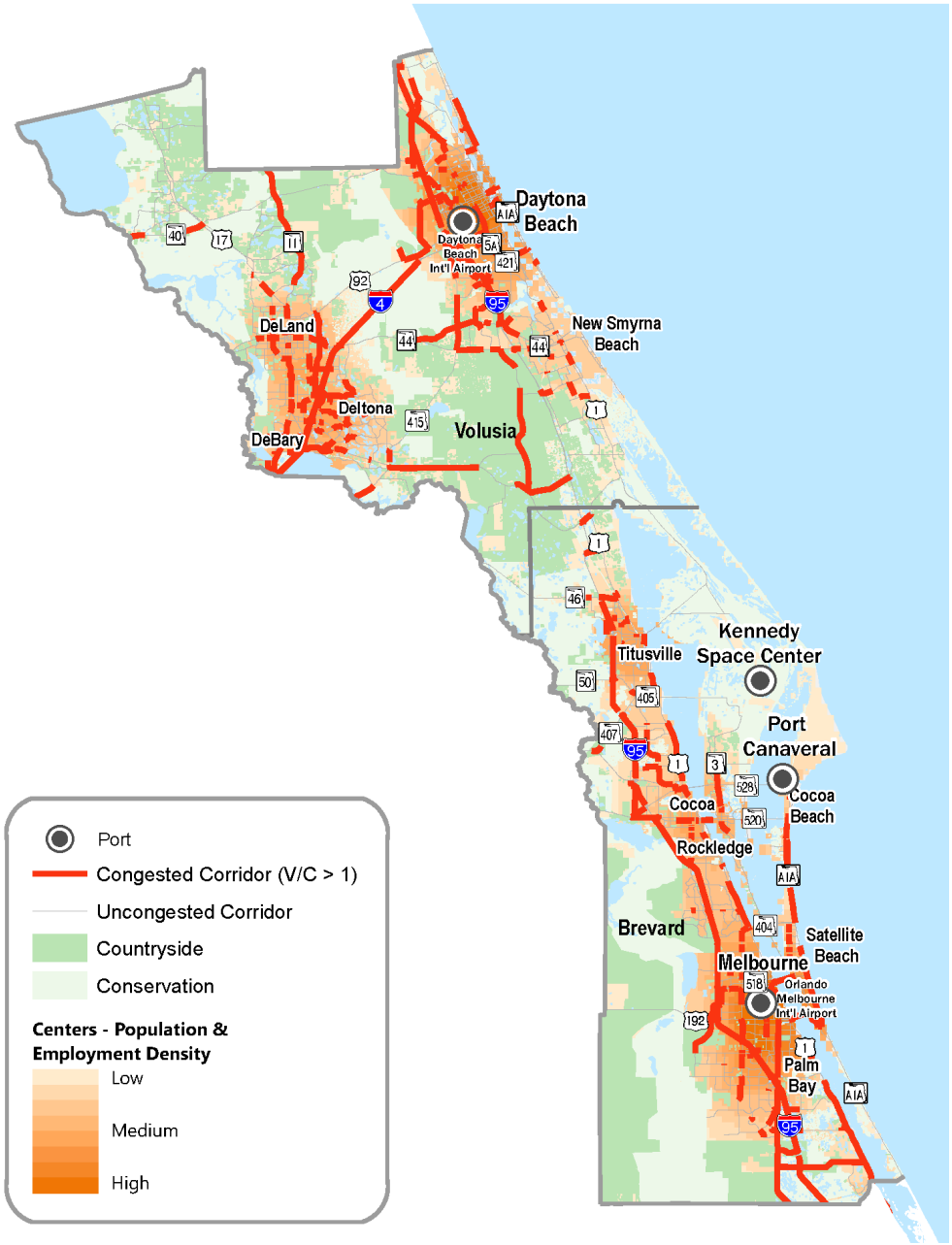


***Figure 56** | 2065 Medium Scenario*

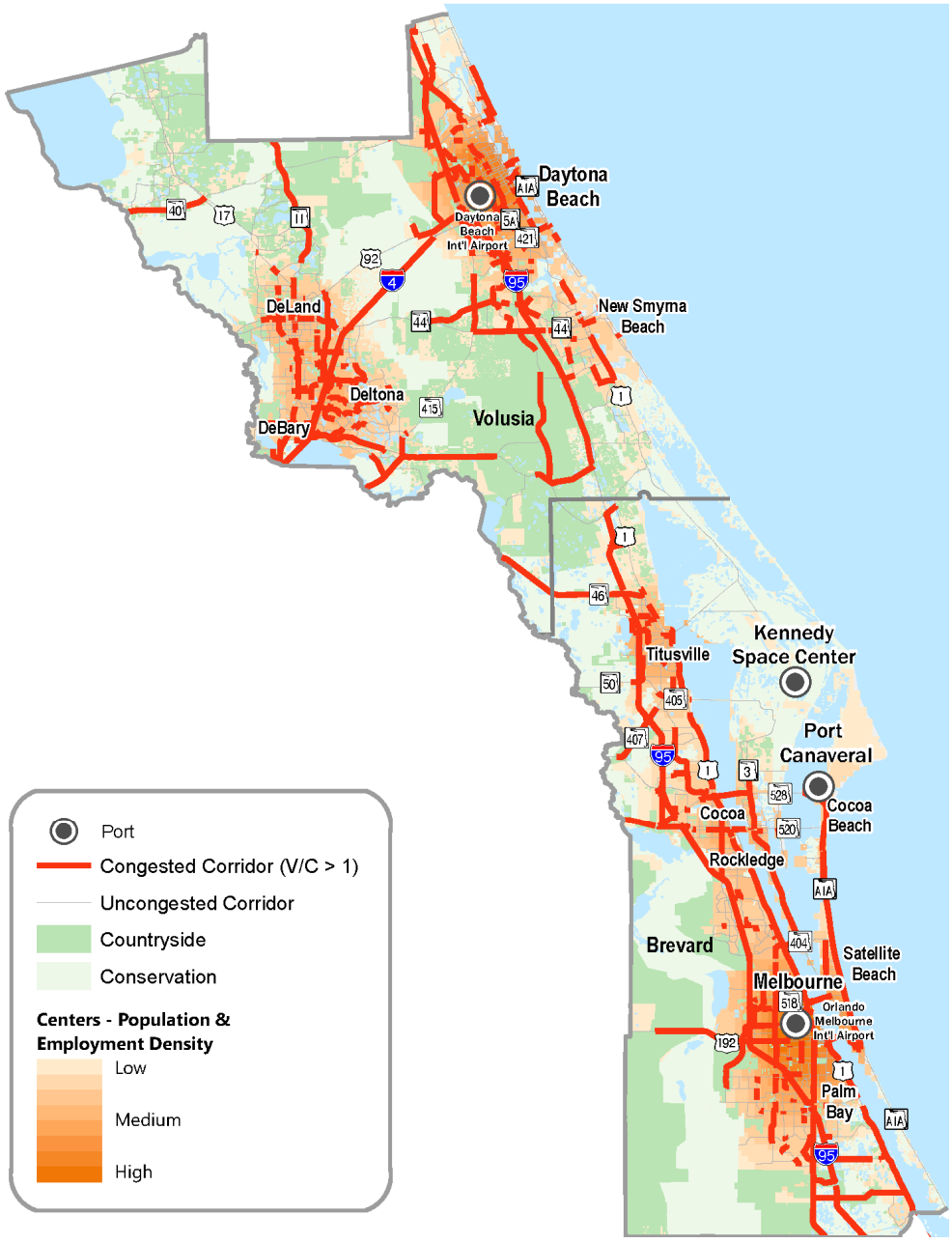
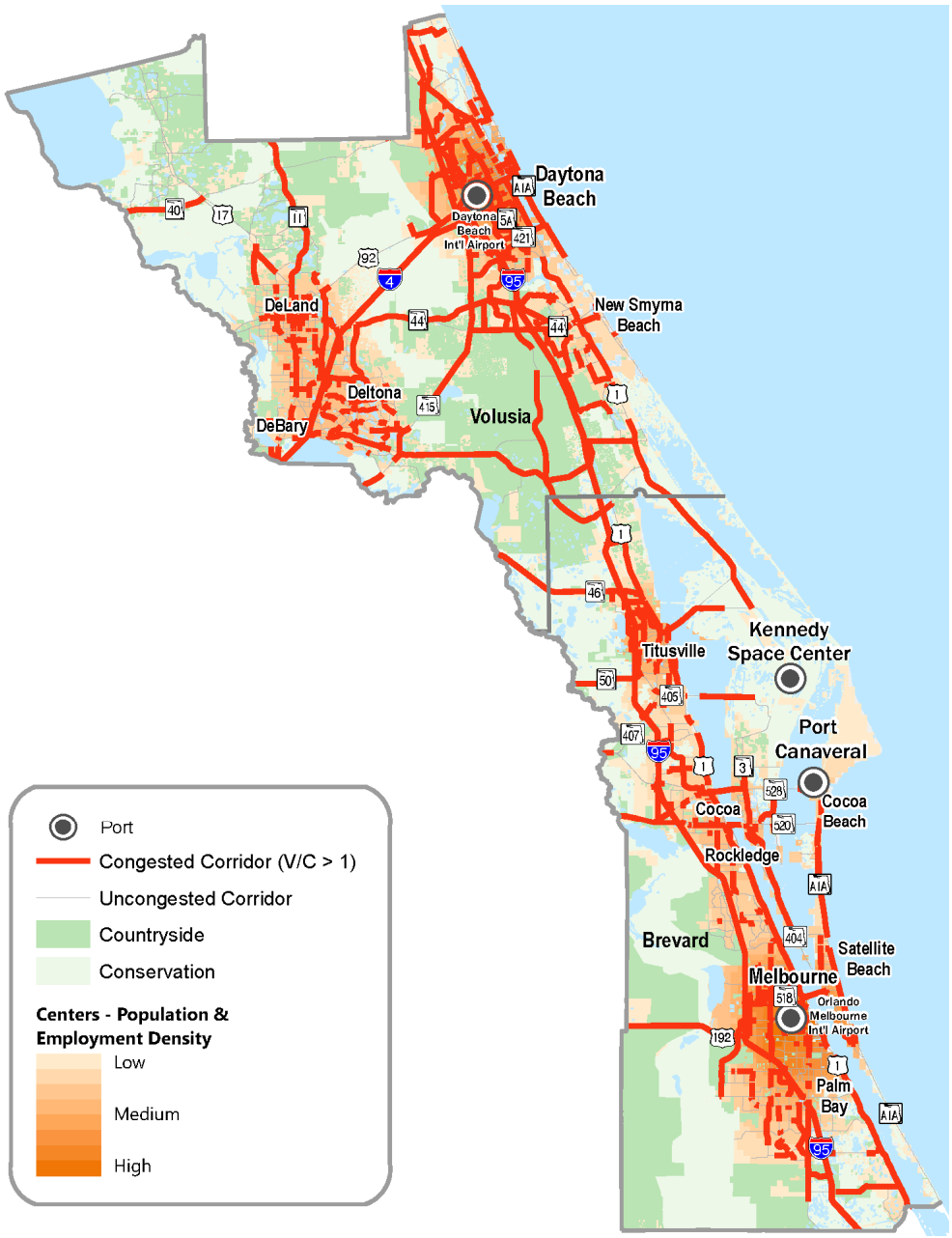


***Figure 57** | 2065 High Scenario*



Automated, Connected, Electric, Shared (ACES) Scenario

An additional 2065 scenario was created by using the 2065 high growth scenario and enabling the CFRPM 7 ACES option 6 – ACES Robo Transit. This option assumes impacts from automated, on-demand shared services that integrate with other modes. This option applies a 75 percent effective capacity increase on highways/freeways and a 35 percent increase on arterial roadways. The option also applies a 5 percent home-based work trip friction factor adjustment, increasing the average trip length. Finally, this option increases the vehicle trip table by 15 percent to account for empty vehicle repositioning and additional trips by people with limited access to drive such as youth or the elderly.

Figure 58 illustrates the congestion results of this scenario. Given the assumptions made by CFRPM for ACES, the result is a dramatic increase in congested roadways. However, there is much uncertainty in this scenario. Given that capacity improvements and trip-making increases are both assumed for ACES, the balance between these will determine the result. If the trip-making increases turn out to be smaller, or the effective capacity increases turn out to be larger, then ACES could improve the level of traffic congestion overall.

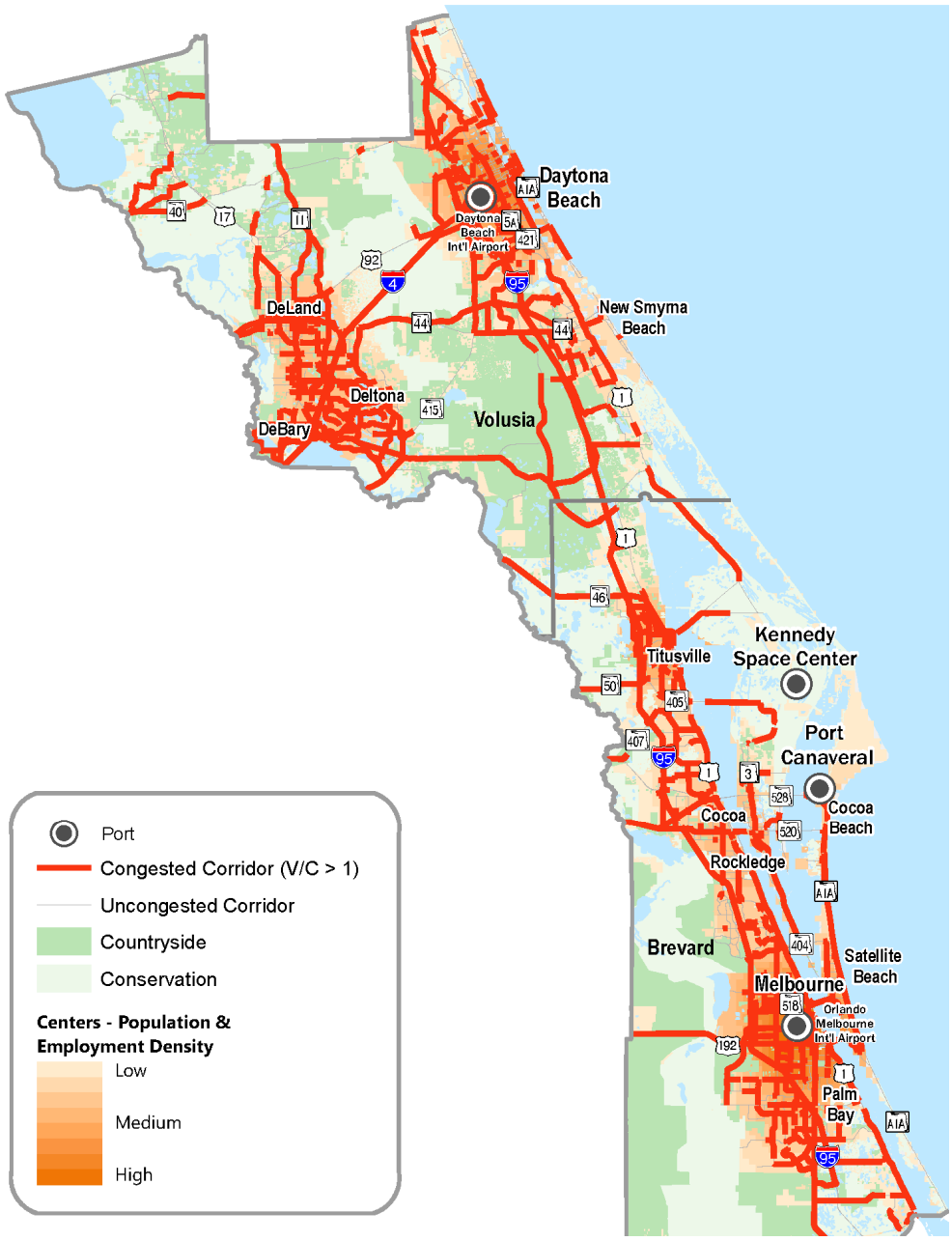
As an example of the uncertainty another scenario, 2065 High ACES Modified in the **Table 7** below, was created with increased effective capacity for ACES vehicles. It shows increased vehicle miles, but decreased vehicle hours compared to the ACES scenario and fewer congested lane miles than the non-ACES scenario.

Table 7 | *Model Scenario Statistics*

Scenario	2045 Base	2045 Low	2045 Medium	2045 High	2065 Base	2065 Low	2065 Medium	2065 High	2065 High ACES	2065 High ACES Modified
VMT	41.1 M	41.5 M	44.8 M	50.7 M	48.8 M	50.2 M	56.5 M	64.7 M	96.5 M	108.3 M
VHT	980 K	992 K	1.1 M	1.4 M	1.4 M	1.5 M	2.1 M	4.4 M	7.6 M	6.8 M
CLM	760	798	1,023	1,634	1,469	1,604	2,298	2,994	3,517	2,385

*VMT – Daily Vehicle Miles Traveled; VHT – Vehicle Hours Traveled; CLM – Congested Lane Miles

***Figure 58** | 2065 ACES Scenario*



Super Region Freight Vision

The modeling exercise demonstrates that the region faces significant congestion, above and beyond what the area anticipates in the area LRTPs. This chapter provides the background for developing a common freight vision to address the region's transportation needs and guide funds for truck-related facilities over the next 20 or more years. The vision statement that can be advanced to influence this is:

The Space Coast region's goods and innovation movement system will be safe and efficient, support economic competitiveness and industry growth, encourage multimodal travel, and improve local communities' quality of life.

The rest of this report will build on this vision to develop short- and long-term transportation strategies for moving both people and goods through the Space Coast.

INFRASTRUCTURE CHALLENGES

The growth of freight in the area can add pressure to already degrading infrastructure and exacerbate conflicts between the public and carriers.[160] This chapter briefly reviews some of these issues including infrastructure conditions, safety, and future resilience.

Infrastructure Conditions

The efficiency of freight movement in the region depends on the condition of the multimodal system. Failing infrastructure is dangerous and costly to address. Regular review and maintenance of the physical transportation assets is important to avoid disruption to the supply chain. The region's MPOs report the conditions of these assets as part of their LRTPs. The **Table 8** details current statistics and targets from these reports.

Table 8 | *FDOT Performance Measures*

Performance Measures	Brevard/ SCTPO	Volusia/ R2S	Target	Florida
Pavement				
% of Interstate pavements in GOOD condition	90.7%	61.0%	≥60%	68.5%
% of Interstate pavements in POOR condition	0.0%	0.8%	<5%	0.2%
% of non-Interstate NHS pavements in GOOD condition	42.1%	27.5%	≥40%	41.0%
% of non-Interstate NHS pavements in POOR condition	0.4%	0.2%	<5%	0.2%
Bridge				
% of NHS bridges (by deck area) classified in GOOD condition	57.8%	63.39%	≥50%	74.2%
% of NHS bridges (by deck area) classified in POOR condition	0.0%	0.89%	<10%	0.4%

Sources: River to Sea LRTP 2045; and Space Coast TPO LRTP 2045.

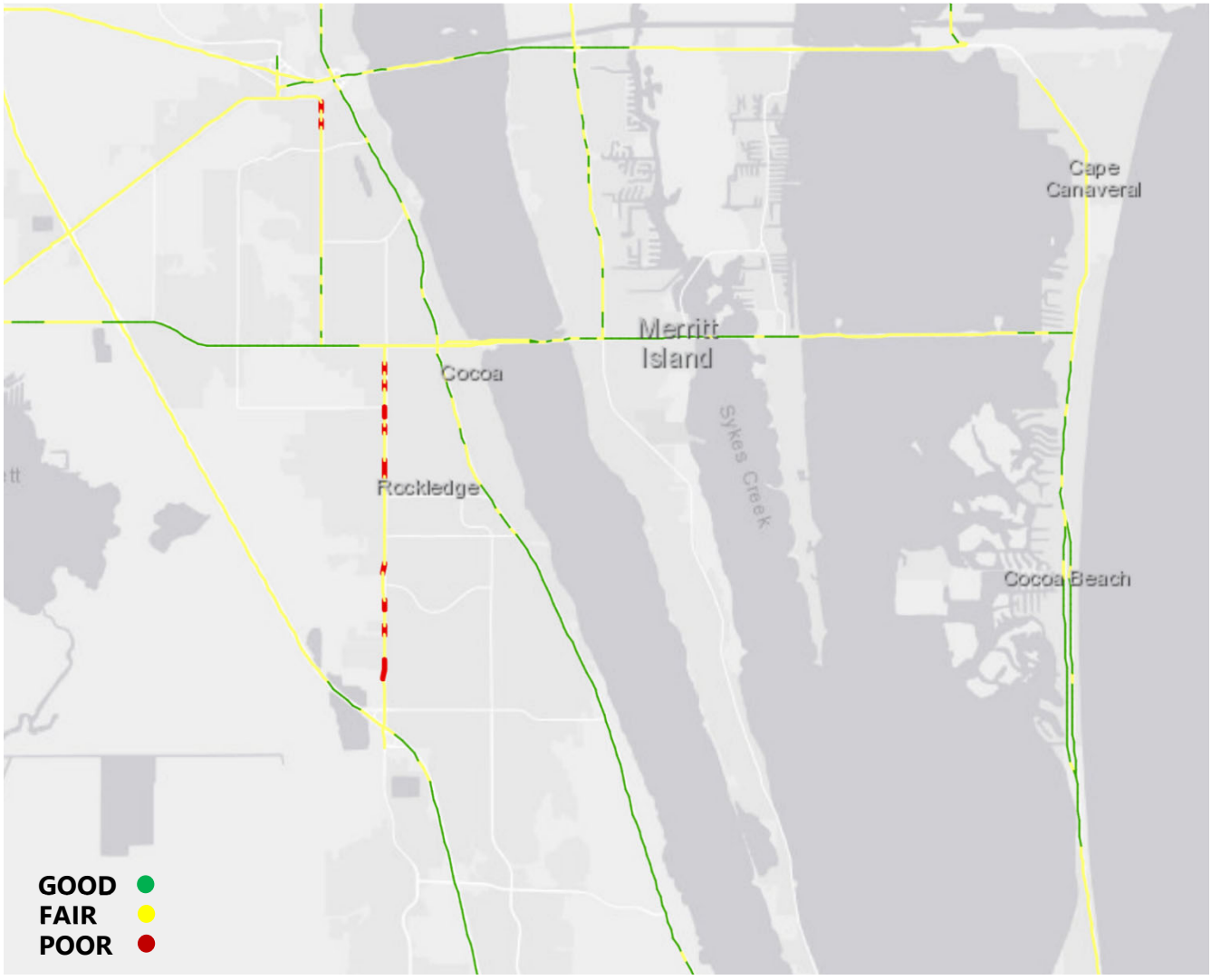
[160] https://ops.fhwa.dot.gov/freight/publications/fhwaop03004/congest.htm

Roadway Condition

Brevard County

The areas in Brevard County with poor pavement conditions are shown in **Figure 59**. These areas are important to note due to proximity to Port Canaveral.

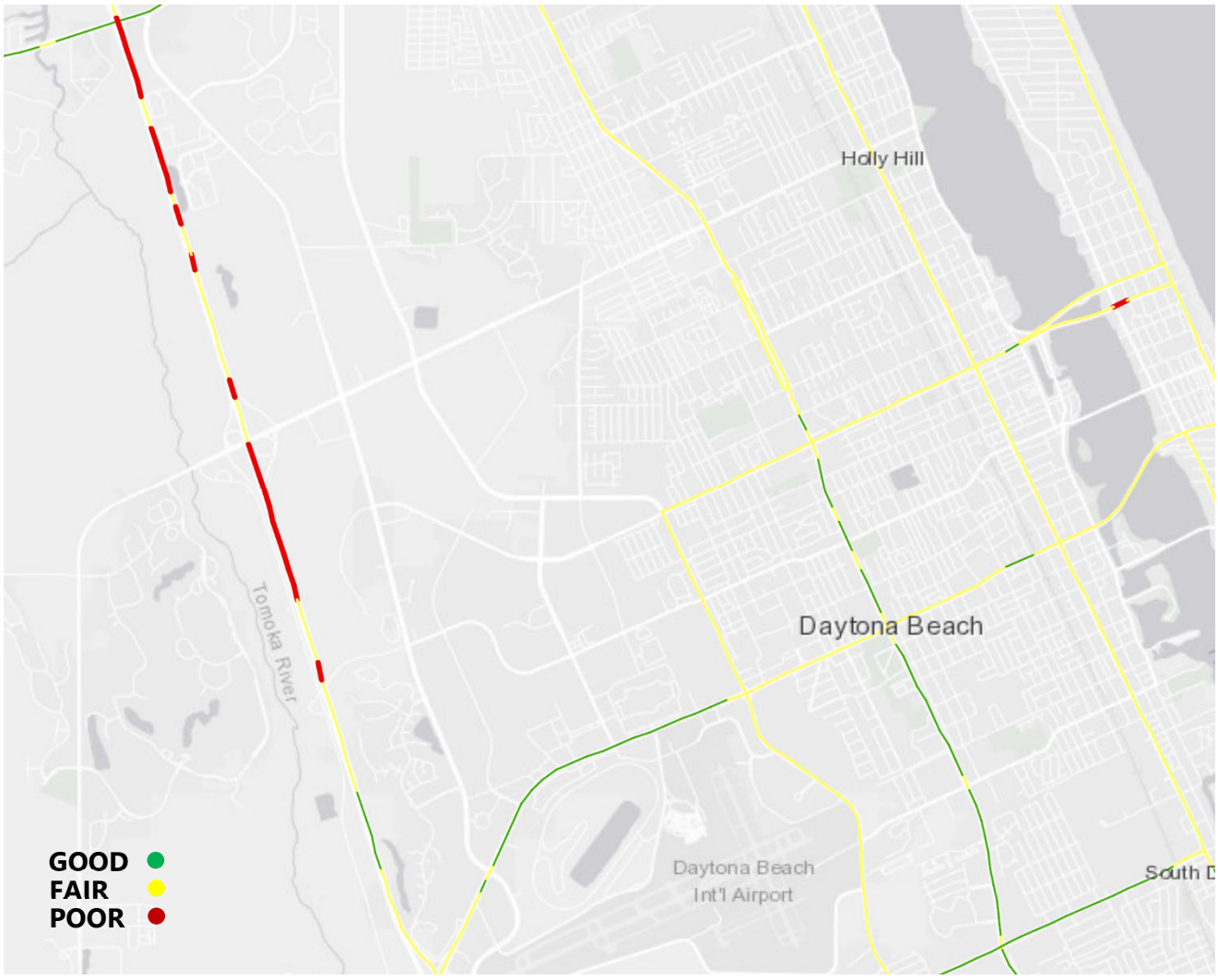
Figure 59 | *Poor Pavement Area in Brevard County (Source: FDOT)*



Volusia County

A few areas in Volusia County have poor pavement conditions. A key area to note for freight impacts is highlighted in **Figure 60.** This area includes portions of I-95, and it is also near the Daytona International Airport.

***Figure 60** | Area of Poor Pavement in Volusia County (Source: FDOT)*



Bridge Condition

Bridge Sufficiency Ratings

Most bridges within Brevard and Volusia counties are rated *good* by the National Bridge Inventory, as shown in **Figure 61** and detailed **Table 9**. The ratings for bridges accessing Merritt Island will be discussed in this section.

Figure 61 | *Region Bridge Conditions (Source: Space Coast TPO SOS, River to Sea TPO LRTP)*

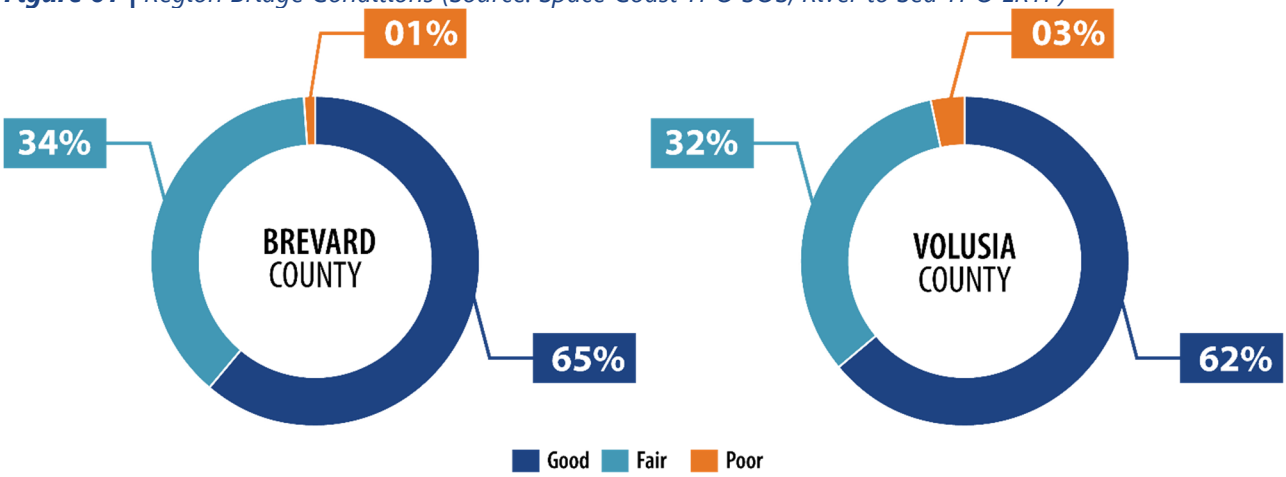


Table 9 | *Bridge Sufficiency Rating Summary*

Sufficiency Rating	Number Of Bridges	Percent of Bridges
Brevard County		
Good	186	65%
Fair	93	33%
Poor	7	2%
Total	286	100%
Volusia County		
Good	154	62%
Fair	84	34%
Poor	11	4%
Total	249	97%*

Source: National Bridge Inventory Data, Bridgereports.com, 2019
**3% of data reported pedestrian overpasses without condition rating.*

Poor Ratings

- The Sea Ray Drive bridge over Sykes Creek was built in 1991 and needs corrective actions to improve the substructure condition, foundations, and channel protections.

Fair Ratings

- The SR 520 bridge over the Indian River was reconditioned in 1969, with updates to the approaches in later years. The deck, superstructure, substructure, and channel protection conditions are classified as either good or satisfactory conditions.
- The SR 405 NASA Causeway Bridge over the Indian River was built in 1964. The deck, superstructure, substructure, and channel protection conditions are classified as either satisfactory or fair conditions.
- The SR 404 bridge over the Indian River was built in 1971. The deck, superstructure, substructure, and channel protection conditions are classified as either good or satisfactory conditions.
- The SR 528 bridge over the Indian River was built prior to 1971. The deck, superstructure, substructure, and channel protection conditions are classified as either good or satisfactory conditions.
- The SR 518 bridge over the Indian River was built in 1988. The deck, superstructure, substructure, and channel protection conditions are classified as in satisfactory condition.
- The eastbound US 192 bridge over the Indian River was built in 1988. The deck, superstructure, substructure, and channel protection conditions are classified as either fair, good, or satisfactory conditions.
- The westbound US 192 bridge over the Indian River was built in 1978. The deck, superstructure, substructure, and channel protection conditions are classified as in satisfactory condition.

Good Ratings

- The SR 406 Max Brewer Memorial Parkway bridge over the Indian River was built in 2010.
- The SR 520 bridge over the Banana River was built in 2003.

The characteristics of each bridge span described above are summarized in **Table 10**. In the table, bridge conditions are rated by Good “G,” Fair “F,” and Poor “P.”

***Table 10** | Bridge Span Characteristics Summary (Source: National Bridge Inventory)*

Bridge Number	Description	Feature Crossed / Spanned	Bridge Condition	Year Built	Operating Rating (Tons)	Approach Roadway Width (Ft)	Minimum Vertical Clearance Over Bridge Roadway (Ft)
700227	Max Brewer Memorial Bridge	Indian River	G	2010	44.1	12.2	99.99
703001	NASA Causeway	Indian River	F	1964	34.2	27.9	99.99
700015	SR 528	CR-515 & Indian River	F	1963	81.6	11.1	99.99
700109	SR 528	CR-515 & Indian River	G	1970	72.6	10	99.99
700110	SR 528	Indian River	F	1970	50.7	10.6	99.99
700221	SR 528	Indian River	F	2006	87	17.1	99.99
700170	SR 520	Indian River	G	1966	64.5	13.8	99.99
700171	SR 520	Indian River	F	1957	62.7	13	99.99
700061	SR 520	Indian River	G	1966	57.2	12.1	99.99
700137	SR 520	Indian River	F	1969	65.4	12.1	99.99
700196	SR 520	Indian River Relief East	G	1993	99.9	15.5	99.99
700076	SR 404	Indian River West Relief	F	1971	55.2	10.5	99.99
700142	SR 404	Indian River West Relief	F	1971	55.2	11.2	99.99
700077	SR 404	Indian River	F	1971	54	10.8	99.99
700143	SR 404	Indian River	F	1971	54	10.7	99.99
700078	SR 404	Indian River Relief East	G	1971	55.2	10.5	99.99
700144	SR 404	Indian River Relief East	G	1971	55.2	11.1	99.99
700183	SR 518	Indian River Relief	F	1988	57.4	21.3	99.99
700184	SR 518	Indian River ICW	F	1988	53.9	24.4	99.99

Bridge Number	Description	Feature Crossed / Spanned	Bridge Condition	Year Built	Operating Rating (Tons)	Approach Roadway Width (Ft)	Minimum Vertical Clearance Over Bridge Roadway (Ft)
700235	US 192	Indian River East Relief	G	2011	43.6	19.5	99.99
700233	US 192	Indian River Relief	G	2011	50.6	9.8	99.99
700234	US 192	Indian River Relief	G	2011	50.6	9.8	30.45
700174	US 192	Indian River IWW	F	1978	56.7	12.3	99.99
700181	US 192	Indian River IWW	F	1985	64.1	10.1	99.99
700172	US 192	Indian River Relief	F	1978	48.2	23.9	99.99
704144	Sea Ray Drive	Sykes Creek	P	1991	59.2	13	99.99

Other Bridge Issues: Roy D. Bridges, Jr. Bridge

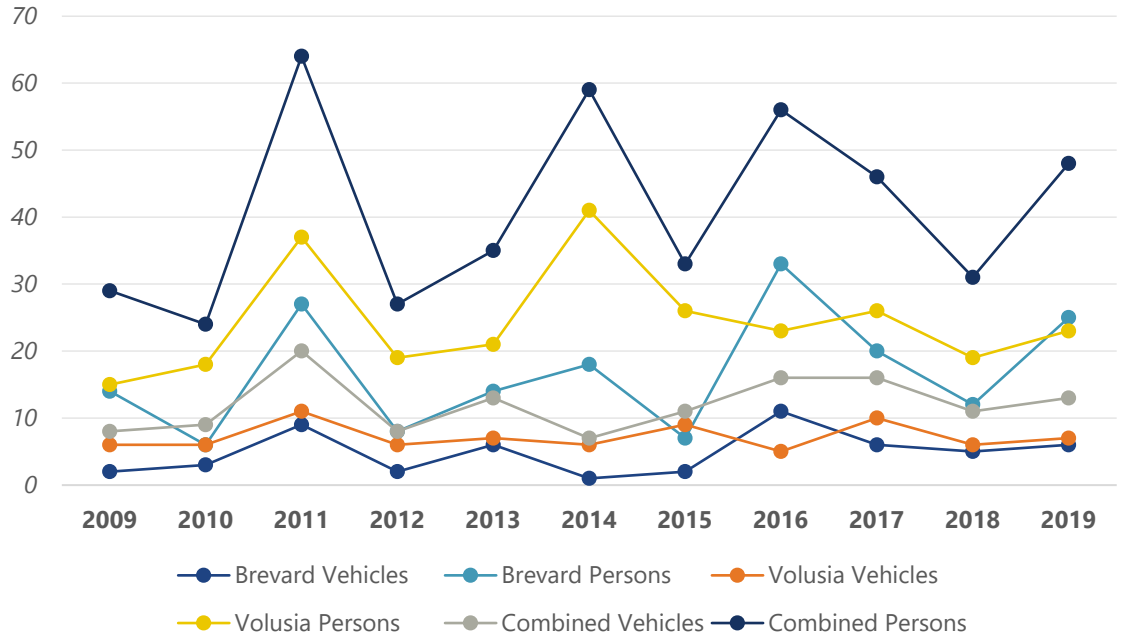
Roy D. Bridges Jr. Bridge (Source: Google)

Bridges provide critical access to KSC and to the CCAFS. However, this access can be constrained by the limitations imposed by the bridges, specifically the Roy D. Bridges Jr. Bridge which connects to Cape Canaveral. Due to the slope of the road and the length of the equipment, specifically rockets, the Roy D. Bridges Jr. Bridge does not allow for access to the base for large cargo. This forces access for this cargo to the north and the south, creating challenges including impacts from traffic and lane impacts to those north/south roadways. To address this challenge, Space Florida developed a proposal for improving and replacing this facility. However, it was not moved forward. Currently, this bridge limits large cargo from direct access to the base. As the USSF increases in daily launch activity, improving this bridge may become an opportunity to address this challenge.

Safety

As shown in **Figure 62,** the number of vehicles and persons involved in fatal crashes with large trucks has slightly increased over the past ten years in Brevard and Volusia counties.

***Figure 62** | Persons and Vehicles in Fatal Crashes Involving a Large Truck (Source: NHTSA)*



All vehicle related crashes are displayed for the region in **Figure 63**. **Figure 64** shows truck crash concentration hotspots as of 2016.

Figure 63 | *High Crash Intersections and Segments (Source: FDOT, 2014-2018)*

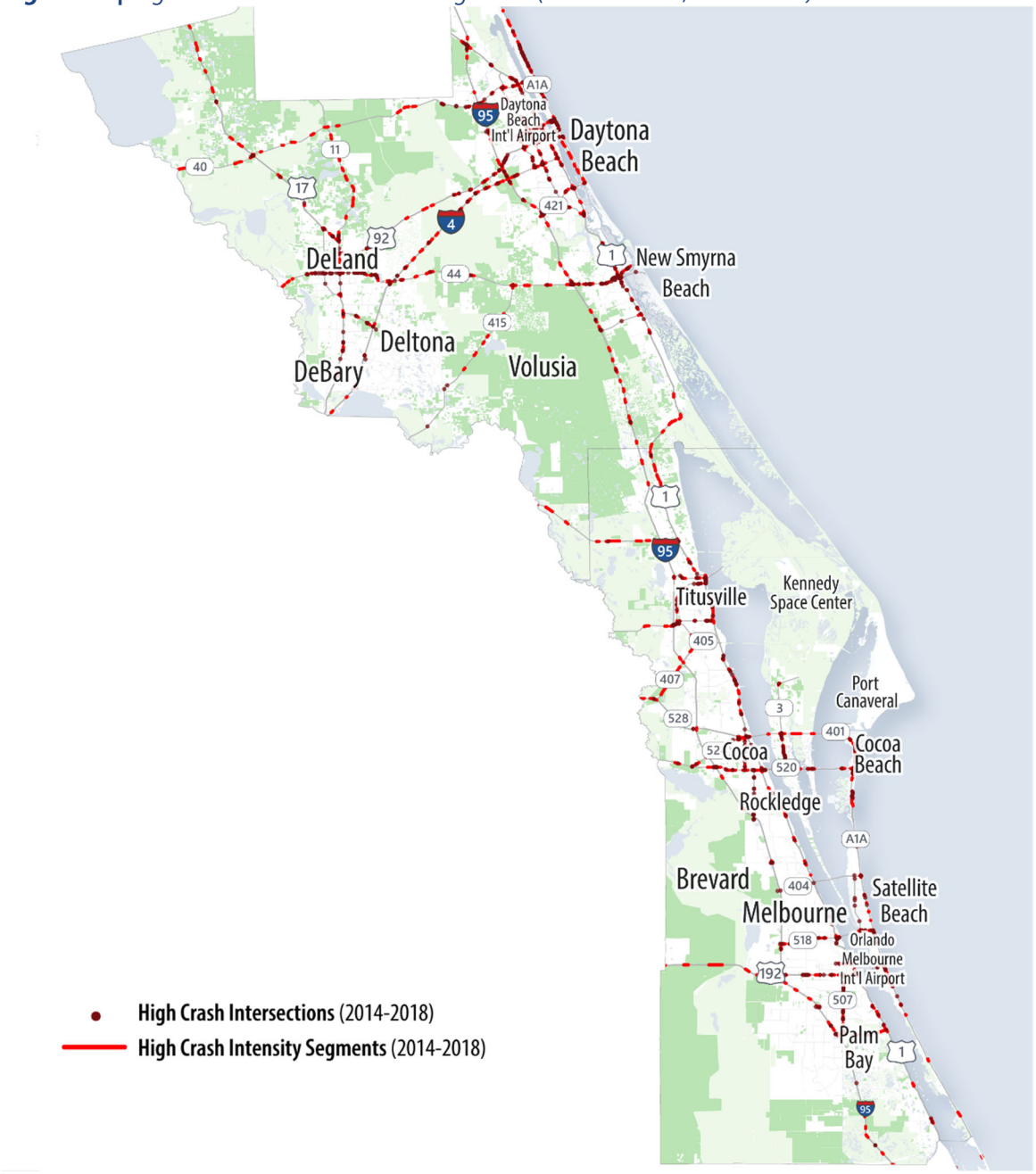
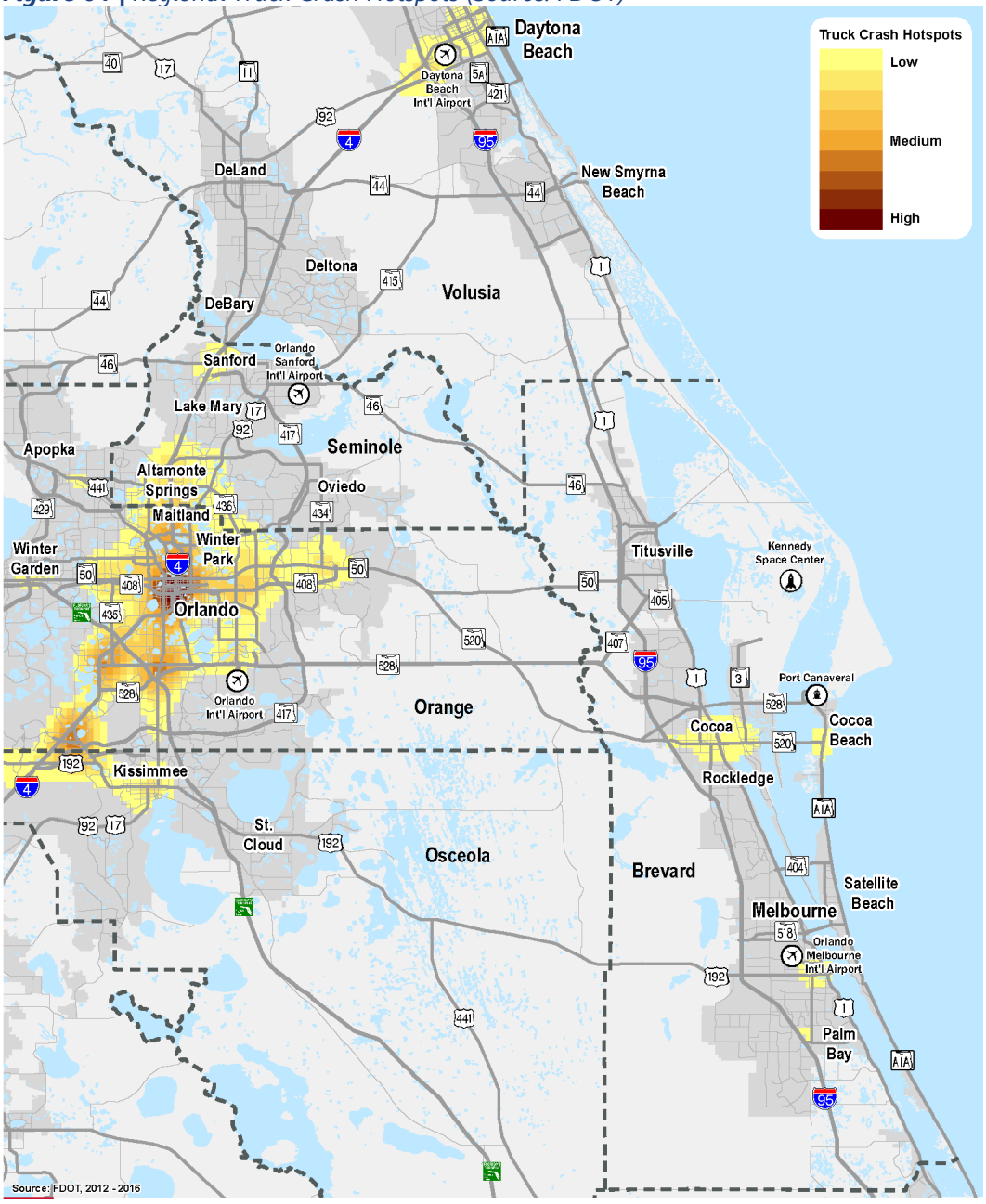


***Figure 64** | Regional Truck Crash Hotspots (Source: FDOT)*



Brevard County

According to the Space Coast 2019 SOS report, the number of overall crashes increased 1.3 percent from 10,383 in 2015 to 10,513 in 2019. Intersection crashes decreased 4.7 percent and serious injury and fatal crashes decreased 22 percent during the same period of 2015-2019. Corridor crashes increased by 0.6 percent. The report does not detail truck crashes.[161] Using FDOT crash data from 2014-2018, **Table 11** displays the Brevard County high crash roadways, and **Table 12** displays Brevard County high crash intersections.

Table 11 | *Brevard County High Crash Roadways (2014-2018, Source: FDOT)*

Roadway	Crashes	Fatal		Injury		PDO	
	#	#	%	#	%	#	%
SR 5	2565	20	1%	1985	77%	1293	50%
SR 520	1634	18	1%	1371	84%	787	48%
SR A1A	1430	14	1%	820	57%	853	60%
SR 507	1232	3	0%	993	81%	567	46%
SR 500	1131	8	1%	886	78%	568	50%
SR 3	1023	3	0%	786	77%	507	50%
SR 9	886	9	1%	601	68%	512	58%
SR 518	884	4	0%	618	70%	462	52%
SR 405	383	10	3%	257	67%	229	60%
SR 50	357	4	1%	207	58%	217	61%
SR 501	343	6	2%	260	76%	158	46%
SR 514	343	3	1%	298	87%	160	47%
SR 406	233	0	0%	151	65%	130	56%
SR 508	207	1	0%	161	78%	92	44%
SR 524	203	7	3%	169	83%	95	47%
SR 5054	182	0	0%	137	75%	91	50%
SR 528	182	4	2%	130	71%	104	57%
SR 519	177	3	2%	142	80%	83	47%
SR 46	137	0	0%	125	91%	60	44%
SR 513	92	0	0%	47	51%	58	63%
SR 404	54	0	0%	47	87%	29	54%
SR 407	41	3	7%	40	98%	18	44%

**PDO: Property Damage Only*

[161] https://spacecoasttpo.com/wp-content/uploads/2020/11/2019-SOS-Draft-Report-2020_10_19.pdf

***Table 12** | Brevard County Top 25 High Crash Intersections (2014-2018, Source: FDOT)*

Intersection	Crashes	Fatal		Injury		PDO	
	#	#	%	#	%	#	%
SR 3 at PALMETTO AVE R	175	1	1%	123	70%	101	58%
SR 507 at CR 516	163	0	0%	138	85%	72	44%
SR 528 at SR 3	161	0	0%	130	81%	89	55%
SR 520 at SR 3	158	1	1%	104	66%	96	61%
SR 5 at SR 520	131	2	2%	100	76%	66	50%
SR 507 at SR 514	130	0	0%	102	78%	65	50%
SR 507 at EBER BLVD	119	0	0%	116	97%	51	43%
SR 514 at EB EXIT TO NB SR 9 L	119	0	0%	77	65%	65	55%
SR 5 at RIVER DR E	118	1	1%	74	63%	64	54%
SR 500 at EB ENT FROM NB SR 9 R	116	0	0%	126	109%	47	41%
SR 5 at HARBOR CITY	115	1	1%	77	67%	61	53%
SR 5054 at BEGIN EXCEPTION	109	0	0%	68	62%	58	53%
SR 5 at OLD OAK ST	108	0	0%	59	55%	65	60%
SR 5 at RIVERSIDE VILLA	106	1	1%	90	85%	52	49%
SR 518 at CR 509	106	3	3%	71	67%	55	52%
SR 507 at UNIVERSITY BLVD	105	0	0%	76	72%	51	49%
SR 406 at SR 406	99	0	0%	58	59%	64	65%
SR 500 at WB EXIT TO NB SR 9 L	99	0	0%	118	119%	37	37%
SR 500 at CR 509	94	0	0%	69	73%	50	53%
SR 500 at C AVE	91	0	0%	67	74%	49	54%
SR 513 at EAU GALLIE BLVD	91	0	0%	46	51%	58	64%
SR 514 at WB ENT FROM SB SR 9 L	91	0	0%	62	68%	47	52%
SR 9 at WICKHAM RD	89	0	0%	64	72%	48	54%
SR 507 at PORT MALABAR RD	88	0	0%	60	68%	52	59%
SR 5 at SR 508	85	0	0%	66	78%	38	45%
SR 507 at FLORIDA AVE	85	0	0%	62	73%	39	46%

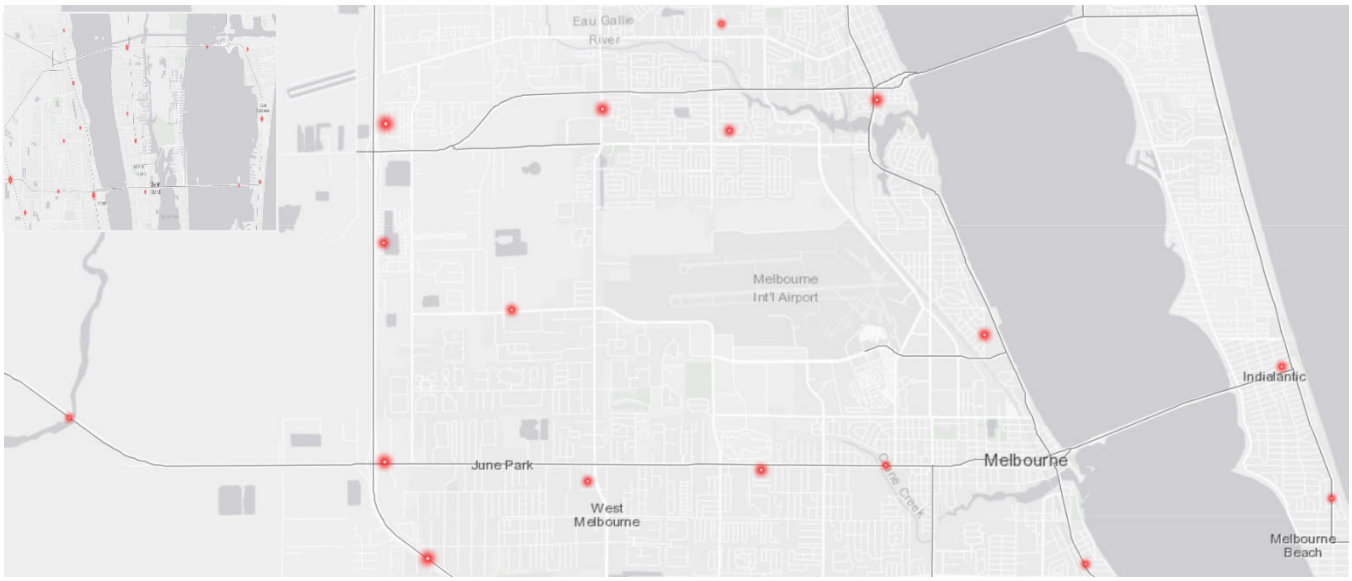
**PDO: Property Damage Only*

Figure 65 shows truck crash concentrations near Port Canaveral. In general, there are three high crash corridors and one high crash intersection surrounding Port Canaveral as identified in the SOS report. US 1 from SR 528 to SR 405 had 119 crashes in 2019, N Courtenay Parkway (SR 3) from SR 520 to SR 528 (162), and SR A1A from Cocoa Isles Boulevard to SR 520 (117). The intersection of N Courtenay Parkway (SR 3) and SR 520 experienced an average of 47.2 crashes a year between 2015-2019. These areas show some truck crashes as well. The areas with the highest concentration of truck crashes include the intersection of I-95 and W King Street, King Street and US 1, and then the intersection of SR 528 and N Courtney Parkway (SR 3).

Figure 65 | *Truck Crashes Near Port Canaveral (Source: FMTP Data Warehouse)*

Another area with truck crash concentrations is around the Melbourne International Airport, shown in **Figure 66.** This area also has several high crash corridors and intersections in general as identified in the SOS. The corridors include US 192 from Wickham Road to Babcock Street with 182 annual crashes, US 1 from Strawbridge Avenue to Sarno Road (146), and Wickham Road from Sarno Road to Parkway Drive (128). The high crash intersections are Wickham Road and Sarno Road with an average of 47.8 crashes a year, Wickham Road and US 192 (44/year), and Lake Washington Road and Wickham Road (41.8/year).[162] These areas also have truck crashes. The highest concentrations of truck crashes here seem to be around I-95.

Figure 66 | *Truck Crashes Near Melbourne International Airport (Source: FMTP Data Warehouse)*



[162] https://spacecoasttpo.com/wp-content/uploads/2020/11/2019-SOS-Draft-Report-2020_10_19.pdf

Volusia County

The River to Sea TPO provides specific truck crash details in its 2045 LRTP. Between 2011 and 2016, the total number of truck crashes went from 685 to 990, a 45 percent increase. Property damage only (PDO) crashes, doubled from 187 to 413, and fatal truck crashes remained consistent between 11 and 18 per year. After falling between 2012 and 2014, **Table 13** displays the Volusia County high crash roadways and **Table 14** displays Volusia County high crash intersections.

Table 13 | *Volusia County High Crash Roadways (2014-2018, Source: FDOT)*

Roadway	Crashes	Fatal		Injury		Pdo	
	#	#	%	#	%	#	%
SR5	2349	28	1%	1703	72%	1122	48%
SR600	1809	23	1%	1261	70%	946	52%
SR5A	1790	21	1%	1309	73%	867	48%
SR400	1767	15	1%	1171	66%	1058	60%
SR9	1431	14	1%	784	55%	919	64%
SR44	1327	13	1%	935	70%	713	54%
SR430	1228	6	0%	868	71%	635	52%
SR40	1088	5	0%	732	67%	587	54%
SRA1A	895	6	1%	601	67%	472	53%
SR15	815	14	2%	638	78%	397	49%
SR421	612	1	0%	438	72%	292	48%
SR483	518	6	1%	344	66%	276	53%
SR15A	217	1	0%	149	69%	120	55%
SR441	171	2	1%	119	70%	84	49%
SR472	140	2	1%	128	91%	67	48%
SR415	113	2	2%	96	85%	55	49%
SR11	93	3	3%	87	94%	35	38%
SR442	53	2	4%	34	64%	26	49%
CR44	23	4	17%	23	100%	7	30%
SR46	20	0	0%	9	45%	13	65%

**PDO: Property Damage Only*

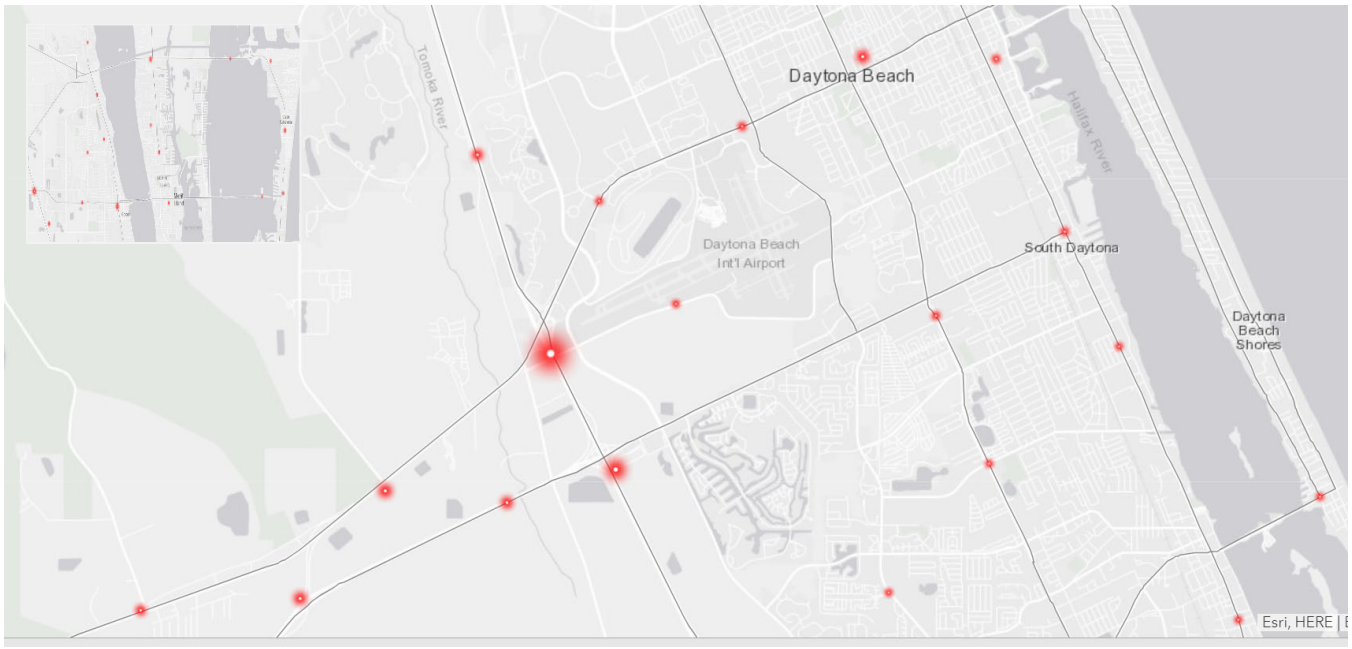
***Table 14** | Volusia County Top 25 High Crash Intersections (2014-2018, Source: FDOT)*

Intersection	Crash	Fatal		Injury		Pdo	
	#	#	%	#	%	#	%
SR 600 at FROM WILLIAMSON BLVD D	263	2	1%	232	88%	120	46%
SR 483 at SIDE ROAD	250	2	1%	134	54%	152	61%
SR 600 at WYE TO SR 483	248	2	1%	135	54%	149	60%
SR 600 at SR 5A	232	3	1%	147	63%	121	52%
SR 600 at JEAN ST R	186	3	2%	109	59%	104	56%
SR 40 at SIDE ROAD	166	0	0%	92	55%	104	63%
SR 5 at SR 600	165	1	1%	100	61%	84	51%
SR 400 at MILE MARKER #131 R	157	2	1%	131	83%	91	58%
SR 400 at SR 5A	157	0	0%	118	75%	82	52%
SR 5A at SR 430	156	2	1%	108	69%	78	50%
SR 400 at RESTARRICK ST R	153	0	0%	112	73%	81	53%
SR 5A at MASON CT	144	2	1%	98	68%	73	51%
SR 483 at BEVILLE RD	143	0	0%	80	56%	84	59%
SR 400 at CLYDE MORRIS BLVD	142	0	0%	79	56%	84	59%
SR 5 at CONGRESS AVE	138	1	1%	100	72%	75	54%
SR 472 at FROM MLK BELTWAY	136	2	1%	104	76%	73	54%
SR 5 at SR 430	134	1	1%	96	72%	74	55%
SR 5 at SR 40	133	0	0%	103	77%	65	49%
SR 600 at CR 4009	132	1	1%	119	90%	59	45%
SR 600 at TO WILLIAMSON BLVD D	127	1	1%	106	83%	59	46%
SR 9 at MILE MARKER #261 L	126	0	0%	57	45%	94	75%
SR 9 at MILE MARKER #261 R	126	0	0%	57	45%	94	75%
SR 421 at CLYDE MORRIS BLVD	125	1	1%	77	62%	68	54%
SR 600 at SR 483	125	1	1%	67	54%	76	61%
SR 483 at WYE TO SR 600	124	1	1%	67	54%	75	60%
SR 600 at WYE FROM SR 483	123	1	1%	67	54%	74	60%

**PDO: Property Damage Only*

The highest concentration of truck crashes, as shown in **Figure 67**, occurs near the interchange of I-4 and I-95 near Daytona Beach. Other key hot spots include the City of Daytona Beach, the intersection of I-95 with US 1, and the intersection of I-95 with SR 421.[163]

***Figure 67** | Truck Crashes Near Daytona International Airport (Source: FMTP Data Warehouse)*



[163] https://www.r2ctpo.org/wp-content/uploads/Tech-G_Freight-Summary_12.18.20_FINAL_ADA-PASS-1.pdf

Resilience

The coast of the super-regional study area is projected to face significant impacts from Sea Level Rise (SLR), starting as early as 2040. Several agencies in the region have already started to assess these impacts including the related potential challenges to transportation infrastructure. The SLR projections from the Space Coast TPO Sea Level Rise Vulnerability Analysis (2018) are displayed in **Table 15.**

***Table 15** | Projected SLR - Daytona Beach Shores Tidal Gauge (inches), (UF GeoPlan Sea Level Rise Scenario Sketch Planning Tool)*

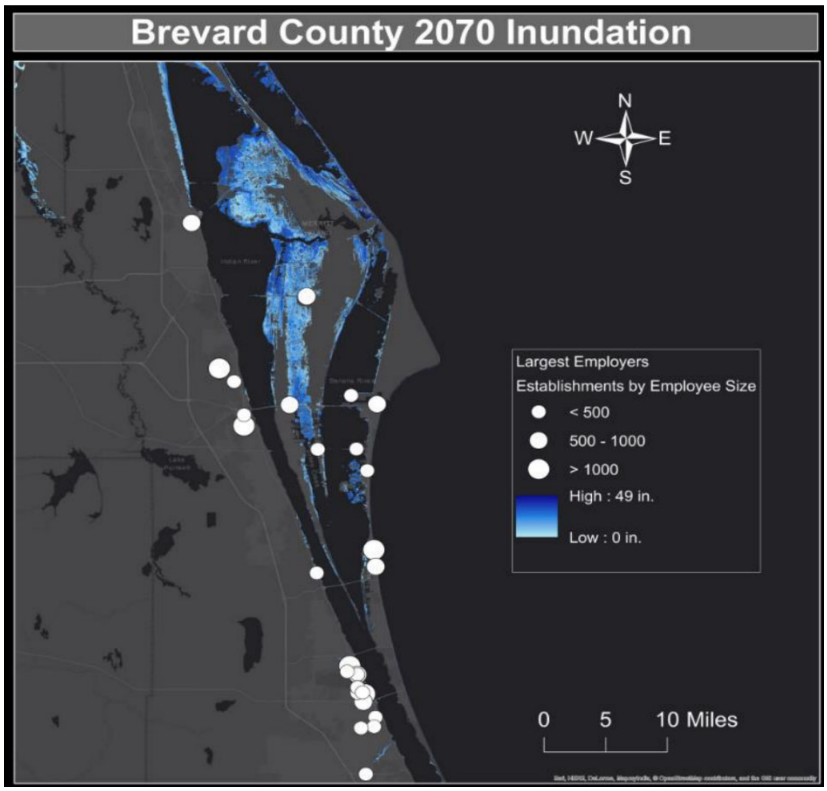
Year	Low	Intermediate	High
2040	4.38”	6.84”	14.63”
2070	7.12”	13.62”	34.19”
2100	9.86”	22.31”	61.76”

The area’s transportation resilience is central to overcoming future SLR challenges. Resilience refers to the capacity of the infrastructure (and connected systems) to sustain, adapt, recover, improve, and grow considering SLR and other climate disruptions.[164] Using the area SLR studies and the recently developed Regional Resilience Action Plan (RRAP), this section will briefly highlight impacts of SLR to the areas industries and transportation infrastructure.

[164] https://a37a849c-d81f-4fdf-8d3e-9fcd452fd4a1.filesusr.com/ugd/4c4fbd_769e7278bcb742e48a2237391963a849.pdf

Brevard County

***Figure 68** | Major Employers Facing Inundation (Source: RRAP)*



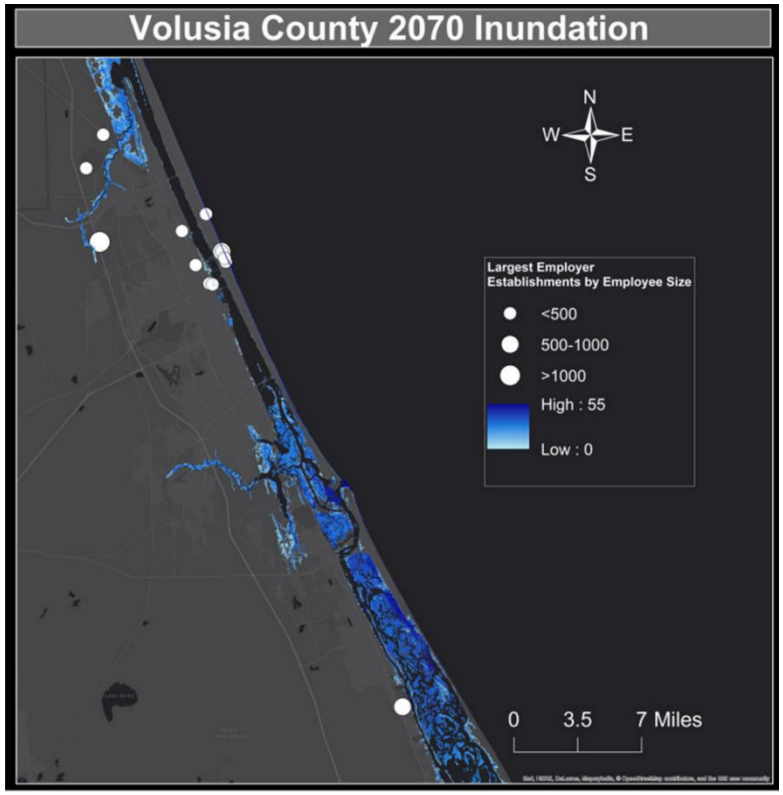
The RAPP provided an overview of employers affected by SLR by 2070 using the U.S. Army Corps of Engineers (USACE) high projection rate curve. Businesses within the vulnerability buffer were located and categorized using the North American Industry Classification System (NAICS). In this area the most vulnerable industries include ambulatory health care services, professional scientific and technical services, and real estate. According to this analysis, several large employers would have their operations severely constrained by the estimated inundation levels. The largest employer is Patrick Air Force Base, with over 2,500 employees. The KSC is the second largest employer that will get affected by inundation. In the case of the Health First Cape Canaveral Hospital, while the flooding would not directly affect the building, the water levels will surround its entrance**. Figure 68** identifies the areas anticipated to be impacted by 2.85 feet of SLR by 2070 (USACE), and vulnerable employer establishments by number of employees.[165]

[165] https://a37a849c-d81f-4fdf-8d3e-9fcd452fd4a1.filesusr.com/ugd/4c4fbd_769e7278bcb742e48a2237391963a849.pdf

Volusia County

In Volusia County, the most vulnerable industries include ambulatory health care services, professional scientific and technical services, and real estate. Florida Hospital New Smyrna is the largest employer with about 700 individuals vulnerable to inundation. **Figure 69** identifies areas anticipated to be impacted by 2.85 feet of SLR by 2070 (USACE), and vulnerable employer establishments by number of employees.[166]

Figure 69 | *Employers Impacted (Source: RRAP)*

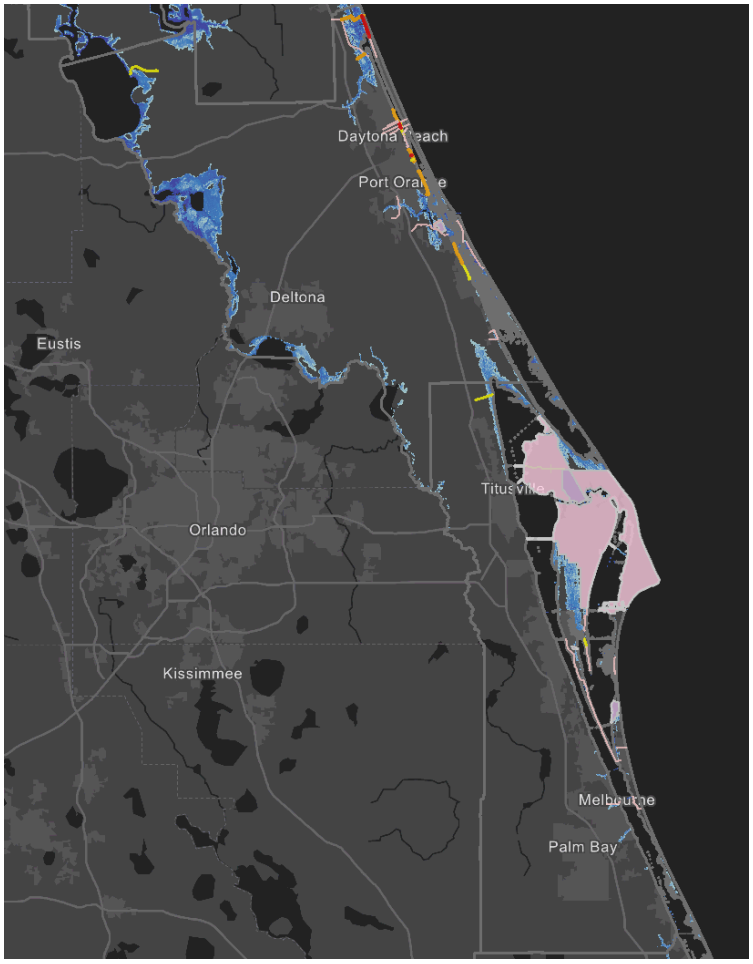


[166] https://a37a849c-d81f-4fdf-8d3e-9fcd452fd4a1.filesusr.com/ugd/4c4fbd_769e7278bcb742e48a2237391963a849.pdf

Impacts to Freight Transportation

As shown in **Figure 70**, the most vulnerable freight-related transportation assets to SLR in 2070 will be the spaceport and seaport.

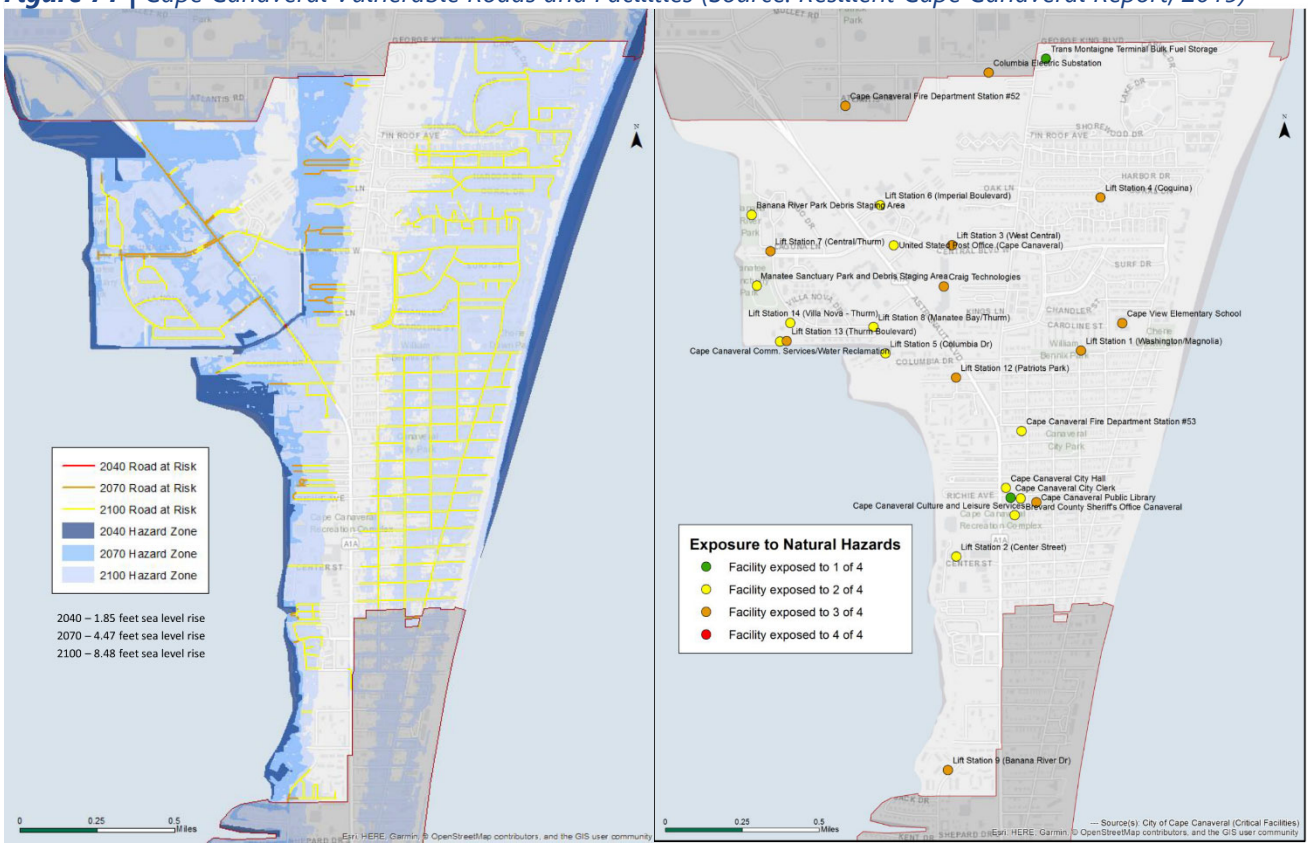
***Figure 70** | Transportation Impacts (Source: Sea Level Rise Sketch Planning Tool Geoplan Florida)*



Cape Canaveral

As shown in **Figure 71** from the City of Cape Canaveral Resilient Cape Canaveral Report (2019) several transportation facilities and spaceport assets face inundation challenges. This study used both the USACE and NOAA High Curves to capture possible inundation scenarios.[167]

Figure 71 | *Cape Canaveral Vulnerable Roads and Facilities (Source: Resilient Cape Canaveral Report, 2019)*



[167] https://www.cityofcapecanaveral.org/document_center/Documents/Community%20Development/cocc_resilient_cape_canaveral_20190730.pdf

To view the impacts to other assets in Cape Canaveral, the Space Coast TPO Sea Level Rise Vulnerability Analysis was reviewed. According to this effort, some key impacts include:

- **CCAFS** - located in one of the most lowly-elevated areas of the county and, thus, is susceptible to projected SLR. Water is expected to infringe approximately 80 feet away from the northwestern portion of the runway and nearly adjacent to the southeastern corner of the runway facility. Nine buildings are projected to be within 200 feet of the inundated area by year 2100. The most vulnerable portion of the Air Force Station are the launch pads, located near the Atlantic coastline.[168]
- **Patrick Air Force Base -** located along the barrier island system and highly susceptible to SLR. The runway is projected to be inundated under the USACE high projection rate curve by year 2100. The administrative area of the Air Force Base is equally susceptible to SLR. While SLR intrusion is projected to be very severe by year 2100, the 2040- and 2070-time frames show minimal-to-no impact on the Air Force Base administrative buildings or runways.[169]
- **KSC -** Kennedy Space Center is among the most important assets to the federal government and contains several critical exploratory transportation facilities. Some impacts include the shuttle landing facility that will be surrounded by water by 2100. Launch Complex 39A will face inundation by 2070. Launch Complex 39B will be susceptible to SLR by 2100. Launch Complex 41 will have SLR start to intrude outer boundary by 2100. The Visitor Center building itself is not projected to be inundated by year 2100. The parking lot on the southern end of the site is projected to be completely inundated by year 2100 under the USACE high projection rate curve.[170]

[168] https://spacecoasttpo.com/uncategorized/sea-level-rise-vulnerability-assessment/
[169] https://spacecoasttpo.com/uncategorized/sea-level-rise-vulnerability-assessment/
[170] https://spacecoasttpo.com/uncategorized/sea-level-rise-vulnerability-assessment/

Port Canaveral

As shown in **Figure 72**, Port Canaveral will be susceptible to SLR as soon as 2040. Several vulnerable areas on Port property are retention areas that will fill up with water over time. Some critical transportation infrastructure assets will also be susceptible to SLR.

Mullet Road is a roadway near the southwestern corner of the property that serves as the only access point for several boat docks. This is will be almost completely inundated by 2100. Cape Marina (which is also in this portion of the property) is expected to be impacted by the same time frame.

The most critical situation is the central portion of the inlet where the Port Canaveral Terminal and Royal Caribbean Terminal are located. In addition to the terminals, many restaurants are also located in this area. The parking area for Royal Caribbean customers is also susceptible to SLR.

***Figure 72** | Sea Level Rise Impacts to Port Canaveral (Source: Space coast TPO SLR Vulnerability Analysis)*

Projects

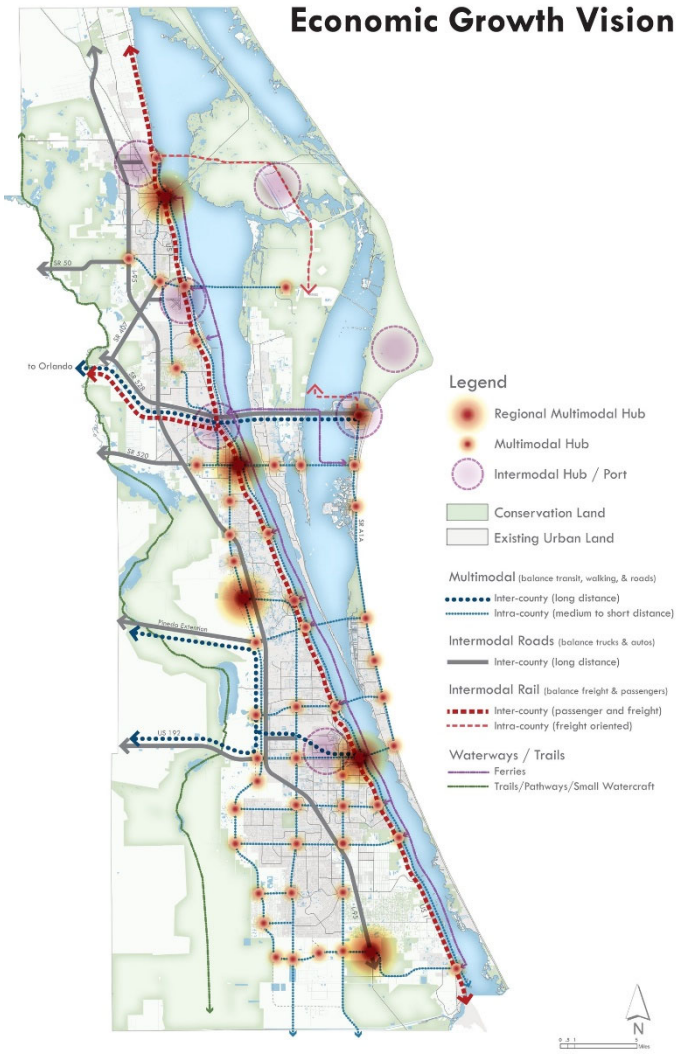
The Space Coast TPO crafted a long-term vision for the development of transportation infrastructure to serve the space industry and the surrounding communities. This vision, as shown in **Figure 73**, includes the development of several multimodal hubs, intermodal hubs/port, and corridor enhancements to support multimodal and intermodal travel.

The intermodal hubs and corridor enhancements identified in this vision are anticipated to service, at least in part, space industry freight. This could include oversize or OS/OW cargo, sensitive technologies or components, and fuel among other items.

The Space Coast TPO has been working towards implementing this vision since its adoption in September 2014. Several needs shown in the vision are identified as projects in the 2045 LRTP. The projects shown in **Figure 74** account for approximately 43 percent of cost feasible project funding for the 2040 LRTP.

Summaries of the projects are included in the following sections.

***Figure 73** | Space Coast TPO 2045 Vision*



SR 528

State Road (SR) 528, also known as the Beachline, provides critical east-west connectivity for personal travel and freight movements from Central Florida to Port Canaveral and Cape Canaveral Spaceport.

Future growth at the Port in both cruise passengers and freight activities is anticipated to significantly impact the level of congestion on this corridor. Two capacity improvement projects have been identified by the Space Coast TPO, both of which are expected to complement the freight network improvements made along other key facilities, including I-95, US 192, SR 405, SR 524, Malabar Road, Babcock Street, Wickham Road, and US 1:

- Widen SR 528 from I-95 to SR 401 to six lanes (Cost Feasible Project – Funded)
- Widen SR 528 from Orange County Line to I-95 to eight lanes (Unfunded Need)

***Figure 74** | Space Coast TPO SIS Facility Improvements*

Ellis Road

Ellis Road provides east-west connectivity from I-95 to the Melbourne International Airport, which serves as a hub for passenger and freight movements. Anticipated growth, including the expansion of cargo facilities at the airport, is anticipated to have significant impacts to the congestion on Ellis Road. Three improvements have been identified by the Space Coast TPO, each of which will also complement the freight network improvements made to other key facilities in the area.

- Widen Ellis Road from John Rodes Blvd. to Wickham Road to four lanes (Cost Feasible Project – Funded)
- Develop a new interchange at I-95/St. Johns Heritage Parkway at Ellis Road (Cost Feasible Project – Funded)
- Establish a Freight Intermodal Hub at Melbourne International Airport (Unfunded Need)

US 192

US 192 also serves as a key east-west connector for Brevard County for freight and passenger trips and is a key facility for the local freight network. The Space Coast TPO has identified several projects to improve the corridor's capacity.

- Intersection improvements on US 192 at Hollywood Blvd. (Cost Feasible Project – Funded)
- Intersection improvements on US 192 at Wickham Road (Cost Feasible Project – Funded)
- Widen US 192 from I-95/St. Johns Heritage Parkway to Wickham Road to six lanes (Cost Feasible Project – Funded)
- Widen US 192 from Wickham Road to Dairy Road to six lanes (Cost Feasible Project – Funded)

SR 405 (NASA Causeway)

The NASA Causeway is a critical connector for military and commercial space freight transported over the Indian River en route to the CCS. This movable bridge also serves as a key connection for military personnel, CCS employees, and visitors to the KSC and the surrounding region. The Space Coast identified the need to replace this bridge by Fiscal Year (FY) 2021 due to the age and deterioration of the structure. If the region were to lose access to this facility, government and commercial space freight would greatly increase the burdens on the federal and commercial sectors while potentially rerouting hazardous materials to less secure routes through Brevard County. The bridge replacement project has been funded for construction, in part through the receipt of a $90 million INFRA (Infrastructure for Rebuilding America) Grant.

SR 401 Bridges Study

The SR 401 corridor and the bascule bridges over the Canaveral Barge Canal, from SR 401/SR 528 Interchange to the Cape Canaveral Air Force Station, have been identified as critical to the Central Florida economy by the Space Coast TPO. Both military and civilian facilities depend on the viability of this corridor, including: Port Canaveral, Space Florida, KSC, Seaport Canaveral, and military port assets for the U.S. Navy, U.S. Army, and the CCAFS. The anticipated growth in freight movements on the SR 401 bridge are expected to exceed its capacity as the space industry continues to grow. Widening the corridor and replacing the bridges are currently funded for the Project Development and

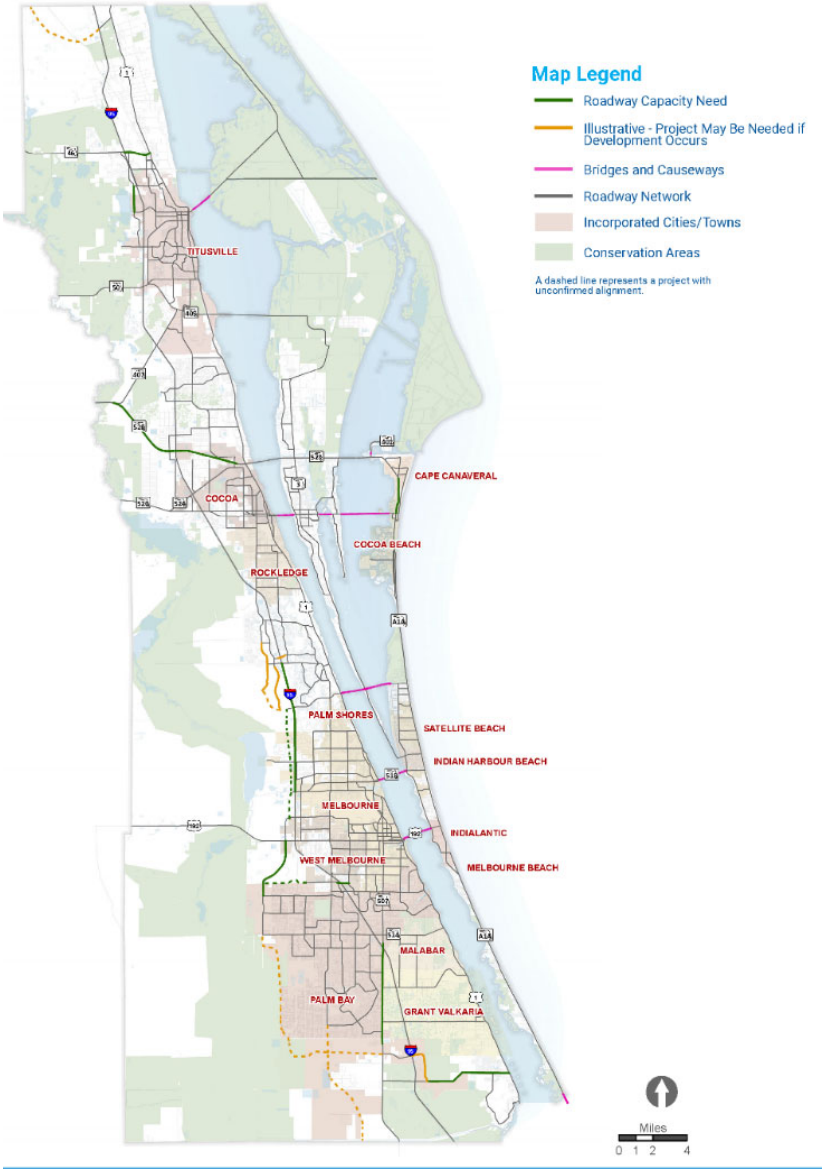
Environment (PD&E) Study. Funding for the design (Preliminary Engineering) and construction will be pursued through the INFRA federal discretionary grant program or through other federal/state programs.[171]

Figure 75 identifies further projects identified by Space Coast TPO which are not funded and should be considered in this study.

Other Related Cost Feasible/Unfunded Projects

The Space Coast TPO has several projects identified in the 2045 LRTP that potentially can be considered for addressing some of the identified freight issues. These are shown below indicating potential recommendation:

Figure 75 | *Space Coast TPO Unfunded Needs*



[171] https://www.cflroads.com/project/444787-1

Funded Projects

- I-95/SR 524 Interchange: *Operational improvements.*
- SR 524 Widening: S Friday Road to Industry Road widen to four lanes.
- SR A1A: International Drive to Long Point Road miscellaneous construction, intersection realignment, new two-lane road; Long Point Road to S of George King Blvd. Curb Gutter/Safety/Signal.

Unfunded Projects

- SR 401 Bridge Replacement: Replacement of SR 401 bridge by Port Canaveral.
- I-95 Widening: SR 518 (Eau Gallie Blvd.) to Wickham Road widen to six lanes.
- SR 528 Widening: SR 407 to I-95 widen to six lanes; I-95 to E of Industry Road widen to six lanes.

Transit/Rail Projects

In addition to the roadway projects, several transit projects that could benefit the Space Coast communities directly while indirectly supporting freight by reducing vehicles on the road are identified. These include:

- Brightline Passenger Rail to Orlando/Jacksonville.
- Proposed Intermodal Facilities – Downtown Cocoa, SR 528/US 1 and Melbourne International Airport.
- Proposed BRT routes – US 1, SR 528, SR 520, SR A1A, Wickham Road.
- Osceola-Brevard Connector – Connection between Osceola Parkway Extension expressway to the west and I-95 in Brevard to the east.

CONGESTION BOTTLENECKS

Infrastructure Capacity

The pace of regional population and employment growth will exceed the resources available to provide additional transportation infrastructure. Development along important roadways can impact the ability of these facilities to expand and service additional capacity. Officials will be forced to find new ways of creating this capacity using technology and operational improvements. As shown in **Table 16**, both Brevard and Volusia counties are meeting their performance measure targets for travel reliability for person miles in general. Truck travel time reliability is below the target and below Florida's overall target.

***Table 16** | System Performance Measures and Targets (Source: Space Coast TPO SOS, River to Sea TPO LRTP)*

Performance Measures	Brevard/ SCTPO	Volusia/ R2s	*Target*	Florida
% of person miles traveled on the Interstate that are reliable	100.0%	100%	≥70.0%	83.0%
% of person miles traveled on the non-Interstate NHS that are reliable	90.0%	90%	≥50.0%	87.0%
Truck travel time reliability (TTR) ratio on the Interstate	1.14	1.17	≤1.75	1.45

As shown in

Figure 76, currently there are few areas in Volusia and Brevard counties with Level of Service (LOS) challenges for freight, apart from around the Melbourne International Airport where segments of US 192 and NASA Blvd. currently have LOS D. The area's growing population, increasing personal vehicle traffic, combined with large truck volumes (**Figure 77**), may place pressure on the network in the future. **Figure 78** shows the areas with truck bottlenecks**.**

***Figure 76** | Level of Service (Source: FDOT)*

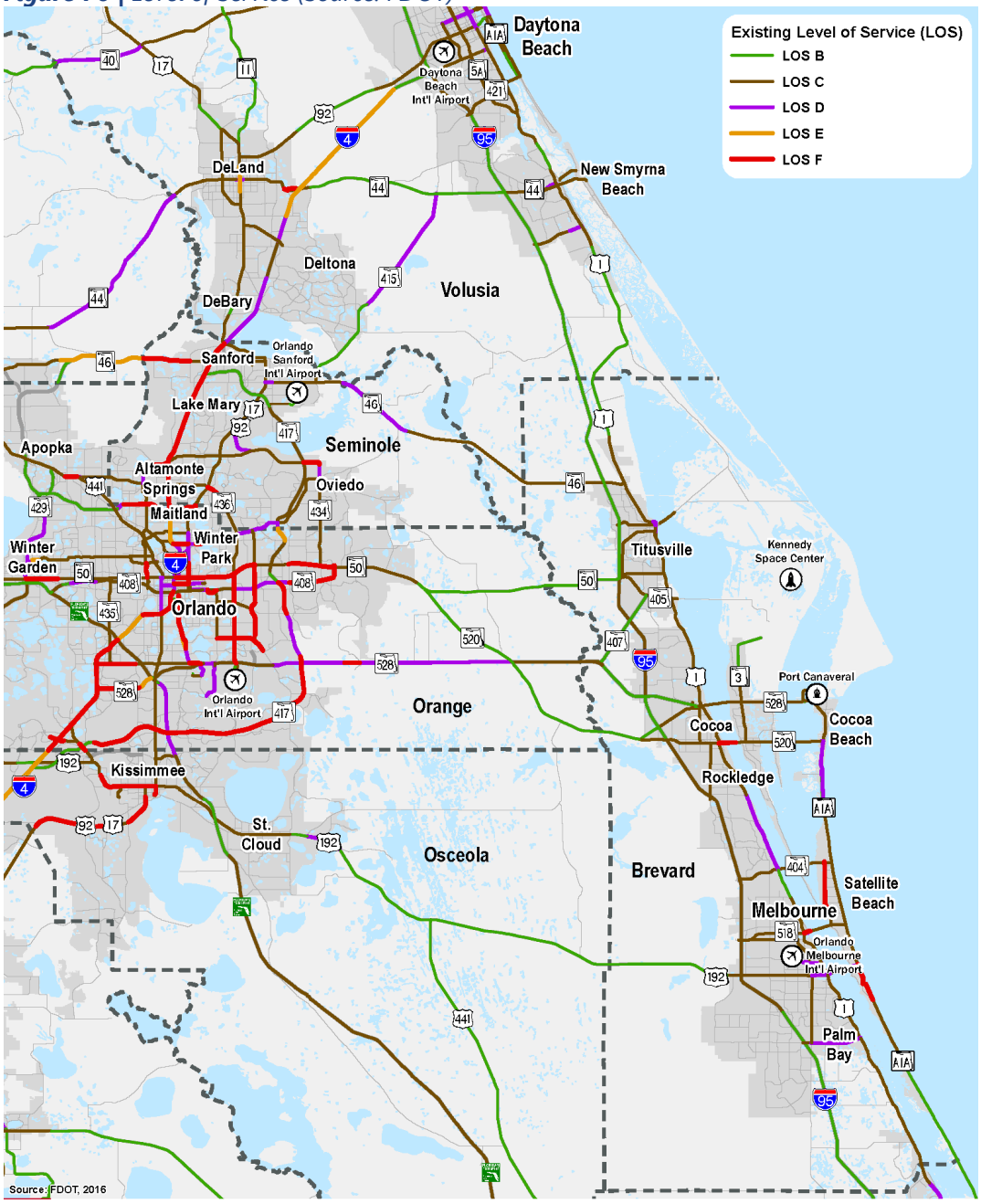


***Figure 77** | Truck Volume (Source: FDOT)*

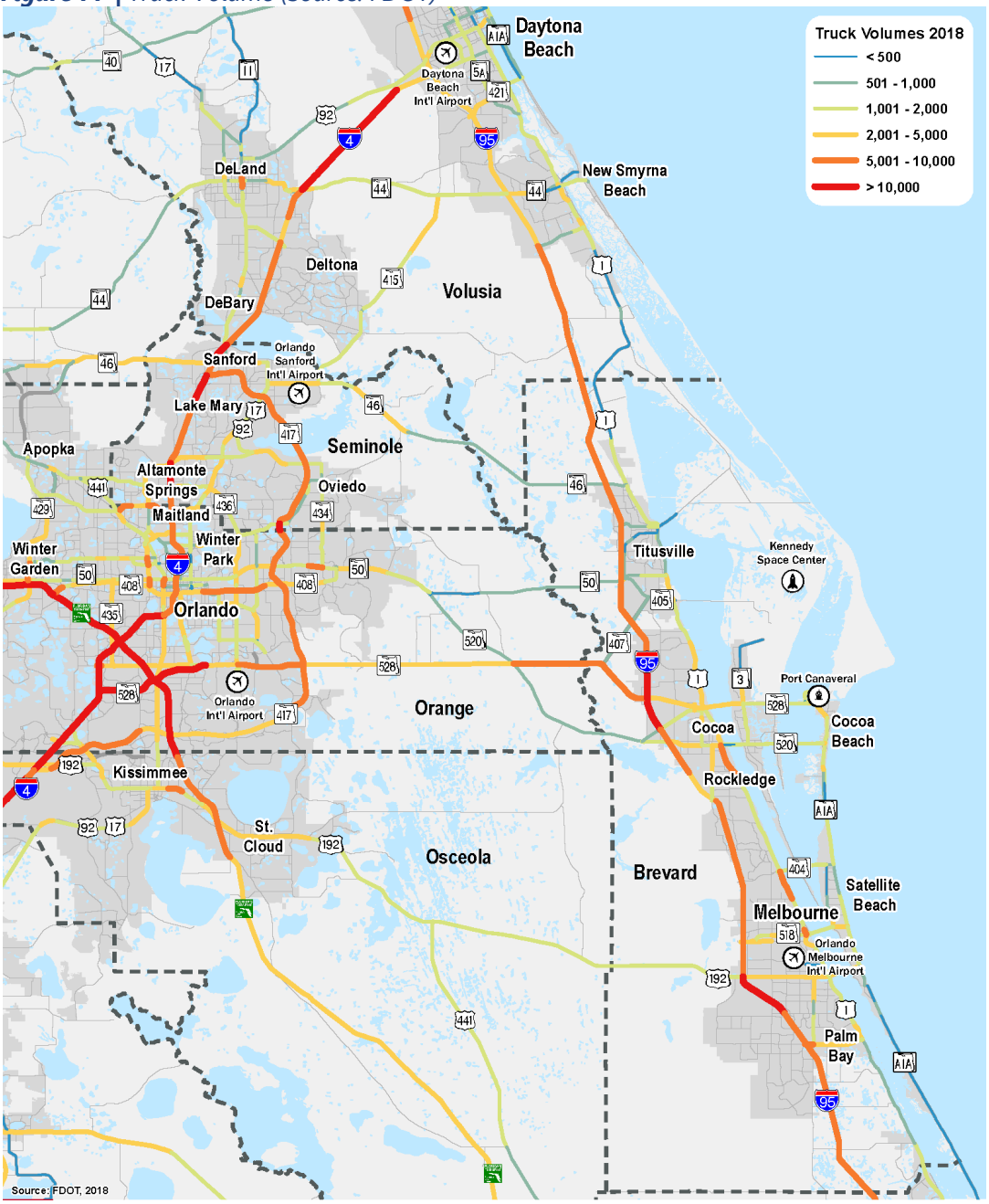
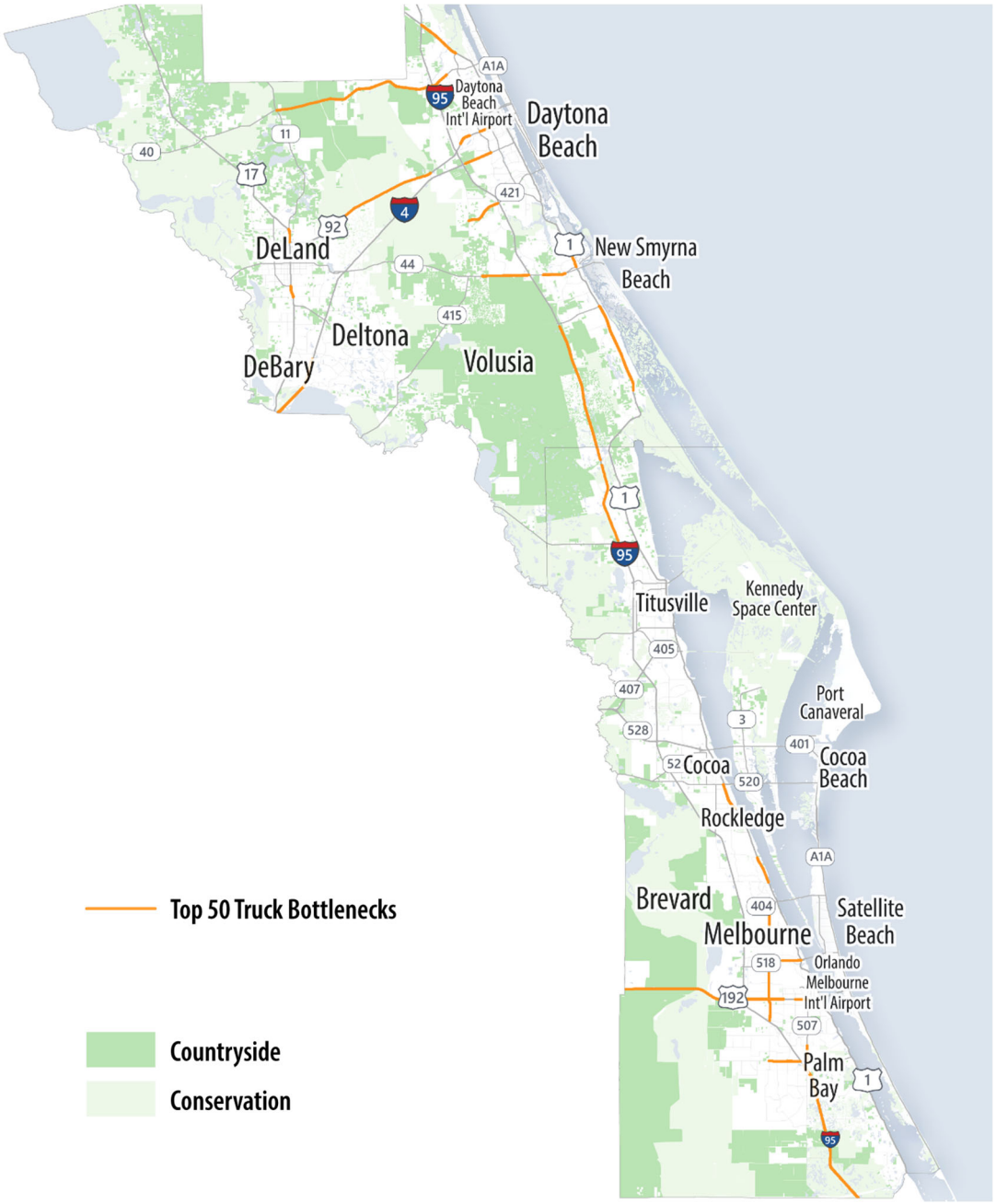


Figure 78 | *Top 50 Truck Bottlenecks (Source: FDOT)*



Brevard County

According to the county's 2019 State of the System (SOS) Report, the combined AADT on the SIS roadway network increased by 5.4 percent over the past year.[172] I-95 saw a collective 5.9 percent rolling average increase from the previous five-year rolling average period, while SR 528 saw a collective 3.2 percent rolling average increase from the previous five-year rolling average period. I-95 saw zero (0) congested lane miles from 2015 to 2019. Although the number of vehicles per lane has increased along I-95, the lack of congestion has been steady through 2019 largely due to the completed six-lane widening projects along I-95 in the county. The total number of congested lane miles along SR 528 remained at 6.51 miles in 2019 due to the segment from the Orange County line to SR 407 experiencing congestion. Overall traffic volumes increased by 1.5 percent on non-SIS roadways between 2018 and 2019.[173] The average truck traffic for I-95, SR 528, and all SIS roadways was calculated in the SOS report. Highlights of truck volumes include:

- Truck traffic volume decreased by 0.1 percent on I-95 from 2018 to 2019. Truck traffic along I-95 increased from 2017 to 2018, remained steady between 2016 and 2017, and experienced a 31 percent increase between 2015 and 2016. The 31 percent increase from 2015 to 2016 corresponds to a similarly large increase in port traffic at Port Canaveral after the port deepening project.
- Truck traffic volume decreased by 15.2 percent on SR 528 from 2018 to 2019. Truck traffic on SR 528 decreased by 0.3 percent from 2017 to 2018, decreased by 4.2 percent from 2016 to 2017, and increased by 93 percent from 2015 to 2016. The 93 percent increase from 2015 to 2016 corresponds to a similarly large increase in port traffic at Port Canaveral after the port deepening project.
- Truck traffic volume on all other SOS roadways decreased for the first time in eight years. Truck traffic on SOS roadways decreased by 0.8 percent from 2018 to 2019, increased by 1.6 percent from 2017 to 2018, increased by 11 percent from 2016 to 2017, and increased by 8 percent from 2015 to 2016.[174]

[172] https://spacecoasttpo.com/wp-content/uploads/2020/11/2019-SOS-Draft-Report-2020_10_19.pdf
[173] https://spacecoasttpo.com/wp-content/uploads/2020/11/2019-SOS-Draft-Report-2020_10_19.pdf
[174] https://spacecoasttpo.com/wp-content/uploads/2020/11/2019-SOS-Draft-Report-2020_10_19.pdf

Volusia County

The River to Sea TPO detailed truck traffic in its 2045 LRTP. According to the LRTP documentation, existing LOS analysis shows only two short roadway segments on SR 40 and SR 44 at LOS F. The segment of I-4 between Daytona Beach and DeLand is shown at LOS E. Truck volumes are highest on I-4 between Daytona Beach and DeLand followed by portions of I-95 throughout the TPO area. Truck volumes have increased on many roadways throughout the area between 2013 and 2018. Many of the roadways connecting the eastern and western portions of the River to Sea TPO area have experienced increases in truck traffic between 20 and 50 percent over the five-year timeframe.[175]

[175] https://www.r2ctpo.org/wp-content/uploads/Tech-G_Freight-Summary_12.18.20_FINAL_ADA-PASS-1.pdf

Non-Recurring Congestion: Events and Launch Days

To assess the extent of non-recurring congestion in the area, an analysis of traffic trends and impacts was conducted for launch activities. Launches occurring from years 2016 to 2020 were considered for this analysis. Information on launches include type, location, mission, company, and description. Only launches that occurred between 9:00 am and 10:00 pm were considered. Launches are grouped by where they occurred (Cape Canaveral vs. KSC) and by launch type (crewed expeditions and satellite/cargo). Crewed expeditions are launches where astronauts are sent to space. The Space Coast had its first crewed expedition since 2011 in May of 2020. Only two crewed expeditions were considered for this analysis. The second type of launch considered was satellite and cargo deliveries to the ISS. Other launch types include testing and classified and do not appear to be as popular or attract as many viewers as the launch types under consideration.

Launches occurring between the hours of 9:00 am and 10:00 pm are grouped by:

- Crewed Expeditions from the KSC
- Cargo/Satellite launches from the KSC
- Cargo/Satellite launches from Cape Canaveral

To understand traffic trends on launch days two different measures were examined: traffic speed and traffic counts.

HERE Speed Data Analysis

HERE speed data was acquired from RITIS for years 2016-2020 in Brevard County. The median monthly hourly weekday speed was calculated for each roadway segment to use as a baseline comparison for traffic speeds occurring on launch days. Travel speeds for hours occurring three hours before, during, and three hours after each launch were averaged and compared to their respective average median monthly hourly weekday speed as percent difference.

Results in terms of average speeds are shown in the following figures:

- Crewed Expeditions from the KSC:
    1. 3 hours before and after crewed launches (**Figure 79)**
    2. 1 hour before and after crewed launches (**Figure 80**)
    3. 2 hours before and after crewed launches (**Figure 81**)

- Cargo/Satellite launches from the KSC:
    1. 3 hours before and after cargo/satellite launches (**Figure 82**)
    2. 1 hour before and after cargo/satellite launches (**Figure 83**)
    3. 2 hours before and after cargo/satellite launches (**Figure 84**)
- Cargo/Satellite launches from Cape Canaveral:
    1. 3 hours before and after cargo/satellite launches (**Figure 85**)
    2. 1 hour before and after cargo/satellite launches (**Figure 86**)

Figure 79 | *3 Hour Average Speed Before and After Crewed Launches*

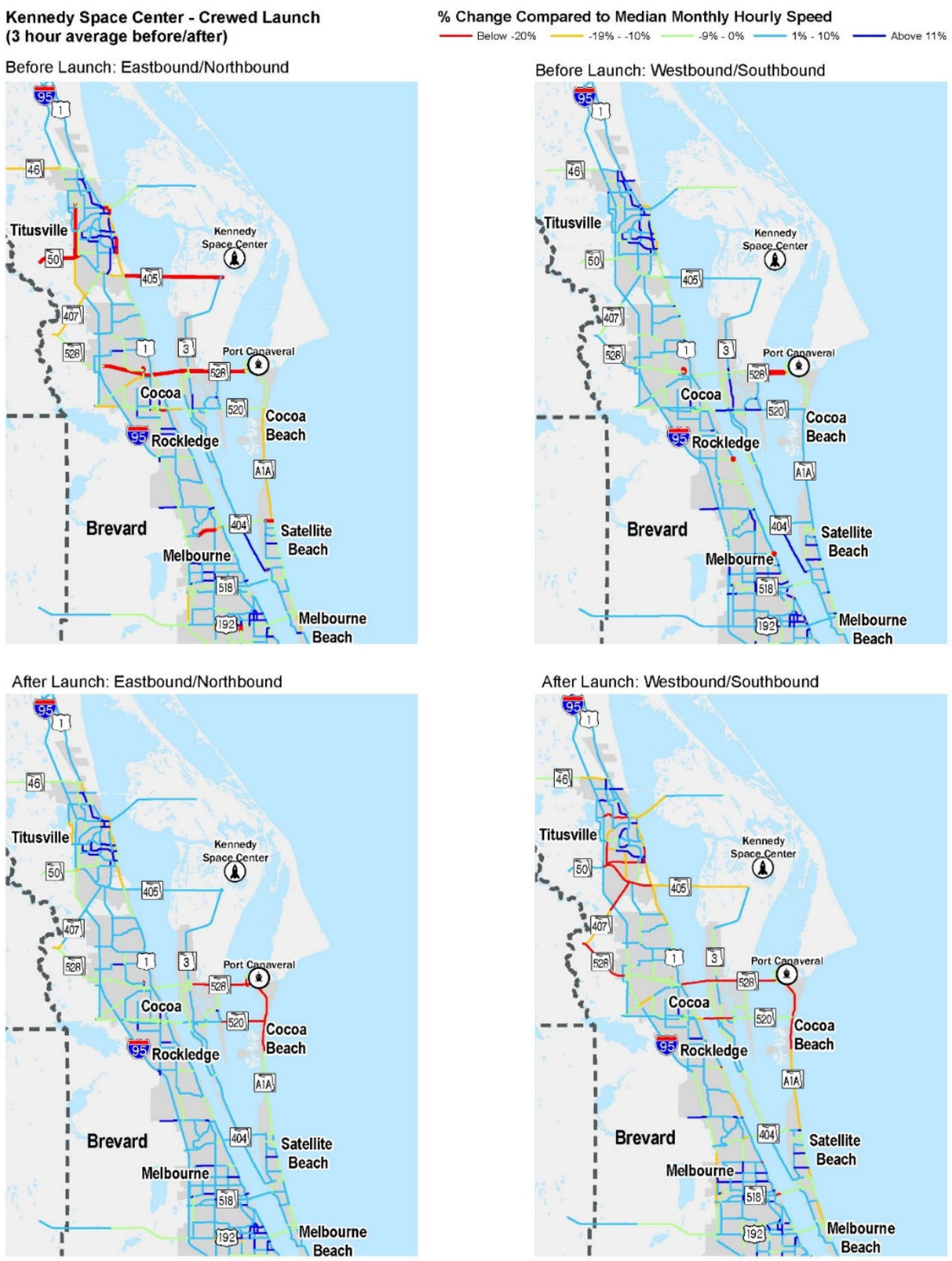


***Figure 80** | 1 Hour Before and After Crewed Launches*

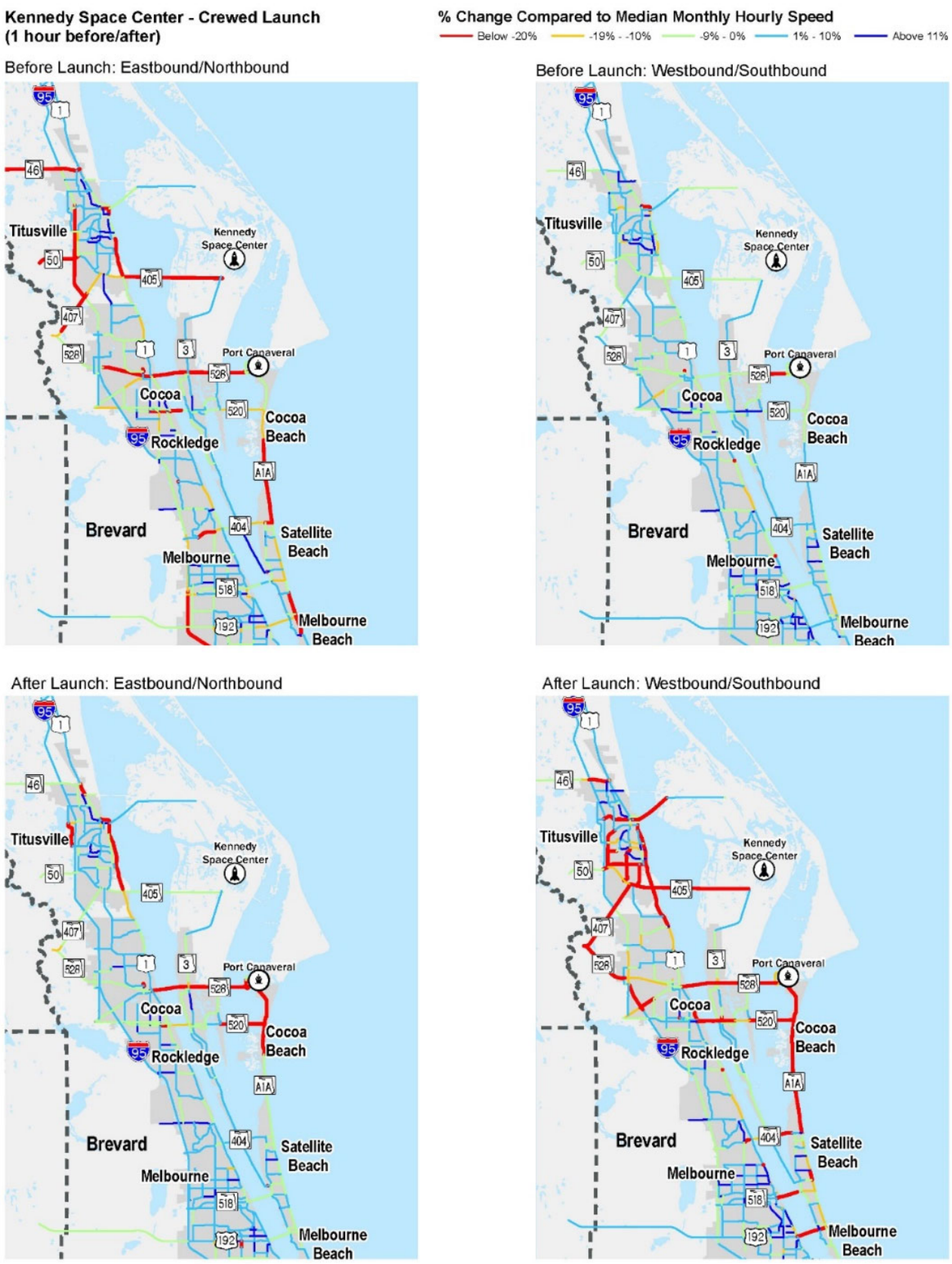


***Figure 81** | 2 Hours Before and After Crewed Launches*

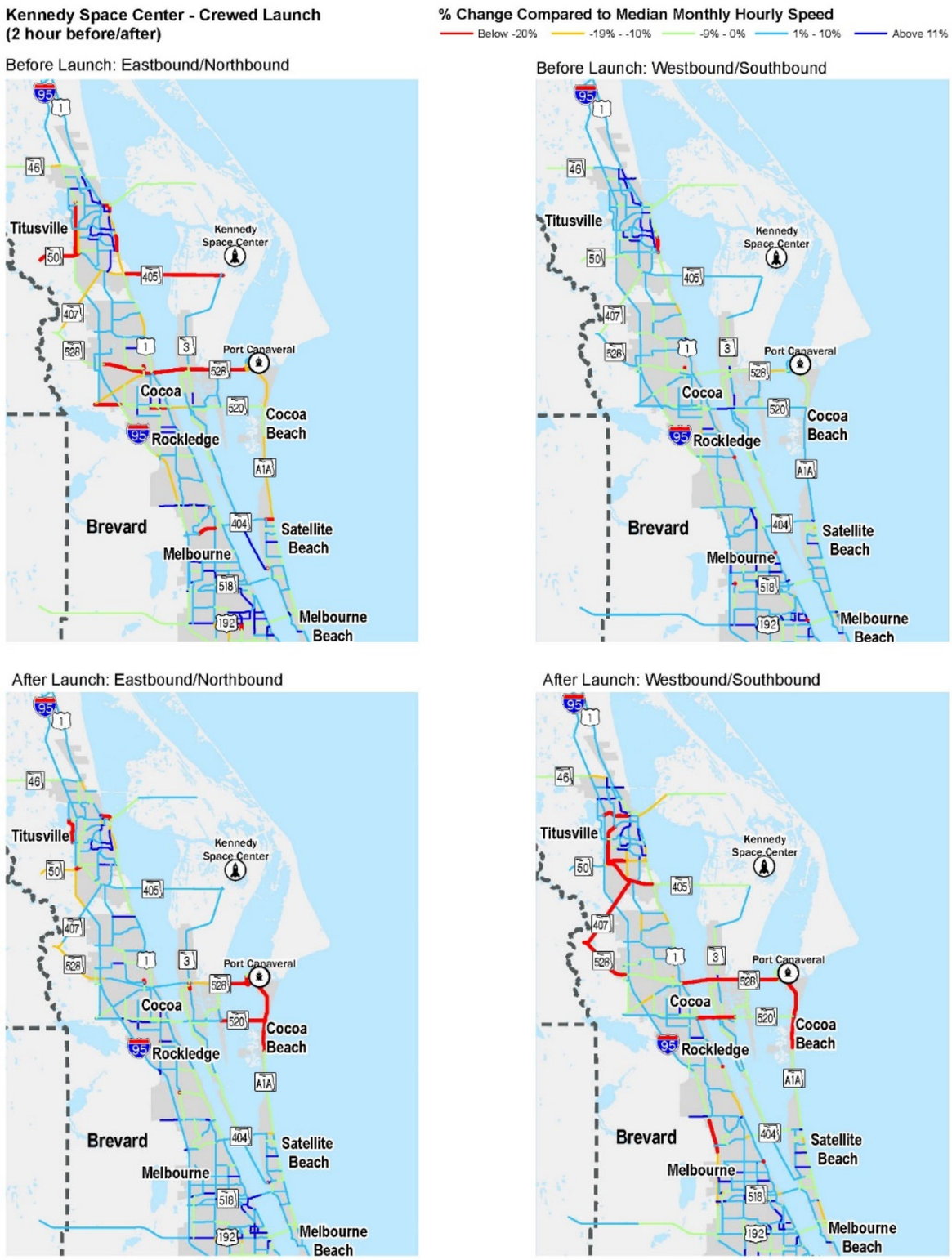


***Figure 82** | 3 Hour Average Speed Before and After Cargo/Satellite Launches*

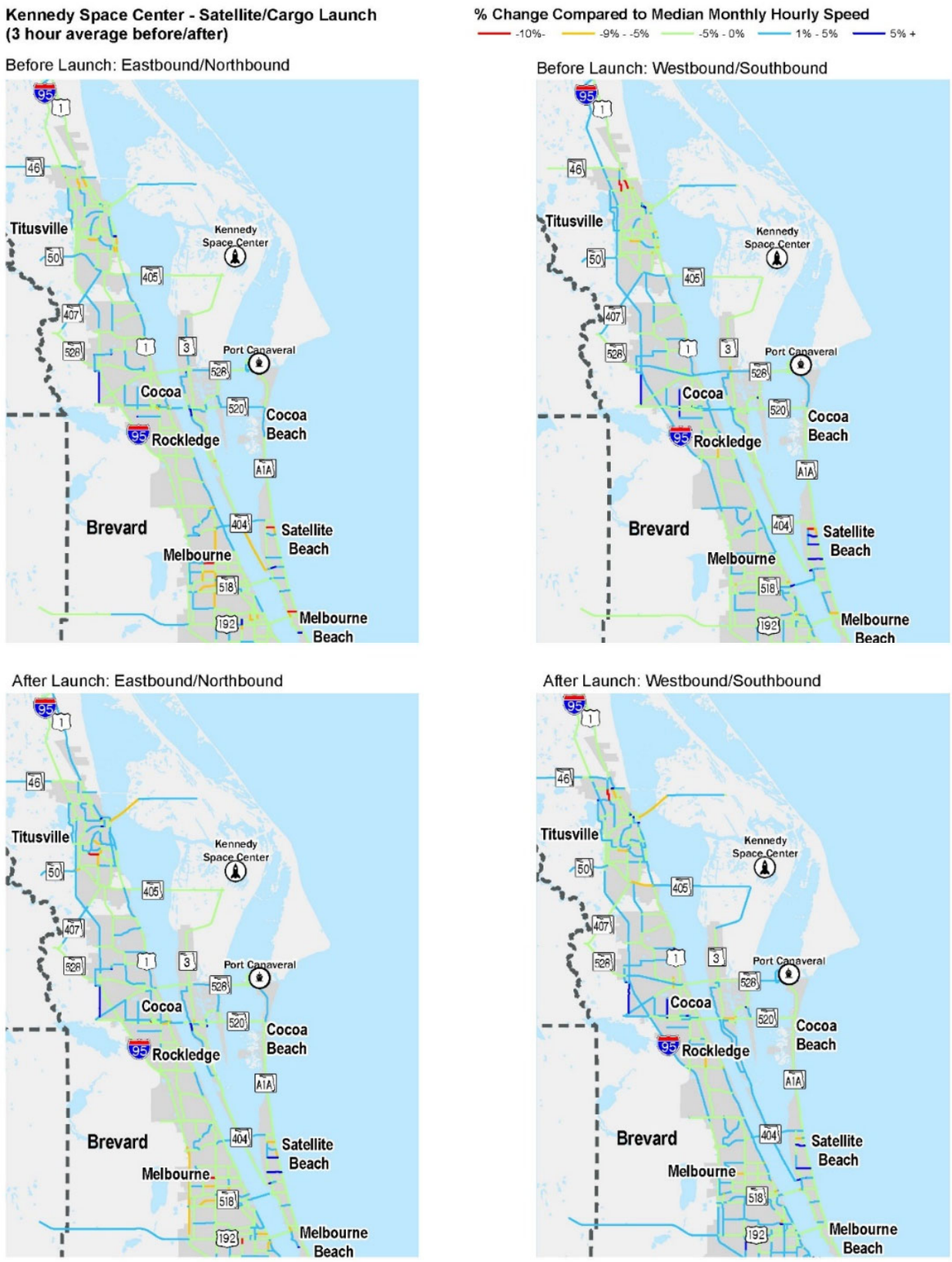


***Figure 83** | 1 Hour Before and After Cargo/Satellite Launches*

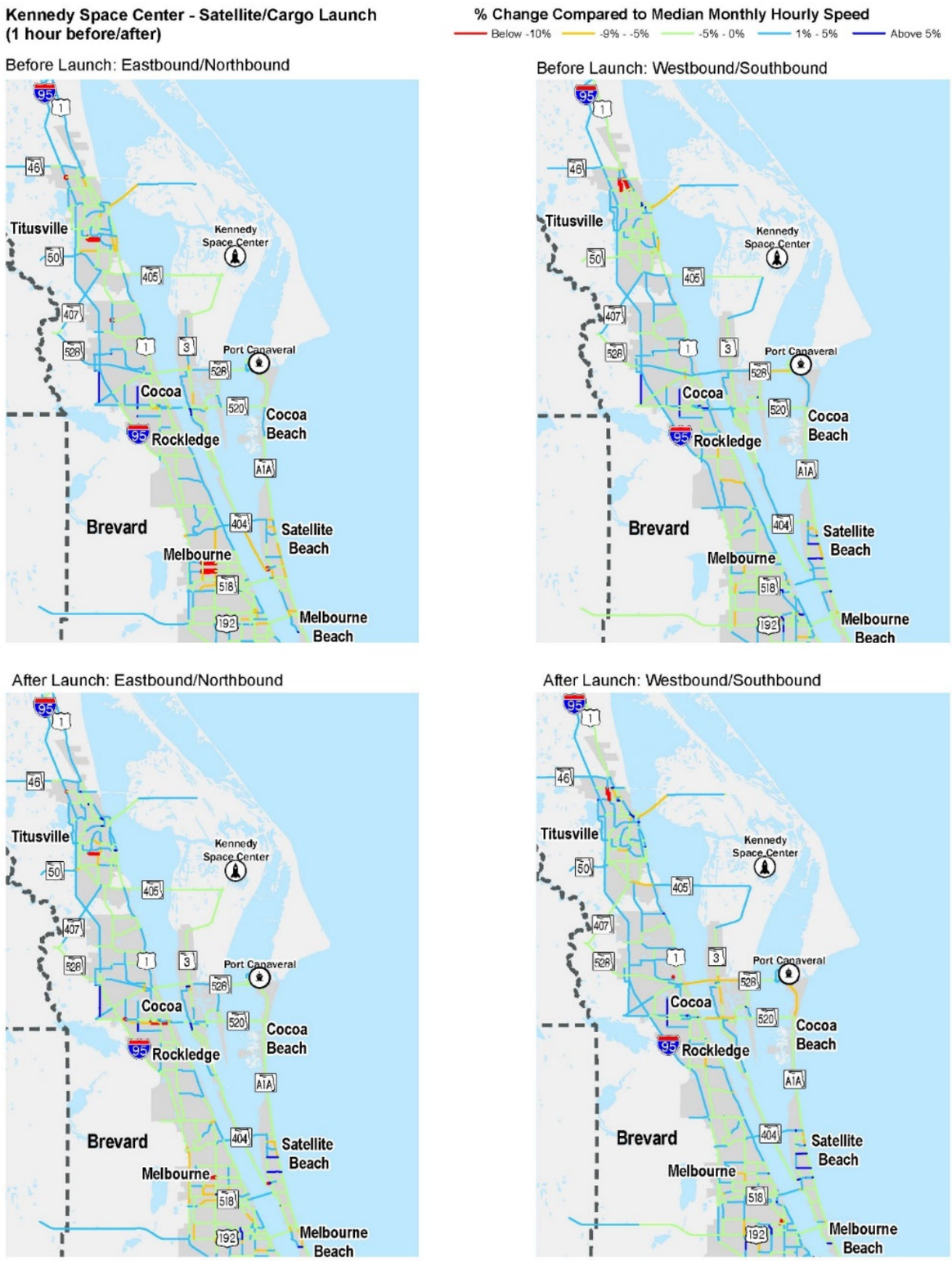


***Figure 84** | 2 Hours Before and After Cargo/Satellite Launches*

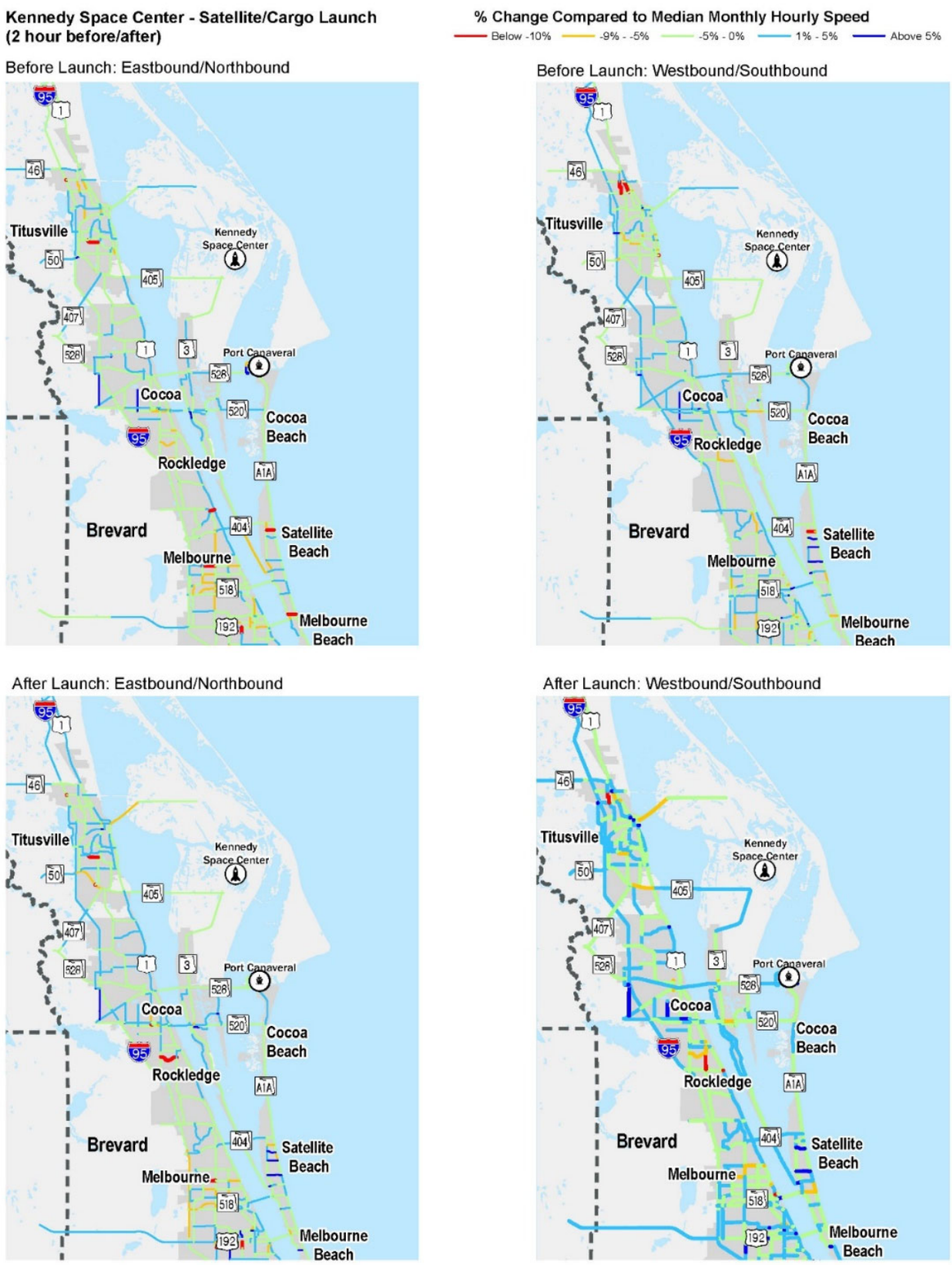


***Figure 85** | 3 Hour Average Speed Before and After Cargo/Satellite Launches*

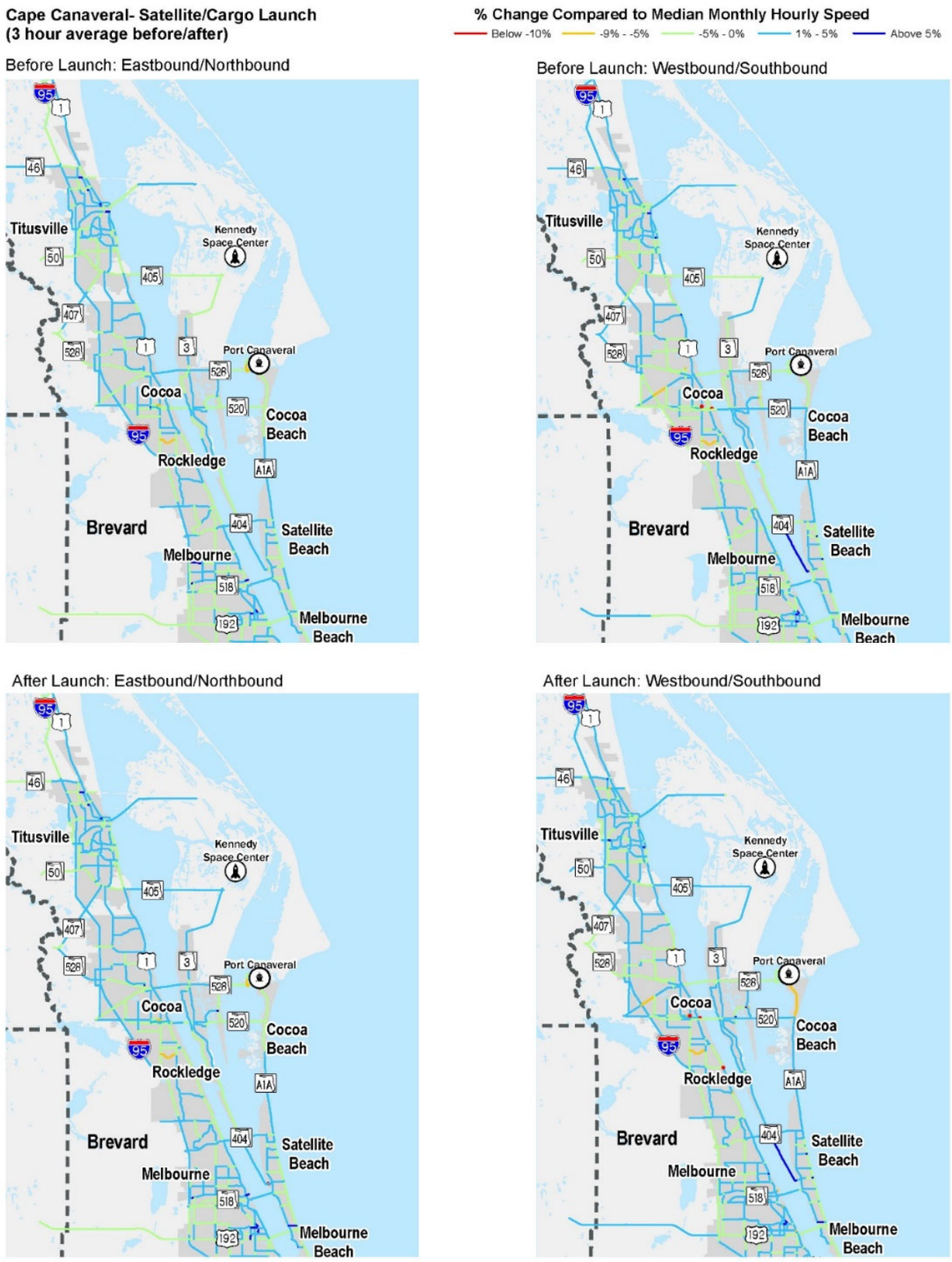
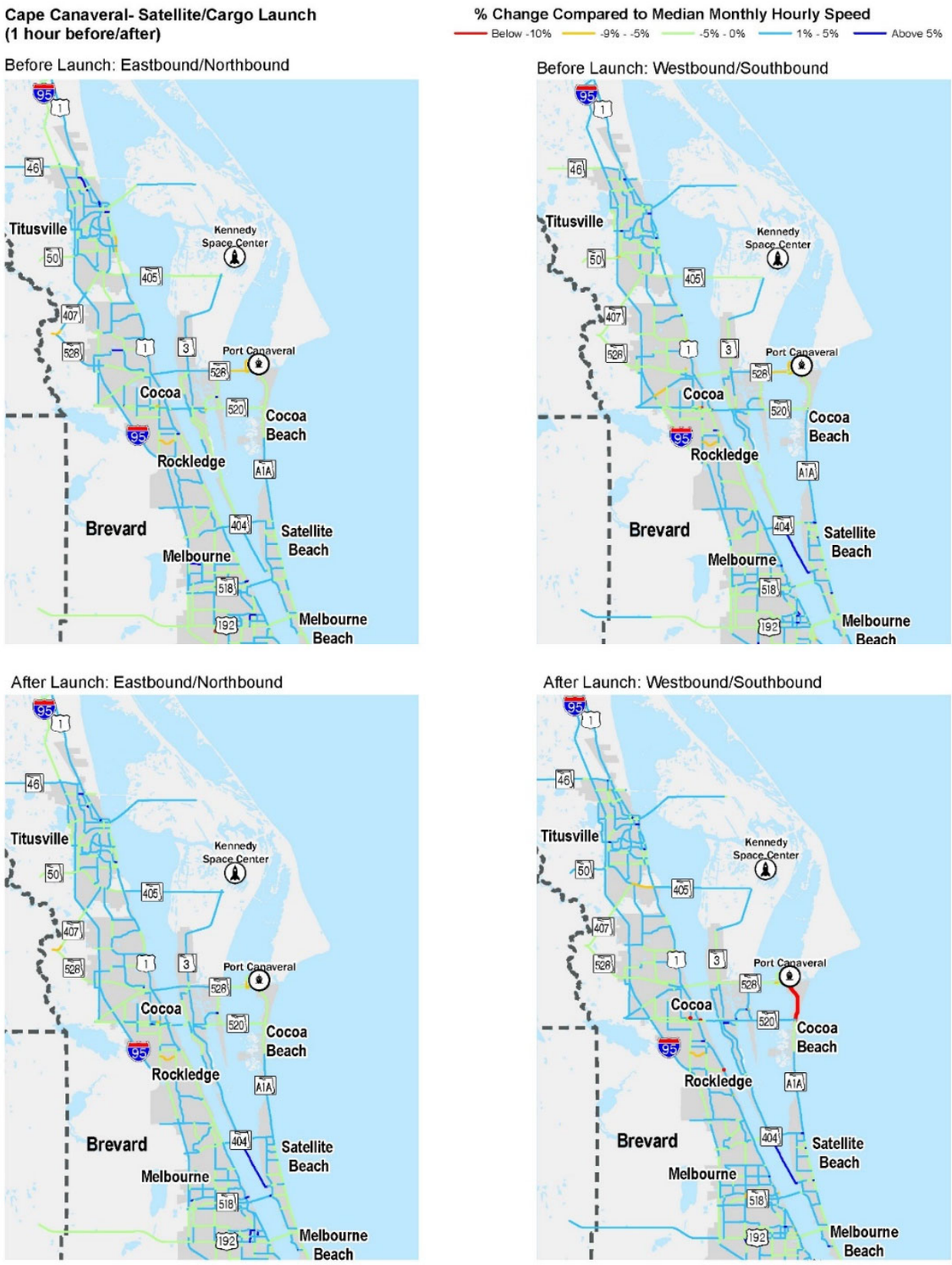


Figure 86 | *1 Hour Before and After Cargo/Satellite Launches*



FDOT Traffic Count Data Analysis

FDOT traffic count data was obtained for all Telemetered Traffic Monitoring Sites (TTMS) in Brevard County for years 2016-2020. The median monthly hourly count was calculated for each TTMS site to use as a baseline comparison for traffic counts occurring on launch days.

Results are shown in the following Figures/Graphs:

- Crewed Expeditions from the KSC
    1. Eastbound - Traffic counts compared to median monthly counts before and after crewed launches (**Figure 87**)
    2. Westbound - Traffic counts compared to median monthly counts before and after crewed launches (**Figure 88**)
    3. Map of TTMS Site Location within 1-3 Hours (average speed) before and after crewed launches (**Figure 89**)
- Cargo/Satellite launches from the KSC
    1. Eastbound - Traffic counts compared to median monthly counts before and after cargo/satellite launches (**Figure 90**)
    2. Westbound - Traffic counts compared to median monthly counts before and after cargo/satellite launches (**Figure 91**)
    3. Map of TTMS Site Location within 1-3 Hours (average speed) before and after cargo/satellite launches (**Figure 92**)
- Cargo/Satellite launches from Cape Canaveral
    1. Eastbound - Traffic counts compared to median monthly counts before and after cargo/satellite launches **(Figure 93**)
    2. Westbound - Traffic counts compared to median monthly counts before and after cargo/satellite launches (**Figure 94**)
    3. Map of TTMS Site Location within 1-3 Hours (average speed) before and after cargo/satellite launches (**Figure 95**)

Figure 87 | *Eastbound - Traffic Counts Compared to Median Monthly Counts Before and After Crewed Launches*

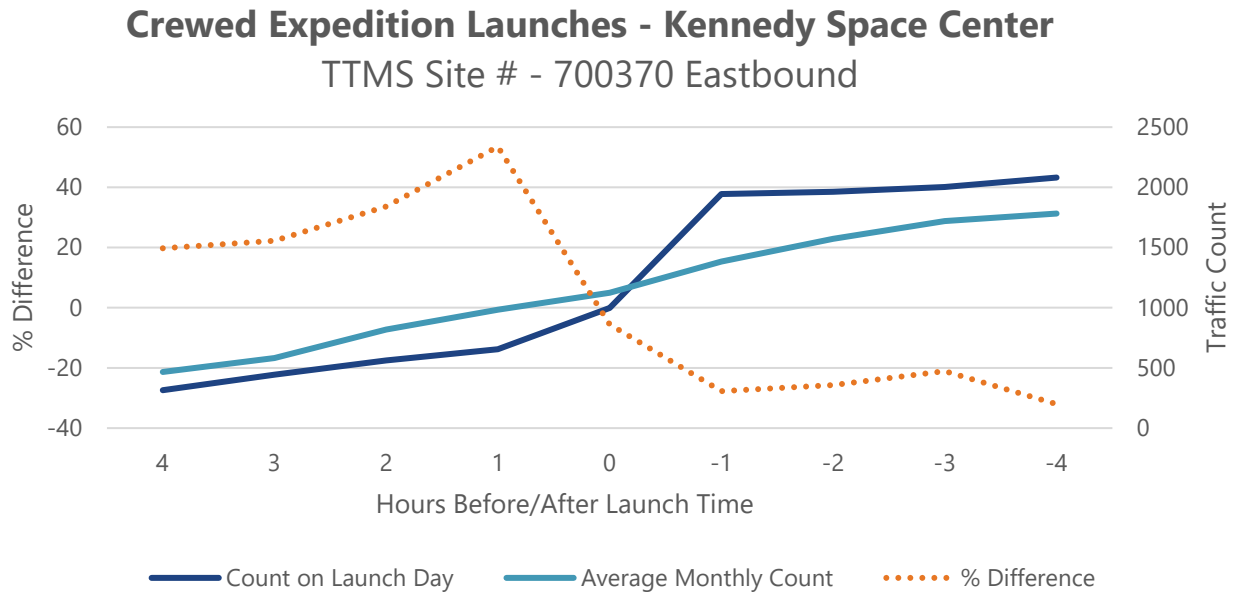


Figure 88 | *Westbound - Traffic Counts Compared to Median Monthly Counts Before and After Crewed Launches*

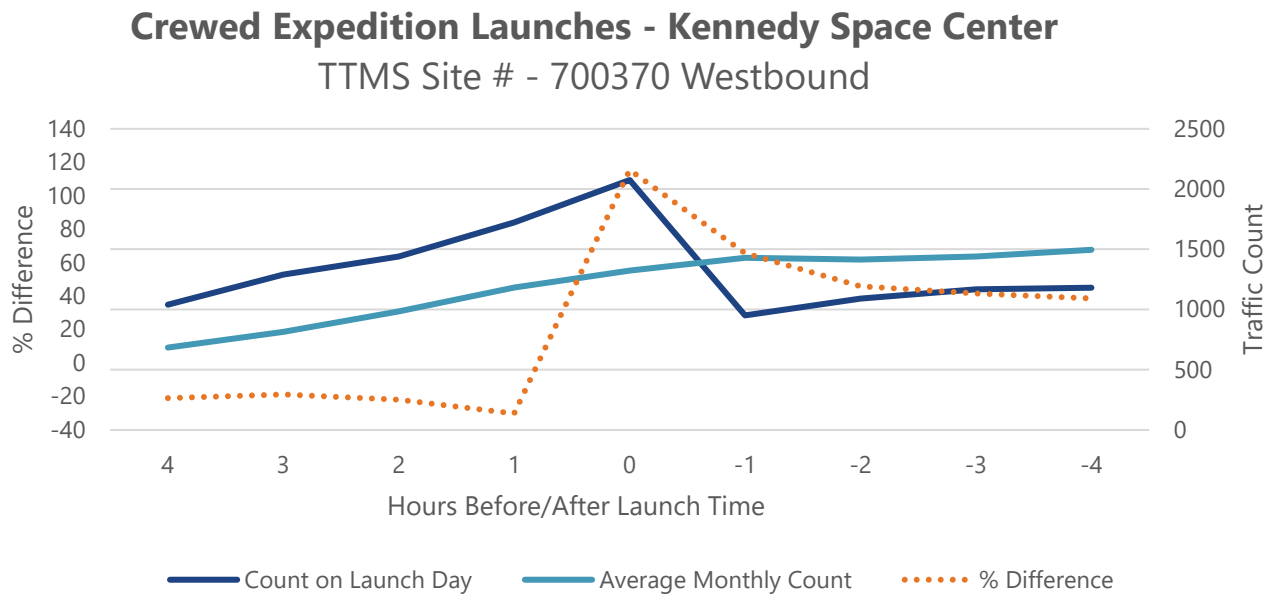


Figure 89 | *Map of TTMS Site Location within 1-3 Hours (Average Speed) Before and After Crewed Launches*

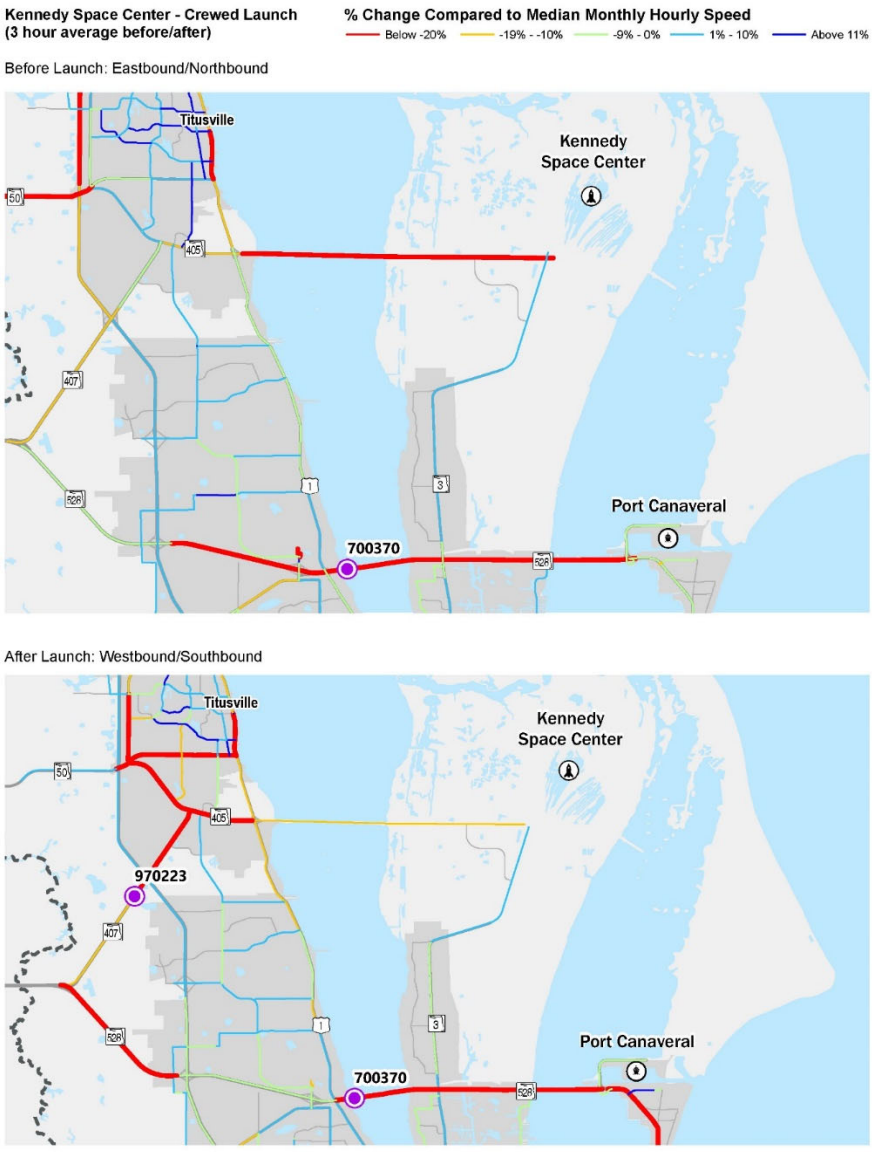


Figure 90 | *Eastbound - Traffic Counts Compared to Median Monthly Counts Before and After Cargo/Satellite Launches*

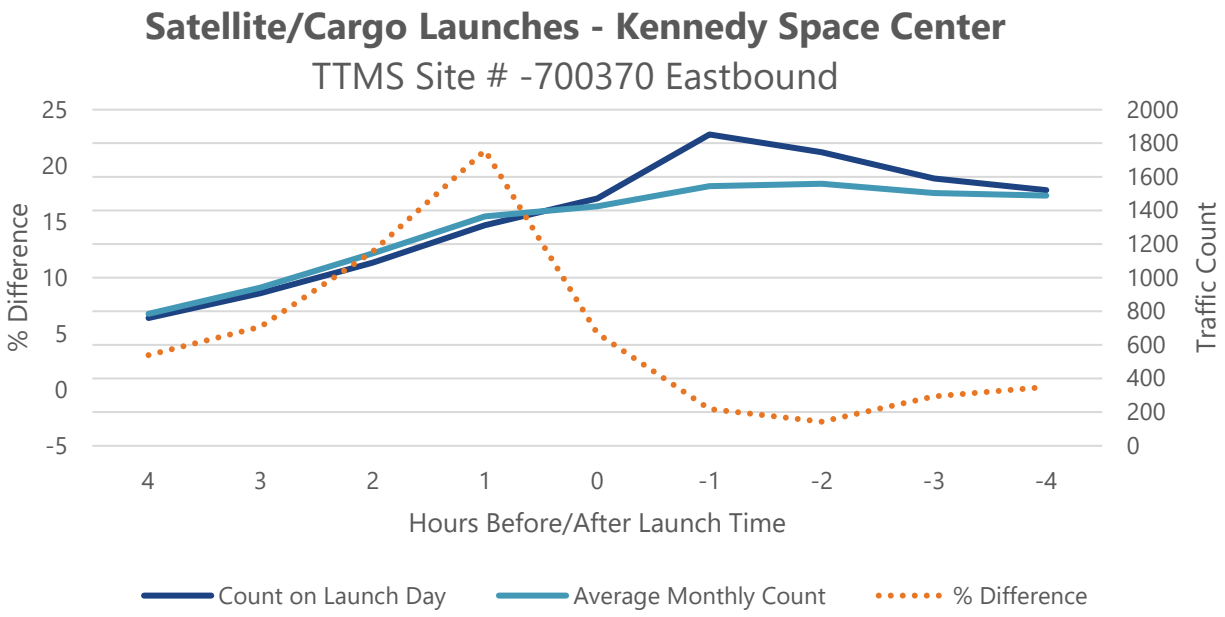


Figure 91 | *Westbound - Traffic Counts Compared to Median Monthly Counts Before and After Cargo/Satellite Launches*

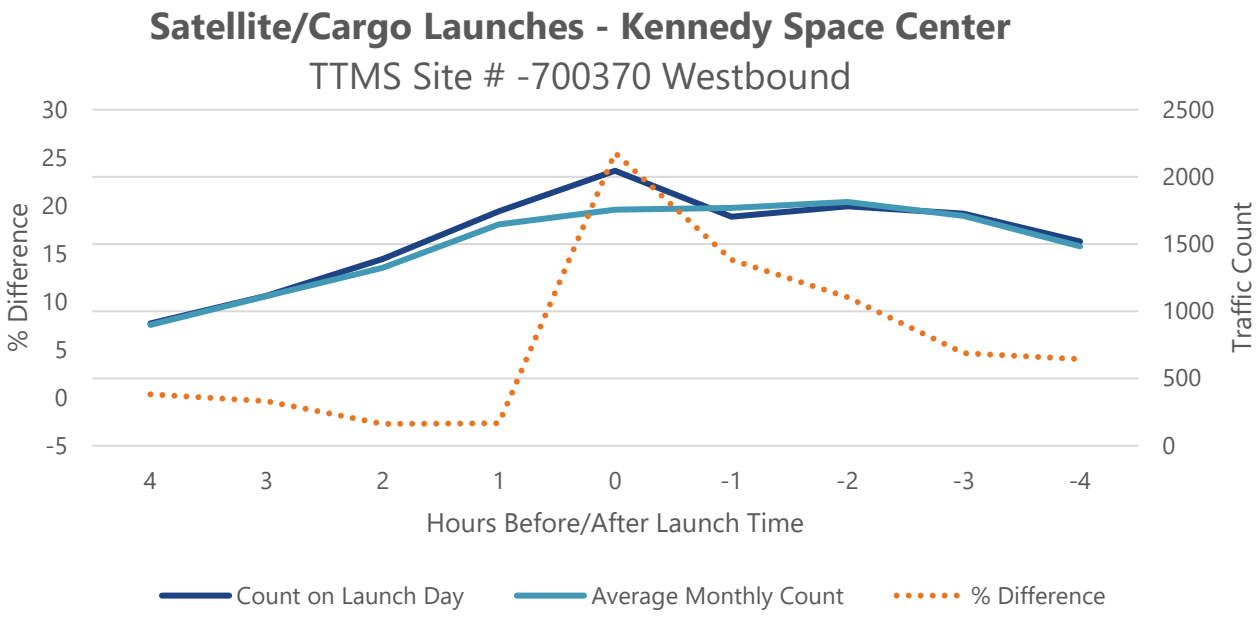


Figure 92 | *Map of TTMS Site Location within 1-3 Hours (Average Speed) Before and After Cargo/Satellite Launches*

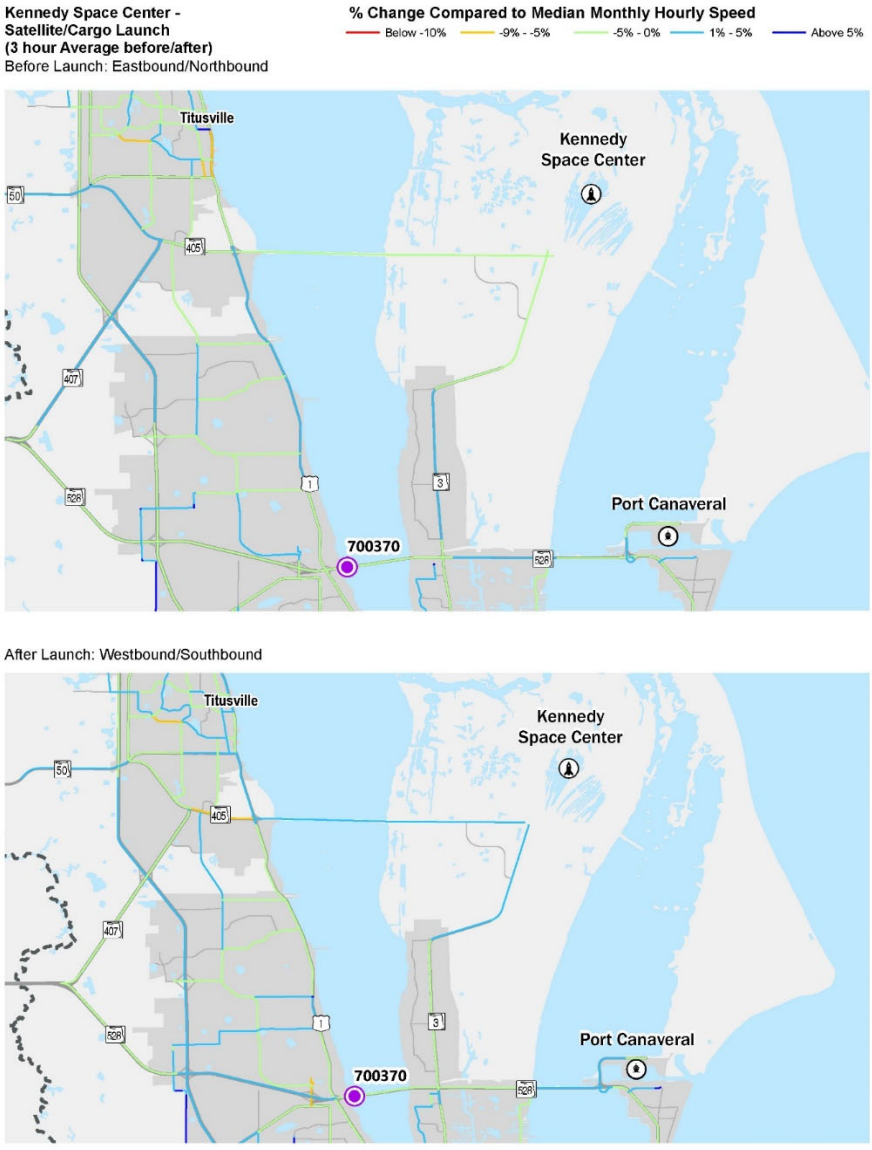


Figure 93 | *Eastbound - Traffic Counts Compared to Median Monthly Counts Before and After Cargo/Satellite Launches*

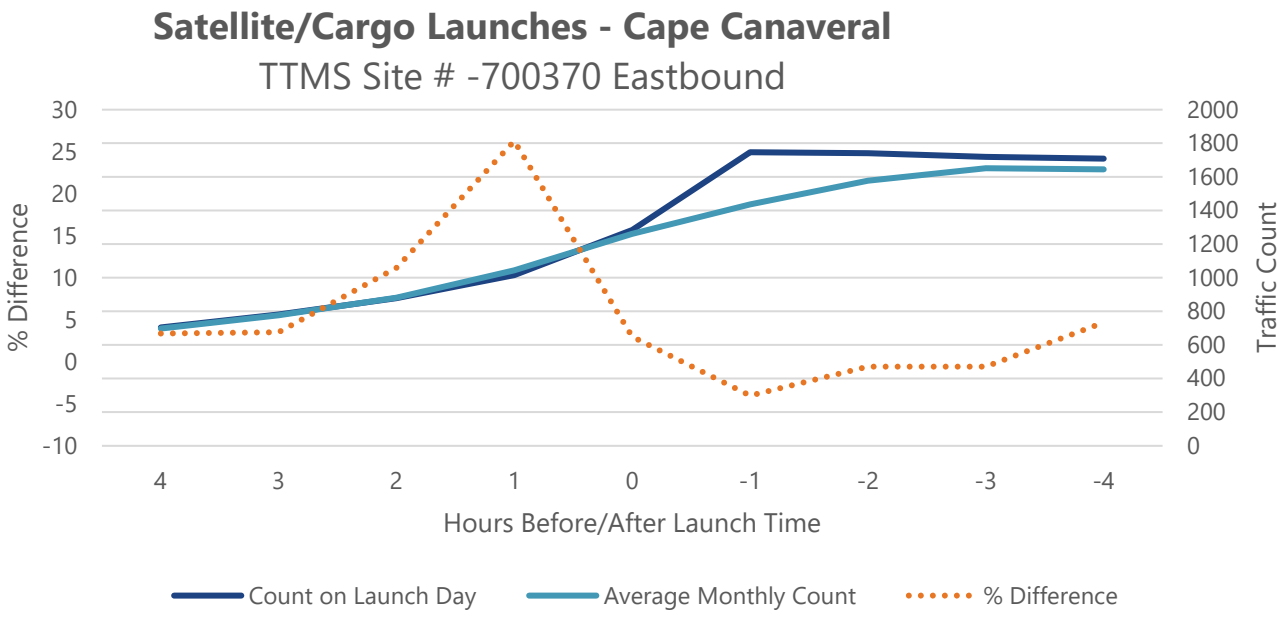


Figure 94 | *Westbound - Traffic Counts Compared to Median Monthly Counts Before and After Cargo/Satellite Launches*

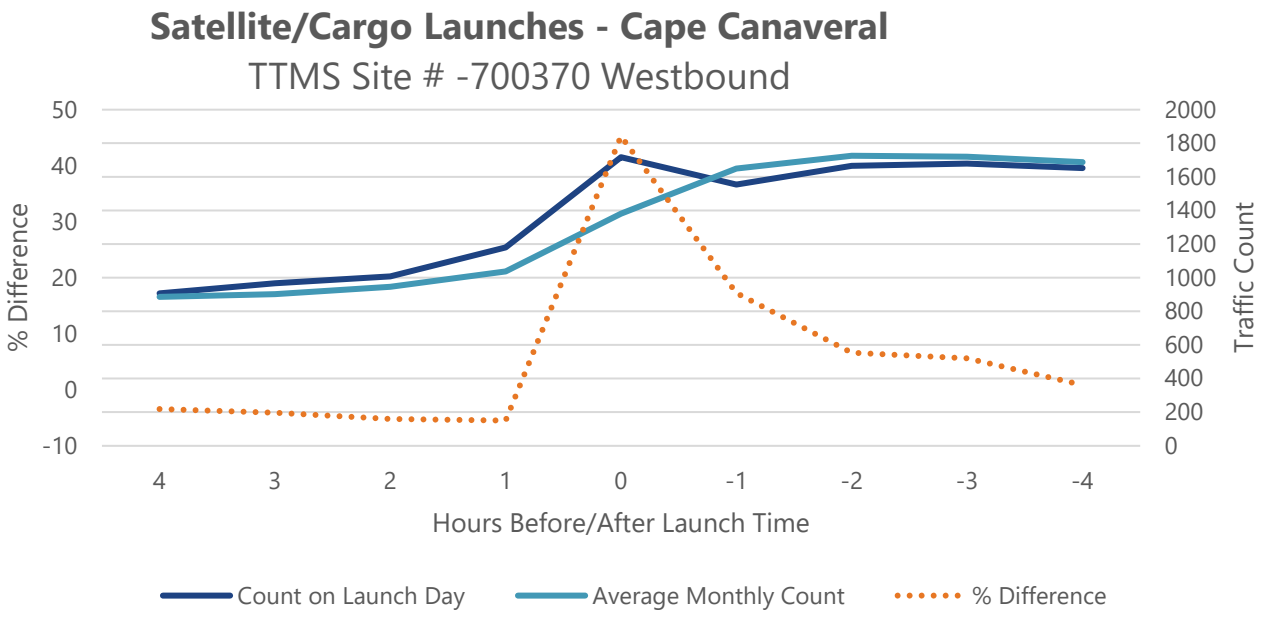
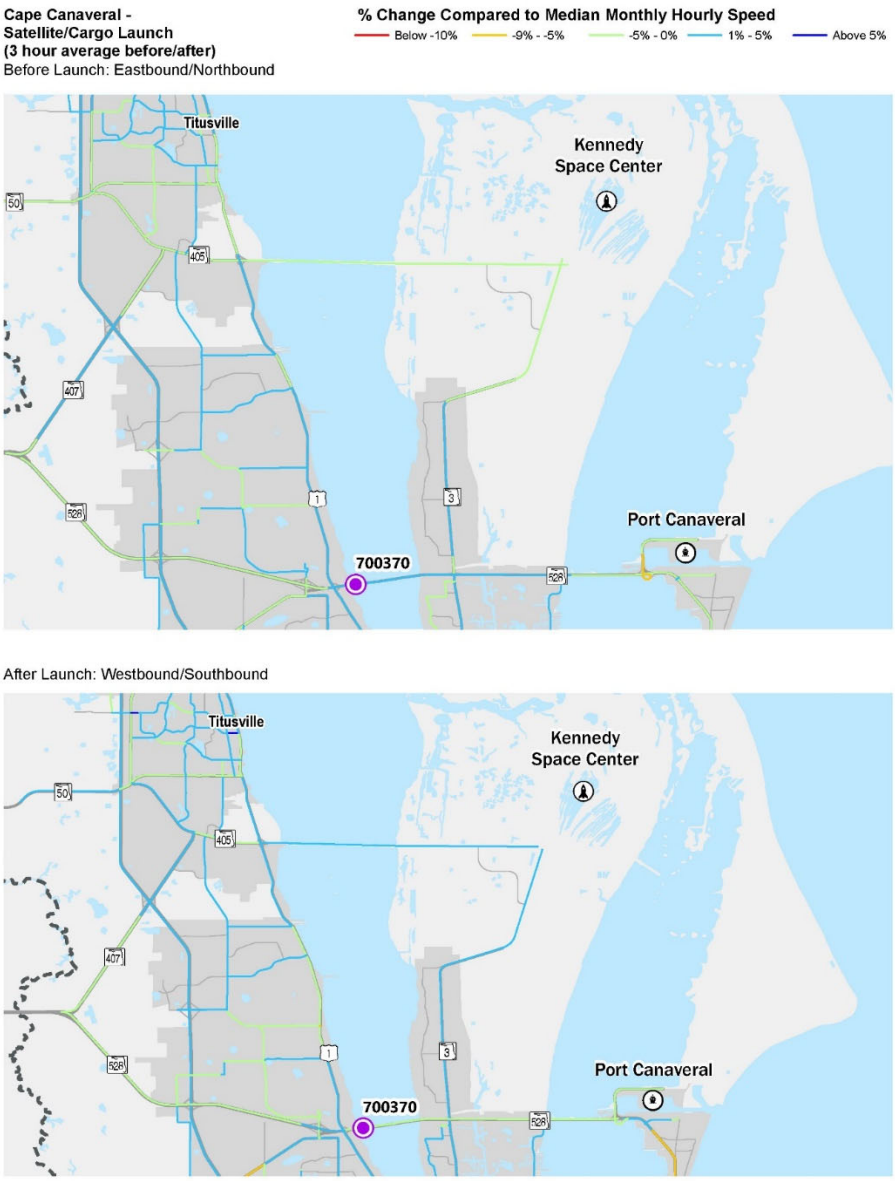


Figure 95 | *Map of TTMS Site Location within 1-3 Hours (Average Speed) Before and After Cargo/Satellite Launches*



Space Coast Launch and Cruise Traffic Impacts

A schedule of all cruise arrival and departure dates and times was acquired for the year 2019 and compared to 2019 space launch dates and times. Most space launches do not occur within the same time window of cruise arrival and departures. Of all the Space Coast launches that occurred in 2019, only one launch occurred on the same date and overlapped with cruise arrival and departures. This launch occurred on November 11, 2019 at 9:56 am. Four cruise ships were also scheduled to arrive and depart within the launch time window when traffic impacts are most likely to occur (**Table 17**).

Table 17 | *Schedule of Cruise Arrivals/Departures*

Date	Day	Terminal	Ship	Arrival Time	Departure Time	Cruise Line	Pax Capacity	Comments
Nov 11, 2019	Mon	CT8	Disney Dream	05:30	17:00	Disney	4,000	
Nov 11, 2019	Mon	CT6	Carnival Liberty	07:00	15:45	Carnival	2,980	
Nov 11, 2019	Mon	CT5	Carnival Elation	07:00	15:45	Carnival	2,052	
Nov 11, 2019	Mon	CT1	Anthem of the Seas	12:00	21:30	Royal Caribbean	4,180	Port of Call

Travel Speed Impacts

HERE speed data was acquired from RITIS for November 11, 2019 in Brevard County. The median monthly hourly weekday speed was calculated for each roadway segment to use as a baseline comparison for traffic speeds occurring on November 11, 2019. Travel speeds for hours occurring three hours before, during, and three hours after the satellite launch are compared to their respective average median monthly hourly weekday speed as percent difference. Results pertaining to average speed are shown in the following:

Satellite launch at Cape Canaveral on November 11, 2019 at 9:57 AM.

- 3 hours before and after satellite launch (**Figure 96**)
- 1 hour before and after satellite launch **(Figure 97**)
- 2 hours before and after satellite launch (**Figure 98**)

Figure 96 | *3 Hour Average Speed Before/After Satellite Launch on November 11, 2019*

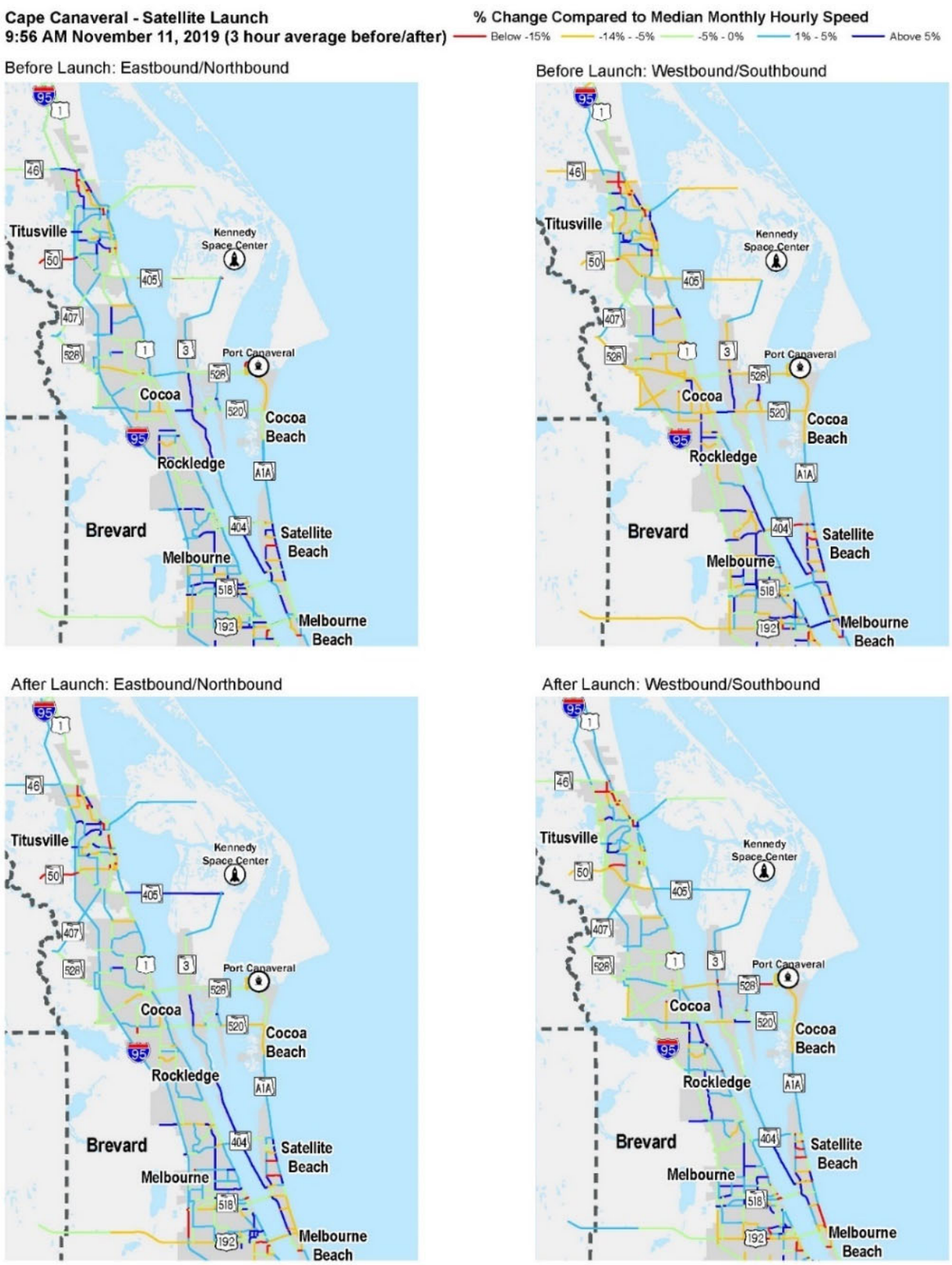


Figure 97 | *1 hour Before/After Satellite Launch on November 11, 2019*

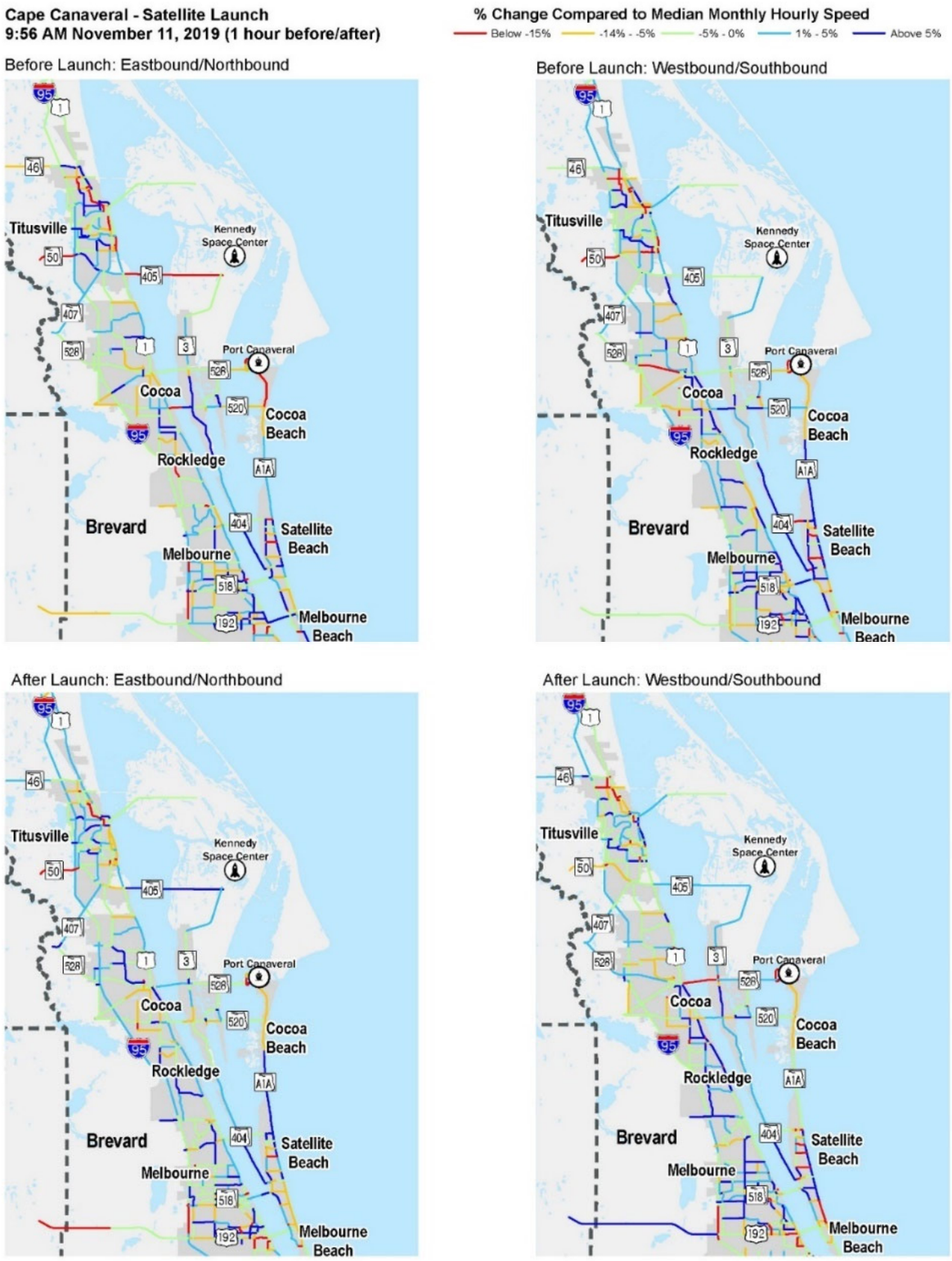
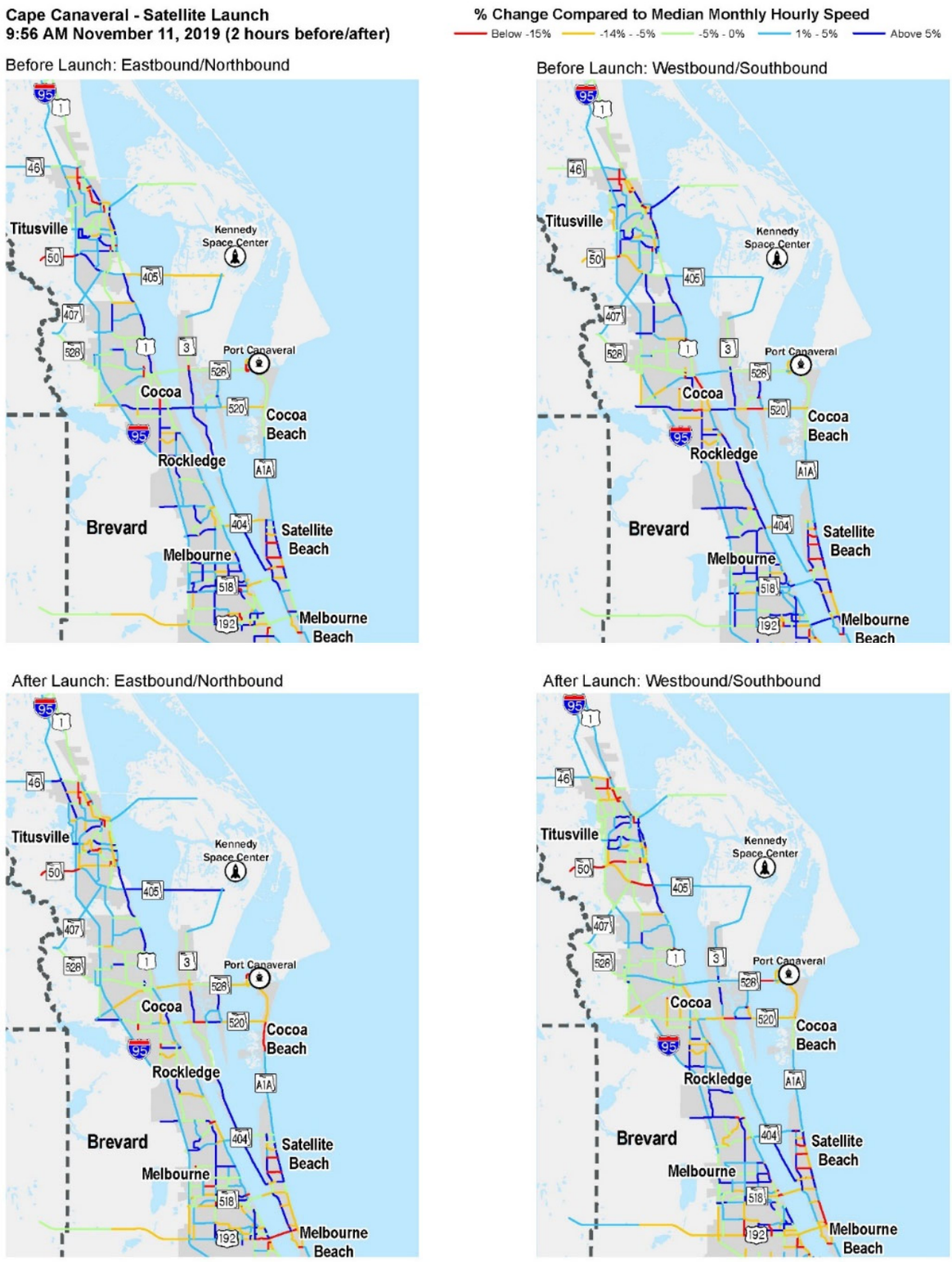


***Figure 98** | 2 hours Before/After Satellite Launch on November 11, 2019*



Traffic Count Impacts

FDOT traffic count data was obtained for TTMS site #700370 in Brevard County stationed on SR 528/SR A1A for November 11, 2019. The median monthly hourly count was calculated for TTMS site #700370 to use as a baseline comparison for traffic counts occurring on November 11, 2019.

Results are shown in the following Figures/Graphs:

- Satellite launch at Cape Canaveral on November 11, 2019 at 9:57 am.
    1. Eastbound - Traffic counts compared to median monthly counts before and after satellite launch (**Figure 99**)
    2. Westbound - Traffic counts compared to median monthly counts before and after the satellite launch (**Figure 100**)
- Map of TTMS Site Location within 1-3 Hours (average speed) before and after the satellite launch (**Figure 101**)

Figure 99 | *Eastbound- Traffic Counts Compared to Median Monthly Counts Before and After Satellite Launch*

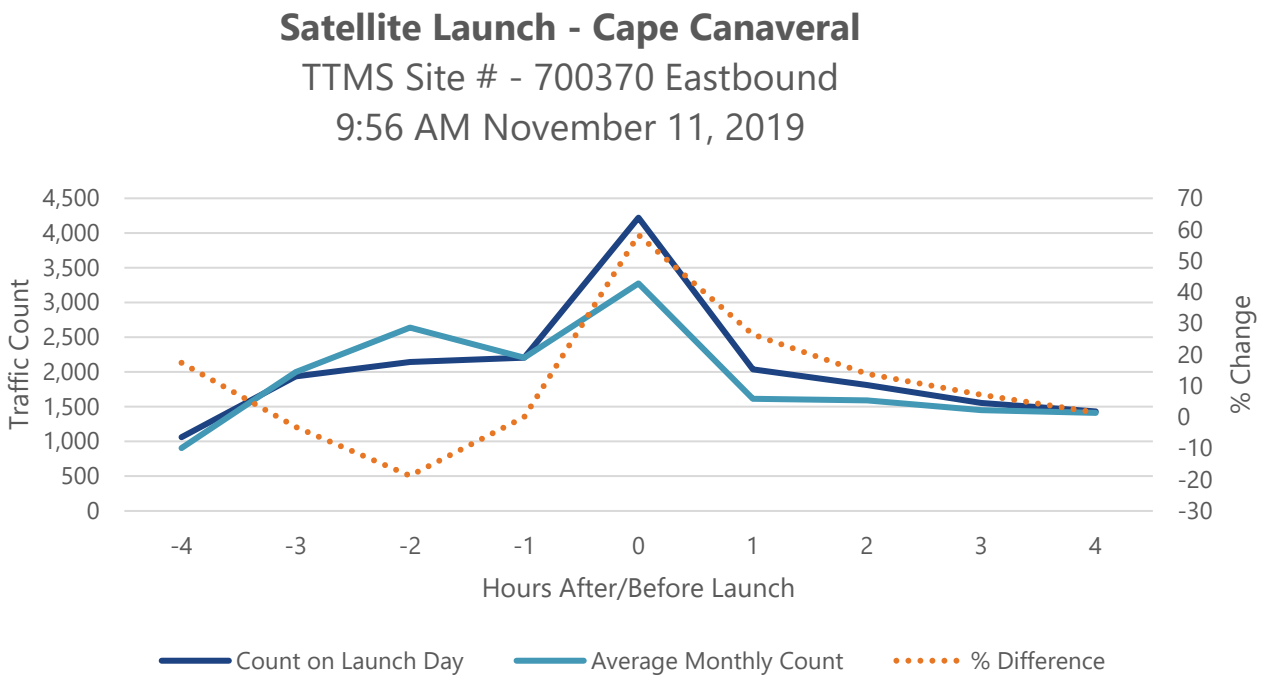


***Figure 100** | Westbound – Traffic Counts Compared to Median Monthly Counts Before and After Satellite Launch*

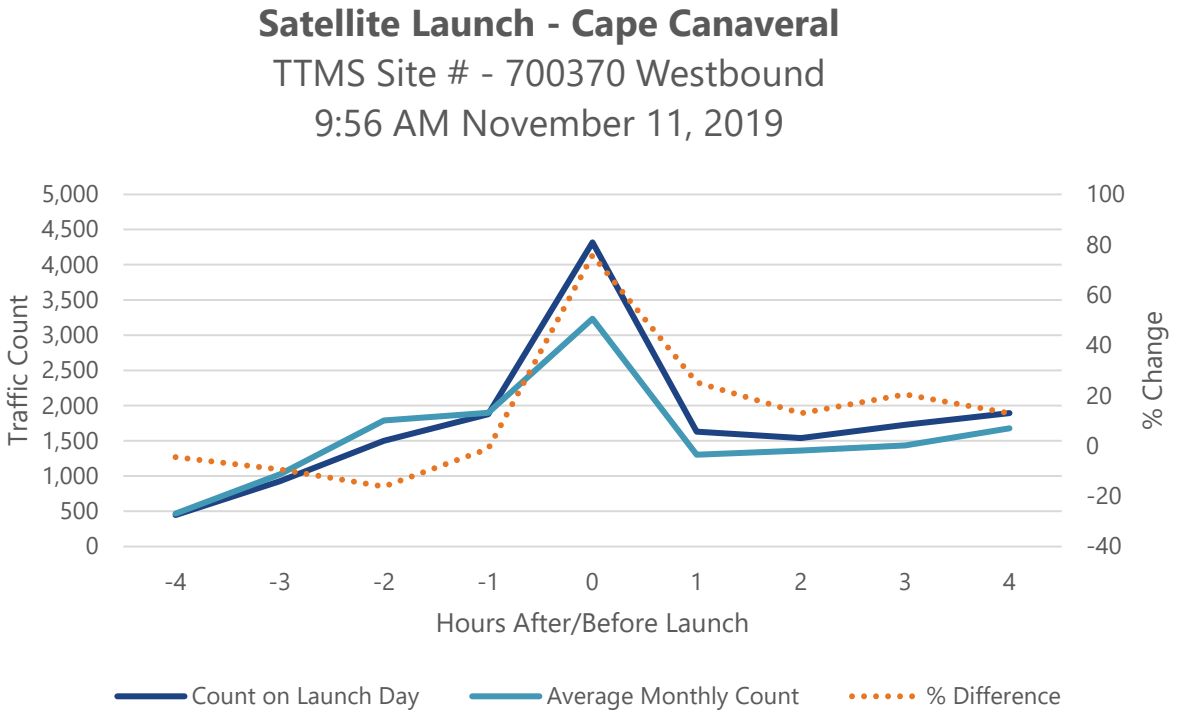
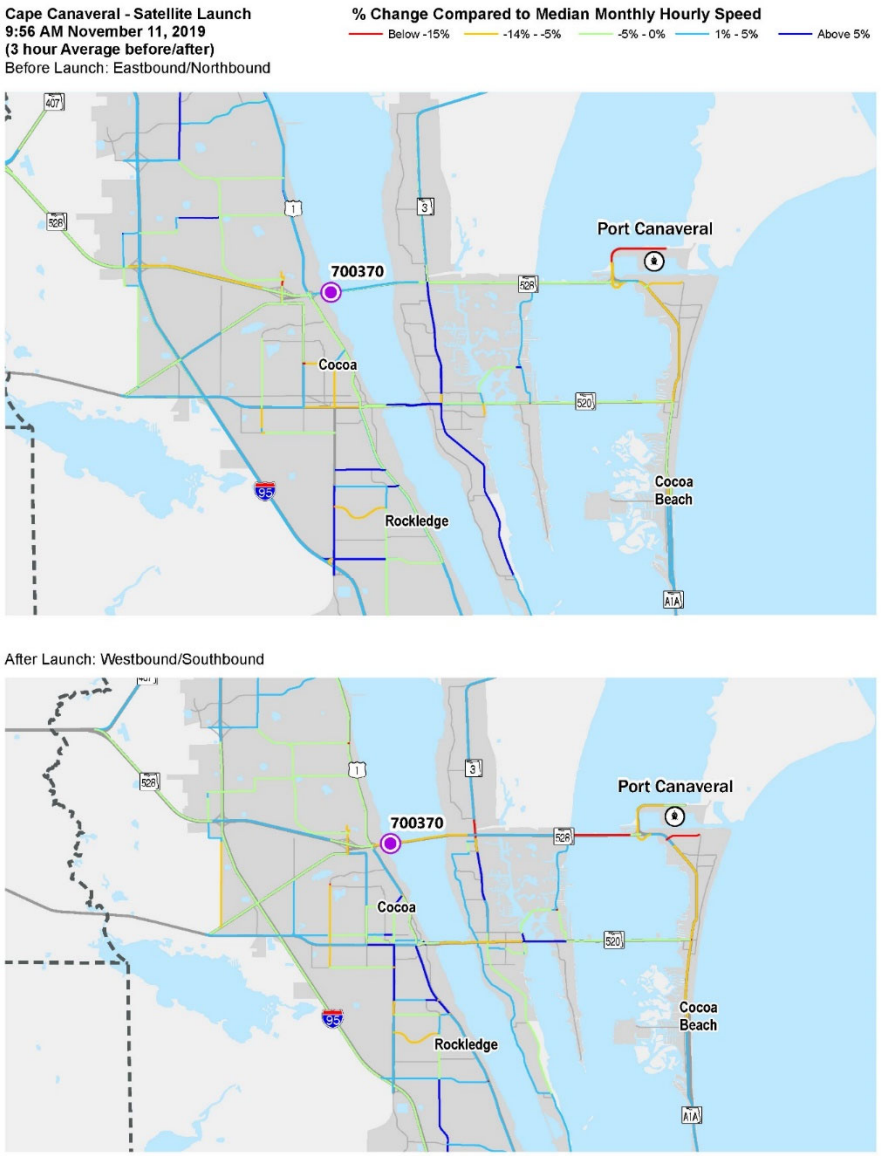


Figure 101 | *Map of TTMS Site Location within 1-3 Hours (average speed) Before and After the Satellite Launch*



Discussion and Conclusion

This analysis examined traffic trends surrounding space launches that occur at Cape Canaveral and KSC. Effects on typical traffic speeds and traffic counts were examined under four different scenarios:

- Crewed Expeditions from the KSC;
- Cargo/Satellite launches from the KSC;
- Cargo/Satellite launches from Cape Canaveral; and
- Satellite launch from Cape Canaveral where cruise arrivals/departures overlap.

Launch days with crewed expeditions from the KSC had the biggest impact on traffic speeds and traffic counts. Within one hour before and after the launch time traffic speeds decreased on many roads close to the launch site by at least 20 percent. Traffic counts heading to the launch site an hour before launch time increased almost 50 percent compared to the monthly average, and traffic counts heading away from the launch site increased approximately 100 percent an hour after the launch time.

Alternatively, launch days with cargo and satellite launches from Cape Canaveral and KSC did not seem to have an impact on traffic speeds close to the launch sites. Traffic counts did increase before and after these launches, but the increase in traffic appears to not have been enough to have a discernable impact on traffic congestion in the area.

Lastly, traffic impacts on a day when a satellite launch is scheduled during the same time that multiple cruise arrivals and departures are scheduled was reviewed. Traffic speeds heading towards the launch site an hour before the launch time decreased by at least 15 percent compared to the monthly average. Traffic speeds heading away from the launch site an hour after the launch time do not appear to have decreased significantly. Alternatively, traffic counts an hour before and after the launch time leading to and from the launch site increased more than 60 percent compared to the monthly average traffic count.

Based on the analysis, launch days with crewed expeditions have the largest impact on traffic speeds and counts in the area, as shown in **Table 18**. It should be noted that these crewed expeditions occurred during the COVID-19 pandemic, and traffic counts have been lower and travel speeds higher during this time. If a crewed launch were to occur during regular traffic conditions, there could be a

larger impact on traffic speeds resulting in traffic bottlenecks throughout the area. Additionally, if a crewed launch were to occur on the same day as the scheduled arrival and departure of cruise lines this could also have an impact on traffic congestion in the area. Coordination among the cruise lines and those responsible for the scheduling of space launches should be considered to prevent unnecessary traffic congestion.

Table 18 | *Percent of Roadway Network Impacted by Crewed Launches*

Direction	Before Launch	After Launch
Percentage of Roadways that Experienced >=20% Decrease in Average Speeds (3 Hour Average Before/After Launch)		
Eastbound and Northbound	4.94%	2.56%
Westbound and Southbound	0.53%	5.56%
Percentage of Roadways that Experienced >=20% Decrease in Average Speeds (1 Hour Average Before/After Launch)		
Eastbound and Northbound	10.49%	4.68%
Westbound and Southbound	0.64%	13.75%

OVERSIZED AND OVERWEIGHT CARGO

Transport of Large Rocket (Source: NASA)

This chapter outlines how the current multimodal transportation system supports oversized/overweight (OS/OW) movements. The ability of the system to facilitate these movements is critical to the long-term growth of the space industry. More space travel will require more frequent large rockets, space vehicles, and satellites traversing through the multimodal system.

Transport of NASA Materials to Astrotech (Source: NASA)

*When Is an OS/OW Permit Required? **

An OS/OW permit is required to move a vehicle or combination of vehicles of a size or weight exceeding the maximum size or weight established by law over state highways. Except for exempt vehicles, any vehicle which exceeds the following size or weight limitations will need a permit:

1. Maximum **width** of vehicle or vehicle combination and load exceeds 102" or exceeds 96" on less than 12' wide travel lane.
2. Maximum **height** of vehicle or vehicle combination and load exceeds 13'6" or 14' for automobile transporters.
3. Maximum **length** of:
   - *A. Single-unit vehicle exceeds 40';*
   - *B. Truck tractor with semi-trailer which exceeds 48' with a kingpin distance which exceeds 41', measured from the center of the rear axle, or group of axles, to the center of the kingpin of the fifth wheel connection;*
   - *C. Straight truck with trailer when the combination exceeds 68';*
   - *D. Truck tractors hauling automobiles with semi-trailer exceeding 50' as a qualifying auto transporter (able to transport automobiles on the power unit) when the exceptions in Florida Statutes 315.515 are exceeded; and*
   - *E. Front end overhang exceeds 3'.*
4. Gross **weight** of vehicle or vehicle combination and load exceeds the legal limits established in Florida Statutes 316.535.

*Source: https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/maintenance/str/owodp/when-do-you-need-a-permit.pdf?sfvrsn=45e8edf1_0 * See Florida State 316.515 for further information.*

Current OS/OW Modal Options

Commercial Truck Transportation

The state of OS/OW movements in the study area are summarized below.

Oversize/Overweight Criteria

The FDOT Office of Maintenance issues OS/OW permits for all state highways and roadways. There are two types of OS/OW permits:

1. A trip-specific permit covers a move from a single point of origin to a single destination, allowing the hauler ten days to make the trip; and
2. A blanket permit covers multiple trips for a period not to exceed 12 months (but for comparable cargo).[176]

The OS/OW routes designated by FDOT include SR 528 from Orlando to Cape Canaveral, and SR 407 from SR 528 to I 95. It is currently unclear if SR 407 from I-95 to SR 405 is rated for overweight loads. However, the SR 405 bridge over the Indian River is currently limited to 80,000 pounds.[177]

NASA has procedural guidelines defining OS/OW transportation to include “non-routine shipments that require special consideration and transportation planning involving transportability factors and one or more of the following:

[176] https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/maintenance/str/owodp/when-do-you-need-a-permit.pdf?sfvrsn=45e8edf1_0
[177] https://tdglobal.ksc.nasa.gov/servlet/sm.web.Fetch/KNPR_6000.1__Rev__B_FINAL_Released.pdf?rhid=1000&did=7248&type=released.

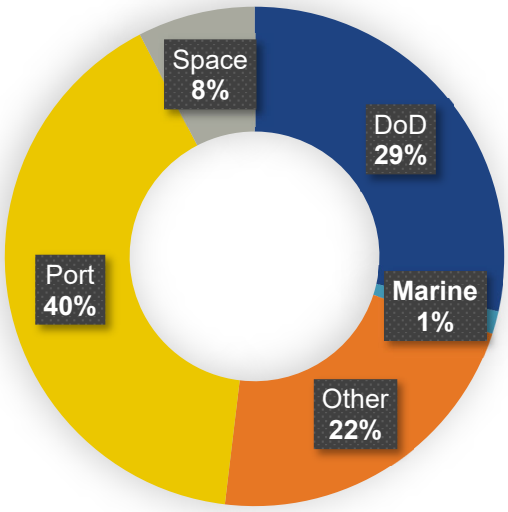
1. Special permits required for shipments scheduled to move over the open highways;
2. Freight exceeding the dimensions or weights prescribed in the Railway Equipment Register and Railway Line Clearance; and
3. Cargo that must move via marine or air modes due to transit time limitations, item configuration, or environmental requirements that do not permit the use of other modes.[178]

Current OS/OW Movements

A database of 3,600 permitted moves (2015-2020) was reviewed for industry, local origins and/or destinations, and last-mile corridors. Most moves were port-related followed by Department of Defense (DoD) facilities. **Figure 102** shows the share of OS/OW (truck) cargo by industry/facility type.

Most of the moves originated from or were destined for CCAFS, followed by Cape Canaveral (proper).[179] The third greatest number of OS/OW movements originated at or were destined for the North Cargo Area in Port Canaveral, while the fourth greatest number of moves originated at or were destined for the South Intermodal Area. **Table 19** shows the number of moves during 2015 to 2020.

Figure 102 | *Industry Share of OS/OW (Source: FDOT)*



[178] https://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PR_6200_001D_&page_name=AppendixA&search_term=oversize.
[179] Note that database corrections assumed moves starting or ending on SR-401 adjacent to Port Canaveral's liquid bulk tanks were port-related.

***Table 19** | Number of Moves per Origin/Destination*

Origin/Destination	2015-2020 Trips
Cape Canaveral Air Force Station	886
Cape Canaveral (Proper)	781
North Cargo Area	743
South Intermodal Area	295
Marina District	171
Port Commercial Tenant (Magellan Rd.)	112
Cape Canaveral Pass & ID Building	86
North Cruise Terminals	72
Blue Origin	53
Port Canaveral (Tank Farm)	49
United Launch Alliance (Int'l Warehouse)	44
Kennedy Space Center	30
Port Canaveral (South) - Other	28
Army Transportation Wharf	19
SpaceX	18
Port Canaveral Admin Bldg.	18
Port Commercial Tenant Facility (Atlantis Rd.)	17
Port Maintenance Facility (South)	15
Interagency Maritime Ops Ctr.	14
Patrick Air Force Base	11
Cape Canaveral Air Force Station (Space Launch Complex 40)	11
Canaveral Container Terminal	11
The Cove	10
Rodney Ketcham Park	10
Cruise Terminal 1	9
Martin Marietta (Port Canaveral Terminal - South)	8
U.S. Coast Guard Facility	5
Port Canaveral Fire Station	4
Cape Canaveral Naval Base	3

Origin/Destination	2015-2020 Trips
Cape Canaveral Public Works	3
Commercial Building (Cape Canaveral)	3
Port Canaveral (North)	2
Cape Canaveral Air Force Station	2
Air Force Space and Missile Museum	2
Port Commercial Tenant Facility (N. Atlantic Ave.)	2
Port Administration Building	2
Cape Canaveral Launch Complex	1
Port Canaveral (South)	1
Titusville	1
Undisclosed location	1
United Launch Alliance	1
Jct - George King Blvd. & SR A1A	1
Jetty Park	1
Wells Fargo Bank	1
George King & Flounder St.	1
Cape Canaveral Fire Department	1
Grand Total	3,559

** The Port portion (i.e., North/South) could not be determined from the data provided. Source: FDOT*

To simplify origins and destinations in the Immediate Study Area and consider routes, the origins and destinations are summarized in **Table 20.** The rank of origins and destinations in the Immediate Study Area appears to change (e.g., Port Canaveral (North)) due to the combination of specific locations such as the Interagency Maritime Operations Center and various port tenants.

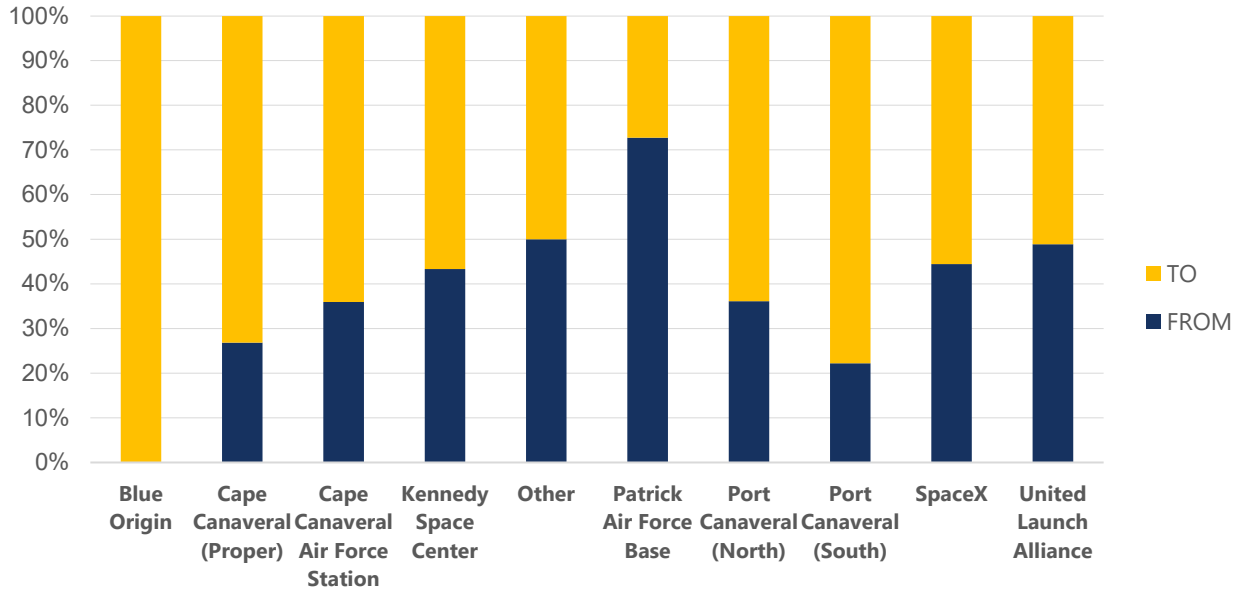
Table 20 | *Grouped Origins/Destinations*

Origin/Destination	2015-2020 Trips
Cape Canaveral Air Force Station*	1,010
Port Canaveral (North)	969
Cape Canaveral (Proper)	809
Port Canaveral (South)	612
Blue Origin	53
United Launch Alliance	45
Kennedy Space Center	30
SpaceX	18
Patrick Air Force Base	11
Other	2
Total	3,559

** Given that some of the moves were likely "classified" by the Department of Defense, records that showed specific origins and destinations inside CCAFS or described as the "Back Gate" were attributed to Cape Canaveral Air Force Station (i.e., "DoD"). Further, this figure appears higher than above because Table 7 shows locations within CCAFS (e.g., Space Launch Complex) that can be added together similarly to other Port Canaveral (North) locations that were itemized above.*

Figure 103 shows the share of moves by direction to or from the grouped origins and destinations.

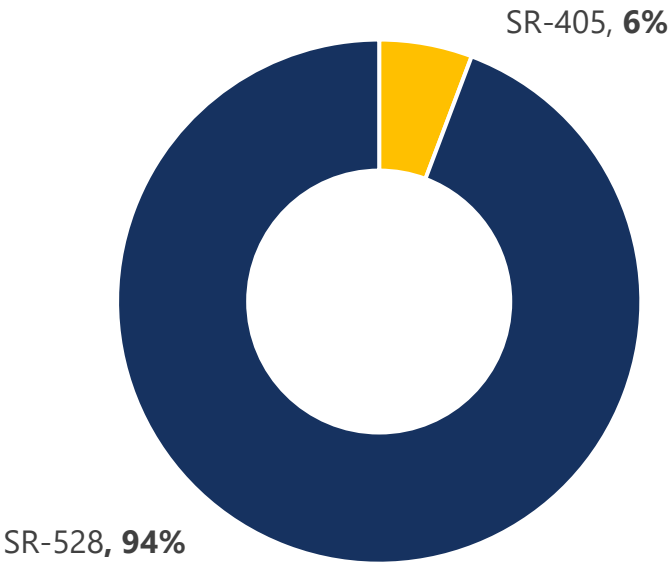
Figure 103 | Direction of Moves for Origins/Destinations, 2015-2020 (Source: FDOT)



Most moves are destined for the Immediate Study Area ("To" versus "From") except for those pertaining to Patrick Air Force Base in which more than 70 percent originated there ("From" versus "To").

Most of the moves were either destined for, originated in, or traveled through Merritt Island; others were strictly relative to Cocoa, Titusville, and other locations in the Palm Bay-Melbourne-Titusville Metropolitan Statistical Area. Therefore, the primary route to access or leave Merritt Island was considered for OS/OW moves. Most of the OS/OW moves used SR 528 (SR A1A or NASA Causeway/Parkway), while a small portion used SR 405. **Figure 104** compares the shares of OS/OW moves between the two routes.

***Figure 104** | Share of OS/OW Moves Accessing Merritt Island, 2015-2020 (Source: FDOT)*



Of the 3,150 moves that make up the almost 95 percent of moves via SR 528, about 40 moves used SR 3 (N. Courtenay Parkway) on Merritt Island or traveled northbound through KSC to access or leave the Immediate Study Area. See **Table 21.**

***Table 21** | OS/OW Moves – SR 3, 2015-2020 (Source: FDOT)*

Jurisdiction	Origin/Destination	To	From	Total
City of Cape Canaveral	Cape Canaveral (Proper)	9	4	13
Port (South)	South Intermodal Area		9	9
	Cruise Terminal 1	4	4	8
CCAFS	Cape Canaveral Air Force Station	4	2	6
Port (South)	Marina District	1	2	3
Port (North)	North Cargo Area		1	1
Port (North)	Port Commercial Tenant (Magellan Rd.)		1	1
Total		**18**	**23**	**41**

Six trips to CCAFS used SR 3 (N. Courtenay Blvd.), accessing SR 3 to/from SR 528 (**Figure 103**). The other 35 trips used SR 3 likely between SR 520 and SR 528 through Merritt Island to enter or exit from SR 528.

Considering a review of the total shares of traffic using all seven bridges accessing Merritt Island/Cape Canaveral, SR 528 handled 21 percent and SR 520 handled 14 percent (while SR 405 handled six percent).[180] This indicates that SR 528 (SR A1A) is the primary route to access Merritt Island and Cape Canaveral.

State Route 3 (near NASA Parkway W) (Source: Google)

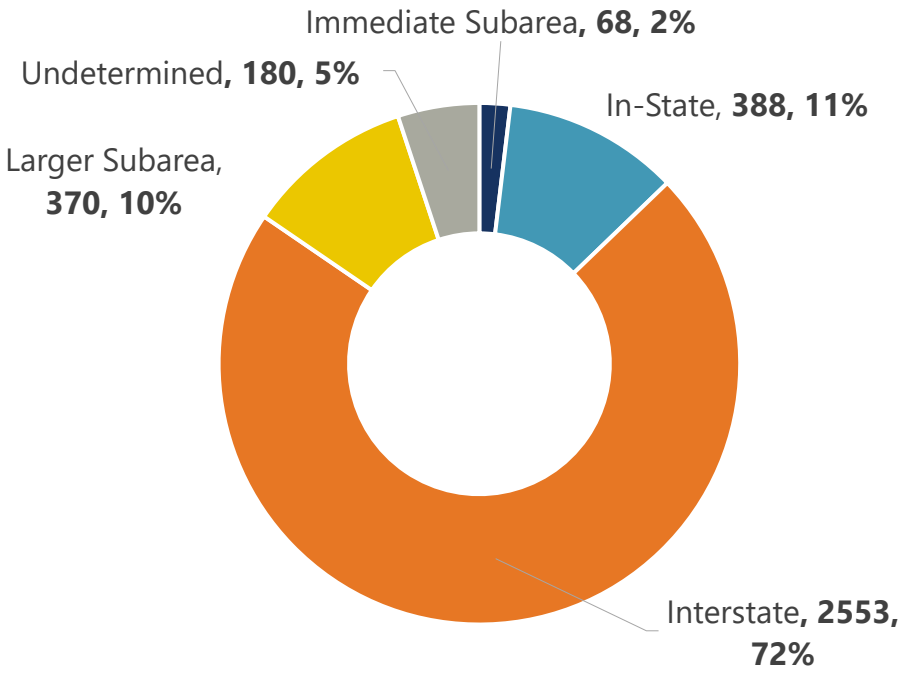
[180] See Figure III-11 of the Phase 1 Study.

Further, to assess moves that started and ended within the greater region, consideration of all moves was given including those that:

- Started and ended within Brevard County (Immediate Subarea);
- Started or ended in Volusia, Seminole, Orange, and/or Osceola Counties (Larger Subarea);
- Started or ended within Florida (In-State); and
- Started or ended outside Florida (Interstate).

The last three options still pertained to one end of all OS/OW trips being in the Immediate Study Area. **Figure 105** shows the breakdown.

***Figure 105** | Proximity of OS/OW Moves in the Super-Region, In-State, and Outside Florida, 2015-2020 (Source: FDOT)*



Most (2,553 trips, or 72 percent) of the 3,559 total trips to/from the Immediate Study Area were moves that were to and from states outside of Florida. Eleven percent (388 trips) started or ended within Florida such as in Tampa, Jacksonville, or Pensacola. Ten percent (370 trips) started or ended in the Larger Subarea - Osceola, Orange, and Seminole counties. Finally, only two percent (68 trips), started and ended within the Immediate Subarea.[181]

Last-Mile Critical Corridors & Intersections

Primary destinations in Port Canaveral (North) included Charles M. Rowland Drive to access Port Canaveral cruise terminals, and Grouper Road, Snapper Road, Payne Way, Poseidon Way, Spaceport Way, and Samuel C. Phillips Parkway (near the liquid build tanks) to access the port cargo facilities. The SR 528/SR 401 interchange is the primary means to reach Port Canaveral (North) and does not appear to pose a critical issue to OS/OW cargo movements. Local roads such as Grouper Road appear to be accessible with enough turning radii for inbound and outbound movements given SR 401 is a four-lane divided roadway.

Primary destinations in Port Canaveral (South) included Mullet Road, Scallop Drive, and George King Boulevard to access hotels and hotels in The Cove, cruise terminals, and commercial/industrial sites on Port Canaveral property. The SR A1A (SR 528) (Astronaut Boulevard)/George King Boulevard interchange is the primary means to access Port Canaveral (South) and does not appear to pose a problem. Local roads such as Dave Nisbet Drive, Flounder Street, and Marlin Street are all accessible from George King Boulevard by dedicated left turn lanes that appear to have enough turning radii.

Other Origins/Destinations

Once goods enter incorporated Cape Canaveral, notably via SR 528, destinations varied. These included W. Central Boulevard, Sabal Avenue, N. Banana River Boulevard, and Canaveral Boulevard. The purpose of these trips seems to be commercial/industrial (e.g., crane rigging) and residential (e.g., trailer homes). As a result, heavily used corridors are Astronaut Boulevard (SR A1A), an extension of SR 528 (the Martin Andersen Beachline Expressway).

[181] Only a few moves appeared to be between Port Canaveral and CCS, due to the quality of the original data.

Freight Rail Movements

While NASA discontinued use of the NASA railroad, it has continued to maintain 17 miles of it. The railroad previously moved rocket components and solid rocket fuel to the KSC for the Shuttle Program. Today, nine years later, NASA uses the railroad to move the Space Launch System (SLS) rocket and Orion spacecraft components to the KSC. The Artemis boosters, like the solid rocket boosters the Shuttle Program used, were recently transported by rail from the Northrop Grumman facility in Promontory Point, Utah.[182] The last mile of this journey was moved by Florida East Coast Railroad, and then NASA's "shuttle wagon" on the NASA railroad.[183]

The NASA railroad connects to the Florida East Coast Railroad that services the Atlantic Coast of Florida from Miami to Jacksonville and/or inland to Orlando. Florida East Coast Railroad then connects to the CSX Railroad. Rocket components are transported 2,800 miles across the United States from facilities such as Northrop Grumman's in Promontory, Utah.[184]

The Space Coast/East Central Florida Freight & Logistics Subarea Study:
Phase 1 (June 2020) – OS/OW Rail

"Within the study area, freight rail is provided by the Florida East Coast Railroad (FEC), which provides direct access to the NASA Railroad serving the KSC and U.S. Air Force Titan Complex. The FEC's 351 mainline between Jacksonville and Miami includes more than 85 miles in the Immediate Study Area and another 40 or more miles in the Larger Subarea. "

"The NASA Railroad consists of 17 inactive miles that could provide access the KSC. The complete 38-mile track system was designed to the 60 mile-per-hour (mph) standard, trains typically only moved at only 10-25 mph depending on payload which included OS/OW Shuttle Program rocket components and hazardous materials. Today, the railroad infrastructure continues to be maintained for reutilization under the contemporary Space Launch System."

[182] https://www.nasa.gov/artemisprogram.
[183] https://www.spaceupclose.com/2020/06/powerful-solid-rocket-booster-segments-for-nasa-sls-artemis-1-moon-mission-arrive-at-kennedy-space-center-photos/.
[184] Source: "NASA's Famous Rocket Railroad is Back in Business," Popular Mechanics, June 17, 2020.

Jay Jay Bridge Transporting Rocket Boosters for Space Shuttle (Source: NASA)

A critical component of the system is the Jay Jay Bridge (over the Indian River), which was refurbished between 2005 and 2009.[185] The bridge continues to be capable of handling 12-foot wide and 150-ton rocket component.[186]

Commercial Marine Navigation

The Phase I Study considered marine transportation for OS/OW cargo to the Immediate Study Area. Rocket components that are developed in Huntsville, Alabama are transported on barges up the Tennessee River to the Mississippi River, and then down the Mississippi, and through the Gulf of Mexico and Atlantic Intracoastal Waterway to Port Canaveral.

No permitted moves from Port Canaveral to local space facilities were identified in the 2015-2020 database of permitted moves. Previous maritime moves are highlighted below.

[185] One can find a description of the rehabilitation at "Jay-Jay Railroad Bridge Rehabilitation," RS&H, Accessed October 22, 2020. Available at https://www.rsandh.com/projects/jay-jay-railroad-bridge-rehabilitation/.
[186] https://www.nasa.gov/sites/default/files/files/NASA-Railroad.pdf

- The main external tank for the Shuttle Program was transported by water from the Michoud facility in New Orleans directly to the KSC via the Canaveral Lock and Banana River barge canal.
- The first mega rocket core for the Artemis mission was transported from the Michoud to the Stennis Space Center in Mississippi by barge in January 2020. That rocket is currently undergoing a series of tests, after which it will again be transported by barge directly to the KSC; that does not require a local permit as an OS/OW move.[187]
- The Launch Vehicle Stage Adapter (LVSA), which connects the core stage of NASA's SLS rocket to the upper stage (the Interim Cryogenic Propulsion Stage), arrived July 29, 2020 via water from NASA's Marshall Space Flight Center to Kennedy's own Launch Complex 39 turning basin wharf.[188]
- On July 10, 2020, the ULA M/V Rocketship (formerly the M/V Delta Mariner, 312-foot LOA) transported Roll-on/Roll-off (Ro/Ro) flight hardware to Port Canaveral (consistent with efforts in 2017 for the delivery of the Alliance Delta IV Heavy rocket to Port Canaveral.)189 The rocket, like the flight hardware, was then trucked to the pre-processing center at CCAFS.

Maritime sector OS/OW traffic impacts are minimal given rocket components, including those for SpaceX returned on barge after a flight and by ULA, are offloaded in Port Canaveral (North) in the West Turning Basin (now at North Cargo Berth 8 with the custom-design Liebherr LHM 600 mobile harbor crane) or at the container facility.[190]

Commercial Air Cargo

The Phase 1 Study also reviewed OS/OW moves by air into the Immediate Study Area. The study cited enplanements at local airports including the Space Coast Regional Airport, which can handle large aircraft including C-17s and Antonov AN-225s. However, no OS/OW commercial permits by truck originated at the Melbourne International Airport or Space Coast Regional Airport, despite either airport's ability to handle Antonov 225s. Also, the database of 2015-2020 permits did not show whether cargo that originated in the CCAFS was originally air cargo. Based on the study's outreach and research, it seems a portion of the 90 OS/OW movements originating on or destined for Hangar Road

[187] https://www.nasa.gov/exploration/systems/sls/first-nasa-artemis-rocket-core-stage-loaded-on-pegasus-barge.html
[188] https://www.nasa.gov/feature/key-connection-for-artemis-i-arrives-at-kennedy
[189] Source: "United Launch Alliance Renames Ship Used to Transport Rockets," WAAY31, September 27, 2019. Available at https://www.waaytv.com/content/news/United-Launch-Alliance-renames-ship-used-to-transport-rockets-561539291.html.
[190] https://spacecoastdaily.com/2020/06/spacex-falcon-9-booster-used-for-starlink-8-launch-arrives-at-port-canaveral-on-drone-ship/.

Super Guppy (Source: NASA)

may have started or ended via air. Further, the former Space Shuttle runway, now the Launch and Landing Facility (LLF) handles OS/OW cargo planes for CCS.

Also, while the Phase 1 Study cited that NASA moves large components such as the Orion Stage Adapter (OSA) by air, there were no related “last-mile” moves in the database. For example, in March 2020, the Super Guppy (111 feet long, 25 feet high, 25 feet wide, and able to carry 26 tons of cargo) moved the OSA from Ohio back to the KSC (after successful testing). However, the Super Guppy utilizes the former Space Shuttle runway from which the OS/OW cargo is transloaded to a specially built carrier and stays within the KSC.[191]

[191] https://blogs.nasa.gov/kennedy/2020/03/26/welcome-home-orion-spacecraft-ready-for-final-artemis-i-launch-preparations/

Modal Advantages & Disadvantages

Each mode has advantages and disadvantages to moving OS/OW cargo. **Table 22** summarizes the relative advantages and disadvantages for each mode.

***Table 22** | Relative Advantages and Disadvantages of Modes in OS/OW Freight Transportation*

Road		Rail		Waterway	
Advantages	Disadvantages	Advantages	Disadvantages	Advantages	Disadvantages
Access	Weight	Weight	Width	Weight	Speed
Speed	Height	Height	Speed	Height	Access
Ease of Use	Price	Price	Access	Width	Ease of Use
Width	Permitting	Multi-Piece Move	Ease of Use	Multi-Piece Move	Price

Source: "Multi-State, Multimodal, Oversize/Overweight Transportation (NCRHP Report 830)," Transportation Research Board, 2016.

Critical Issues

This section summarizes industry critical issues, last-mile OS/OW issues, and best practices. Industry critical issues focus directly on or affect the urban environment and those that would pertain to the "Super Region" including the Larger Subarea for access to the Immediate Subarea.

Industry & Regional Issues

The growth of the "Super Region" increases goods moved, including OS/OW, for the industries cited in the micro-scenario assessment. As a result, expected OS/OW movement issues that will likely affect the Immediate Study Subarea include:

- Inconsistent state regulations;
- Small, older intersections;
- Overcrossing structures;
- Divergent diamond interchanges;
- Other traffic (including for special events); and
- Increased roadway maintenance (funding).

Florida and Adjacent State OS/OW Thresholds

Currently, the maximum weights permitted on the National System of Interstate and Defense Highways (and reasonable access thereto) include:

- 80,000 pounds gross vehicle weight;
- 20,000 pound single axle weight; and
- 34,000 pound tandem axle weight.

Also, weight on each axel is important for crossing bridges. A related federal bridge formula was established to limit the weight-to-length of a vehicle crossing a bridge.

Permits are available through states for non-divisible and divisible vehicles or loads. Divisible load permits may be granted based on historic state "grandfather" rights or congressional authorization.[192] Grandfathered rights relate to preexisting state laws in place before enactment of the Federal-Aid Highway Act of 1956, which permits weights exceeding 80,000 pounds.

Permits are provided by FDOT authorizing commercial vehicles (hauling divisible loads) to operate off the Interstate Highway System more than the vehicle's legal gross weight limit.[193] Divisible loads can be permitted to travel on the state network only, no interstate travel. Also, local roadway usage must be coordinated by local authorities.[194]

The OS/OW thresholds for Florida and surrounding states are important to consider because loads can travel beyond state lines. In fact, 21 percent of all OS/OW moves between 2015 and 2020 had destinations outside Florida. **Table 23** shows the variance in OS/OW thresholds for Florida, its surrounding states, and Mississippi (noted for rocket testing at the Stennis Space Center).

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[192] https://ops.fhwa.dot.gov/freight/sw/permit_report/index.htm
[193] https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/maintenance/str/owodp/divisible-load-permit-instructions-5-21-20.pdf?sfvrsn=7dab10b8_2
[194] https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/maintenance/str/owodp/when-do-you-need-a-permit.pdf?sfvrsn=45e8edf1_0

***Table 23** | Florida and Adjacent State OS/OW Thresholds*[195]

State	Width	Height[196]	Length	Weight (Lbs.)
Florida	16’	18’	150’	199,000*
Georgia	16’	16’	100’	150,000
Alabama[197]	12’	14’	75’	150,000
Mississippi**	12’ – 16”	13’6” – 15’6”	99’ – 120’	150,000 - 180,000

* *Specific to tractor trailers*
** *Ranges were provided given the source distinguished daylight moves from 24-hour moves.*

In contrast, **Table 24** shows the average width, height, length, and gross vehicle weight for the 3,599 OS/OW moves between 2015 and 2020.

***Table 24** | Average Width, Height, Length, and GVW – to/from the Immediate Subarea, 2015-2020, (Source: FDOT)*

Geography	Avg. Width	Avg. Height	Avg. Length	Avg. Gvw (Lbs.)
Immediate Subarea	16.8’	16.4’	93.4’	99,786.6
In-State	12.6’	14.4’	100.0’	97,810.6
Interstate	11.7’	13.9’	85.1’	46,469.4
Larger Subarea	11.0’	13.6’	84.6’	83,666.5
Undetermined	12.1’	14.4’	116.9’	126,372.1
Grand Total	11.8’	14.0’	88.4’	60,993.5

The OS/OW moves that remained in the Immediate Study Subarea exceed Florida’s width requirements. Further, interstate moves (those to/from the Immediate Study Subarea) and originating in or destined for outside Florida are just within the Alabama limits. A typical truck with a 53-foot trailer is 8.6 feet wide, 14 feet high, and 65 feet long with 80,000 pounds gross weight (which includes the truck itself).[198]

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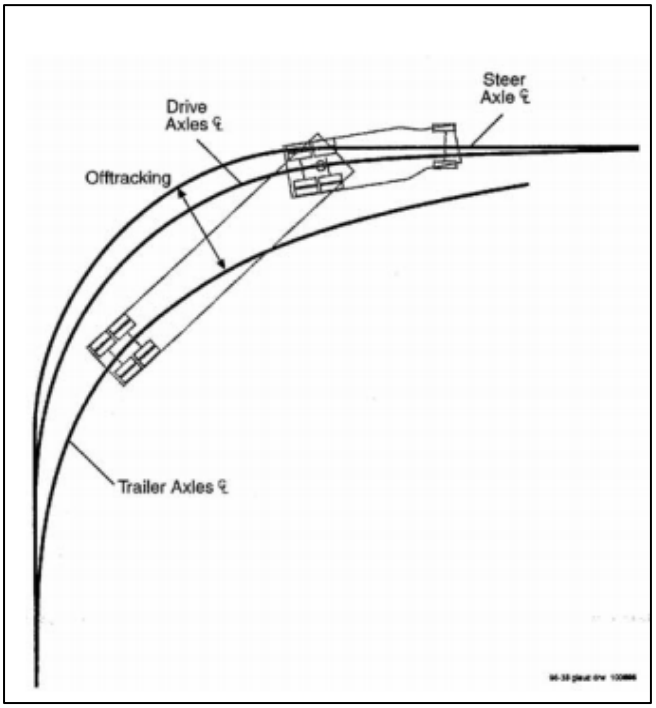
[195] Source: “Best Practices in Permitting Oversize and Overweight Vehicles – Final Report,” Federal Highway Administration, February 2018. Available at https://ops.fhwa.dot.gov/publications/fhwahop17061/fhwahop17061.pdf.
[196] Height based on GAO Report (“Based on current legislation, FHWA has established rules and regulations for vehicle width, truck trailer length, and vehicle weight standards for certain federal-aid highways aimed at protecting highways and bridges from damage while providing a safe and efficient highway network. FHWA does not, however, have the authority to establish a height requirement, a decision that goes back to the Interstate System’s construction in the 1950’s, when height clearances already varied from state to state.”) Source: https://www.gao.gov/assets/670/668711.pdf
[197] Source: “Chapter 9 – Trucks, Trailers, and Semi-Trailers,” Alabama State Law. Available at https://www.dot.state.al.us/maweb/pdf/Permits/AlabamaCode32-9(1.18.2017).pdf.
[198] https://trucksmart.udot.utah.gov/motorist-home/stopping-distances/

Older, Smaller Intersections

Older intersections with smaller radii such as those in the South Intermodal Area of Port Canaveral (South) can hinder OS/OW movements. An intersection that does not have sloping curbs will likely result in additional infrastructure damage and repair costs due to off-tracking by the OS/OW load.[199] See **Figure 106** to understand off-tracking.

Other critical issues for design elements on OS/OW routes include presence of a center island, lack of right-turn bypass lanes, narrow entry and exit lanes, non-removable signage, lack of setbacks for utility infrastructure, fixed mast arms, and poor information for splitter island height (for low-boy vehicles).[200]

***Figure 106** | Illustration of Truck Off-Tracking*



Source: Review of Truck Characteristics in Roadway Design, TRB National Highway Capacity Research Program, 2003.

[199] "Where a radius of less than 50 ft (15 m) is used, the island should be bordered by sloping curbs to permit the maneuvering of an occasional oversized vehicle." Source: "A Policy on the Geometric Design of Highways and Streets (7th Edition)," American Association of State Highway and Transportation Officials, 2018.

[200] Source: "Facilities Development Manual (Chapter 11, Design – Section 25, Intersections at Grade)," Wisconsin Department of Transportation, August 15, 2019. Available at https://wisconsindot.gov/rdwy/fdm/fd-11-25.pdf. In addition, the Florida "Manual of Uniform Minimum Standards for Design, Construction and Maintenance for Streets and Highways" cites that "supports for bridges, barriers, or other structures should be placed outside the required shoulder."

Older, Narrow Corridors

Older, narrow corridors can determine the configuration of intersections, which may hinder OS/OW moves. For example, from NASA Parkway West, Space Commerce Way tapers to two lanes.[201] In addition, the grass median (like an intersection center island), which entails a swale and stormwater drainage infrastructure prevents an OS/OW trailer from turning and continuing southbound.

Diverging Diamond Interchanges

There are several diverging diamond interchanges (DDI) that access the Immediate Study Subarea including at SR 528 and SR 3, and at SR 528 and George King Boulevard (to access Port Canaveral). Cited in the 2018 AASHTO "Policy on the Geometric Design of Highways and Streets (7th Edition), "Another operational consideration is that the DDI form does not accommodate typical 'up and over' (up the ramp and down the ramp) grade separated, exit-to-entrance movements for oversized vehicles or authorized vehicles during maintenance or emergency situations." The

Overcrossing Structures

In 2018, the American Association of State Highway Transportation Officials (AASHTO) published "A Policy on the Geometric Design of Highways and Streets (7th Edition)." It cited "The overcrossing structure has no limitation as to vertical clearances, which can be a significant advantage in the case of oversized loads requiring special permits on a major highway or route."

Further, the Florida Department of Transportation's "Manual of Uniform Minimum Standards for Design, Construction and Maintenance for Streets and Highways" (Draft, 2018) cites, "Freeways and major arterials shall have a vertical clearance of at least 16 feet-6 inches (includes 6 inch allowance for future resurfacing). Other streets and highways should have a clearance of 16 feet unless the provision of a reduced clearance is fully justified by a specific analysis of the situation (14 feet minimum)." This height is not a critical issue for OS/OW cargo; however, it is for a Superload as addressed in the Case Study.

[201] There are contemporary planned improvements to key corridors including Space Commerce Way. Source: "Request for Bids for Economic Development Fund Infrastructure Improvements Roadway Package – Cape Canaveral Spaceport - Brevard County, FL (FDOT FM#439053-1-54-01/RFB-SF-01-0-2020), Published March 19, 2020. See https://www.spaceflorida.gov/wp-content/uploads/2020/03/RFB-SF-01-0-2020-EDTPF-Roadway-Improvements-Final-with-Attachments.pdf for more information. Project status is pending at this time.

policy cites, “A disadvantage of the DDI design is the inability to route oversized…from the exit ramp directly through the intersection and onto the entrance ramp.”[202]

Cloverleafs & Bridge Heights

Cloverleafs can be restrictive, depending on a radius of the turn and the overall length of the load, trailer, and tractor. There is at least one cloverleaf to access north Port Canaveral and CCAFS – WB SR 528 to NB SR 401. In addition, the cloverleaf from SB I-95 to WB SR 528 could be utilized, if the oversize load can fit under the Port St. John Parkway and Citrus Boulevard overpasses on I-95. The Citrus Boulevard is only 15’4” tall, which impeded a truck on September 3, 2014.[203]

Overweight Moves

Local Moves

Bridges and bridge load ratings can present significant challenges for OS/OW. An example is the critical chokepoint in the Immediate Study Area, the SR 401 drawbridge over the barge canal near Port Canaveral. This chokepoint hinders OS/OW providers from accessing critical points such as the North Cargo Area and CCAFS.

Multistate Moves

Multistate permitting is available through the Western Regional permit, New England Transportation Consortium permit, WINNDOT Cross-Border permit, and in Florida, the Southern Regional permit, shown in Error! Reference source not found.. This allows a carrier to submit one permit application and receive permits for the states participating in the agreement. This is for loads within a defined length, width, height, and weight envelope where loads outside these parameters must still apply for permits in individual states.[204]

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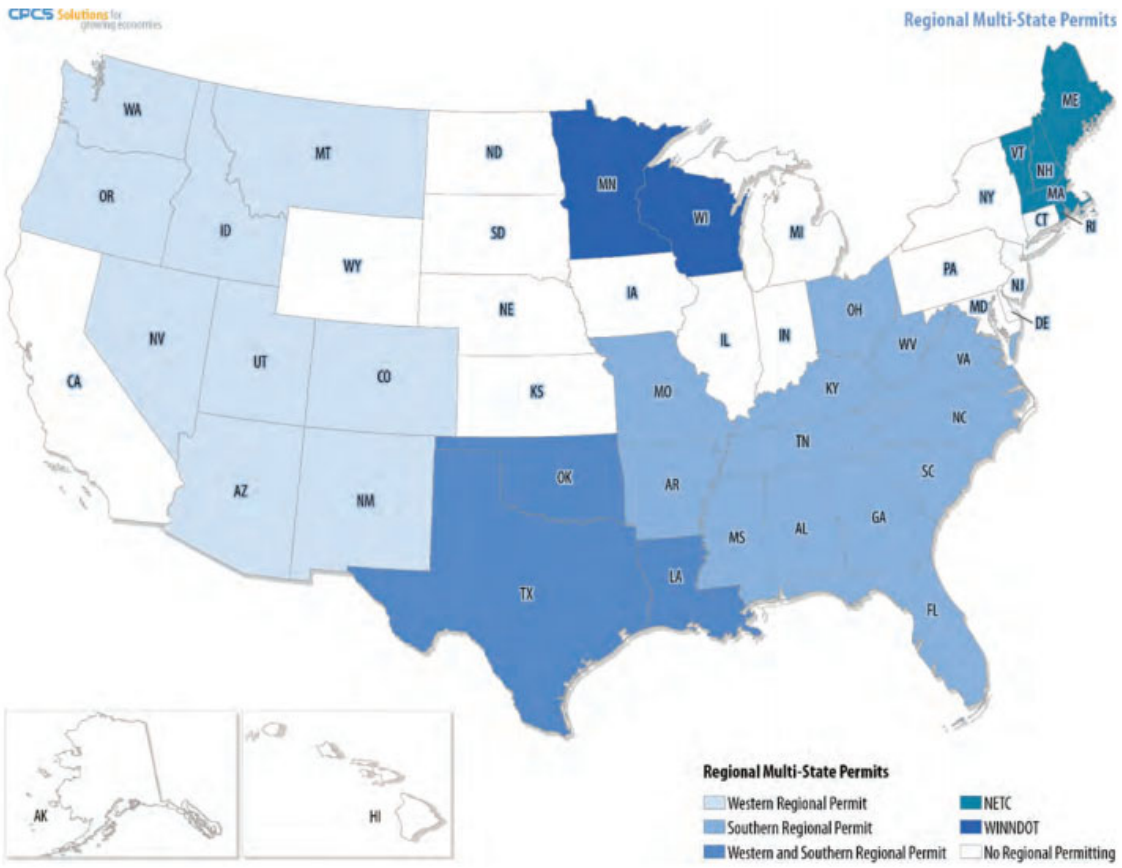
[202] Source: “A Policy on the Geometric Design of Highways and Streets (7th Edition),” American Association of State Highway and Transportation Officials, 2018. Note that this issue was not cited by OS/OW transport providers.
[203] Source: “Truck unable to clear I-95 overpass,” Florida Today, September 3, 2014. Available at https://www.floridatoday.com/story/news/local/2014/09/03/truck-unable-to-clear-i-95-overpass/15022457/.
[204] https://www.nap.edu/download/23607#

Figure 107 | *Multi-State Regional Permits (Source: Transportation Research Board)*



For the share of loads coming into and leaving Florida, the Southern Regional permit may be helpful for OS/OW moves in the area, but the parameters are limiting. This permit (for Alabama, Arkansas, Georgia, Kentucky, Louisiana, Mississippi, Missouri, North Carolina, Ohio, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia) allows a carrier to transport a vehicle and load up to a gross vehicle weight of 120,000 pounds. The Southern Regional permit limits width to 14 feet (2.8 narrower than moves between the Immediate Subarea and states other than Florida), height to 13.5 feet (like a conventional 53' trailer), and 100 feet long (only 25 feet longer than a 75-foot tractor and

trailer with a 53-foot trailer). In comparison, the Western Regional permit allows a carrier to transport a vehicle and load up to 160,000 pounds (across many western states).[205]

These multistate arrangements can be beneficial for carriers obtaining permits, but they do not improve the operations of the move. Drivers still face jurisdictional challenges with escorts, hours of travel, overhead, and warning sign requirements. While the industry may prefer the uniform permitting aspect of multistate agreements, there is also preference for simplifying the operational side. For example, the NETC standardizes hours of travel, warning signs, lights, and escorts along with the single permit for the states.[206]

Interaction with Other Traffic

Some states require OS/OW moves to occur during daytime hours, which means more traffic and pedestrian/bicycle conflicts, compounded in the Immediate Subarea by the potential for special event traffic. However, moves in Florida can operate 24/7 except during peak travel times (7:00 AM to 9:00 AM, and 4:00 PM to 6:00 PM). The ability to move during the night has benefited the Immediate Subarea. The 3,599 OS/OW moves over the recent five years has translated to an average of one move every two days.

Traffic associated with residential and commercial/industrial land uses is a critical issue. The commercial parcels in the Palm Bay-Melbourne-Titusville (PBMT) MSA are located near the CCS and commercial airports to support air cargo operations. Industrial land uses are predominantly located across the Indian River from the CCS but accessible via the SR A1A, SR 520, and SR 404 bridges. This creates a convergence of traffic on the SR A1A (SR 528) and SR 404 bridges, which each handled 21 percent of total traffic and the SR 520 bridge that handled 14 percent.

[205] http://perba.dotd.louisiana.gov/welcome.nsf/Southern%20regional%20Permit%20Agreement.pdf
[206] https://www.nap.edu/download/23607#

Roadway Maintenance

Heavy loads create wear-and-tear on roadway infrastructure designed for conventional traffic. The average of one OS/OW move every two days, the wear-and-tear on the road surface and older intersections (with raised curb lines) results in additional maintenance costs to the county and ultimately FDOT. Some local jurisdictions impose a separate fee in addition to the fee levied by the state to address related roadway maintenance. However, Brevard County does not have a distinct fee.

Transport Providers Feedback

Immediate Study Subarea Access

The database of nearly 3,600 permitted OS/OW moves between 2015 and 2020 included transporters of rocket components and recreational boats. All transporters cited using SR 528, the FDOT OS/OW designated route.[207] Transport providers that moved larger equipment like rocket boosters that were closer to 16-foot tall (on the trailer) cited height limitations on SB I-95 from the Port St. John Parkway and Citrus Boulevard overpasses.[208] As a result, OS/OW trucks took one of four routes:

1. State Route 405 to FL-3 (Space Commerce Way);
2. State Route 407 (Challenger Memorial Parkway) to SR 528 (Martin Anderson Beachline Expressway) WB, having to U-turn from WB SR 528 to EB SR 528 at SR 520;
3. Exit at Port St. John Parkway EB to take Grissom Parkway SB to access SR 528; or
4. US 98 to SR 44 to US 27 to I-4 to SR 417 to SR 528.

In almost every case, loads utilized SR 401 to access CCAFS.[209] However, one load had to drop its airbags one-inch to travel under the SR 528 overpass to continue on NB SR 401.

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[207] https://spacecoasttpo.com/projects-and-studies/active-projects/sr-528-i95-to-port/
[208] Traffic signals were not considered a height restriction. If load heights reached the signals, drivers drove slowed to a crawl to drive between the signals.
[209] One provider cited having to drive past George King Boulevard and u-turn on SR-528 due to the load height, instead of exiting from SB SR-528 and drive under the overpass to continue EB on George King Boulevard.

Bridge Loading Ratings

Bridge load ratings were not specifically cited as an issue, given SR 528 is the designated FDOT OS/OW route. However, the SR 401 drawbridge was denoted as a limitation but is currently planned for replacement.[210]

Load Lengths

Load lengths of approximating 100 feet were not considered restrictive, either. However, if total loads were 150 feet long or greater (e.g., 180 feet), there was a concern for traversing cloverleafs:

1. From SB I-95 SB to EB SR 528 if the load's height allowed it to travel on I-95 under the Port St. John Parkway and Citrus Boulevard bridges and then merge into traffic (despite the use of escorts), and
2. From WB SR 528 to NB SR 401 to reach Port Canaveral (North) and CCAFS.

Permitting

For the potential of local fees, one operator cited preference to have a higher state cost distributed to local communities instead of separate fees. This would also simplify route planning.

Route Planning

Finally, two providers stated that they use Delorme to map and plan routes, although one noted it as "dated" (for the last update in 2015). Delorme provides all the relevant information; however, it does not show live traffic updates. No other technologies such as driver assistance were cited; respondents instead noted they rely on 'substantial driver experience.'

[210] FDOT is currently conducting a Project Development and Environment (PD&E) Study to develop and analyze alternatives to improve the bridges and address access, future mobility and safety. See https://www.cflroads.com/project/444787-1 for more information.

Best Practices for an OS/OW Route

This section envisions the development of a hypothetical OS/OW route where best practices and unique solutions are incorporated throughout. These practices focus on the urban environment for "last-mile" OS/OW moves including design standards for roundabouts and intersections (where OS/OW trucks turn), designated corridors, rotating mast arms and other ideas.

Design Standards – OS/OW Routes (Roundabouts, Intersections, Driveways, etc.)

While there are no roundabouts on OS/OW routes in the area, it is likely that they would be used as a mitigation tool as traffic volumes increase in the region. Because of this, it is important to understand the design considerations involved in constructing a roundabout on an OS/OW route.

There are two potential solutions for OS/OW truck turns – roundabouts intersections and driveways:

- **Temporary resolutions**: Place mats on the outside of a roundabout's center island or a soil or turf stabilization system like grasscrete.[211]
- **Permanent solutions:** Include developing a through-lane, which could also accommodate pedestrians/ bicyclists (at other times) over the center island to address truck off-tracking. **See Figure 108**.

Figure 108 | *Roundabout Development – OS/OW Straight Lane*

Source: "Accommodating Oversize/Overweight Vehicles at Roundabouts," Kansas State University Transportation Center. January 2013.

[211] https://www.grasscrete.com/docs/paving/grasscrete.html.

Figure 109 | *Roundabout with Truck Aprons (Source: FHWA)*

Other potential solutions include a wide central island apron (that could be permeable), a tapered island (explored by the Wisconsin DOT), a splitter island truck apron, and outer ring truck aprons (**Figure 109**). This helps to provide a clear path free from mountable obstacles for the movement of the OS/OW vehicle.[212] Further, these design solutions can also be applied to intersections and corridor components such as those along SR 3 (N. Courtenay Parkway) on Merritt Island and roads in the South Intermodal Area, given the proximity to Cruise Terminal 1, the Cove, and other general traffic to Jetty Park (which included one OS/OW move in the database).

Truck Considerations for Geometric Design

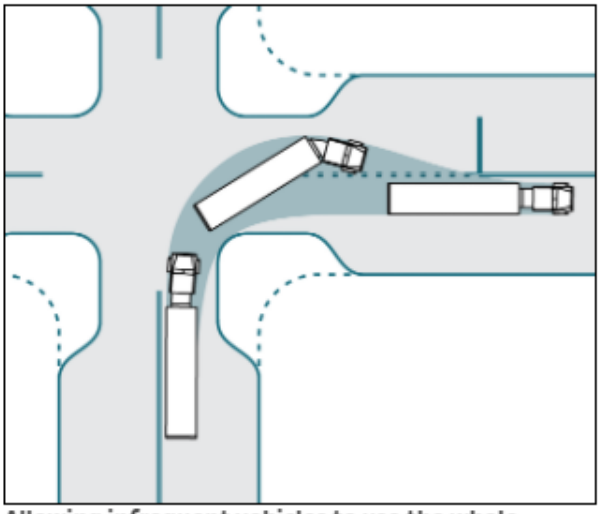
"In establishing a maximum length of a load that could successfully negotiate a turn in an intersection, the type of trailer needs to be known. It is most likely that the loads that will be carried on Kansas highways will be wind generator components. Since there is no way to design and construct highway that can accommodate every conceivable load, an assumption must be made that provides the most reasonable service within budget limitations."

Source: "Optimizing the Analysis of Routing Oversize/Overweight Loads to Provide Efficient Freight Corridors," Kansas State University Transportation Center, July 2012.

[212] "Accommodating Oversize/Overweight Vehicles at Roundabouts," Kansas State University Transportation Center, January 20013.

It is possible for large trucks, including OS/OW, to successfully navigate urban intersections if permitted to use the whole intersection and outside lane. As shown in **Figure 110**, when large trucks enter urban intersections and turn right, if permitted to use the outside lane, the movement of the truck makes the intersection narrower. The narrower intersection slows turning speeds for other vehicles creating safer conditions for pedestrian/bicycle movements.[213]

***Figure 110** | Truck Turn Movement – Narrow Intersections (NACTO, 2013)*



Allowing infrequent vehicles to use the whole intersection (moving left slightly before the turn and using the lane adjacent to the right lane on the receiving side) allows the entire intersection to become more compact, reducing turning speeds of regular vehicles to 12–15 mph. A recessed stop bar prevents conflicts with opposing traffic.

A critical consideration for intersections is the placement of non-removable signage:

- Permanent relocation of traffic signals, signs, and other street appurtenances;
- Removable signs and street appurtenances (similarly suggested in the New York State DOT Design Manual, Chapter 5);
- Traversable curbs; e.g., sloping face curbs that are 4-inches or lower;
- Paved islands (versus the currently grass islands cited in the “Surface Transport Feasibility Study;”
- Truck aprons (with designed load capacity) behind the outside curb radii and stabilized/paved areas behind curbing; and
- Full depth and/or wide shoulders.

[213] In fact, the National Association of City Transportation Officials cites, “Designation of freight routes should be considered in coordination with mapping of primary bicycle, transit, and pedestrian corridors, as well as through the analysis of key access routes, bridge hazards, and industrial or commercial land uses.” See https://nacto.org/publication/urban-street-design-guide/design-controls/design-vehicle/.

Example of Lowboy Trailer (Source: Wikimedia Commons)

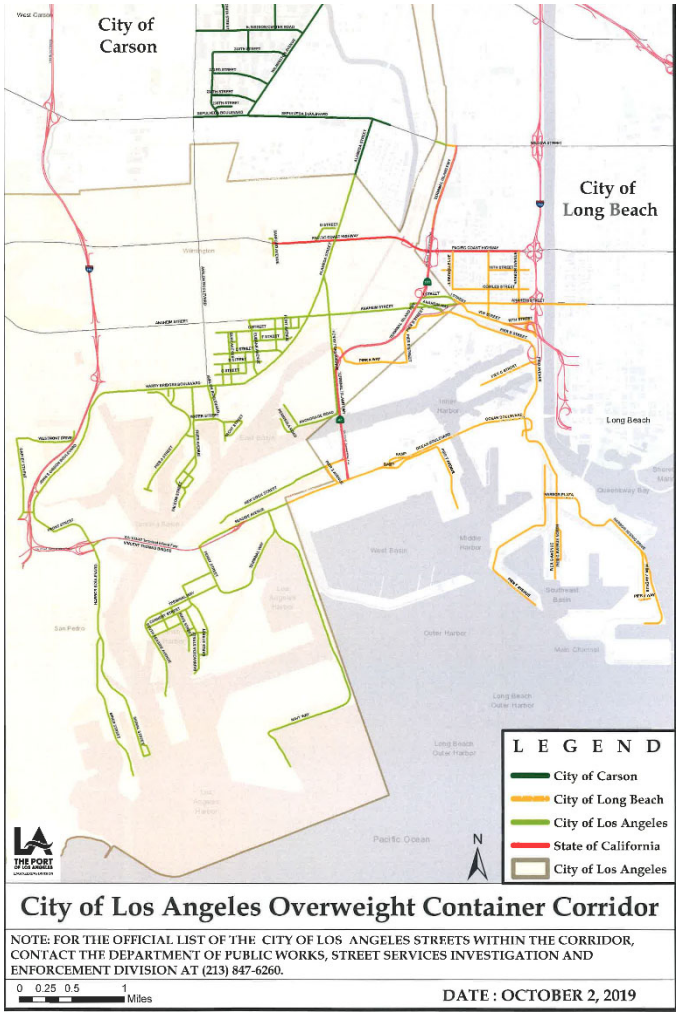
Further, if constructing new or reconstructing intersections with civil three-dimensional (3D) software, design pavement grades and cross slopes to ensure sufficient “lowboy” clearance can be considered.

The implementation of OS/OW-centric design guidelines can include other solutions such as addressing center islands’ splitter island height (for low-boy vehicles), right turn bypass lanes, wider entry and exit lanes, removable signage, setbacks for utility infrastructure, and traffic signals on power lines (versus fixed mast arms) that can be raised.

Designated Corridors

The designation of OS/OW corridors could entail local/regional roadways accessing freight activity centers, and address OS/OW design standards for eventual redevelopment of an intersection or corridor.[214] For example, just outside of the Ports of L.A. and Long Beach is an overweight/heavy container corridor, see **Figure 111**. It is a roughly four square-mile grid of local roads in which overweight containers can be freely moved by trucks that have the proper permits. There are three permits needed to operate within the corridor: one from the City of Los Angeles, one from the City of Long Beach, and one from Los Angeles County. Trucking companies can purchase each of these permits – for each of their trucks – on an annual basis. [215]

***Figure 111** | Port of LA Overweight Corridor (Source: POLA)*



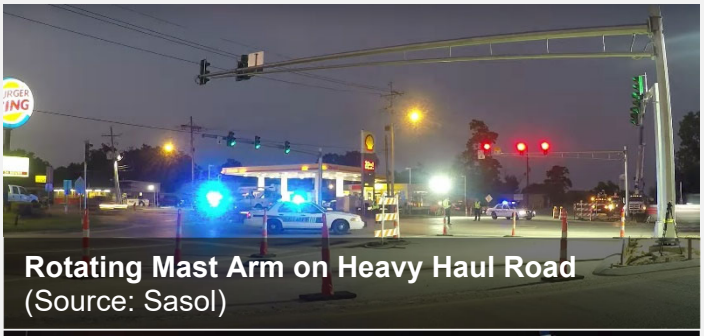
[214] See the Phase 1 Study, Figure III- 18. In addition, the Texas Transportation Institute is currently developing a new OS/OW study; however, it is not yet publicly available.
[215] "Overweight Container Logistics at the Ports of L.A. and Long Beach," Weber Logistics, February 21, 2019. Available at https://www.weberlogistics.com/blog/california-logistics-blog/overweight-container-logistics-ports-la-long-beach

Traffic Signal Rotating Mast Arms

As part of designated freight corridors, innovative features can be incorporated to support efficient movement of oversized cargo, such as traffic signal rotating mast arms. These allow OS/OW moves to pass through signalized intersections by rotating the mast arm out of the way until the cargo has passed. Once the cargo has moved through the intersection, the mast arm is rotated back in place for normal traffic operations.

An innovative use of rotating mast arms was implemented along a 2.5 mile "Heavy Haul Road" in Westlake, Louisiana. This was completed as part of a larger project to widen and upgrade the facility that connected the Calcasieu River Construction Dock to a new chemical facility, the Sasol Lake Charles Chemical Complex. In addition to pavement improvements to withstand the frequent heavy haul movements, the project included a pair of rotating traffic signals at the Sampson/Sulphur intersection, which had mast arms 45-55' long with 22' signal poles.[216]

Since the redesign of this route, the chemical plant has completed at least 1,500 massive shipments, sometimes completing two or three



Rotating Mast Arm on Heavy Haul Road
(Source: Sasol)

[216] https://www.barriere.com/project/sasol-heavy-haul-road/

per night. Additionally, other industry companies have also started to utilize the Heavy Haul Road. The project was successful through extensive coordination of Sasol - the chemical plant, the Louisiana DOTD and local government.[217]

Other Program Ideas

Further, other programmatic ideas that could improve OS/OW moves for the long-term vision of the "Super Region" are shown in **Table 25.**

***Table 25** | Other Programmatic Concepts to Improve OS/OW Movements*

Type	Concept	Partner(S)
Regulatory	Add Weigh-in-Motion sites [218]	FDOT
	Leverage the FDOT automated Permit Application System to identify segments of highway system that undergo stress from overweight and oversize freight vehicles.[219]	FDOT
	Develop regional land use guidelines for mitigation freight OS/OW conflicts with residential and other commercial land uses	Space Coast TPO River2Sea TPO
	Work with FDOT to establish an OS/OW freight data program with GIS[220]	Space Coast TPO River2Sea TPO FDOT
	Leverage better FDOT D5's Regional Traffic Management System[221]	Space Coast TPO River2Sea TPO FDOT
	Address OS/OW moves in Brevard County's "Advanced Traffic Management System (ATMS) Concept of Operations (June 2015).	Space Coast TPO River2Sea TPO "Super-Regional" Counties FDOT

[217] https://www.driveasphalt.org/why-asphalt/innovation/road-built-for-super-heavy-hauls-to-louisiana-chemical-plant
[218] Existing sites can be seen at http://www.floridatruckinginfo.com/Whatsnew/WIM20160620.htm and https://gis-fdot.opendata.arcgis.com/datasets/weigh-in-motion-tda..
[219] Source: "Permit Application System for Oversight and Over-Dimensional Vehicles," Florida Department of Transportation, accessed November 4, 2020. Available at https://www.fdot.gov/docs/default-source/statistics/multimodaldata/multimodal/Permit-Application-System-for-Overweight-and-Over-dimensional-Vehicles.pdf.
[220] This concept is consistent with the opportunity cited in NCHRP Report 830, "State permitting offices collect origin, destination, route, weight, dimensions, and commodity data that state DOTs rarely have access to outside of private data sets or expensive data collection." Source: "Multi-State, Multimodal, Oversize/Overweight Transportation (NCHRP Report 830)," TRB National Cooperative Highway Research Program, 2016.
[221] See the FDOT site "Regional Transportation Management Centers" for https://www.fdot.gov/traffic/ITS/Projects-Deploy/RTMC.shtm#D5 for more information.

Type	Concept	Partner(S)
	Develop an administrative permit manual for oversize and overweight permits.[222]	FDOT
Stakeholder Outreach	Develop an OS/OW public outreach/awareness program	Space Coast TPO River2Sea TPO
	Establish a Space Coast FAC or address through TAC	Space Coast TPO River2Sea TPO
Research	Conduct research on human factors	Space Coast TPO River2Sea TPO FDOT
	Review existing truck parking for future/expected growth and explore P3 opportunities	Space Coast TPO River2Sea TPO FDOT
Funding	Establish a dedicated funding source based on a county fee for OS/OW moves [223]	"Super-Regional" Counties
Technology	Leverage ITS better for OS/OW moves [224]	Space Coast TPO River2Sea TPO FDOT

[222] The Alaska Permit Manual (February 2019) provides an example and is available at http://www.dot.state.ak.us/mscve/assets/webdocs/permits_manual.pdf.
[223] The FHWA cites that trucks weighing more than 80,000 lbs. pay between 40 and 50 percent of the attributable costs. Source: "2000 Federal Highway User Fee Equity Ratios, Addendum to the 1997 Federal Highway Cost Allocation Study Final Report," FHWA, May 2000, available at http://www.fhwa.dot.gov/policy/2010cpr/pdfs/cp2010.pdf.
[224] The Space Coast TPO "Intelligent Transportation Systems Master Plan" (2015) does not address OS/OW moves.

EMERGING TECHNOLOGIES

Context

Phase 1 Study

The Space Coast Subarea Freight Study concluded its first phase in June 2020 and included a definition of the project area, existing conditions analysis, stakeholder engagement, and recommendations for future study. As part of the first phase study, the following weaknesses were identified:

- Limited north-south and east-west corridors;
- Non-recurring congestion; and
- Movement of OS/OW cargo.

Emerging technologies, such as connected and automated vehicles and alternative fuels, were identified as one potential opportunity to address challenges within the project areas. A key recommendation from this study was to evaluate how these can be leveraged to improve safety, mobility, and transportation system efficiency.

Space Coast TPO ITS Master Plan

The most recent version of the Space Coast TPO ITS Master Plan was completed in 2015. This document established a 10-year plan for capital improvements, operations and maintenance, and lifecycle replacement costs totalling $120 Million. Primary objectives of this plan included:

- Increase the number of roadway miles under surveillance by 50 percent;
- Reduce system wide delay for cars, trucks, and transit;
- Reduce corridor delay for cars, trucks, and transit with traffic management;
- Improve reliability and predictability of travel;
- Improve real time transit management; and
- Improve real time traffic and transit information.

An identified strategy supporting these objectives is the buildout of fiber and wireless network to connect intersections throughout the county to the central signal management software. **Figure 112** illustrates existing and proposed fiber as of 2015. The plan also calls for the expansion of Brevard County's existing ATMS network. **Figure 113** identifies corridors with existing adaptive signal coordination as well as proposed corridors.

This ATMS currently in use in Brevard County enables the following capabilities (though not all are in use):

- Real-time event management;
- Monitoring of field alarms;
- Alarm notifications for certain congestion levels;
- Time of day plans;
- Incident triggers;
- Signal plans for emergency vehicles; and
- Publicly available real-time traffic and congestion information.

Other ITS components installed in the county include:

- Closed-circuit television (CCTV) cameras;
- Travel speed and volume detection sensors (Bluetooth and microwave vehicle detection system);
- Traffic signal detection (loop detection and video-based); and
- Arterial dynamic message signage (DMS).

The plan addresses several topics related to emerging technologies but does not establish specific projects. These topics include:

- Connected vehicles, including vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) deployments.
- Freight Advanced Traveler Information Systems (FRATIS), including freight real-time traveler information, drayage optimization, and dynamic route guidance.
- Advanced parking management and guidance systems.

A summary of all existing and planned ITS assets is included on in **Figure 114**.

***Figure 112** | Brevard County Proposed Fiber Infrastructure*

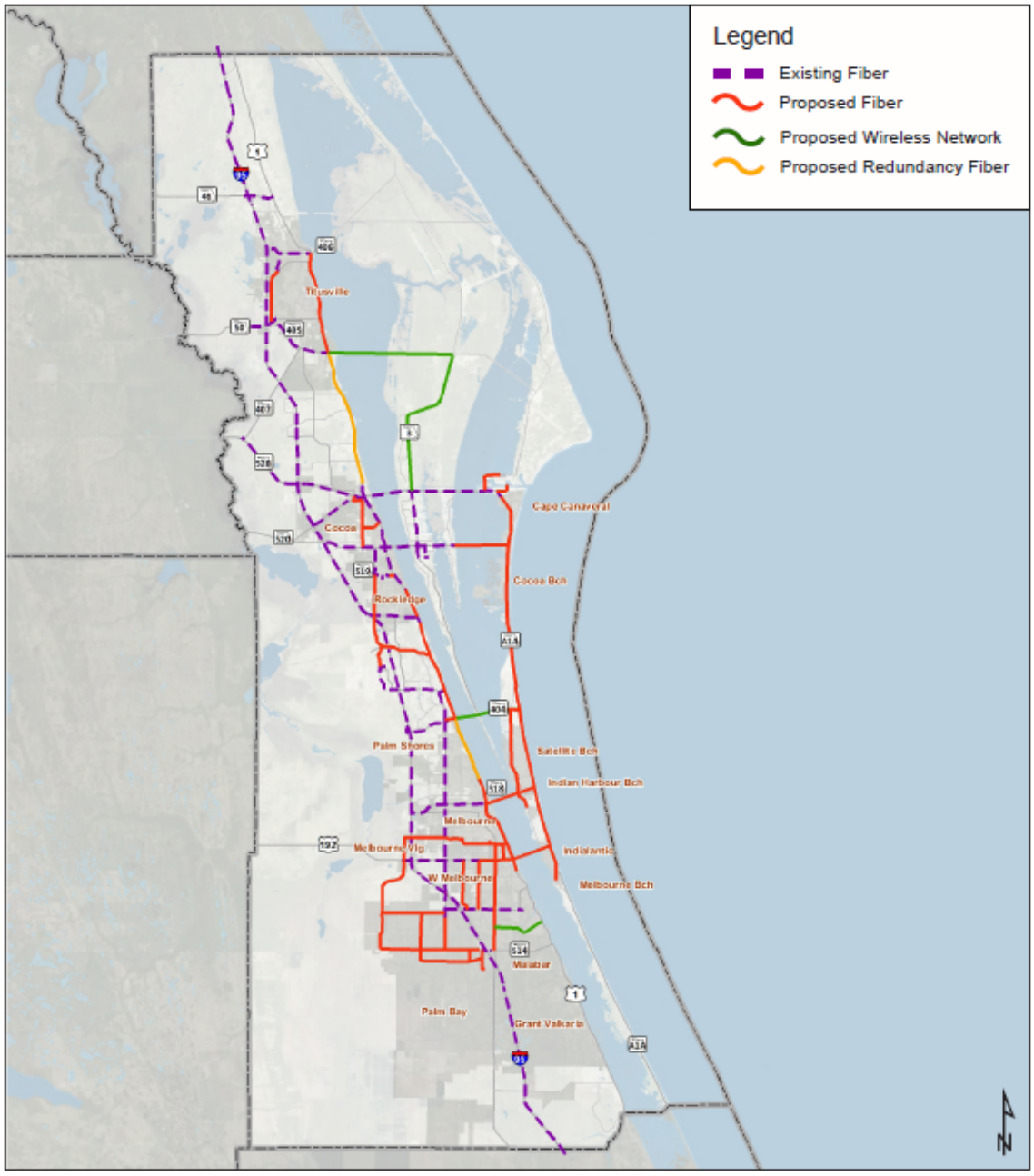


***Figure 113** | Brevard County Adaptive Signals*

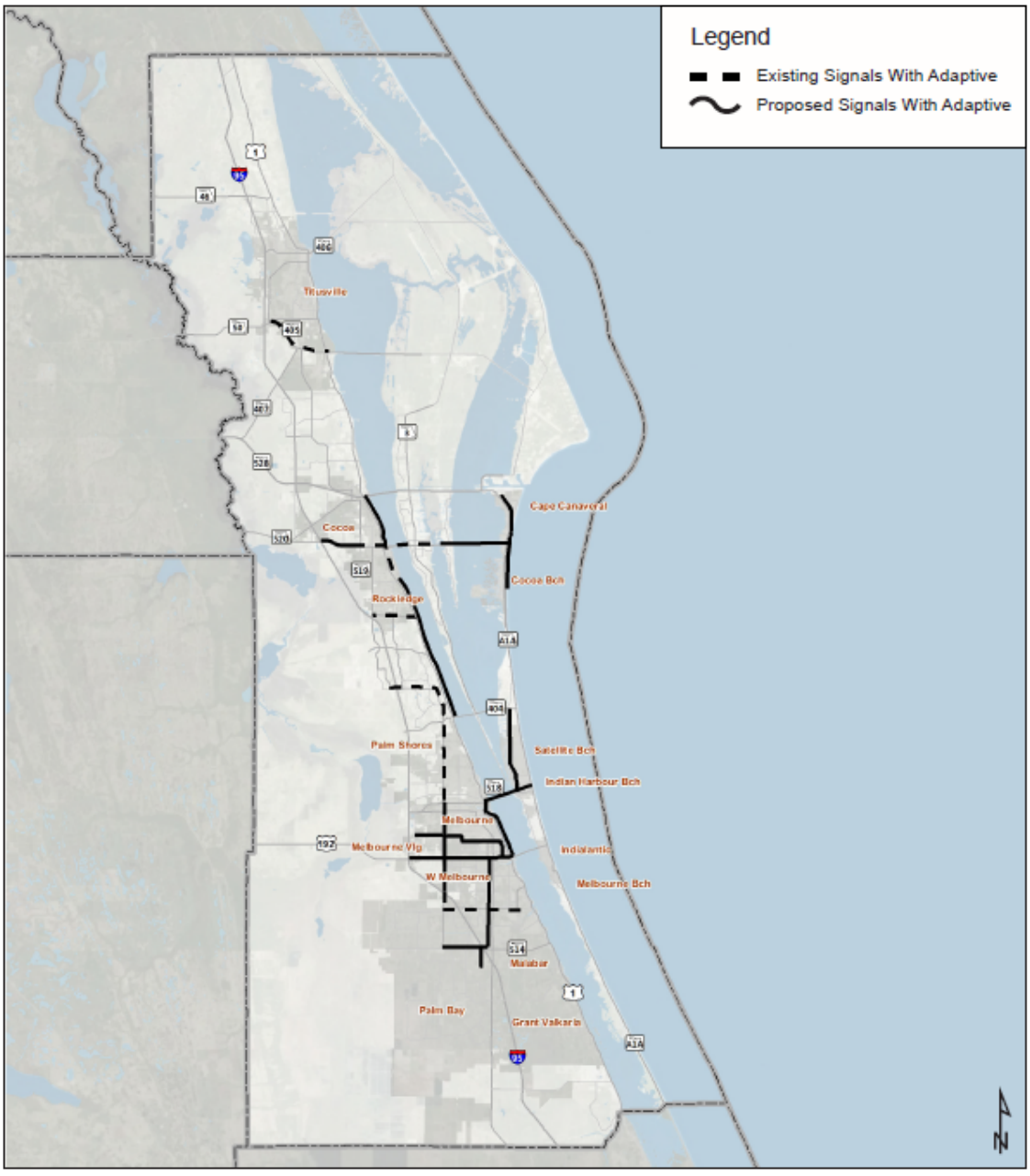


***Figure 114** | ITS Master Plan*

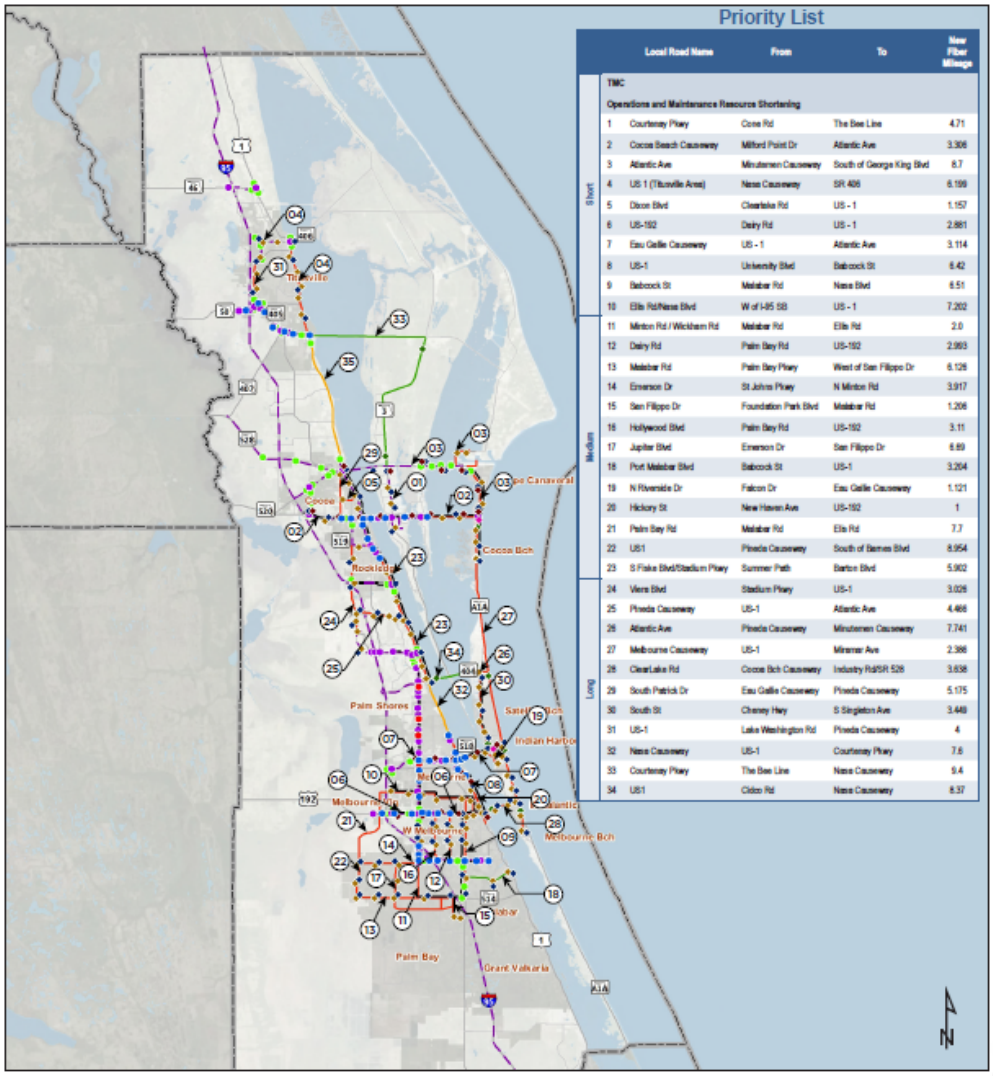


Figure 31 - Overall ITS Master Plan

Legend

- Existing MVDS
- Proposed MVDS
- Existing Bluetooth
- Proposed Bluetooth
- Existing ADMS
- Existing CCTV
- Proposed CCTV
- Proposed RWIS
- Proposed ADMS
- Existing Fiber
- Proposed Fiber
- Proposed Wireless Network
- Proposed Redundancy Fiber
- Existing Adaptive System
- Proposed Adaptive System

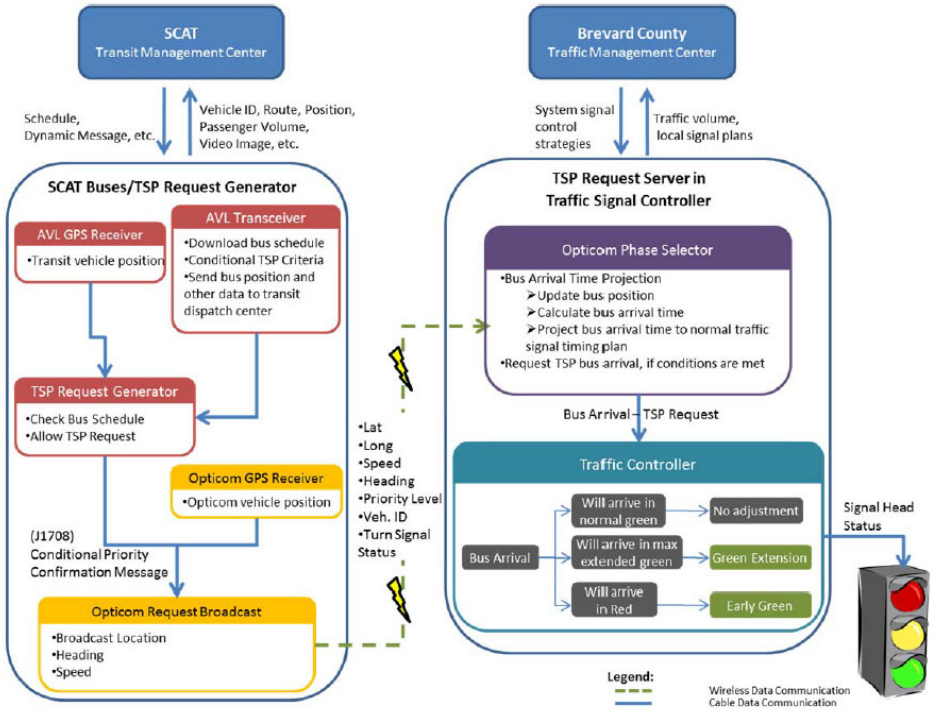
Brevard County ATMS Concept of Operations

In 2015, Brevard County developed a Concept of Operations for its AMTS System. At a high level, the following components are included:

- Traffic signals;
- CCTV;
- Arterial DMS;
- Adaptive signal control;
- Roadway weather stations; and
- Transit signal priority and emergency vehicle pre-emption.

The document includes a physical architecture diagram, **Figure 115**, describing the interactions between the Brevard County TMC and the SCAT TMC. SCAT plans to install automated vehicle location (AVL) on their buses, a key component in the proposed system.

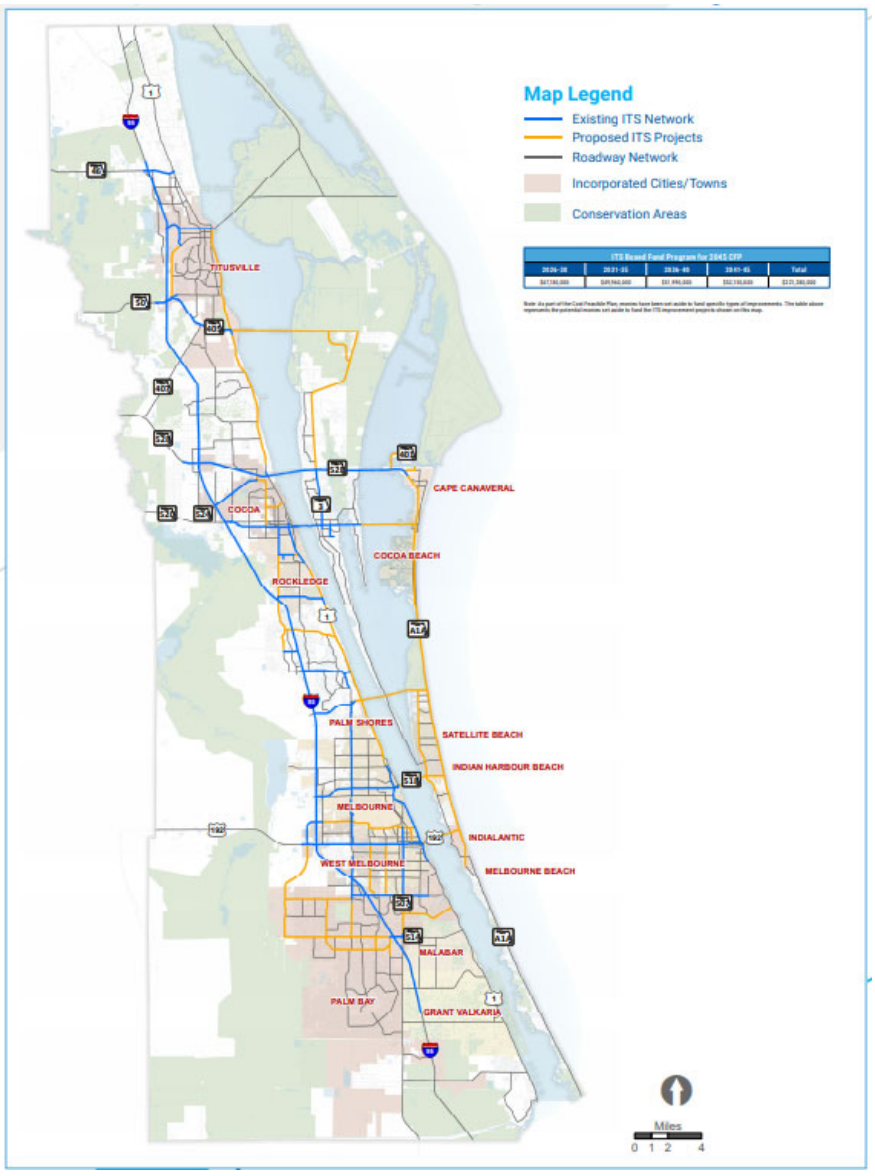
Figure 115 | *ATMS Diagram*



Space Cost Long-Range Transportation Plan Elements

Figure 116 identifies the ITS network for Brevard County.

Figure 116 | *ITS Network*



FDOT District 5 Relevant ITS Projects

Table 26 | *FDOT District 5 Relevant ITS Projects*

Project	Timeframe	Description
Brevard County ITS Phase 1a	**Short**	ITS expansion priority project. CCTV, Travel Time System, Road Weather Information System, Microwave Vehicle Detection System, Signal Upgrade (Adaptive). Area includes Cocoa, Merritt Island and the Titusville area. Includes a new TMC.
Brevard County ITS Phase 2	**Long**	ITS expansion and congestion reduction. Includes CCTV, Travel Time System, Road Weather Information System, Road Weather Information System, Microwave Vehicle Detection System, Signal Upgrade (Adaptive). Area: Throughout the county.
Brevard County ITS - Evacuation Route	**Long**	Upgrade DMS signs to provide public with evacuation and transit related information.
Brevard County ITS Road Ranger	**Medium**	Provide basic Road Ranger service at I-95 in Brevard County.
Brevard County Transit Upgrade	**Short**	Install AVL and APC systems to improve transit system.
Brevard County 511 Plug-in	**Medium**	Incident management: gathered information by TMC operators - communicate emergency response.

Summary of Existing Infrastructure Readiness

Table 27 existing and proposed assets will be beneficial in deploying emerging technologies:

Table 27 | *Existing Assets for Emerging Technologies*

Asset	Status	Relevance
Fiber Network	**Existing / Planned**	Enabling technology for advanced signal, connected vehicle, and smart parking applications
ATMS	**Existing / Planned**	Provides advanced congestion management strategies
Adaptive Signal Control	**Existing / Planned**	Ingests data from multiple sources for real-time signal control based on conditions
DMS on I-95 / Arterial Network	**Existing**	Mechanism for providing traveler information during non-recurring congestion and evacuation events
511 System	**Existing**	Mechanism for providing real-time travel information and trip planning capabilities
AVL on Transit Vehicles	**Planned**	Provides real-time vehicle location and mechanism for transit signal priority

Local Industry Uncertainty

There are several short-term and long-term forces that will impact the Space Coast. Economic shifts may impact the speed of adoption and the types of emerging technologies that will be most beneficial. For example, a dramatic increase in cruise ship traffic may necessitate the aggressive adoption of traffic management technologies to access Port Canaveral from I-95.

Tourism Industry

The COVID-19 global pandemic has upended the tourism industry, with cruise ships and theme parks temporarily shut down and significant declines in airline and hotel use. While these industries are expected to recover in the long-term, the demand for cruise ship travel should be monitored as infrastructure for Port Canaveral is planned and phased.

Space Industry

The space industry is quickly growing, with rocket launches projected to double in 2021 from 2020 numbers. This will increase the need for freight shipments to launch pads, including OS/OW cargo. Space travel could dramatically shift the needs of the space industry. For example, should recreational space travel become commercially viable, launch events will require planning for passenger pick-up and drop-off, much like the cruise industry.

Shipping Industry

Petroleum has historically constituted a significant percentage of cargo shipments at Port Canaveral. In the short-term the demand for petroleum has declined due to decreased travel during the COVID-19 pandemic. In the long-term, transportation electrification could significantly decrease the demand for petroleum products. Potential adoption timelines for electric vehicles (EVs) are further discussed in the section that follows.

Technology Uncertainty

The range of possible future scenarios will pose a challenge to FDOT and its stakeholders. The market share and speed of adoption for technologies such as connected, automated, shared, and electric vehicles will drive investment decisions for supportive infrastructure. All of this will occur against a backdrop of shifts in the local and global economy.

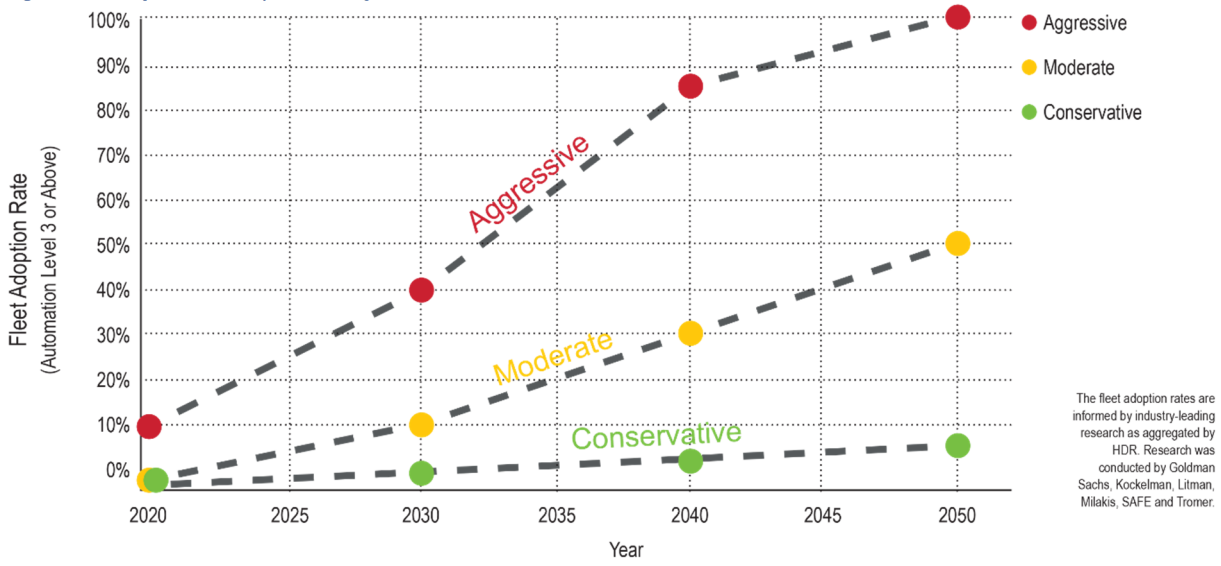
Connected and Automated Vehicle Adoption Trajectories

Projected connected and automated vehicle adoption rates vary widely based on industry uncertainty related to the following factors:

- A dominant protocol for connected vehicle technology has not yet emerged. Dedicated short-range communications (DSRC) was originally seen as the likely protocol, with U.S. DOT planning to mandate the technologies on new vehicles starting in the early 2020s. The agency has since backed away from that mandate to give cellular vehicle-to-everything (C-V2X) technology time to mature. Should the Federal Communications Commission (FCC) release the DSRC spectrum, C-V2X is likely to proliferate.

- Automated vehicle technology has not matured as quickly as originally projected. Automakers originally predicted widespread availability of Level 3 automated vehicles starting around 2020, but that has not materialized. **Figure 117** illustrates a range of potential trajectories for AV adoption. Once the technology matures and proliferates throughout the vehicle fleet, adoption may quickly increase based on typical fleet turnover assumptions.

Figure 117 | *Fleet Adoption Projections*



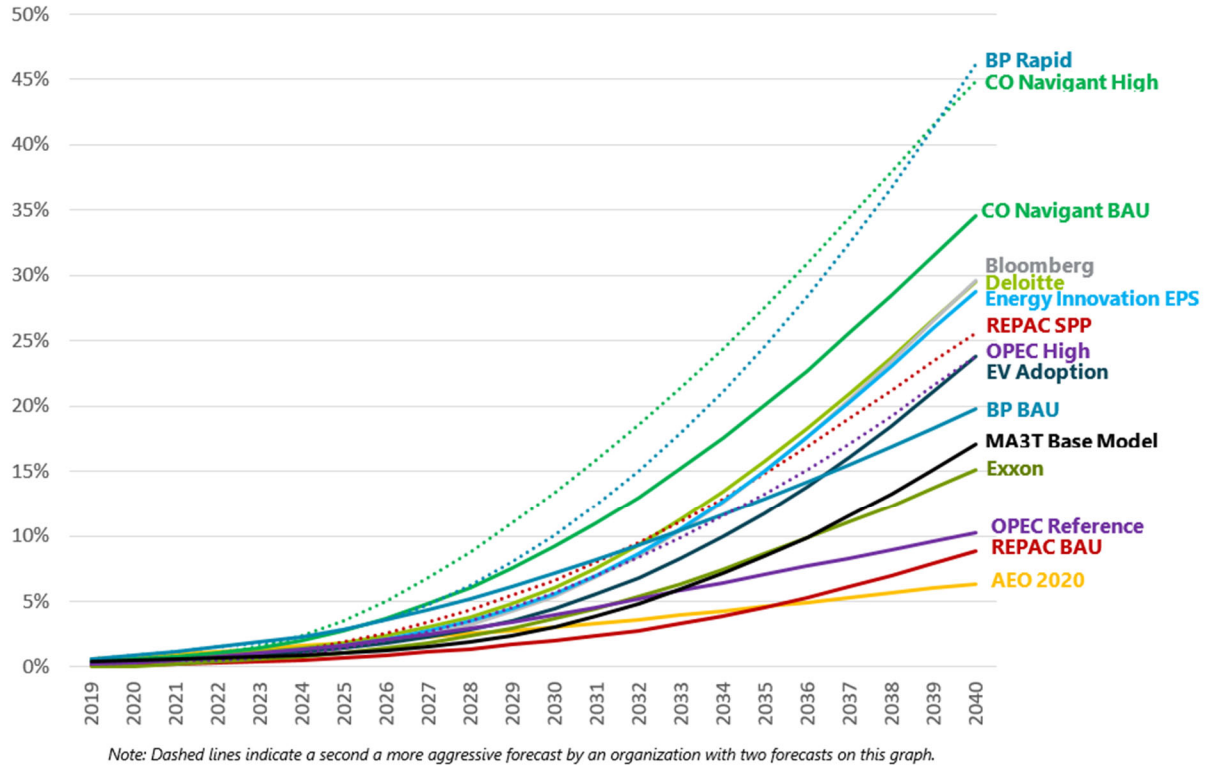
Truck platooning, which utilizes a combination of connected vehicle technology to transmit the driving inputs of a lead truck, and automated vehicle technologies to mimic these inputs in a series of following trucks, is currently at a prototype and testing stage. One differentiator that may point to faster adoption is that platooning relies on relatively low-level automated vehicle technologies. Fuel savings from platooning and decreased driver fatigue may create an advantageous cost-benefit ratio for the freight industry once the technology is more widely available.

Uncertainty about connected and automated vehicle adoption in the coming decades will impact investment decisions in supportive infrastructure such as communications and power, ITS field devices, back-office support, and user-facing applications. These investments are discussed in the section that follows.

Vehicle Electrification

Electric vehicles (EVs) are expected to rapidly increase, as shown in **Figure 118**, in market share in the coming decades: by the year 2040, adoption could be as high as 45 percent. EVs will create a shift from petroleum refueling infrastructure to EV supply equipment (EVSE), which will vastly increase power requirements both on long-distance highway corridors and at local destinations of interest. Potential EV investments are further discussed in the section that follows.

***Figure 118** | EV Projections*



Note: Dashed lines indicate a second a more aggressive forecast by an organization with two forecasts on this graph.

Port Automation and Electrification

Ports present an ideal use case for early deployment of emerging technologies due to the relatively small geographic footprint and high number of potential conflicts. Connected and automated technologies may be applied to yard tractors, cranes, and other freight terminal vehicles to improve

efficiency and reduce potential safety incidents. These vehicles may also be suitable for electrification due to the ease of locating accessible charging equipment and the relatively short distances terminal vehicles travel in a day.

Potential Solutions

Signalized Corridor Upgrades

Adaptive Signal Control

The Space Coast TPO has already installed adaptive signal systems on corridors in the study area and plans to expand this coverage. Key considerations in enhancing the network over time include prioritizing freight vehicles and expanding coverage to include corridors used by cruise ship traffic and launch event viewers.

Connected Vehicle Readiness

Brevard County has a robust fiber network, with existing or planned coverage on I-95 and the arterial network. As fiber installation and signal upgrades are made, this presents an opportunity to install connected vehicle roadside units (RSUs) or develop specifications to make them connected vehicle ready. While there are dozens of potential applications that could be deploy, **Table 28** lists the most relevant to the Space Coast Freight Subarea.

***Table 28** | Connected Vehicle Applications*

Type	Application	Rationale
V2I Safety	**Red Light Violation Warning**	Aids in preventing red light running
	Pedestrian in Crosswalk Warning	Provides additional layer of protection for pedestrians at signalized intersections and mid-block crosswalks
V2I Mobility	**Advanced Traveler Information System**	Creates in-vehicle mechanism for providing traffic alerts from 511 system
	Signal Priority	Provides low-cost mechanism for providing freight or transit signal priority on equipped corridors
	Emergency Vehicle Preemption	Provides low-cost mechanism for providing emergency vehicle preemption on equipped corridors
	Dynamic Speed Harmonization	Maximizes highway capacity during congestion events
	Queue Warning	Prevents end of queue collisions during congestion events
	Emergency Communications for Evacuation	Creates in-vehicle mechanism for providing evacuation guidance during emergency events
	Freight-Specific Dynamic Travel Planning	Enhances traveler information from other sources by adding wait times at ports, road closures, work zones, and route restrictions

Freight Signal Priority

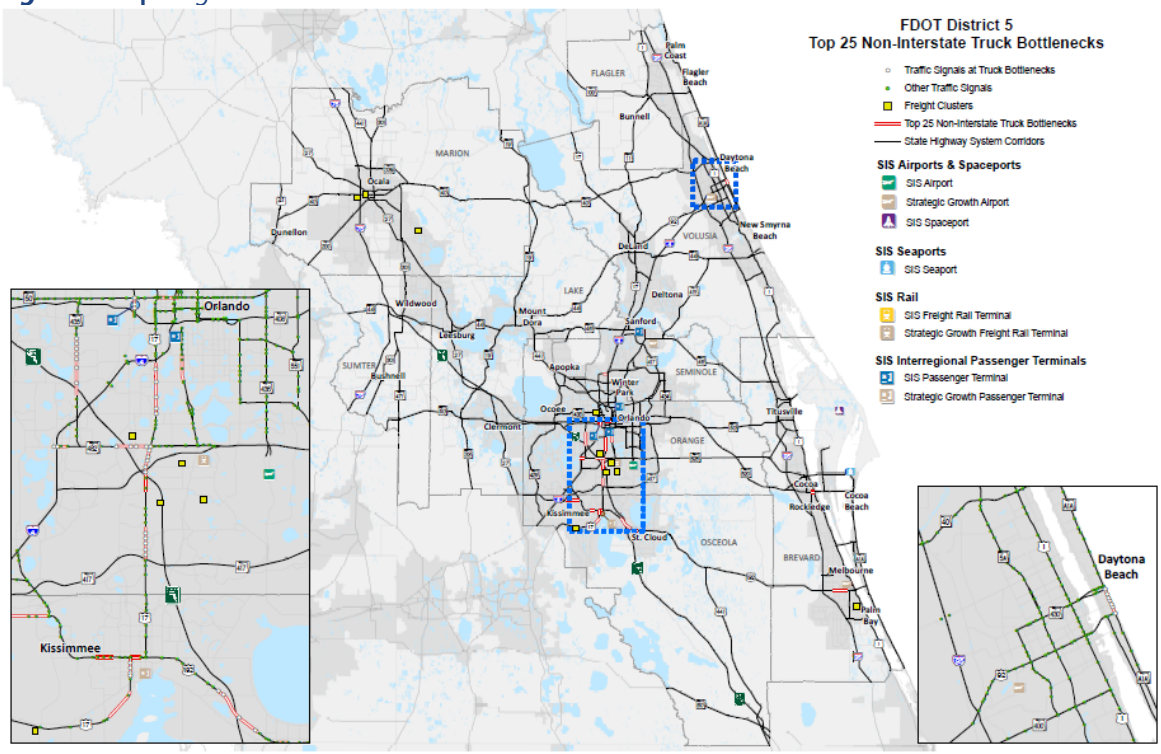
The Brevard County ATMS Concept of Operations describes the physical architecture for transit signal priority in the county, with AVL on transit vehicles planned in the ITS Master Plan. This architecture could also provide a potential mechanism for granting signal priority to freight vehicles.

- SR 520 east of I-95
- US 192 east of I-95

Figure 119 shows the Top 25 freight bottlenecks in District 5, with two in the study area:

- SR 520 east of I-95
- US 192 east of I-95

***Figure 119** | Freight Bottlenecks*



Short-term installation of freight signal priority is recommended on both of these east-west corridors. Traditional detection methods include line-of-sight emitters, localized radio units, and GPS units. Each of these require the installation of a device on freight vehicles, making these methods most suitable for vehicles that frequently travel the corridor. Connected vehicle radio units can also be used to grant freight signal priority. Other types of detection, such as video or weight-based vehicle classification could be used to avoid the installation of specialized equipment on trucks. These methods may have degraded accuracy compared to on-vehicle technologies.

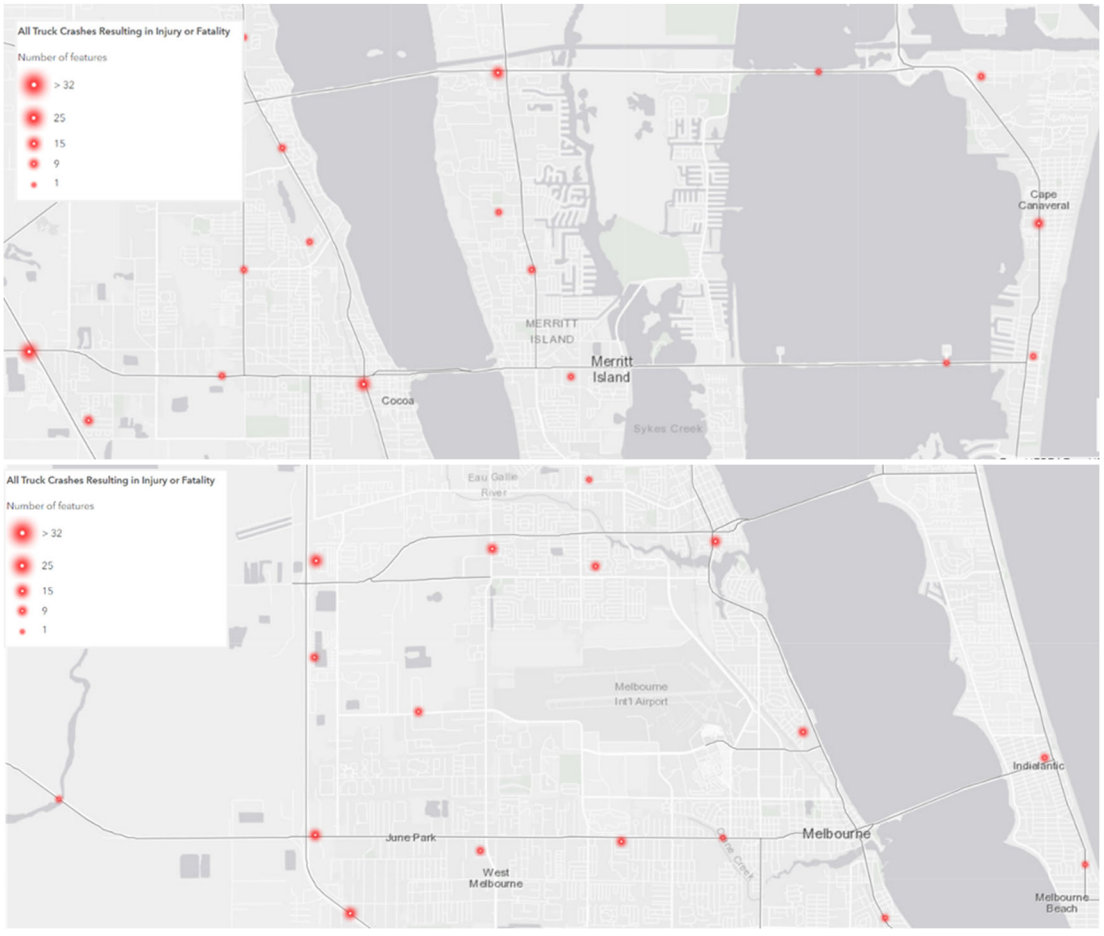
Intersection Safety Applications

One advantage of a connected vehicle solution is the potential for deploying other recommended applications in the table above. In addition to the V2I safety applications above (red light violation warning, pedestrian in crosswalk warning), V2V applications will increase in effectiveness as fleet

penetration increases. Other potential connected vehicle safety applications include left turn assist and intersection movement assist. **Figure 120** show the prevalence of truck crashes resulting in injury or fatality. Many of these crashes occur at signalized intersections. Based on the data, installation of roadside units for intersection safety is recommended along the following east-west corridors:

- SR 528 / SR A1A east of I-95; SR 520 east of I-95; and SR 192 east of I-95

***Figure 120** | Truck Crashes*



Dynamic Event Routing

Dynamic event routing involves ingesting real-time data about traffic conditions and providing optimal routing to drivers. The Space Coast TPO ITS Master Plan identifies several key elements in developing the requisite environment to provide this routing effectively:

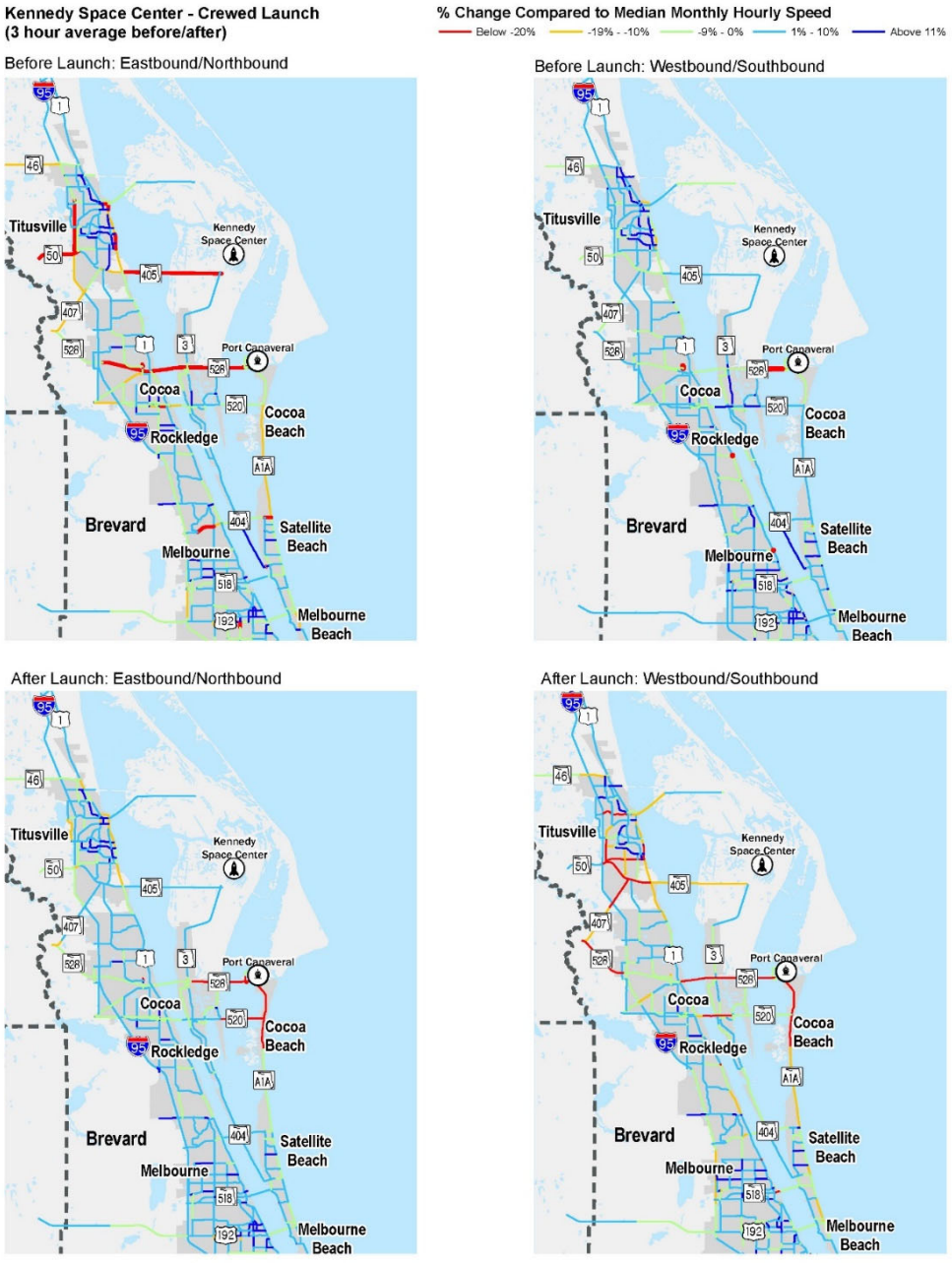
- Roadway conditions monitoring including video and MVDS;
- Arterial DMS;
- Traveller information outputs to 511 system and third-party applications; and
- ATMS with adaptive signal control capabilities.

These assets can be leveraged to provide real-time routing information to drivers during launch events, the arrival and departure of cruise ships, traffic incidents, and emergency evacuations. To advance this concept the Space Coast could develop a concept of operations to identify use case scenarios, data flows, and any remaining infrastructure or software gaps required to provide real-time dynamic routing. **Figure 121** below shows typical launch event congestion for crewed launches.

Based on current conditions, the installation of dynamic event routing via DMS and Florida 411 is recommended along east-west corridors connecting to I-95:

- SR 528 / SR A1A
- SR 520
- SR 405

***Figure 121** | Crewed Launch Congestion*



Highway Corridor Upgrades

Speed Harmonization and Queue Warning

Speed Harmonization and Queue Warning can alleviate both recurring and non-recurring congestion by smoothing traffic flow, increasing throughput, and reducing end of queue crashes. These applications are often deployed simultaneously because both make decisions using the same data using the following steps:

- Traffic sensors and roadside units monitor travel speeds for slowdowns;
- A slow down is detected and an algorithm determines the appropriate response;
- If merited, a lower speed limit is presented to drivers via roadside signage and on-board units to smooth traffic flows and maximize roadway capacity; and
- If an extreme slow down occurs, a queue warning can be presented to drivers by the same methods.

Even at relatively low connected vehicle penetration rates these applications can present effective warnings based on the granularity of data provided by on-board units. Both applications can be deployed without connected vehicle technology by using speed detection sensors, dynamic speed limit signage, and roadside queue warning alerts.

Future congestion is expected along the majority of I-95. Even with aggressive adoption of CAV technology, congestion is still projected along I-95, with a continuous segment of congestion projected from SR 406/Garden Street to Stuckway Road. A long-term recommendation is the implementation of speed harmonization along this segment to maximize capacity and improve the effectiveness of CAV platooning (the formation of vehicles into groups with a lead vehicle and one or more vehicles that follow at close headways). While platooning will be enabled primarily by automated and V2V communication technologies, infrastructure-provided speed recommendations yield additional capacity while providing a benefit to drivers of self-operated vehicles

Truck Platooning Considerations

Truck platooning is most likely to occur on highway corridors as it is most effective over longer distances. While V2V communications to enable platooning will not require infrastructure communications investments, potential considerations for platooning include:

- Number of lanes in each direction;
- Bridge load capacity (platooning trucks will follow more closely than is modelled when designing bridges);
- Pavement structure (vehicles in platoons may degrade pavement more quickly than vehicles traveling individually);
- Opportunities for dedicated lanes, including shoulder use.

A future inventory of the above assets is recommended to identify whether I-95 is suitable for truck platooning.

EV Charging for Long Distance Travel

Both personal and freight vehicles are expected to see an increase in EV market share in the coming years. FDOT is currently developing an Electric Vehicle Master Plan (EVMP). One key goal for this initiative is to establish a network of electric vehicle supply equipment (EVSE) on long-distance travel corridors such as I-95. As the technology matures, in-ground inductive charging may be installed on highway corridors to allow vehicles to charge as they drive instead of pulling over to re-fuel. As a short-term strategy, power needs for EVSE at rest areas and truck stops should be considered, while the supportive infrastructure for inductive charging should be a long-term consideration.

FDOT has evaluated the need for EVSE for long distance travel as part of its *Electric Vehicle Infrastructure Master Plan*. Installation of EVSE along I-95 is recommended at the locations recommended in this report.

Evacuation and Emergency Support Technologies

Connected Autonomous Vehicles (CAVs) will enable a mechanism for providing in-vehicle evacuation instructions. Additionally, they can serve as a data point for real-time traffic conditions. Automated vehicles may present unique data requirements for evacuations, particularly when operating in contraflow lane reversal scenarios. Signage and striping should clearly communicate traffic control instructions to vehicles traveling in the reverse direction; connected vehicle traveller information messages can also be used to supplement signage with temporary evacuation instructions to drivers and vehicles.

Evacuations will require special considerations for EVs, which require more frequent refueling than internal combustion vehicles. As part of the EVMP currently being developed by FDOT, evacuation routes are a key consideration for the location of EVSE. Mobile charging trucks that can be deployed during evacuation events should also be considered.

Managing Launch Event and Cruise Ship Parking

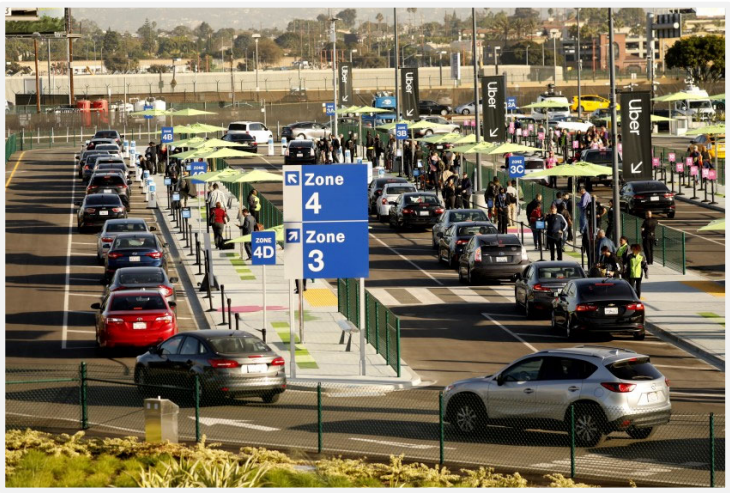
Regionally Coordinated Smart Parking

Parking during launch events is a significant cause of non-recurring congestion in the region. Several cities have installed parking occupancy detection technologies to provide real-time data on availability using in-ground sensors or video detection. While in-ground sensors can provide accurate information on a space-by-space basis, they are prone to damage and can result in false readings. Video detection can provide coverage for multiple parking spaces but requires more sophisticated electric and communications infrastructure. Availability can be provided to drivers by smartphone app, dynamic wayfinding signage, or both. Some existing applications, typically those covering private garages in central business districts, allow users to reserve a space.

Implementing smart parking will be most effective if done at a network or regional basis to maximize parking options, which will require buy-in from multiple public agencies as well as private parking lot and garage owners.

Smart Curbside Pick-Up and Drop-Off

As automated and shared transportation increases in market share, arrival and departure from cruise ships and launch events may shift from people driving and parking to utilizing ridehailing services such as Uber and Lyft. While this will decrease parking demand, it will shift competition for space to the curb and create new problems. The congestion observed at airport pick-up and drop-off lanes is indicative of how this congestion may play out.



Recognizing that current curbside capacity cannot accommodate the existing demand for ridehailing, several airports have converted a portion of parking into pick-up and drop off zones. When a passenger requests a ride, they are directed to a space to meet their driver. This model could be applied to cruise passengers or viewers of launch events.

Support for Community EV Charging

Beyond long-distance EV charging support on I-95, short-term charging must be considered, particularly for cruise terminal and launch event viewing parking. If EV market share increases along the most aggressive projection, nearly half of the vehicle fleet will be electric in 2040. An inventory of parking and electric supply should be conducted to determine which lots and garages will be best able to support EV charging. Level 1 charging will be sufficient for long-term cruise ship parking, while DC Fast Charging may be required for launch events and beach parking.

Improvement Opportunities

Arterial Corridors

Installation of arterial corridor connected vehicle technology is recommended to support several applications:

- Freight signal priority is recommended along the following corridors:
  - SR 520 east of I-95
  - US 192 east of I-95
- Intersection mobility and safety applications are recommended along the following corridors:
  - SR 528 / SR A1A east of I-95
  - SR 520 east of I-95
  - SR 192 east of I-95
- Alternate routing support for launch events, cruise terminals, and evacuation and emergency events is recommended along the following corridors:
  - SR 528 / SR A1A east of I-95
  - SR 520 east of I-95
  - SR 405 east of I-95

Highway Corridors

Installation of connected vehicle infrastructure to support highway applications including dynamic speed harmonization and queue warning along I-95, with a particular focus on the segment from SR 406/ Garden Street to Stuckway Road. In support of future truck platooning operations, an evaluation of infrastructure readiness to support significantly decreased truck headways is also recommended. Installation of long-distance EVSE is recommended in accordance with the FDOT EVMP. Finally, special consideration should be given to the data needs of CAVs and the charging needs of EVs during evacuation and emergency events.

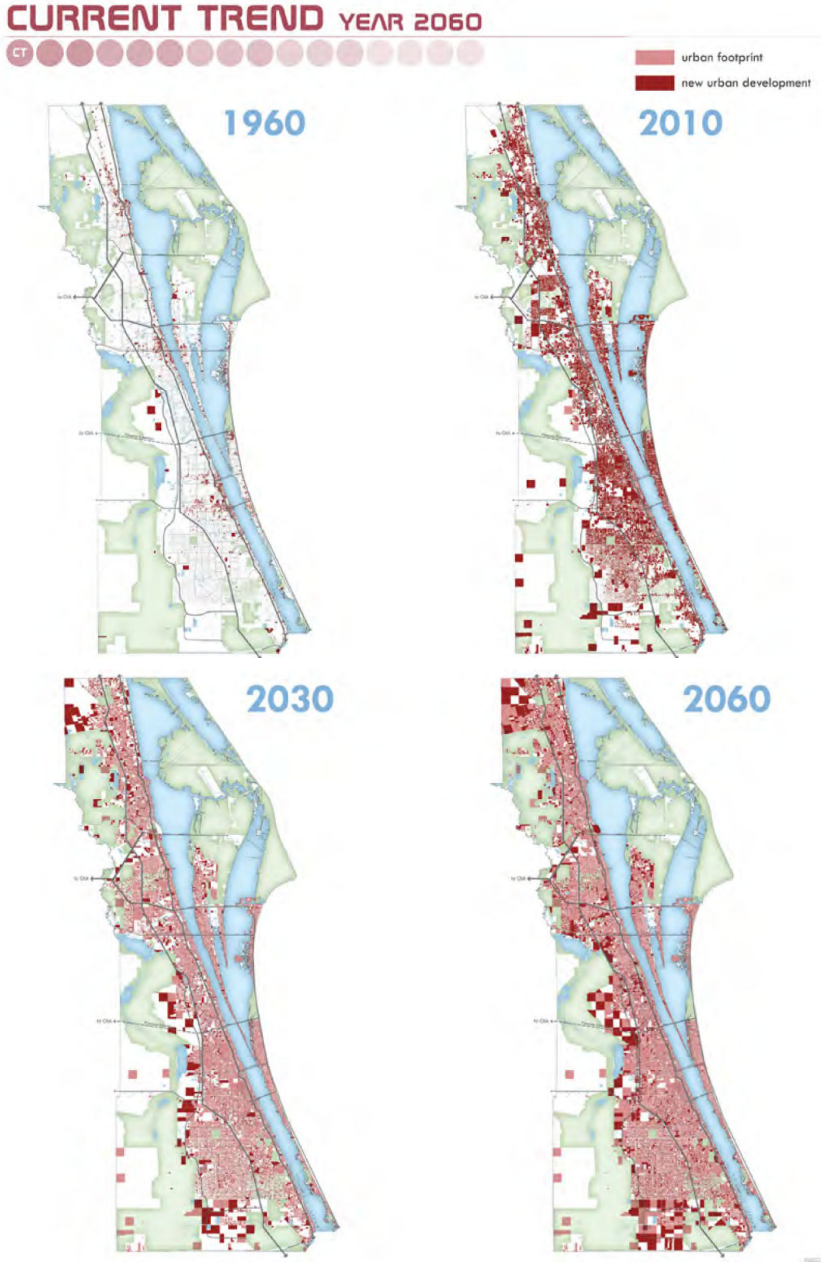
Managing Launch Event and Cruise Ship Parking

The development of a regional approach for smart parking is recommended to support cruise terminal traffic and launch day events in and around the KSC Visitors Complex. Additionally, the installation of community charging is recommended in accordance with the EVMP.

RECOMMENDATIONS

This effort has identified mobility issues the Space Coast Super Region faces now and with anticipated growth. Given the importance freight plays in the area's economy, it is crucial to understand these issues and provide practical, actionable solutions that the area's transportation planning community can implement. The key freight issues include truck safety and bottlenecks, oversized/overweight cargo movement, and launch activity impacts. These issues are summarized in this section, incorporating stakeholder feedback, and highlighting potential projects. This is followed by near- and long-term actionable recommendations, which help meet the regional vision for freight. The base scenario, or current trend scenario, developed for the Space Coast TPO 2040 LRTP (**Figure 122**) illustrates the anticipated growth for Brevard County. Considering this along with the issues described in this report illustrates the need for proactive solutions if the region is to meet the Super Region Freight Vision and for the LRTPs vision of Port Centers, High Tech Lifestyles, and Connected Communities.

***Figure 122** | Space Coast Scenario Growth*



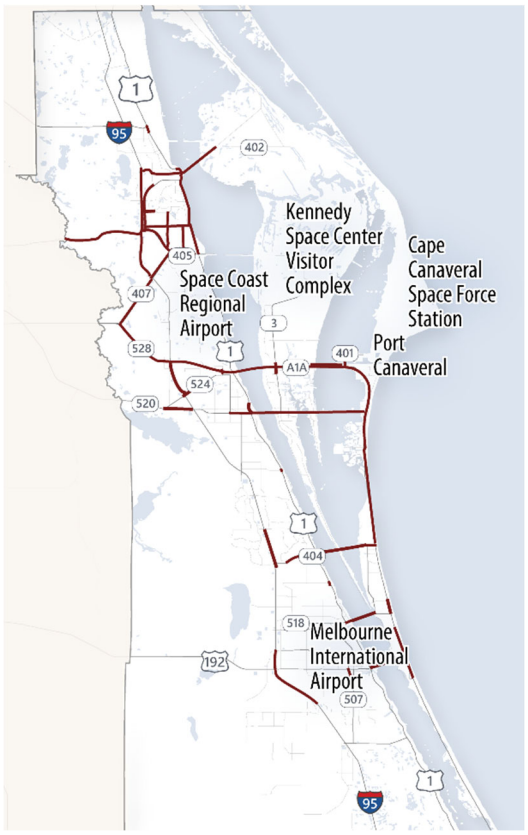
Short-Term Recommendations

Address Non-Recurring Congestion from Space Launch Activities

Spectators congregate throughout Brevard County to watch launches from the Spaceport. Resulting traffic tends to occur along causeways and bridges, around communities such as Titusville and Cocoa Beach, and along key roadways such as US 1 and SR A1A (**Figure 123** | **Launch Impacts**). Crewed launches result in travel speed decreases of 20 percent on roads nearest to the launch facilities undertaking the launch (approx. 5 percent of the network). Key areas include:

- SR 528/SR A1A before/after a crewed launch had traffic volumes increase by 50 percent.
- Several roadway network areas important to freight are impacted by crewed launches – specifically SR 528, SR 407, SR 405, SR A1A, SR 401.
- SR 528/SR A1A before/after a satellite launch combined with multiple cruise arrivals/departures had traffic counts increase by about 60 percent.

***Figure 123** | Launch Impacts*



Given these conditions, launch traffic may be impacting freight movements. The following is recommended to address this challenge:

- Use Intelligent Transportation Systems (ITS) to coordinate event travel between I-95 and launch viewing locations. Install dynamic message signage (DMS) and parking occupancy sensors at designated parking sites and along SR 520, SR 528/SR A1A, SR 407/SR 405, and US 1. Incorporate into current SR 528 Widening and Indian River Bridge/Space Commerce Way Replacement & Improvements.
- To reduce event traffic impacts on local roads, identify a remote parking site (west of I-95 for visitors and within Cocoa Beach/Titusville for locals) and provide shuttle services to and from launch

viewing areas. Prioritize enforcement to address safety and prevent parking in a hazardous manner along SR 528, SR A1A, US 1, and NASA Causeway/SR 405. Add mobility hubs near popular launch viewing areas, cruise terminals, and airports for local access to alternative modes.

Improve Recurring Congestion in Region Causing Truck Bottlenecks

While congestion is not currently a major issue for the region, there are some freight bottlenecks. Truck bottlenecks occur around the region's airports, along US 1 in New Smyrna Beach, Cocoa, and Viera Blvd., and along I-95, especially at the interchanges of I-4, SR 40, SR 421, SR 44, US 192, and SR 514. The project scenario modeling illustrated that anticipated growth in the immediate area and in the Volusia County region will impact roadways starting in 2045 and compounding by 2065. This growth will lead to more congestion potentially impacting area industries. The Space Coast TPO's Vision activity centers may be compromised with current bottleneck conditions intensifying, including the Melbourne International Airport, which is anticipated to become a multimodal freight hub. To address this recurring congestion, the following is recommended:

- Incorporate freight signal priority (**Figure 124** | **Freight Signal Priority**) into current projects: Ellis Road Widening, Indian River Bridge Replacement/Space Commerce Way Widening & Improvements, and SR 528 Widening. Evaluate key east-west corridors (SR 520 east of I-95, and US 192 east of I-95) and facilities close to ports (SR 3, SR A1A, SR 401) for implementation.
- Reduce personal automobile traffic through travel demand management (TDM) incentives activating carpool, vanpool, transit, rideshare and active transportation along freight corridors and implementation of proposed Bus Rapid Transit (BRT) routes: US 1, SR 528, SR 520, SR A1A, and Wickham Road.

***Figure 124** | Freight Signal Priority*

Improve Safety Conditions at Truck Crash Hotspots

Truck crash hotspots are located along key space industry routes including I-95 and SR 528/ SR A1A. Other high crash locations near freight activity centers include the I-4 at I-95 interchange, I-95 at US 1 interchange, and SR 528 at SR 3 interchange. More in-depth analysis is needed at the segment and intersection level but there are several safety countermeasures that can be applied to address issues including:

- Rumble Strips
- Truck Restrictive Lanes
- Virtual Weigh Stations
- Flatten Curve
- High Friction Surface Treatments
- Static Warning Signs
- Updating Retroreflective Traffic Signs
- Dynamic Warning Signs
- Truck Rollover Warning Systems
- Contrast Marking
- Horizontal Signing
- Traffic Incident Management
- Truck Parking Availability Systems

To begin to address truck crash hotspots, the following is recommended:

- Incorporate freight safety countermeasures into current projects: SR 528 Widening, I-95 at US 1 PD&E, SR A1A –Misc./Intersection Realignment/ New 2 lane Rd/Curb Gutter/Safety/Signal improvements.
- Intersection mobility and safety applications can be used on the following corridors: SR 528 / SR A1A east of I-95, SR 520 east of I-95 and SR 192 east of I-95; SR 3 at SR A1A and SR 405 (crossovers specifically noted as issue) at US 1.

Designate Oversize/Overweight (OS/OW) Routes

Supporting the regional movement of OS/OW cargo is critical for many area industries to transport components for rockets, satellites, and more. Several challenges exist for OS/OW transport, for example most OS/OW movement originates or is destined for Cape Canaveral. Most commercial cargo must use the south entrance to Port Canaveral due to security protocols and getting to this entrance can be a challenge for cargo coming from the north. These OS/OW movements must often take illogical, out-of-the-way paths to avoid restrictive routes, bridges, and overpasses. Other OS/OW issues include:

- Traveling through areas with small turning radii including the South Intermodal Area of Port Canaveral.
- Using narrow corridors including NASA Parkway West and where Space Commerce Way tapers into two lanes.
- Navigating Diverging Diamond Interchanges SR 528 and SR 3, and at SR 528 and George King Boulevard (to access Port Canaveral).
- Using the cloverleaf to access north Port Canaveral and CCAFS at WB SR 528 to NB SR 401.
- Bridge/overpass height restrictions at Port St. John Parkway and Citrus Boulevard overpasses going south on I-95 to reach SR 528; also, there may be issues with the SR 528 overpass to continue NB on SR 401.

***Figure 125** | OS/OW Route Ideas*

With increased space launches, streamlined, OS/OW supporting, direct routes will be needed. To address OS/OW issues, the following is recommended:

- Designate Super Haul Routes/Corridors with flexible features (**Figure 125 | OS/OW Route Ideas**) like swivel mast arms, removable/flexible signage, truck aprons, flexible median/zipper barriers, etc. Candidates include: SR 405, SR 528, US 1, and SR

3. The stakeholders should study OS/OW restrictions to eliminate circuitous routing. Areas of concern for study include Port. St. John Parkway and Citrus Boulevard overpasses. As key freight corridors are reconstructed in the future, ensure they are designed to handle the oversize/overweight needs of the region.

- Incorporate OS/OW freight needs into the following projects and advance SR A1A – Misc./Intersection Realignment/New 2 lane Road/Curb Gutter/Safety/Signal improvements, SR 528 Widening, SR 401 Bridge Replacement, and I-95 Widening.
- Support secondary route for Cape Canaveral launches, specifically improving Roy Bridges Jr. Bridge to accommodate OS/OW movements to the base.
- Improve access to maritime facilities (on the land and water side) to allow oversized moves that could be completed by barge to shift from highways.

Advance Regionally Significant Priority Projects by Identifying Construction Funding

With the availability of additional formula and discretionary funding opportunities through the Infrastructure Investment and Jobs Act, the regional partners should collaborate to secure construction funding for regionally significant priority projects.

Space Coast TPO

- Ellis Road Widening
- Babcock Street Widening
- Malabar Road Widening
- SR 528 Widening
- SR 401 Bridge Replacement over Canaveral Barge Canal
- SR A1A Multimodal Corridor Improvements
- Rail highway crossing safety projects

River to Sea TPO

- I-4 BtU
- Widening of SR15, SR40, and SR100

- I-95 Interchanges at LPGA, US1, Pioneer Trail, and SR44

Long-Term Recommendations

Provide a Direct, High Capacity, Freight Corridor Facility to Ports

With future acceleration in launch activities, reliable and direct transport of cargo to the ports is vital to maintain the region's prominence in the aerospace industry. To prepare for this, it is recommended to conduct a feasibility study to identify direct, high capacity, limited access facilities from I-95/SR 528 to the ports. The study should consider a facility which:

- Is freight focused while accommodating passenger vehicles.
- Uses time of day freight priority treatments (e.g., movable medians and freight signal priority) to facilitate fast, off peak deliveries (both standard shipments and OS/OW cargo).
- Incorporates waterside and landside connectivity for cargo to come of off barges, or other vessels and go to the launch facilities directly.
- Separates freight and passenger traffic closer to the ports and equip with technology enabled infrastructure.

Enhance and Leverage Multimodal Freight Infrastructure Including Water, Air, and Rail

Private industry partners should have more choices into and out of the ports other than just highway. Better utilization of water and air to reach the port should be considered. In addition, preparing for future modes of transport including vTOL, urban air mobility, point-to-point space travel, etc. should be considered. It is recommended to conduct a study to develop a multimodal freight network that can improve goods movement in and out of the region. This may include the use of NASA railway and area waterways. Future modes like vertiports and space point-to-point cargo transport should also be considered. Additionally, consider transport connecting to offshore launch facilities. Review tradeoffs and potential constraints, for example, use of drawbridges impacting roadway congestion across the Canaveral barge canal.

Near-Source Rocket and Satellite Manufacturing and Assembly

The demand for faster delivery of space components can be addressed if they are manufactured and assembled closer to launch operations. There has already been significant progress in this area, and it is recommended that Space Florida continue to attract industry partners and incentivize near-source rocket and satellite manufacturing and assembly targeting development sites in the area that allow for streamlined connections to the ports. This includes the undeveloped acres in the Spaceport Commerce Business Park and the utility corridor around Cape Canaveral, which recently signed Terran Orbital as the first tenant. Work with educational institutions within the Central Florida High-Tech Corridor like Embry-Riddle Aeronautical University, University of Central Florida, and area state and private colleges to develop workforce of the future.

Develop Automated Freight Corridors between Major Freight Origin and Destination Centers

Movement of cargo can be automated and accomplished through innovative, flexible alternatives to avoid congestion. As freight activities in the area grow and new freight activity centers emerge, automated corridors between major activity centers can offer improved efficiency of the system. Technology considerations may include freight shuttle express, hyperloop freight, and automated freight highways, shown in **Figure 126 | Examples of Automated Corridor Technology**.

Figure 126 | *Examples of Automated Corridor Technology*

Establish Direct Corridors between Activity Centers to Enhance System Connectivity and Accessibility for both Passenger and Freight

Lack of direct connections between major activity centers creates longer trips and congestion bottlenecks. To improve congestion and travel time between the Space Coast and Central Florida, consider developing a new direct b corridor between the Orlando and Melbourne areas.

Reduce Personal Vehicle Traffic Along Major Freight Routes Leading to the Ports

Develop strategies to prioritize cargo movement while shifting personal travel to other modes of transportation along freight routes. Identify a package of mobility solutions to encourage mode shift including transit, land use controls, incentives, strategic/controlled parking, etc.

All the recommendations along with the issues they address and potential agencies for leading implementation are identified in **Table 29.**

***Table 29** | Matrix of Recommendations*

Recommendation	Projects to Advance/Studies to Conduct	Non-Recurring Congestion	Recurring Congestion	Safety	OS/OW	Growth
Short-Term Recommendations						
Address Non-Recurring Congestion from Space Launch Activities	Use Intelligent Transportation Systems (ITS) to coordinate event travel between I-95 and launch viewing locations. Install dynamic message signage (DMS) and parking occupancy sensors at designated parking sites and along SR 520, SR 528/SR A1A, SR 407/SR 405, and US 1. Incorporate into current projects of SR 528 Widening and Indian River Bridge/Space Commerce Way Replacement & Improvements.	x	x			
	To reduce event traffic impacts on local roads, identify a remote parking site (west of I-95 for visitors and within Cocoa Beach/Titusville for locals) and provide shuttle services to and from launch viewing areas. Prioritize enforcement to address safety and prevent parking in a hazardous manner along SR 528, SR A1A, US 1, and NASA Causeway/SR 405. Add mobility hubs near popular launch viewing areas, cruise terminals, and airports for local access to alternative modes.	x	x			
Improve Recurring Congestion in Region causing Truck Bottlenecks	Incorporate freight signal priority into current projects: Ellis Rd Widening, Indian River Bridge Replacement/Space Commerce Way Widening & Improvements, and SR 528 Widening Evaluate key east-west corridors (SR 520 east of I-95, and US 192 east of I-95) and facilities close to the ports (SR 3, SR A1A) for implementation.	x	x			
	Reduce personal automobile traffic through travel demand management (TDM) incentives activating carpool, vanpool, transit, rideshare and active transportation along freight corridors and implementation of proposed Bus Rapid Transit (BRT) routes: US 1, SR 528, SR 520, SR A1A, and Wickham Rd. Also encourage Transit Oriented Development (TOD) along US 1 and SR 528.	x	x			x
Improve Safety Features at Truck Crash Hotspots	Incorporate freight safety countermeasures into current projects: SR 528 Widening, SR A1A – Misc./Intersection Realignment/ New 2 lane Rd/Curb Gutter/Safety/Signal improvements.			x		
	Intersection mobility and safety applications can be used on the following corridors: SR 528 / SR A1A east of I-95, SR 520 east of I-95 and SR 192 east of I-95; SR 3 at SR A1A and SR 405 (crossovers specifically noted as issue) at US 1.			x		x

Recommendation	Projects to Advance/Studies to Conduct	Non-Recurring Congestion	Recurring Congestion	Safety	OS/OW	Growth
Designate Oversize/Overweight (OS/OW) Routes	Designate Super Haul Routes/Corridors with flexible features like swivel mast arms, removable/flexible signage, truck aprons, flexible median/zipper barriers, etc. Candidates include: SR 405, SR 528, US 1, and SR 3. FDOT/Space Coast TPO should study OS/OW restrictions to eliminate circuitous routing. Potential solutions include crossover/road undercuts and future design standards. Areas of concern for study include Port. St. John Parkway and Citrus Boulevard overpasses. As key freight corridors are reconstructed in the future, ensure they are designed to handle the oversize/overweight needs of the region.		x	x	x	
	Incorporate OS/OW freight needs into the following projects and advance SR A1A – Misc./Intersection Realignment/ New 2 lane Rd/Curb Gutter / Safety/Signal improvements. SR 528 Widening, SR 401 Bridge Replacement, and I-95 Widening.				x	
	Support secondary route for Cape Canaveral launches, specifically improving Roy Bridges Jr. Bridge to accommodate OS/OW movements to the base.				x	
	Improve access to maritime facilities (on the land and water side) to allow oversized moves that could be completed by barge to shift from highways.				x	
Advance Regionally Significant Priority Projects by Identifying Construction Funding	With the availability of additional formula and discretionary funding opportunities through the Infrastructure Investment and Jobs Act, the regional partners should collaborate to secure construction funding for regionally significant priority projects. **Space Coast TPO:** Ellis Road Widening; Babcock St. Widening; Malabar Road Widening; SR 528 Widening; SR 401 Bridge Replacement over Canaveral Barge Canal; SR A1A Multimodal Corridor Improvements; Rail-highway crossing safety projects. **River to Sea TPO:** I-4 BtU; Widening of SR15, SR40, and SR100; I-95 Interchanges at LPGA, US1, Pioneer Trail, and SR44		x		x	x

Recommendation	Projects to Advance/Studies to Conduct	Non-Recurring Congestion	Recurring Congestion	Safety	OS/OW	Growth
Long-Term Recommendations						
Provide a Direct, High Capacity, Freight Super Corridor Facility to the Ports	Conduct a feasibility study to identify direct, high capacity, limited access facilities from I-95 / SR 528 to the ports. -Facility should be freight focused while accommodating passenger vehicles. -Use time of day freight priority treatments (e.g., movable medians and freight signal priority) to facilitate fast, off peak deliveries (both standard shipments and OS/OW cargo). -Incorporate waterside and landside connectivity for cargo to come of off barges, for other vessels and go to the launch facilities directly. -Separate freight and passenger traffic closer to the ports and equip with technology enabled infrastructure.				x	x
Enhance and leverage multimodal freight infrastructure including water,air, and rail	Conduct a study to develop a multimodal freight network that can improve goods movement in and out of the region. This may include the use of NASA railway and area waterways. Also, should consider future modes like vertiports and space point-to-point cargo transport. Additionally, consider transport connecting to offshore launch facilities. -Review tradeoffs and potential constraints, for example, use of drawbridges impacting roadway congestion across the Canaveral barge canal, etc.				x	x
Near-Source Rocket and Satellite Manufacturing and Assembly	Space Florida can continue to attract industry partners and incentivize near-source rocket and satellite manufacturing and assembly targeting development sites in the area that allow for streamlined connections to the ports. This includes the undeveloped acres in the Spaceport Commerce Business Park and the utility corridor around Cape Canaveral, which recently signed Terran Orbital as the first tenant. -Work with educational institutions within the Central Florida High-Tech Corridor like Embry Riddle, University of Central Florida and area state and private colleges to develop workforce of the future.		x		x	x
Develop Automated Freight Corridors between Major Freight Origin and Destination Centers	As freight activities in the area grow and new freight activity centers emerge, automated corridors between major activity centers can offer improved efficiency of the system. -Technology considerations may include freight shuttle express, hyperloop freight, and automated freight highways.				x	x

Recommendation	Projects to Advance/Studies to Conduct	Non-Recurring Congestion	Recurring Congestion	Safety	OS/OW	Growth
Establish Direct Corridors between Activity Centers to Enhance System Connectivity and Accessibility for both Passenger and Freight	To improve congestion and travel time between the Space Coast and Central Florida, consider developing a new corridor between Orlando and Melbourne areas.					
Reduce Personal Vehicle Traffic Along Major Freight Routes Leading to the Ports	Identify a package of mobility solutions to encourage mode shift including transit, land use controls, incentives, strategic/controlled parking, etc.		x		x	x



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