Land Use Changes & SIS Functionality

Final Report

December 2020

Executive Summary

The Strategic Intermodal System (SIS) is Florida's high priority network of transportation facilities important to the state's economy and mobility. The SIS was established to focus the state's limited transportation resources on the facilities most significant for interregional, interstate, and international travel. The SIS is the state's highest priority for transportation capacity investments and a primary focus for implementing the Florida Transportation Plan (FTP), the state's long-range transportation vision and policy plan.

This project examines the effect of multiple land use changes and their potential impact to the SIS. If not managed or proactively planned for, the cumulative impact of multiple new developments has the potential to undermine the function and efficacy of the SIS.

The motivation for this project is:

To understand cumulative developments impacts on SIS facilities	**To identify strategies for preserving the capacity of SIS roadways**	**To make recommendations regarding SIS policy and community planning practices**

This report provides a summary of the stakeholder engagement, literature review, cumulative impact analysis, recommendations, and tools developed for this project.

Working Group

A Working Group, consisting of staff from each District, Central Office, and the Turnpike, was formed to guide the project, discuss current issues, and identify three case studies. Three meetings were held with the Working Group and a survey was conducted to solicit additional information and feedback.

Literature Review

A literature review was conducted which identified examples of many industry best practices to manage traffic growth from developments on public roadways, specifically on high priority state facilities. The findings include strategies for increased state and local government coordination as well as policy and engineering solutions.

Data Gathering

Three SIS corridors were selected by the Working Group to demonstrate issues and concerns related to cumulative development impacts, as well as to help establish a framework to proactively plan for potential strategies and improvements to address these issues and concerns. The following case studies were identified:

- SR 70 in Arcadia, SR 72 to SR 31, 3.6 miles, in District 1
- SR 200 between Callahan and Yulee, Griffin Road to Chester Road, 11.6 miles, in District 2
- US 27 south of Clermont, Lake/Polk County Line to Hartwood Marsh Road, 11.2 miles, in District 5

The information gathered for each case study, as documented and summarized in this report, were used for the cumulative impact analyses.

Cumulative Impact Analysis

Cumulative impact analyses were conducted for the case studies of SR 70, SR 200, and US 27. The analysis results show an increase in roadway demand with the anticipated growth from the nearby planned and approved developments. The findings confirmed that the regional cost feasible (CF) models may not account for a substantial amount of proposed developments, and that additional approved or planned developments negatively impact each case study corridor in the long-range planning horizon year.

Scenario planning was conducted for the case studies to develop a framework to proactively plan for corridor strategies and improvement options. A range of engineering solutions was assessed for each segment by determining the needed percent increase in capacity and then reviewing available strategies to determine viable options to carry forward. Based on these three case studies, a toolbox of engineering solutions and a screening tool were developed to vet potential solutions for corridors determined to need increased capacity in the long term.

Recommendations

Based on input received from the Working Group, best practices from the literature review, and analysis of the three case studies, a list of recommendations was developed for preserving the capacity of SIS roadways. The following ten recommendations have been grouped in four categories.

1. Partnership

1.1 Establish stronger partnerships with local governments

- a Promote early engagement in planning stages between FDOT and local governments to coordinate land use/transportation decisions that impact SIS corridors.
  - i Create a formal structure and policy framework to guide early and continuous communication.
  - ii Coordinate with local governments when FDOT receives a permit application.

- iii Attend/review local government development review committee meetings or have an FDOT representative participate as a part of the committee to learn about upcoming developments, as appropriate.
- iv Encourage local governments to coordinate with FDOT early and throughout the private development planning and approval process.

b Partner with local governments to develop collaborative strategies/plans in order to promote the community's vision and goals while preserving the capacity and safety of SIS corridors.

- i Consider existing and future context classification.
- ii Consider establishing Planning Studios and interagency corridor plans, similar to the District 1 Planning Studio Concept and the District 4 I-95 Corridor Mobility Planning Project.

c Consider collaborative approaches with local governments to plan for and implement transportation/land use decisions. For instance, New Hampshire DOT has an MOU process which provides an agreement between the New Hampshire DOT and the community to coordinate the review and issuance of driveway permits to access state roads.

d Establish a program to identify and enhance parallel corridors and connections, both state and local roadways, that can provide relief to SIS facilities with existing or anticipated capacity issues. For example, VDOT maintains state roads as well as a network of secondary streets. For a roadway to be accepted into the secondary street system for maintenance, it must meet certain criteria and ensure roadway and pedestrian connectivity with external connections and stub outs for future connections. These requirements are based on the state's recognition of a well-connected street network and its ability to lessen the demand on more significant state arterials.

2. Systems Approach

2.1 Incentivize and/or facilitate best practices at a local level

a Provide technical assistance to local government partners to coordinate land use/transportation decisions early (before comprehensive plan amendments), similar to the District 2 technical assistance program.

b Establish incentives and/or grant programs for local governments to implement livable communities, non-auto modes of transportation, well-connected local street network, transportation demand management, and coordinated land use and transportation planning. For example, the NJDOT Futures in Transportation (NJFIT) program is a similar incentives and grants program. NJDOT adopted a philosophy that the state's limited transportation funds should be prioritized for communities that adopt land use plans to preserve the utility of the state's investment. Incentives such as programs and grants are available to local governments for projects that promote livable communities, non-auto modes of transportation, and smart growth.

c Encourage and support smart zoning, designating targeted growth areas, reverse frontage development (service roads), coordination with FDOT during site plan review, etc.

2.2 Increase multimodal options on state-maintained facilities

a Base future requirements and discussion on future context classifications.

b Improve transit and bike/pedestrian amenities and connectivity within FDOT's ROW.

2.3 Develop a shared multi-agency database to track developments

a Create a central database to track developments and identify future capacity issues earlier to allow for proactive planning and improvements. Currently, FDOT does not have a standard system to track planned or approved developments. Without an effective way to track developments, it can be difficult to understand the cumulative impacts of all recent or planned developments when reviewing a single development. A central database to track developments can allow for future capacity issues to be identified earlier and promote proactive planning. The system can be maintained by FDOT and updated by FDOT, FDEO, and participating local governments.

2.4 Develop a systematic approach to identify at-risk SIS facilities

a Utilize multiple datasets to identify and project at-risk SIS facilities. For example, Washington State created a GIS tool to identify state facilities vulnerable to land development (adverse risks). Identifying land at risk for development along state routes can provide opportunities for proactive, collaborative planning to improve access, mobility, and safety while supporting economic development. This project provides tools to help turn adverse risks of land development into opportunities to make route improvements.

3. Engineering Solutions

3.1 Anticipate context-based design needs using current and future context classifications

a Consider the ultimate typical, based on future context classification and community visions, early in the design process.

b Consider the need for additional roadway network and connectivity in advance based on context classification, community needs, and capacity issues.

c Acquire right-of-way in advance, where feasible.

3.2 Establish thresholds for planning/implementing capacity management strategies

a Monitor at-risk SIS facilities - track V/C in addition to LOS to see the incremental increase as the SIS facility reaches the LOS threshold.

b Conduct scenario planning to evaluate a broad range of potential strategies when an established threshold trigger is reached.

i Follow the scenario planning methodology described in the **Cumulative Impact Analysis** section

ii Utilize Engineering Toolbox and Screening Tool to determine the range of possible engineering solutions. These are further discussed in the

iii **Engineering Toolbox and Screening** Tool section of this report.

4. Policy

4.1 Enhance the Access Management/Driveway Permit process

a Consider separate access class for SIS facilities. If implemented, update FAC 14-97 – State Highway System Access Control Classification System and Access Management Standards. For example, Indiana DOT has different access management standards for their three corridor classifications; strictest access management standards for their top-end Statewide Mobility Corridors with no direct private access allowed.

b Require that SIS roadway driveway permits, median modification, and signalization related to land development projects be reviewed and approved by the District SIS coordinators.

4.2 Provide SIS funding flexibility

a Expand funding eligibility for mobility projects within existing SIS statutory framework to provide the Districts the option to flex existing traditional and non-traditional SIS capacity funding to mobility projects (being discussed as part of Vital Few Initiative). These proposed changes will provide flexibility in the SIS program so the highest priority mobility projects of the Districts can be funded regardless of mode, while maintaining a statewide strategic focus. These changes will expand funding eligibility projects within the existing statutory framework and allow for the funding of projects such as premium transit or non-SIS highway capacity projects that provide relief to the SIS. Each District will have the option to put forth projects that best support their mobility needs. This recommendation strategy also allows the Department to make decisions using a holistic approach vs. the focus on highway or other modes.

4.3 Leverage existing statutes and/or request new legislative action

a Require local governments to identify any SIS facilities within the municipal boundaries in their Comprehensive Plan, as well as to project future growth (per Section 163.3177 F.S.), to identify projected deficiencies on the SIS facilities, and to determine how deficiencies will be corrected to meet the mobility needs of the SIS. A similar example is that localities in Virginia are required to identify Corridors of Statewide Significance in their comprehensive plans and on official maps (Code of Virginia, §§ 2.2-229 and 15.2-2232).

b Establish partnerships and coordination with local governments to effectively plan for and protect the state's critical SIS corridors. For example, Virginia DOT requires that developments be consistent with the Arterial Management Plan if located along a highway with one in place, or to coordinate with the Arterial Preservation Program Manager if an Arterial Management Plan is being developed.

Engineering Toolbox and Screening Tool

As part of the recommendations, the following tools were developed to identify potential engineering strategies to address capacity issues on SIS facilities:

- Engineering Strategies Screening Tool
- Engineering Toolbox

The 'Engineering Strategies Screening Tool' is an excel-based tool with the capability to screen and filter a broad range of potential engineering solutions. The engineering improvements can be filtered by a variety of specific project context and need characteristics, including the following: percent increase in capacity, project cost, needed right-of-way (ROW), driveway access level of accommodation, pedestrian level of accommodation, and compatible context classification.

The 'Engineering Toolbox' is an interactive list of engineering strategies with a comprehensive summary of specific improvement and strategy across several improvement types with: description, use cases, benefits, etc.

Based on the anticipated percent increase in capacity needed to accommodate future traffic volumes, the range of potential engineering solutions can be identified using the 'Engineering Strategies Screening Tool.' The 'Engineering Toolbox' can then be used to review each improvement option to determine if it is a viable option for the corridor to carry forward for further review.

Conclusion

This study found that identifying existing and potential future deficiencies along priority corridors based on approved and planned future development offers an opportunity to proactively plan for mitigation strategies to maintain system efficiency.

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1. Introduction

The Strategic Intermodal System (SIS) is Florida's high priority network of transportation facilities important to the state's economy and mobility. The SIS was established to focus the state's limited transportation resources on the facilities most significant for interregional, interstate, and international travel. The SIS is the state's highest priority for transportation capacity investments and a primary focus for implementing the Florida Transportation Plan (FTP), the state's long-range transportation vision and policy plan.

This project examines the effect of multiple land use changes and their potential impact to the SIS. If not managed or proactively planned for, the cumulative impact of multiple new developments has the potential to undermine the function and efficacy of the SIS.

The motivation for this project is:

To understand cumulative developments impacts on SIS facilities	**To identify strategies for preserving the capacity of SIS roadways**	**To make recommendations regarding SIS policy and community planning practices**

The project involved stakeholder engagement, a literature review, analysis of three case studies, and development of a list of recommendations for preserving the capacity of SIS roadways. The report provides a summary of these efforts, a description of the preliminary recommendations, and a toolbox of engineering solutions.

2. Working Group

A Working Group, consisting of staff from each District, Central Office, and the Turnpike, was formed to guide the project, discuss current issues, and identify three case studies. Three meetings were held with the Working Group and a survey was conducted to solicit additional information and feedback.

The first meeting was held on May 26, 2020. This meeting provided an overview of the project to explain the project purpose and goals and provide an opportunity for discussion of experience, insight, and ideas from each District. Three case studies were selected by the Working Group during the meeting. These case studies represent SIS corridors with known future developments along or near the corridor. The following case study corridors were selected:

1. District 1, SR 70 in Arcadia, SR 72 to SR 31, 3.6 miles
2. District 2, SR 200 between Callahan and Yulee, Griffin Rd to Chester Rd, 11.6 miles
3. District 5, US 27 south of Clermont, Hartwood Marsh Rd to Polk County Line, 11 miles

A survey was distributed to the Working Group to gather additional feedback and experience from the members. The following questions were asked:

1. Have you experienced this issue? If so, provide one or more examples.
2. What was the nature of the problem?
3. What specific solutions worked or could work in your opinion?
4. Which example from the literature review do you think would work most effectively in Florida?
5. What recommendations would you like to see come out to this Working Group?

In general, most respondents indicated that they have experienced this problem with cumulative impacts from developments on SIS facilities. Typically, developments are reviewed in isolation from other developments with little to no consideration of the cumulative impacts. Further, some impact analyses are based on future roadway networks with new roadways or other enhancements that are not yet fully funded. Another issue noted is that there is a gap between local government processes and state interests; developments can be approved at the local level with little to no involvement from the state, even on SIS facilities that are of critical statewide importance. Possible solutions suggested by respondents include network connectivity, increased coordination with local governments and developments, engineering solutions, development of a tool to identify at-risk SIS facilities, and policy solutions.

A second meeting was held on July 21, 2020. During this meeting, the survey results, the cumulative impact analysis results, as well as preliminary recommendations based on the input and findings were discussed. Other potential recommendations discussed include changes to access management regulations, increased partnerships with local governments, multimodal options, and increased network connectivity and alternative routes to SIS facilities.

A third meeting was held December 16, 2020 to review the draft report, discuss comments, revisions to the recommendations, and next steps.

3. Literature Review

A Literature Review was conducted to identify and document industry best practices across the country to understand how other jurisdictions and state governments are managing development impacts on critical or significant state transportation facilities and systems. The literature review findings are organized by the following three main topics and are discussed in the subsequent sections:

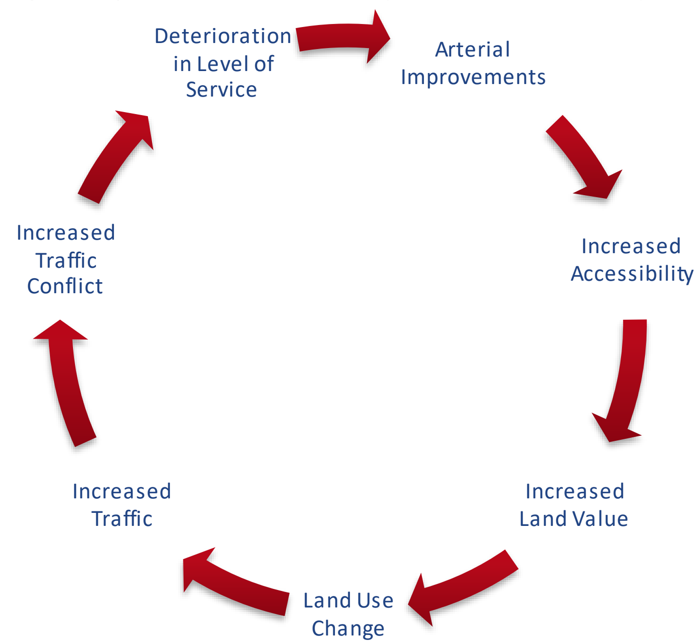
1. **State and Local Government Coordination** – This section includes strategies to encourage and facilitate coordination between land use and transportation planning. Case studies from other states exemplify procedures that can be used to promote coordination between agencies to improve planning processes.
2. **Policy Solutions** – This section provides principles adopted and implemented by an agency to protect and preserve the integrity of priority statewide networks. A comparison between state policies is provided to show how adding new criteria to existing state policies could further protect facilities from the impacts of development.
3. **Engineering Solutions** – This section provides examples of geometric and/or operational improvements designed to preserve or improve the capacity of a transportation facility. The projects discussed show how design considerations can help reduce traffic burdens on priority corridors.

The literature review references are provided in Appendix A.

3.1. State & Local Government Coordination

It is generally known that there is often a gap between land use planning and transportation planning. However, coordination between the two is necessary to provide optimal functionality of state roadways as well as effectively planned communities. There are several strategies used in other states to encourage and facilitate coordination between land use and transportation.

Figure 1 | Unsustainable Transportation Land Use Cycle



The Challenge: Separation of Responsibilities

Transportation and land use are fundamentally interrelated; land use decisions directly impact transportation facilities, and transportation decisions impact surrounding land use and development potential. Figure 1 depicts the transportation land use cycle. If capacity improvements are made to arterials, this increases accessibility to the surrounding properties. This in turn increases the land value of the surrounding properties and will likely result in land use changes and new developments. However, these land use changes and new developments will then increase the traffic along those arterials and eventually cause congestion and degrade the level of service. This then creates the need for more capacity improvements along those arterials, which ultimately restarts the transportation land use cycle. As such, it is unlikely that adding roadway capacity alone will provide a long-term solution to improving mobility.

The challenge lies in the fact that there is a separation of responsibilities for transportation and land use decisions. The state is responsible for transportation on state-maintained roadways, and local governments are responsible for land use decisions along and near those roadways. Often there is little to no coordination regarding those responsibilities. Activity patterns in communities are dictated by land use decisions that are handled by local governments, which affects the surrounding transportation facilities that are handled by the state. In turn, transportation-related decisions impact accessibility to properties, which can influence land use decisions and development patterns. In order to protect the mobility of important arterials and maintain the quality of living in communities, it is necessary to integrate land use and transportation decisions to manage this cycle.

The Texas Department of Transportation (TxDOT) provides examples of the potential consequences of failing to manage land use and transportation coordination, based on their TxDOT Guidelines on Corridor Management and Preservation in Texas document. Long-term consequences may include:

- Reduced mobility and increased congestion and accidents;
- A decline in property values and tax base;
- A loss in aesthetic quality;
- Gradual economic disinvestment along corridors;
- A loss or re-alignment of a planned corridor due to development;
- Displacement of homes and businesses;
- Increase in time and delays in project development; and
- Increase in project costs due to damages paid and purchase of improved right-of-way (ROW).

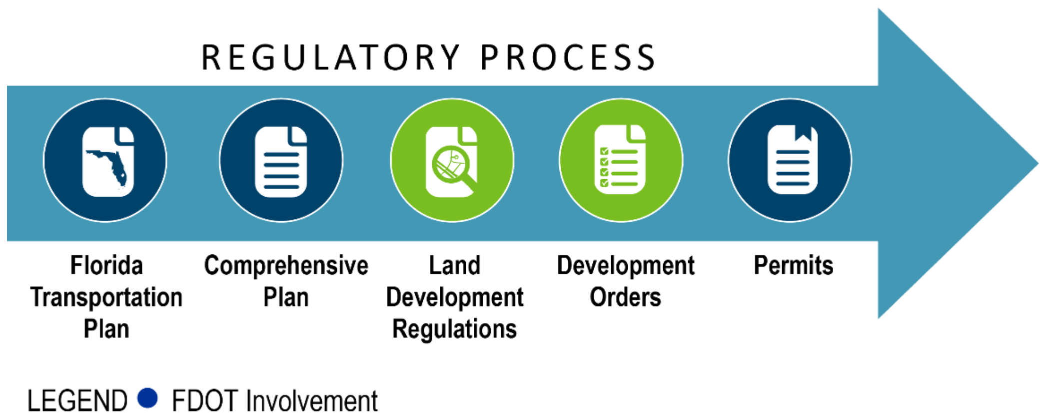
Managing land use and development along state roadways ensures a level of planning sustainability within a region. If developments are not properly managed along statewide priority corridors, then some of those segments could become prone to problems that will require mitigation efforts in the future (Texas Transportation Institute, July 2008).

Development Regulatory Process in Florida

In Florida, the development regulatory process includes the following steps (shown in Figure 2):

- Florida Transportation Plan (FTP)
- Comprehensive Plan
- Land Development Regulations
- Development Orders
- Permits

Figure 2 | Development Regulatory Process in Florida



As shown, the FDOT is involved in the development of the FTP, Comprehensive Plan reviews, and developer permit stages if there is access proposed to a state facility.

Florida Transportation Plan

Community planning and the preservation of the state's transportation network begins with the FTP. The FTP is the single overarching statewide plan guiding Florida's transportation future. It is a plan for all of Florida created by, and providing direction to, FDOT and all organizations that are involved in planning and managing Florida's transportation system, including statewide, regional, and local partners.

Comprehensive Plan

Per State of Florida Law, every city and county must adopt a Comprehensive Plan (F.S. §163.3167(2)). Also according to this law, the transportation element in the community's Comprehensive Plan must be coordinated with plans and programs, including the FTP. The local Comprehensive Plan must also be consistent with the Metropolitan Planning Organization (MPO) long-range transportation plan and transportation improvement program (F.S. §339.175).

If a community desires to change its comprehensive plan in order to better plan for future growth or to allow a proposed development that is currently inconsistent with the comprehensive plan, the local government is required to submit a plan amendment to the state for review. FDOT is responsible for reviewing comprehensive plans (including amendments) and their review is limited to facilities within the agency's jurisdiction as it relates to transportation resources and facilities of state importance.

> *"The Department of Transportation shall limit its comments to issues within the agency's jurisdiction as it relates to transportation resources and facilities of state importance." (F.S. § 163.3184(3), 2019).*

Land Development Regulations and Development Orders

Consistent with the framework laid out by the comprehensive plan, local governments can adopt land development regulations to manage land uses and growth. Land development regulations are ordinances adopted to effect policies and plans. They regulate the development of land to guide growth to achieve the community's vision and goals while avoiding unmanaged growth, traffic congestion, incompatible land use patterns, and overburdened public infrastructure such as schools and public utilities.

Development orders are issued to grant permission for the proposed development of land. When a new development is proposed, a local government can issue a development order if it is consistent with the local comprehensive plan and land development regulations.

Land development regulations and development orders are local processes and offer little opportunity for state involvement.

Permits

The permitting process occurs after the issuance of the development order. This step allows FDOT to review the proposed project if a connection is proposed to a state-maintained facility. FDOT is involved in the design of any access to a state-maintained facility. Additionally, FDOT is involved in any off-site improvements to state facilities.

As described in the Development Regulatory Process in Florida steps above, FDOT's involvement with the review and approval of developments is limited. Partnerships between state and local agencies provide an opportunity for collaboration regarding the impact of future developments on state roadway systems, and vice versa. These partnerships can be critical to mitigating adverse effects on roadway networks. The following text provides examples of strategies for coordination with local agencies to improve land use and transportation decisions.

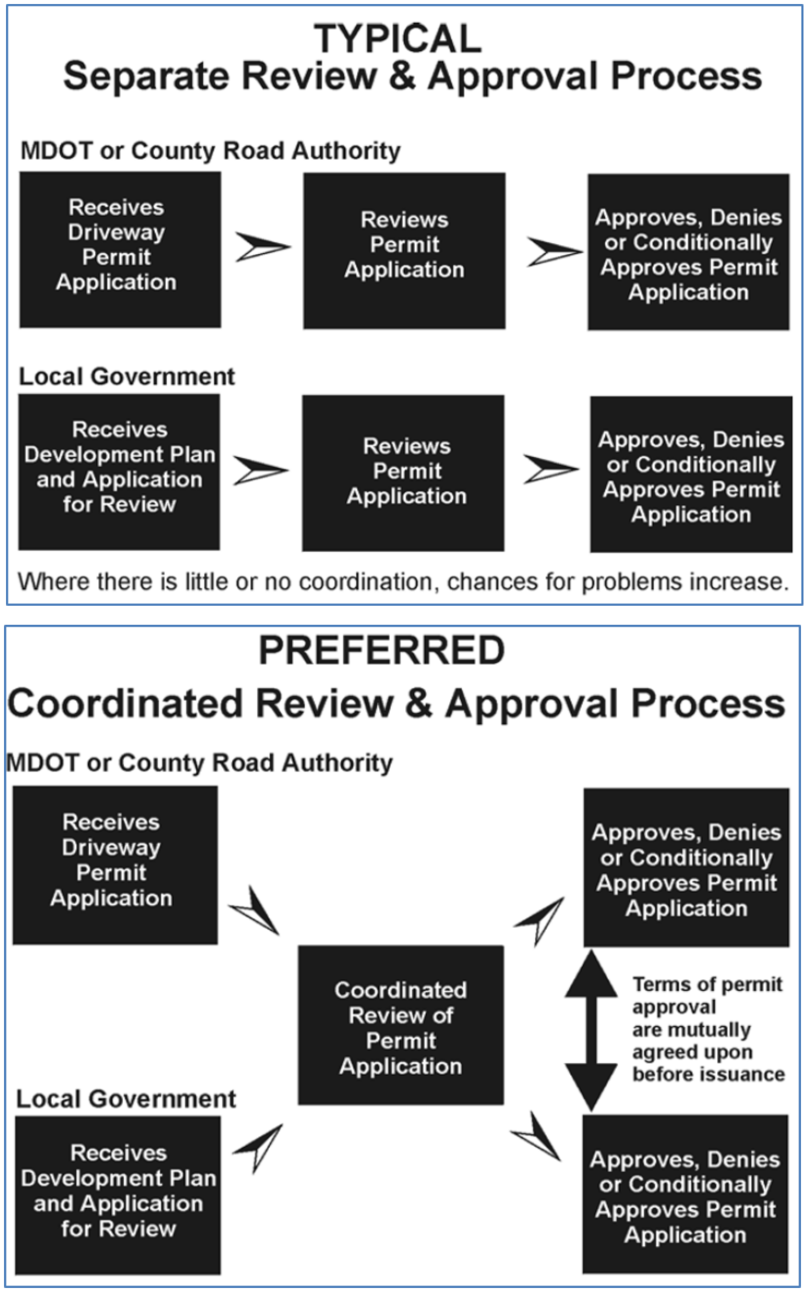
Strategy: Permit Coordination for Developments

There are opportunities for local and state governments to coordinate during the site plan approval and/or permit review process of a proposed development. Several states provide programs or guidance to encourage local governments to engage in this coordination.

Example: Michigan DOT

The Michigan DOT Access Management Guidebook provides a summary graphic of the typical vs. preferred permit review process (Figure 3).

Figure 3 | Typical and Preferred Review Process



The typical review process consists of a separate review and approval process where the local road authority and the local government are each responsible for reviewing and approving the permit application separately; in this process, there is little coordination and problems are more likely to occur. Alternatively, implementing a coordinated review and approval process where both parties coordinate on the review of the permit application and the terms of permit approval may mitigate future problems. In the coordinated process, comments from both parties can be shared and discussed before decisions are made.

Michigan DOT's Access Management Guidebook discusses that "some local governments specify within their zoning ordinance that coordination with and between the developer, local agency and the local road authority is **required** and that site plan approval is not granted until there is written agreement on driveway number, location, spacing, and other key access considerations." Coordination efforts between local governments and the Michigan DOT have demonstrated the improved quality and efficiency of permit decisions, which also helps all parties involved in the process to achieve their respective objectives (Michigan Department of Transportation, October 2001).

Example: New Hampshire DOT

The New Hampshire DOT has typically been the primary entity to issue permits, with minimal input from local agencies. New Hampshire DOT recently developed a Memorandum of Understanding (MOU) to improve coordination between local and state planning processes. The MOU is an agreement between the DOT and a community to coordinate the review and issuance of driveway permits to access state roads. A summary of a few of the MOU requirements is provided below:

- The community develops and adopts access management standards for state highways, consistent with best practices
- The community must notify the DOT when a development is proposed that requires a state driveway permit and solicit input on the design
- The community will require that access points are consistent with adopted access management standards

Communities who are interested in coordinating with their DOT more closely have the option of using the MOU strategy, which will inevitably improve the communication of ideas and goals between agencies (New Hampshire Department of Environmental Services, October 2008).

Strategy: Increase Roadway Connectivity/Provide Parallel Routes

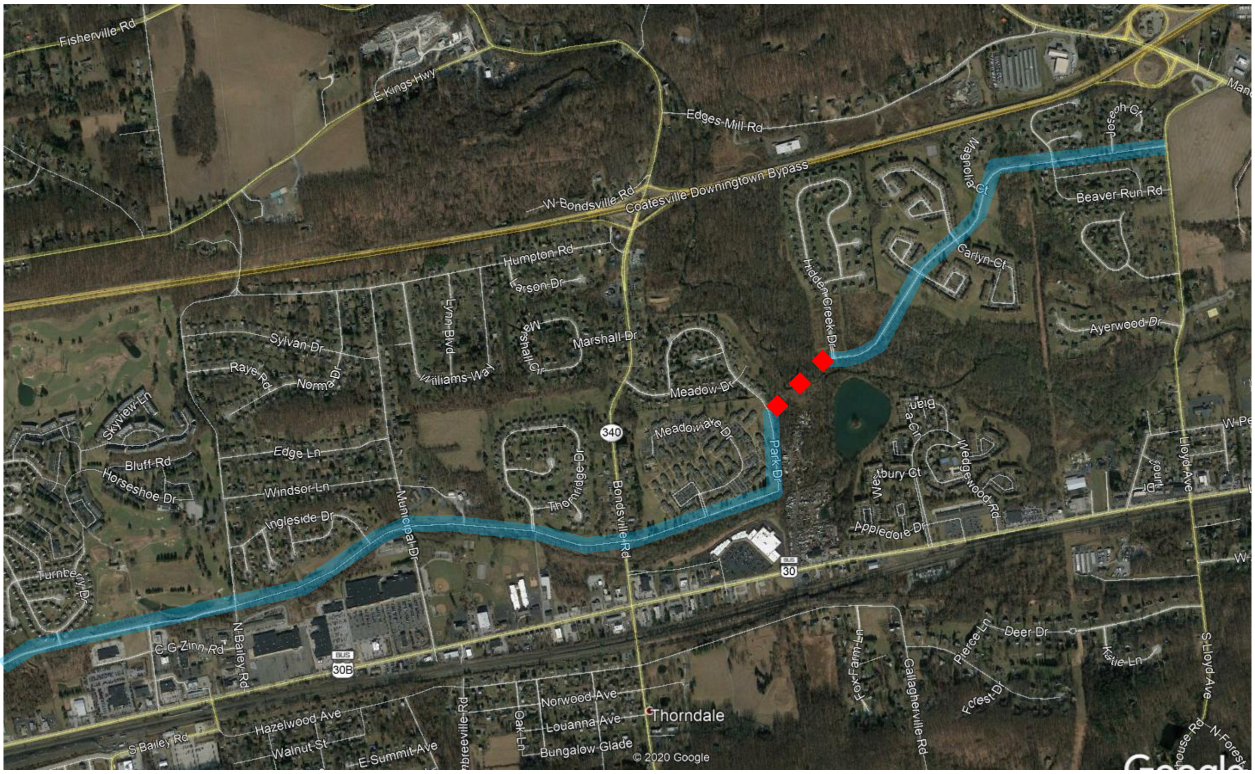
Trips will seek the most convenient path to reach their destination. A lack of convenient route options to travel between land uses except for SIS facilities funnels all trips to these important roadways. The aggregation of trips to the SIS increases demand and degrades the safety and operation of these roadways. Conversely, providing parallel routes and network connectivity can disperse trips and alleviate the pressure on SIS facilities.

A well-connected street network has shorter block lengths, many intersections, and minimal cul-de-sacs. Improved connectivity can reduce vehicular trip lengths and provide alternative routes for trips to reduce demand on busy arterials. Furthermore, a well-connected network can facilitate walking and biking by providing more direct routes and routes options on lower speed and volume roadways. Other advantages include better emergency response with more access options, energy conservation, and improved safety.

Local governments can create a collector street plan, incorporate future roadways and connections in the comprehensive plan, designate future street extensions for future connectivity, require maximum block lengths and perimeters in zoning codes, or create subdivision regulations. During site plan review, local governments can enforce new developments to adhere to the plan and connectivity guidelines, to build stub-outs as needed, and to limit cul-de-sacs to constrained areas where connectivity is not feasible. State and local governments can implement the connectivity plans by building or identifying funding for the surrounding roadway network and connections to support SIS facilities.

Figure 4 shows an example in Chester County, PA. G.O. Carlson Boulevard has been built incrementally over time and will ultimately serve as a parallel route for the congested Business Route 30. The new roadway is identified in the Future Transportation Plan element of the Caln Township's Comprehensive Plan. (Chester County Planning Commission, n.d.)

Figure 4 | Improved Connectivity Example



Example: Virginia DOT

Virginia DOT (VDOT) maintains state roads as well as a network of secondary streets. In order for a roadway to be accepted in the state's secondary system for maintenance, it must meet certain criteria per the Secondary Street Acceptance Requirements (SSAR). The SSAR was established to improve connectivity to other roadways and maintain an efficient transportation network. The state acknowledges that connectivity is not solely dependent on the SSAR, but will be possible through careful planning and coordination by all parties involved. Additionally, there are state requirements for new roads incorporated into the Secondary Street system to ensure connectivity:

> *"…the regulations shall include requirements to ensure the connectivity of highway and pedestrian networks with the existing and future transportation network" (Code of Virginia § 33.2-334, n.d.).*

There are three goals in Section 33.2-334 which the SSAR are required to meet:

- Ensure the connectivity of roadway and pedestrian networks for existing and future transportation facilities
- Minimize stormwater runoff and minimize the use of impervious surfaces
- Addressing performance bonding of new secondary streets, including any associated cost recovery fees

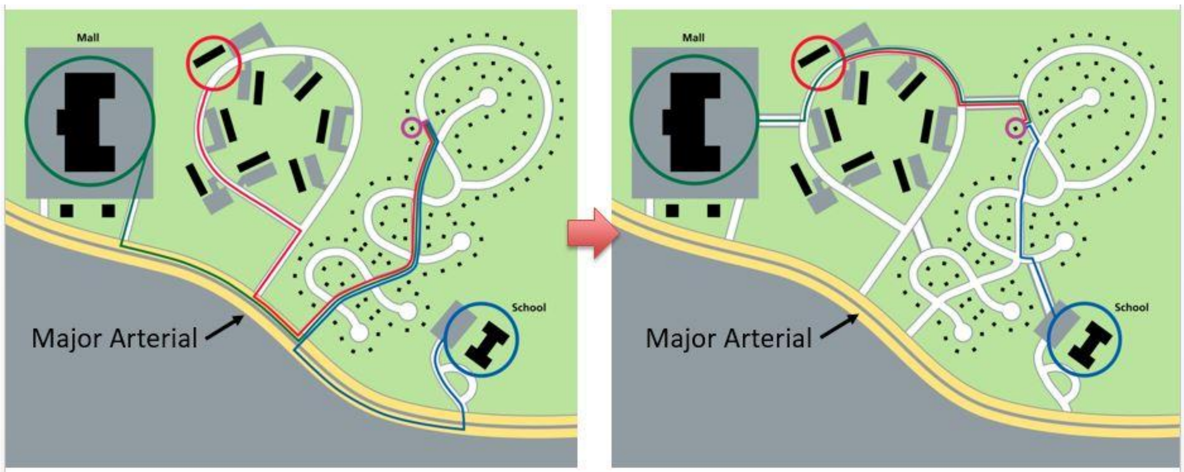
When developments are designed in a manner that limits vehicle accessibility, such as a one-way in/one-way out approach, congestion is more likely to occur. Incorporating secondary streets into project design increases the capacity of a transportation network within a particular area. Secondary streets can be integrated to improve the connectivity between adjacent developments, which ultimately eliminates the number of trips taken on major arterial roadways and reduces the likelihood of congestion.

One of the requirements of the SSAR is that developments should have at a minimum two external connections with multiple directions – this requirement ensures that traffic can utilize alternative roadways which minimizes congestion on primary streets. Those connectivity requirements include the following:

- At least two external connections
- Stub out for future connections
- Connection to existing stub outs

These requirements are based on the state's recognition of a well-connected street network and its ability to lessen the demand on more significant state arterials. VDOT also ensures that streets proposed to be added to the secondary streets network will have a positive public benefit, such as increased connectivity between land uses and communities. Not only does this provide multiple points of entry for traffic, but it also helps reduce the burden on major arterial roadways. Additionally, it provides alternate routes that can be used in case a road is closed or it can provide more efficient options for emergency responders. Figure 5 illustrates how trips along major arterials could be minimized by increasing connectivity within neighboring communities. The first image illustrates how people are forced to make trips on the major arterial roadway to get from point A to point B, while the second image illustrates how adding a few secondary streets provides an alternative option that deters trips from the arterial roadway. Secondary streets can reduce VMT on major roadways by dispersing traffic throughout a transportation network, and ultimately improving efficiency, safety, and livability within a community (Virginia Department of Transportation, December 2018).

Figure 5 | Connectivity Near Major Arterials



Strategy: Encourage Smart Growth

Smart growth concepts offer a way to reduce traffic on major roadways and can help reduce congestion. For example, smart growth concepts encourage mixed-use and high-density developments and discourage urban sprawl. This concept reduces the impact on major arterial facilities by reducing the number of trips and trip distances between complementary land uses. Shorter trip lengths also help to encourage the use of other modes of transportation (i.e. transit, walking, or biking) and reduce trips on major roadways as it decreases the number of people driving personal automobiles. Additionally, enhancing the operational efficiency of local roadways also helps decrease traffic on major arterials by diverting traffic to other roadways.

Example: Washington State

Washington State conducted a study that provided strategies the state can use to collaboratively and proactively work with local agencies and developers to manage land use decisions and new development within the transportation system. Washington identified numerous strategies that could help agencies manage adverse risks for transportation facilities, including smart growth strategies to reduce trips on state facilities:

Non-Engineering Strategies

- Transit-Oriented Development (TOD) to improve mobility options
- Transportation Demand Management (TDM)

Encourage Smart Growth

- Smart zoning (nodal, traditional neighborhood development, and transit-oriented development)
- Designating targeted growth areas

Increase Other Modal Options

- Improved transit
- Improved bike/pedestrian connectivity

The study also identified planning, coordination, engineering, funding, enforcement, and operational efficiency strategies. Many of these strategies should occur simultaneously with each other as some examples may be dependent on others, such as funding sources and availability. It should also be noted that these strategies are dependent on the context of the region and may be adapted to fit the needs of other jurisdictions (Washington State Department of Transportation, September 2013).

Example: California

The California Environmental Quality Act (CEQA) is an environmental law that establishes state sustainability requirements and promotes the development of healthy communities that can be maintained for future generations. The CEQA requires state and local agencies to identify significant environmental impacts of proposed developments and to mitigate or avoid adverse impacts whenever possible. These goals directly correlate to developments based on land uses, as well as transportation networks (State of California Department of Justice, n.d.).

Since California is required to reduce greenhouse gas emissions by 40 percent below 1990 levels by 2030, goals established to accomplish this requirement are largely centered on making automobiles more environmentally friendly and reducing total Vehicle Miles Traveled (VMT). As a result, a CEQA transportation analysis is required for most developments. The analysis of transportation impacts should promote:

- The reduction of greenhouse gas emissions
- The development of multimodal transportation networks
- A diversity of land uses

For developments that generate less than 110 trips per day, the local agency may not need to conduct an analysis as there would be a minimal transportation impact. However, developments that are anticipated to increase VMT and may have a significant impact on surrounding transportation facilities should conduct transportation analyses and identify options to reduce total VMT and mitigate adverse environmental impacts.

California's Technical Advisory on Evaluating Transportation Impacts in CEQA provides many ways to reduce total VMT, as summarized below:

- Increased accessibility to transit, goods, and services
- Increase multimodal options and associated infrastructure
- Incorporate affordable housing into the project
- Incorporate an electric vehicle network
- Limit parking supply and implement costs for parking a vehicle
- Provide incentives to use transit and other mobility options (e.g. biking, carpooling) (State of California Governor's Office of Planning and Research, December 2018)

Initiatives like the CEQA establish minimum standards for state and local agencies to follow and helps to create sustainable communities in the long-term. Although the Act is focused on environmental quality, the state acknowledges that increased VMT (which can be attributed to land use patterns) should be mitigated to make communities more environmentally friendly and provide alternative mobility options which will improve the functionality and preservation of surrounding roadways.

Strategy: Identify At-Risk Transportation Facilities

Land development and transportation planning should be a collaborative planning process to ensure that state routes are functioning properly. Developing a process to identify areas that may become at risk for congestion can help mitigate transportation issues and promote mobility throughout the region.

A system could be implemented to systematically analyze growth potential along corridors and compare to the available capacity. Vulnerable facilities can be identified in advance and enable the state to proactively plan for improvements, coordinate with local governments, and take other appropriate measures to protect the corridor.

Example: Washington State

To manage adverse risks, Washington State conducted a study to identify adverse risks created by land development and turn those risks into opportunities to improve access, mobility, and safety while fostering economic development. The first part of the study consisted of created a scoring system to identify state facilities that were vulnerable to land development. Below is a list of potential state and local level risk factors that could cause congestion if not managed properly:

State-Level Risk Factors

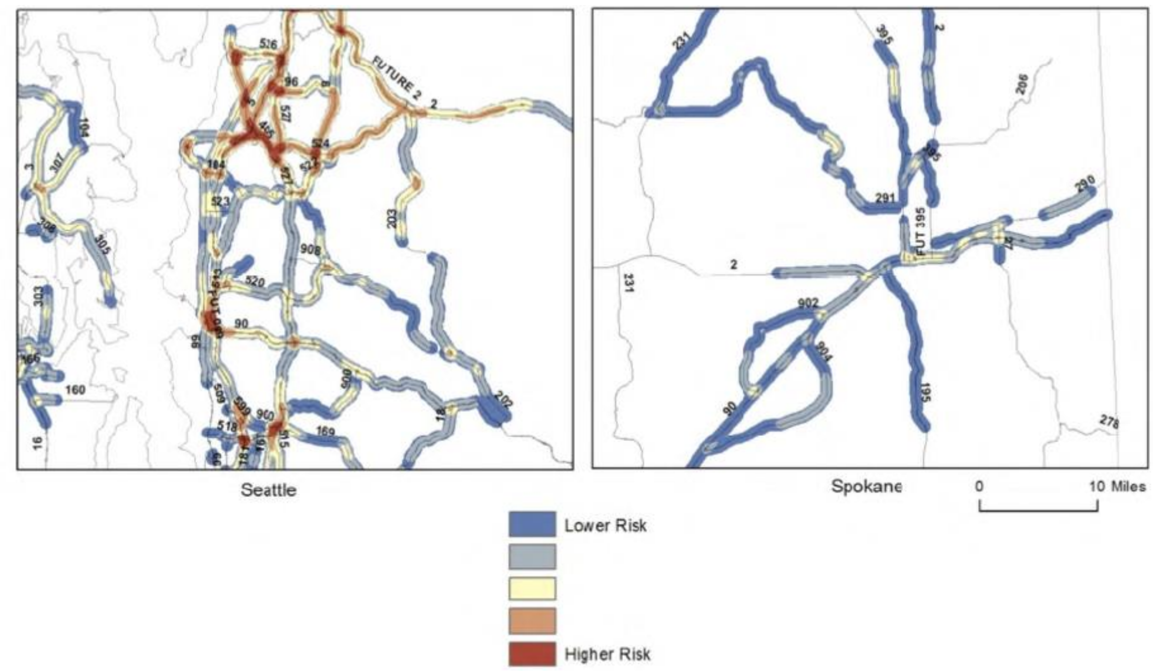
- Historic population and job growth
- Population and job forecasts
- Traffic conditions

Local Risk Factors

- Historic population and job growth
- Population and job forecasts
- Traffic conditions
- Regulatory constraints (zoning and urban growth boundaries)
- Critical Areas
- Vacant and undeveloped lands
- Recent sales history
- Building permit history
- Sewer and water utilities

Figure 6 is an example of how state roadway systems are scored in Washington based on the density of composite risk factors; in this example, a 0.5-mile buffer was created along roadways where areas highlighted in blue pose a lower risk while areas highlighted in red show a higher risk.

Figure 6 | Line Density of Composite Risk Score within 0.5-Mile Buffer



Strategy: Provide Funding Incentives

State agencies can provide funding programs and opportunities to local governments for projects that can improve mobility for communities or encourage smart growth in the region. These strategies provide regional agencies an opportunity for local involvement and also help to mitigate impacts to state transportation systems that could affect mobility at a greater scale.

Example: New Jersey

The New Jersey Future in Transportation (NJFIT) effort by New Jersey DOT (NJDOT) is helping agencies improve partnerships and coordination for transportation goals across the state. To accomplish this, they are using a comprehensive and cooperative approach to transportation and land use planning which supports their regional transportation objectives. According to the overview of the program:

> *"The current land use development in New Jersey cannot be maintained and compromises future generation's needs. Current developments in transportation also contribute to unsustainable conditions that include greenhouse gas emissions, energy insecurity, congestion and environmental impacts" (New Jersey Department of Transportation, n.d.).*

This stance has encouraged NJDOT to implement a more cooperative and comprehensive approach to transportation and land use planning to reshape their communities so that they are integrated more effectively. NJFIT is encouraging connections between statewide transportation facilities and surrounding land uses through increased coordination among planning agencies to relieve transportation demands on transportation systems.

The NJDOT adopted a philosophy where the state's limited transportation funds should be prioritized for communities that adopt land use plans to preserve the utility of the state's investment. Many programs and grants are provided through NJFIT that are available to local governments for projects that promote livable communities, non-auto modes of transportation, and smart growth. These include:

- Transportation Enhancements Program
- The Congestion Mitigation and Air Quality (CMAQ) Program
- Local Bicycle/Pedestrian Planning Assistance
- Local Aid and Economic Development Program
- Park and Ride initiatives

Transportation Enhancement (TE) funds are funds that are set aside from the federal Surface Transportation Program and are available for local governments. They are designed to foster more livable communities, preserve and protect environmental and cultural resources, and to promote non-auto modes of transportation. The CMAQ Program provides funding to transportation projects that improve air quality in areas of the state that do not meet the national air quality standards, which improves the environmental quality and livability of surrounding communities. Additionally, the Local Bicycle/Pedestrian Planning Assistance helps implement the Statewide Bicycle/Pedestrian Master Plan, which encourages non-auto modes of transportation and also contributes to improved overall air quality and decreased vehicular demand on state facilities.

NJDOT also provides local agencies transportation assistance through the Local Aid and Economic Development Program. Through the Centers of Place program, grants of $750,000 to $3 million are awarded to encourage development where infrastructure exists to accommodate growth. Additionally, they have initiated a Park and Ride program that is seeking to promote smart growth strategies by providing more than 20,000 additional parking spaces near transit facilities to relieve congestion and provide other mobility options in the region. Since this program was implemented, over 14,000 commuter parking spaces have been added across the state to accommodate the increasing demand for alternative transportation options (New Jersey Department of Transportation, n.d.).

3.2. Policy Solutions

State policies can be implemented to protect and preserve the integrity of priority statewide networks. In Florida, there are several existing policies to help protect and maintain the integrity and safety of state-maintained facilities. These are discussed below.

LOS Policy

FDOT updated the Level of Service (LOS) policy (Topic 000-525-006-c) for the state highway system on April 19, 2017 (Florida Department of Transportation, April 2017a). This policy states that “The automobile mode level of service targets for the State Highway System during peak travel hours are ‘D’ in urbanized areas and ‘C’ outside urbanized areas. The Department shall work with local governments to establish appropriate level of service targets for multimodal mobility and system design. The targets shall be responsive to all users, for context, roadway function, network design, and user safety.”

Access Management

If a development seeks a permit to connect the project to the State Highway System, it enters a round of review by FDOT to assess its impacts on the adjacent transportation facilities through access management. Access management promotes the safe and efficient movement of people and goods by providing a balance between access and mobility. One of the most important responsibilities of FDOT is to maintain this balance. Access management helps provide accessibility to developments on major transportation facilities through strategic planning and design processes (Florida Department of Transportation, 2016). This process is governed by FAC Chapters 14-96 and 14-97.

Complete Streets

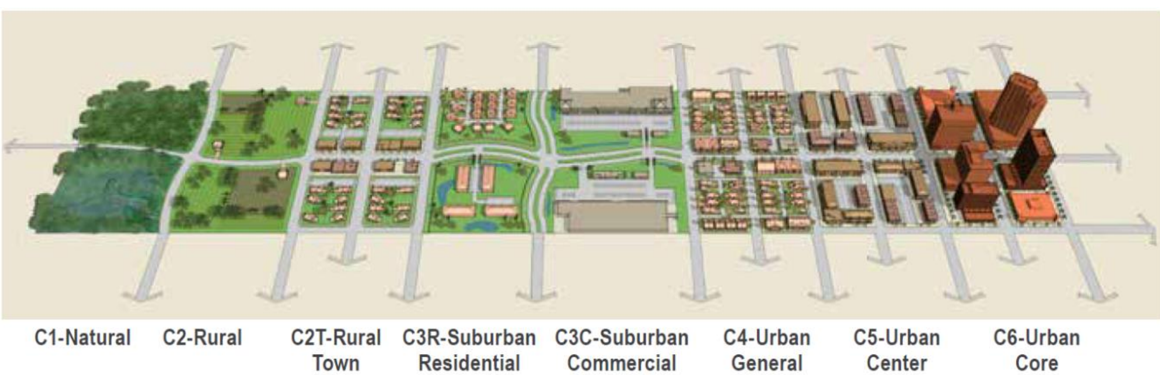
In September 2014, FDOT adopted a Complete Streets Policy to promote the safety, quality of life, and economic development in Florida. Under this policy, FDOT will "routinely plan, design, construct, reconstruct, and operate a context-sensitive system of 'Complete Streets'" (Florida Department of Transportation, April 2017b). The Complete Streets policy is to be integrated into all of FDOT's internal manuals, guidelines, and related documents that govern the planning, design, construction, and operation of transportation facilities. The purpose of FDOT's Complete Streets Policy is to:

- Design and operate a transportation system that serves the needs of transportation users of all ages and abilities including pedestrians, bicyclists, transit riders, motorists, and freight handlers;
- Implement a context-sensitive approach in transportation system design that considers local development patterns; and
- Have a transportation system that promotes safety, quality of life, and economic development.

Context Classification

The context classifications broadly identify the different built environments in the state and inform FDOT staff on what elements are needed to ensure that the roadways are supportive of safe and comfortable travel for their anticipated users. The context classifications are shown in Figure 7.

Figure 7 | FDOT Context Classifications



These context classifications along with the functional classification guide how the roadway is to be designed or reconstructed. Per the FDOT Design Manual, the context classification determines the appropriate lane width, median width, sidewalk placement, and other features to ensure that the needs of all users are taken into consideration. For instance, the FDM states that sidewalks are to be provided on "high speed curbed and flush shoulder roadways within C2T, C3R, C4, C5 or C6 context classification; and within C1, C2 or C3C where the demand for use is demonstrated" (Florida Department of Transportation, 2018). FDOT will rely on partners within the affected jurisdictions to help meet and maintain this balance of transportation needs in a community.

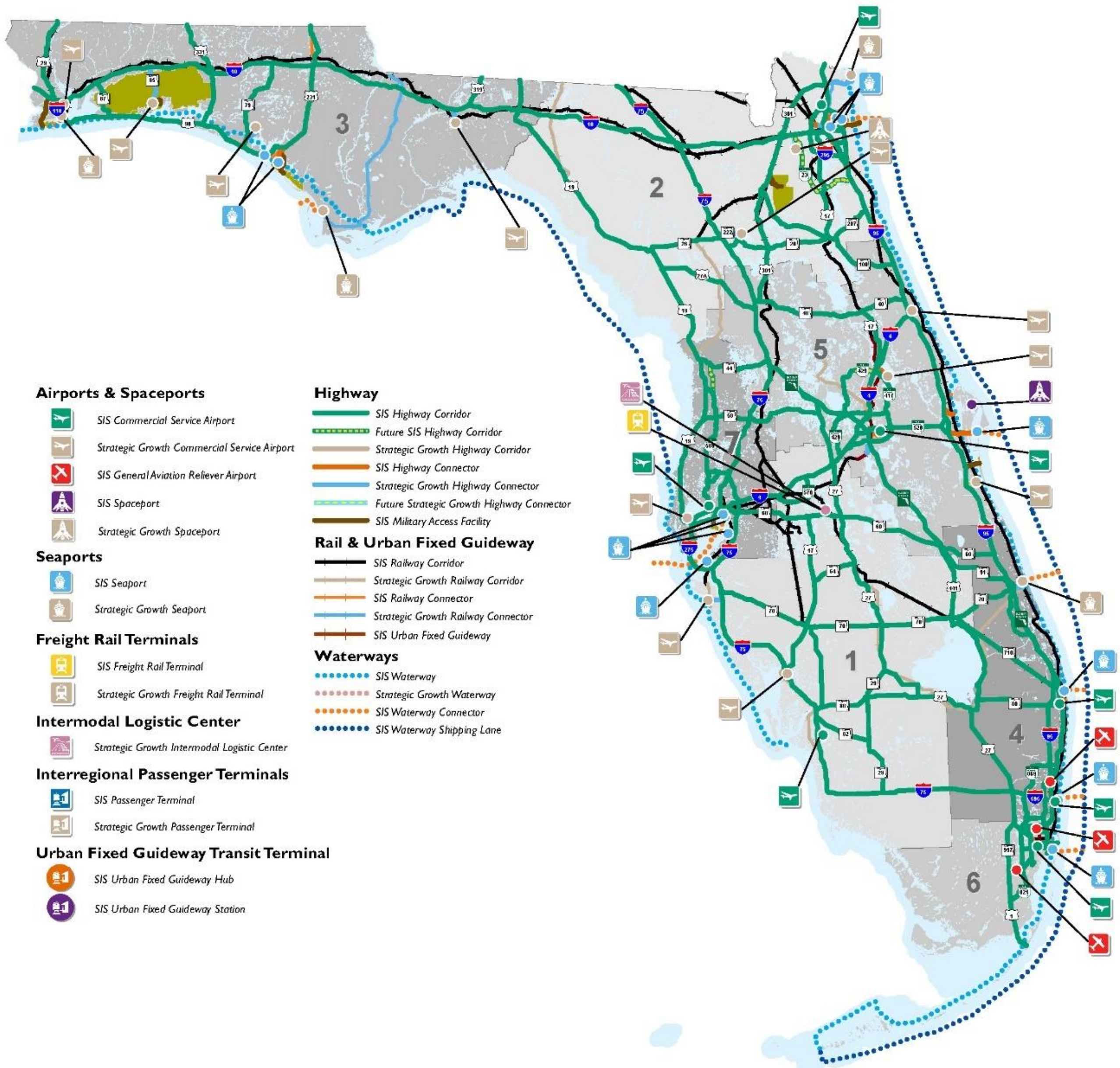
Systems of Statewide Significance

The Strategic Intermodal System (SIS) is Florida's high priority network of transportation facilities important to the state's economy and mobility. Figure 8 shows the SIS corridors, hubs, and connectors.

Many states have deployed programs similar to SIS to maintain the functionality of critical state roadway networks. The establishment of these priority networks also allows states to better plan roadway improvement projects and develop a better sense of how to disperse funds for multiple projects across the state. Below are a few examples of state programs that have established Systems of Statewide Significance:

- Indiana Statewide Mobility Corridors
- Michigan DOT Corridors of Highest Significance (COHS)
- Ohio DOT Strategic Transportation System (STS)
- Virginia DOT Corridors of Statewide Significance (CoSS)
- Washington Highways of Statewide Significance (HSS)
- Wisconsin Statewide System-Level Priority Corridors

Figure 8 | FDOT's Strategic Intermodal System (SIS)



These systems provide an opportunity for states to establish criteria to identify high-priority corridors that are critical to the mobility of the states' roadway networks. As a result, these states have a better grasp on how best to prioritize roadway projects and how to accommodate for population and economic growth.

Some of these states utilize this distinction to further protect the facilities from the impacts of developments. These are discussed below.

Strategy: Designate SIS-Specific Access Management Policies

Although Florida has established the SIS network to identify corridors of significance, FDOT has not initiated regulations that distinguish design standards or policies for SIS facilities versus non-SIS facilities. Incorporating separate policies or design standards for SIS facilities could help maintain functionality along priority corridors.

Example: Indiana DOT

The Indiana DOT (INDOT) has categorized its statewide network into three corridor classifications as summarized in their 2030 Long Range Transportation Plan (LRTP): Statewide Mobility Corridors (Tier 1), Regional Corridors (Tier 2), and Local Access Corridors (Tier 3). The Statewide Mobility Corridors are considered the top-end corridors that connect major metropolitan areas and economic hubs across the state, which have the largest priority. Figure 9 shows how the Statewide Mobility Corridors are primary connections to major cities and communities across the state, especially nodes with the highest population.

The INDOT has also developed an Access Classification System based on the corridor classifications, shown in Table 1. This table summarizes roadway characteristics by Level of Importance, Roadway Type, Traffic Function, and Access Management Design Standards.

Figure 9 | Indiana DOT's Statewide Mobility Corridors

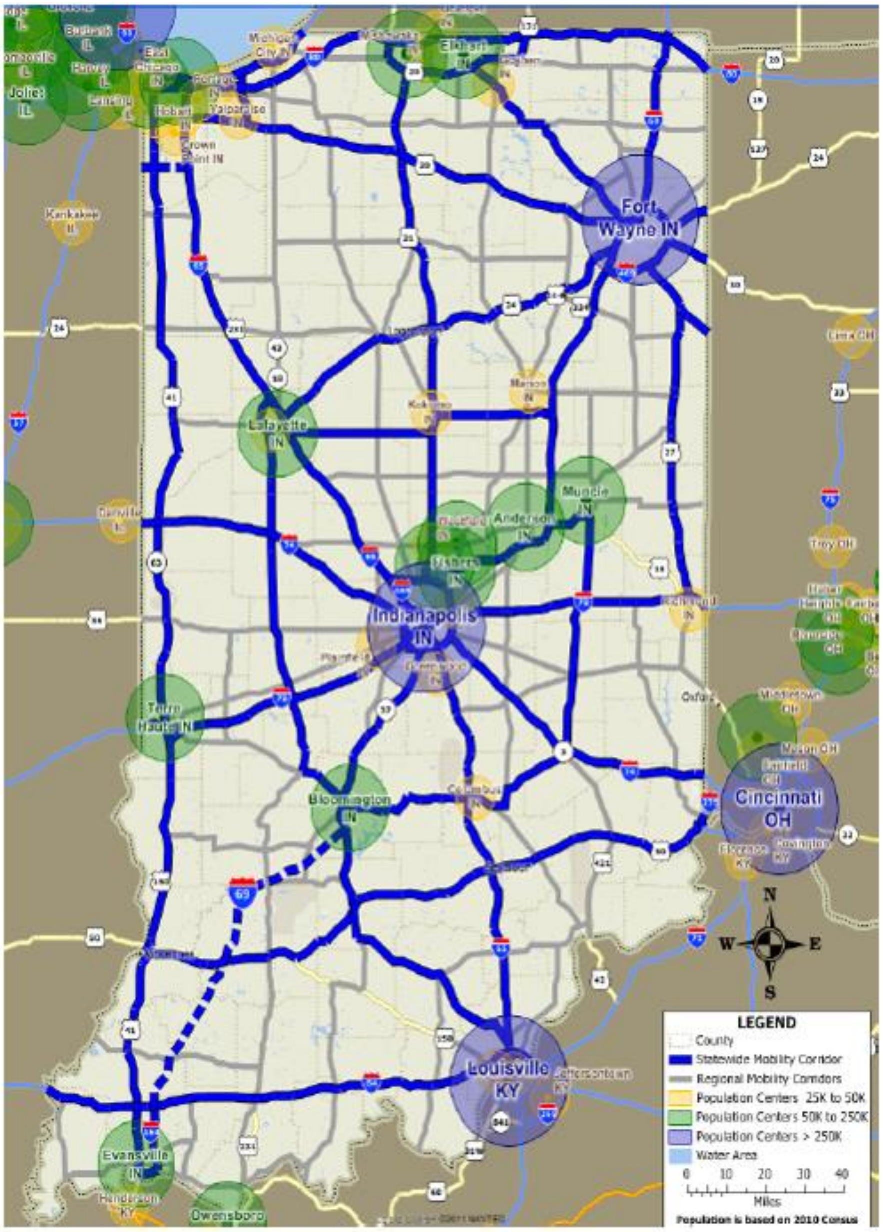


Table 1 | Indiana DOT's Access Classification System

Level of Importance / Access Category	Type	Traffic Function	Design Standards
Interstate Highways and Freeways		Accommodates high-speed, high-volume, and long-distance through traffic for interstate, intrastate, or intercity travel. Also can provide a major connection between suburban areas and metropolitan centers.	Multi-lane roadways with full access-control. Access via intechanges only (no direct private access to abutting properties allowed). All roadways are multi-lane and median-controlled/divided. At-grade intersections and access driveways not permitted under any circumstances. Interchange spacing is in accordance with the INDOT *Roadway Design Manual*.
Tier 1: Statewide Mobility Corridor	A	Provides connections to major metropolitan areas within the State and to neighboring states. Provides accessibility to cities and regions around the state. Accommodates high-speed and long-distance trips. Can accommodate heavy commercial vehicle traffic. Includes most rural non-Interstate routes on the Principal Arterial System.	Includes all multi-lane roadways. Access generally occurs only at interchanges or at-grade public street intersections. Some movements at public street intersections may need to be restricted based on existing and projected operating conditions and intersection spacing. Private access to abutting properties is <u>not</u> allowed, unless property has no reasonable alternative access (via joint-use driveways or frontage roads) or opportunity to obtain such access.
	B	Same traffic function as Tier 1, Type A. Generally provides key rural connections between metropolitan areas.	Includes only 2-lane roadways. Access generally only occurs via at-grade public street intersections. Some movements at public street intersections may need to be restricted based on existing and projected operating conditions and intersection spacing. Private access to abutting properties is <u>not</u> allowed, unless property has no reasonable alternative access (via joint-use driveways or frontage roads) or opportunity to obtain such access.
Tier 2: Regional Corridors	A	Provides connections to smaller cities and regions, feeds traffic to the Statewide Mobility Corridors, and provides for regional accessibility. Accommodates moderate to high-speed traffic, medium distance trips, and moderate volumes of through traffic and commercial vehicle traffic. Can accommodate local heavy traffic volumes.	Includes all multi-lane roadways. Generally median-controlled/divided. Public street connections occur at-grade. Private access to abutting properties is allowed. Full movements and signalization are allowed for public steet connections and "commercial major" driveways only. All other private driveways are limited to unsignalized, right-in/right-out (median-controlled) access, with left-turns allowed conditionally subject to INDOT review and approval.
	B	Same traffic function as Tier 2, Type A.	Includes only 2-lane roadways. Public street connections occur at-grade. Private access to abutting properties is allowed. Full movements are allowed at all private driveways, with the exception of access driveways located within 300 feet of an existing (or potential future) signalized intersection which must be right-in/right-out (with left-turn access allowed conditionally subject to INDOT review and approval). Signalization is allowed for public street intersections and "commercial major" driveways only.
Tier 3: Sub-Regional Corridors	A	Typically provides access to local residences and businesses in rural areas and small towns. Accommodates moderate to low speed traffic, short distance trips, and moderate local traffic volumes.	Includes all multi-lane roadways. Public street connections occur at-grade and may be signalized. "Commercial major" driveways may also be signalized. Full movements are allowed at public street intersections and all private access driveways.
	B	Same traffic function as Tier 3, Type A.	Includes ony 2-lane roadways. Public street connections occur at-grade and may be signalized. "Commercial major" driveways may also be signalized. Full movements are allowed at public street intersections and all private access driveways.

Each of the Tiers is subdivided by Types (A or B) to account for variations by Tier, where Type A defines multilane roadways and Type B defines two-lane roadways. The highest priority Tier 1, Type A Statewide Mobility Corridors are defined by the following Design Standards:

> *"Access generally occurs only at interchanges or at-grade public street intersections. Some movements at public street intersections may need to be restricted based on existing and projected operating conditions and intersection spacing. Private access to abutting properties is not allowed, unless property has no reasonable alternative access (via joint-use driveways or frontage roads) or opportunity to obtain such access."*

The Traffic Function defines Tier 1, Type A Corridors as providing primary connections and accessibility to major cities within Indiana and neighboring states. These corridors can accommodate high-speed and long-distance trips made by automobiles and commercial vehicles (Indiana Department of Transportation, August 2006).

INDOT's Access Management Program seeks to accomplish the following goals which serve as a framework to account for future development and growth:

- Reduce traffic congestion
- Preserve the flow of traffic
- Improve traffic safety and reduce the frequency of crashes
- Preserve existing road capacity
- Support economic growth
- Improve access to businesses and homes
- Maintain or improve property values
- Preserve the public investment in transportation infrastructure

Primary roadway networks can become burdened by increased developments and the subsequent increase of traffic along priority corridors. INDOT's goals to support growth and maintain roadway functionality can be accomplished by implementing the following actions:

- Implementing a statewide Access Classification System and incorporating those design plans for existing and future state highways
- Improved management of the driveway permitting process and enforcing violations
- Increased coordination with government agencies and local communities
- Educating the INDOT staff to ensure awareness of access management policies to increase coordination and efficiency in the planning and design process (Indiana Department of Transportation, August 2006)

Example: Virginia DOT

Virginia DOT (VDOT) has adopted a policy to ensure that major arterial roadways (that are not part of the interstate highway system) are preserved to support the functionality of priority networks across the state. Those major arterial segments serve as critical linkages to priority roadways and help maintain safety and capacity. Their Arterial Preservation Network includes segments of roadway facilities that are part of the Corridors of Statewide Significance (CoSS) system or are functionally classified as Principal or Other Principal Arterials.

Figure 10 illustrates the Arterial Preservation Network, including CoSS corridors and non-CoSS corridors, across Virginia. Although the CoSS-designated segments make up the majority of the priority statewide network, it is also evident that non-CoSS Mobility Preservation Segment (MPS) and Mobility Enhancement Segment (MES) segments provide critical linkages to reduce burdens on primary roadway segments (Ruff, T., May 2018).

Figure 10 | Mobility Preservation & Mobility Enhancement Segments

Strategies and procedures for the Arterial Preservation Program are currently under review by the VDOT to ensure consistency among the different documents. The transportation policies to be reviewed include the following:

- Access Management Regulations
- Current design exemption process
- Innovative intersection and interchange design policy and guidance
- Traffic signal warrants
- Coordination with stakeholders

VDOT is currently in the process of updating rules, policies, and guidelines in their documentation to protect the Arterial Preservation Program to ensure consistency and maintain statewide roadway functionality (Virginia Department of Transportation, May 2018).

To maintain the functionality of the Arterial Preservation Network, access management strategies are being implemented. One of the strategies is to limit the number of new signals to locations where they are both warranted and justified. This could minimize congestion in areas with heavy traffic by reducing the amount of stopping, especially during peak hours. Another strategy is to ensure that access for new developments is consistent with the Arterial Management Plans, which could also help minimize congestion.

Below are examples of the recent policy regulation revisions to implement these strategies:

IIM-LU-200.2 – Review of Rezoning Proposals

> *"When reviewing rezoning proposals that include a high likelihood of signalization, especially on highways that are designated as part of the **Arterial Preservation Network effort should be made to ensure that such signals are likely to be determined to be both warranted and justified**, consistent with the requirements in the latest version of IIM-TE-387" (Virginia Department of Transportation IIM-LU-200.2, July 2019).*

IIM-LU-500.2 – Review of Site Plans and Subdivision Plats

> *"For plan submissions on or adjacent to highways that have Arterial Management Plans in place, the site's access should be consistent with the arterial management plan. In cases where a site plan is being reviewed concurrently with the development of an arterial management plan, the **land use staff should consult with the Arterial Preservation Program Manager to coordinate recommendations**" (Virginia Department of Transportation IIM-LU-500.2, July 2019).*

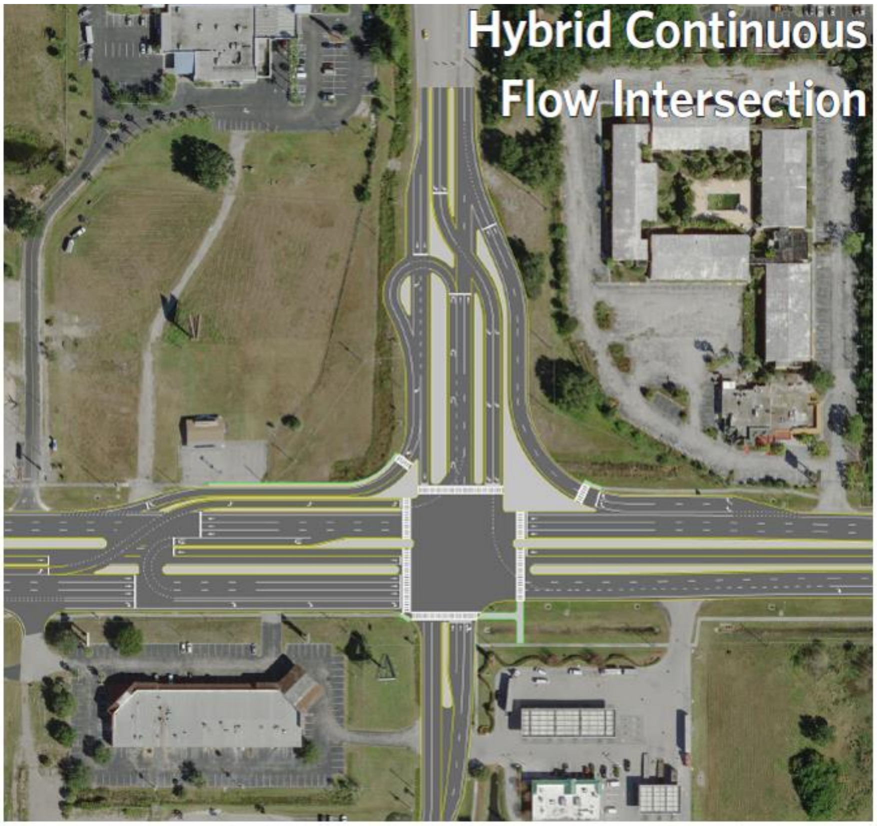
IIM-LU-501.2 – Access Management Spacing Exceptions/Waivers

> *"For waivers or exceptions involving potential signalized intersections, especially on highways that are designated as part of the Arterial Preservation Network, consideration must be given to the requirements in the latest version of IIM-TE-387, the Virginia Supplement to the MUTCD, and the relevant portions of Appendices A and F of the Road Design Manual. Finally, **new crossovers on the Arterial Preservation Network must also be approved by the District Administrator/District Engineer (DA/DE) and the State Location & Design Engineer**, regardless of whether the proposed crossover is subject to an access management exception, so final approval of such waivers should also include review by the DA/DE and the State L&D Engineer" (Virginia Department of Transportation IIM-LU-501.2, July 2019).*

3.3. Engineering Solutions

Several engineering design solutions can be implemented to reduce the transportation burden on high priority corridors. Below are a few design solutions that can be implemented to divert traffic and reduce congestion:

Figure 11 | Hybrid Continuous Flow Intersection



- Limited Access Facilities – promotes a consistent flow of traffic and reduces congestion for through traffic
- Innovative Intersections and Interchanges – minimize vehicle stopping and reduce the delay for through traffic on major roadways. Examples include the hybrid continuous flow intersection (Figure 11) and Restricted Crossing U-Turn (RCUT) facilities.
- Frontage Roads – diverts local traffic from primary roadway facilities

Strategy: Limited Access Facilities

Limited access facilities are roadways that have been designed to prioritize through traffic, which helps roadways maintain their efficiency. While many agencies have converted roadways to limited access facilities to improve traffic flow, there are potential downsides with these facilities including adverse impacts on business access, community cohesion, and travel by walking, bicycling, or transit. Below are some examples of non-limited access roads that were converted to limited access highways to improve speed and safety.

- US 31 – Marion County, Indiana
- US 12 – Dane County, Wisconsin
- Route 7 – Fairfax & Loudoun Counties, Virginia
- US 69/75 – Bryan County, Oklahoma
- Route 17 – Sullivan County, New York

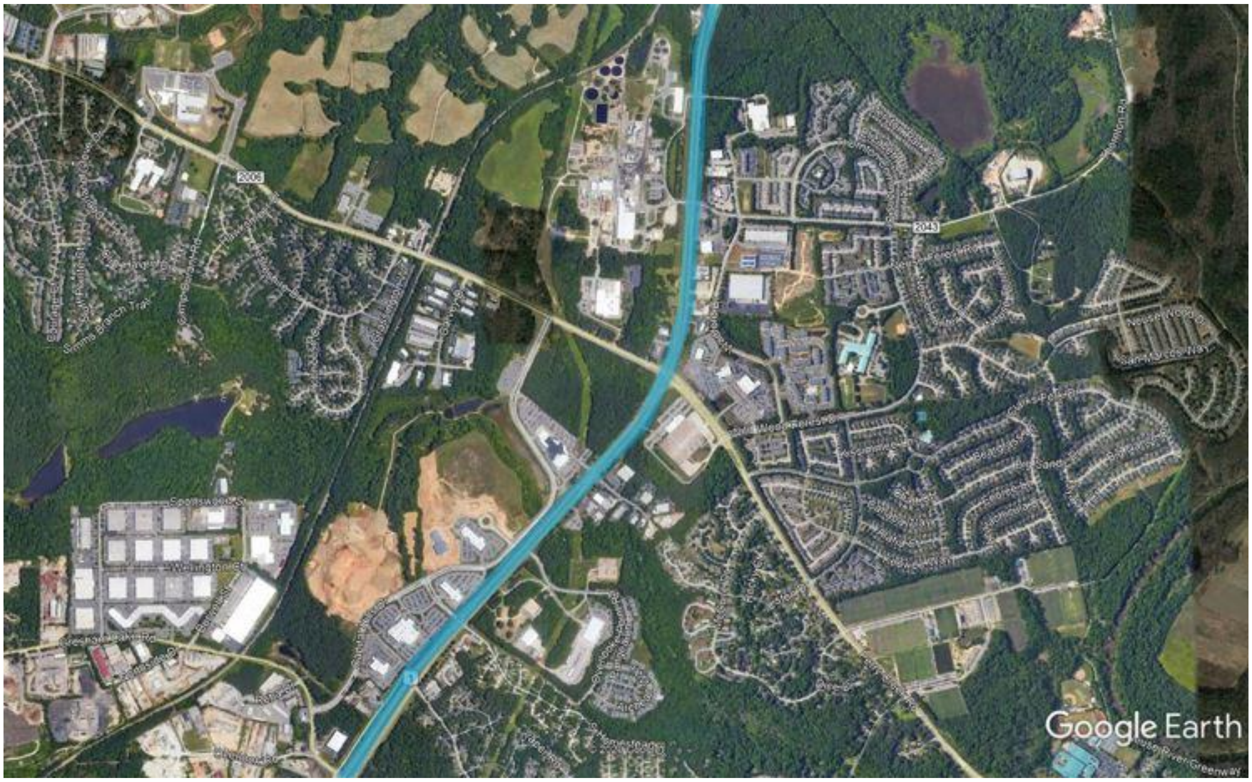
- US 380 – Collin County, Texas
- US 127 – Clinton & Gratiot Counties, Michigan
- US 89 – Davis & Weber Counties, Utah
- US 30 – Whitley County, Indiana
- US 1 – Wake County, North Carolina
- US 19 – Pinellas County, Florida

Example: US 1, Wake County, NC

In North Carolina, the US 1 corridor (Capital Boulevard) from Raleigh to Wake Forest is being converted to a controlled-access facility where access will only be provided at interchange ramps. The purpose of the project is to reduce congestion and improve travel time along the corridor by creating grade-separated cross-streets and prohibiting driveway connections along US 1. The travel time for trips made on Capital Boulevard can vary drastically – a trip taken during peak hours can take four times longer than a trip taken during off peak hours, which can be inefficient and burdensome for surrounding communities. The project is currently in the early development stages and construction is anticipated to begin October 2021 (North Carolina Department of Transportation, February 2019).

Figure 12 shows the study area within Wake County respective to I-540 and US 401. US 1 currently supports between 32,000 and 65,000 vehicles per day along the study segment and is anticipated to carry between 44,000 and 75,000 vehicles per day in 2040. Changing the classification of US 1 to a

Figure 12 | US 1, Wake County, North Carolina



limited access facility will account for the increased number of trips in the future and ensure that the corridor remains functional as a major arterial throughout the region (North Carolina Department of Transportation, February 2020).

Example: US 380, Collin County, TX

An economic analysis conducted in Collin County, Texas shows that converting the US 380 corridor to a limited access highway would solve numerous issues related to increased traffic and congestion. There are many major highways in Collin County that are becoming burdened by heavy traffic, and officials are looking into potential solutions to maintain efficiency. Additionally, the analysis shows that the conversion could result in a huge economic boon by influencing development patterns. The facility change could result in more office spaces being constructed along the corridor which would raise property values. The economic analysis projected that the conversion could result in 60 percent more employment and 170 percent more gross product (Wigglesworth, V., March 2017).

The decision to move forward with the limited access conversion was led by Collin County Commissioners, which superseded TxDOT's recommendation to construct a bypass to relieve traffic congestion. Although the proposed limited access conversion is anticipated to be more expensive and more difficult to construct based on the context, the commissioners believe it is the best decision moving forward to account for future growth and transportation demands in the county (Ritter, C., May 2019; Davis, E., May 2019).

Example: US 19, Pinellas County, FL

US 19 in Pinellas County spans 34 miles from Tarpon Springs to St. Petersburg and is also the most heavily traveled arterial road in the county. US 19 is also part of the SIS network, which shows that it is a high priority corridor that is integral to the functionality of the regional network. In addition to an increasing demand burden on US 19 safety is also a concern since it has the highest crash rates in the county. Through a coordinated effort among agencies, the goal of the US 19 project is to create a corridor that will increase mobility and safety for communities in the region (Forward Pinellas, n.d.).

The US 19 project changes the existing six-lane divided highway to a six-lane controlled access roadway and will include one-way frontage roads in both directions parallel to US 19. The purpose of the project is to improve transportation operations along the corridor and provide a more reliable system for surrounding communities. Additionally, Pinellas County conducted a study along the corridor and found that the planned improvements will change access and visibility, and ultimately make properties along US 19 more competitive and attract opportunities for land use changes and new investments. The project is currently in the design stages and construction is anticipated to begin in 2022 (Florida Department of Transportation, n.d.; Pinellas County, n.d.).

Strategy: Innovative Intersections

Intersection Control Evaluation (ICE) is a framework used to screen potential alternatives for an intersection by using the AASHTO Highway Safety Manual methodologies. The ICE process reviews potential intersection configurations and helps determine which intersection type is the best solution for a particular project. FDOT has implemented the ICE process and guidance (Florida Department of Transportation, November 2017) with a three-step process to determine the appropriate control measure for an intersection:

1. Screening
2. Preliminary Control Strategy Assessment
3. Detailed Control Strategy Assessment

The ICE process assesses the following intersection/interchange configurations:

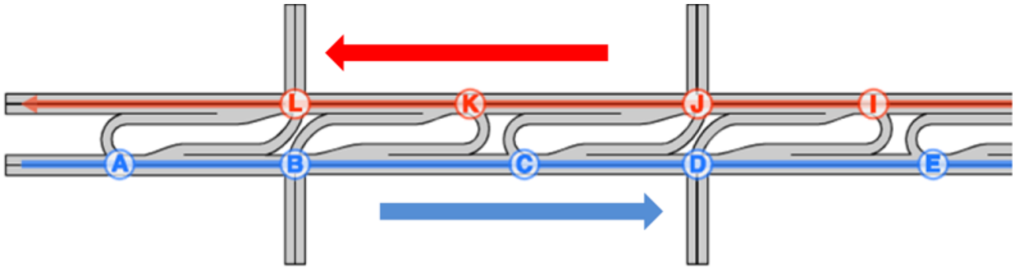
- Roundabout
- Median U-turn (MUT)
- Restricted Crossing U-turn (RCUT)
- Displaced Left-turn (DLT) or Continuous Flow Intersection (CFI)
- Jughandle
- Continuous Green-T Intersection (CGT)
- Quadrant Roadway Intersection
- Diverging Diamond Interchange

ICE procedures ensure that the alternative selection process results in a facility that is safer and more cost-effective and efficient for the public through innovative geometric and design solutions (USDOT FHWA, n.d.).

Strategy: Reduced Conflict U-Turn Facilities

A Reduced Conflict U-Turn (RCUT) – also known as a J-Turn, Superstreet, Synchronized Street, Restricted Crossing U-Turn, or Alternative Intersection – is a type of intersection design that changes how traffic from minor roads makes left turns at major roads, which reduces potential conflicts and crashes. Nationally, RCUTs have reduced the number of crash fatalities by 70 percent and have reduced crash injuries by 42 percent, which helps increase safety along corridors. These intersections provide simultaneous signal coordination in both travel directions, which improves traffic flow and reduces the number of crashes on roadways. Figure 13 illustrates this street design (Georgia Department of Transportation, n.d.; North Carolina Department of Transportation, April 2015).

Figure 13 | RCUT Street Design



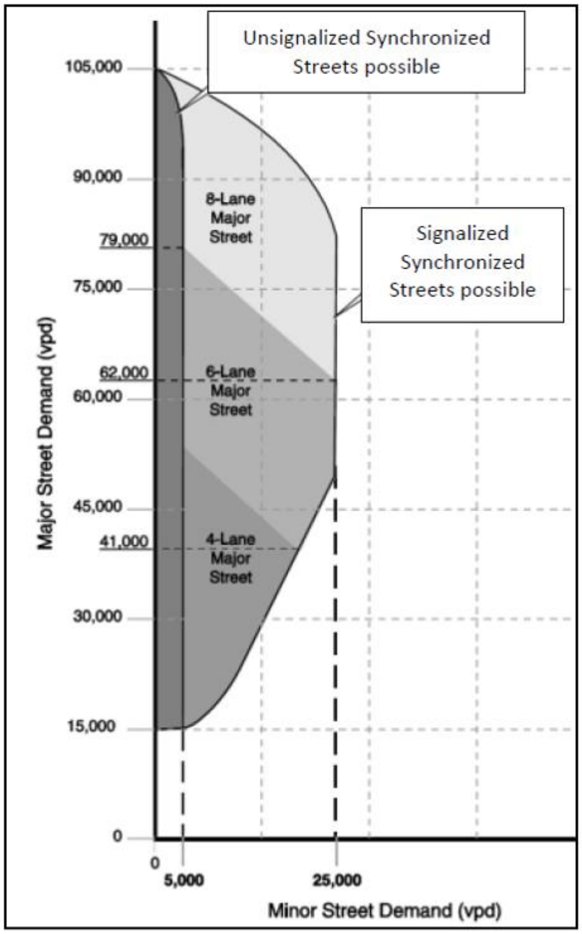
Example: NC 55 Bypass, Holly Springs, NC

The NC 55 Bypass in Holly Springs, North Carolina is one of many examples of synchronized streets in the state. Figure 14 shows that synchronized streets have a greater capacity to support vehicle travel per day:

- Four Lane Synchronized Streets: supports 40,000 - 50,000 vehicles per day
- Six Lane Synchronized Streets: supports 60,000 - 80,000 vehicles per day
- Eight Lane Synchronized Streets: supports 80,000 - 100,000 vehicles per day

Capacity improvements, like synchronized street design, can be funded through public/private partnerships between NCDOT and the developer to improve traffic flow, maintain roadway efficiency, and accommodate growth created by surrounding developments (North Carolina Department of Transportation, April 2015).

Figure 14 | Synchronized Street Capacity

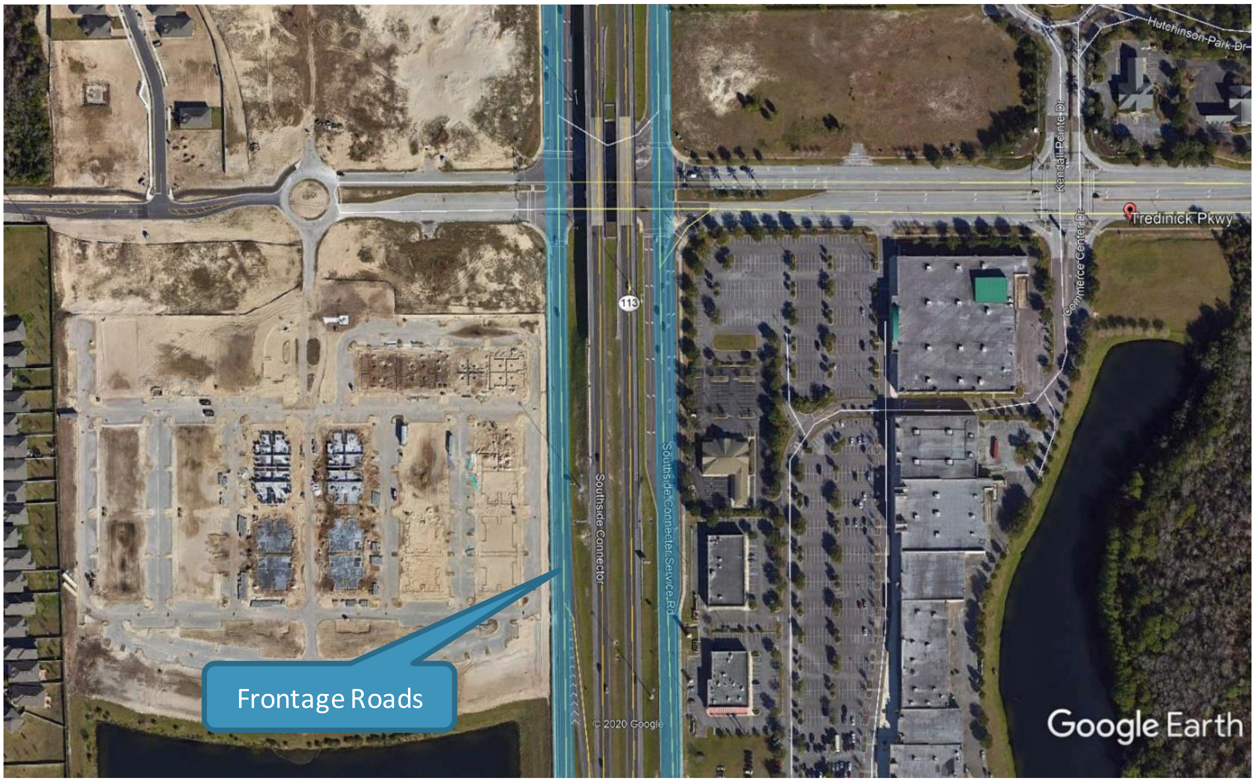


Courtesy Federal Highway Administration (FHWA)

Strategy: Frontage Roads

Frontage roads are defined as "a street or highway constructed adjacent to a higher classification street or other roadway network for the purpose of serving adjacent property or control access" (Florida Department of Transportation, May 2005). These roadways provide an opportunity to divert traffic from major arterial roadways and alleviate congestion, especially during peak hours, or in the event of a road closure or accident. Additionally, frontage roads help improve accessibility to adjacent businesses and reduce congestion that can be caused during turning movements. They provide a way to disperse traffic within a region and preserve the efficiency of major arterials that are critical to traffic flow.

Figure 15 | Frontage Road in Jacksonville, FL



4. Data Gathering Summary

Information on the three case study corridors selected by the Working Group was obtained from the respective Districts to conduct cumulative impact analyses. The following corridors were selected for the case studies:

- SR 70 in Arcadia, SR 72 to SR 31, 3.6 miles, in District 1
- SR 200 between Callahan and Yulee, Griffin Road to Chester Road, 11.6 miles, in District 2
- US 27 south of Clermont, Lake/Polk County Line to Hartwood Marsh Road, 11.2 miles, in District 5

The following sections document the information that was collected for the three case studies and used in the cumulative impact analysis. The data gathering effort is summarized by the case study corridor in the following sections.

4.1. SR 70 in Arcadia

The study area of SR 70 is located in District 1 in Arcadia, FL, approximately 3.6 miles long from SR 72 to SR 31. An overview map of the study corridor is provided in Figure 16. Corridor detail maps are provided in Appendix B.

In 1984, Arcadia became a Main Street City, prompting revitalization and new developments in the downtown area. The city has a population of 8,314 (based on 2019 data) and a total land area of 4.08 square miles (based on 2010 values).

As shown in Figure 17, there are a variety of land use types along the study corridor. The western end is primarily surrounded by agricultural and recreational land uses, while the middle and eastern areas are primarily near residential, institutional/public, and commercial uses.

Study team members met with District 1 staff on June 2, 2020 (via GoToMeeting) to discuss the corridor and the needed data for the cumulative impact analysis. District 1 staff explained that there is currently a corridor study for SR 70 underway, as well as a PD&E study for a new bypass which will extend SR 31 north to connect with SR 35 (US 17). This bypass will provide an alternative route, particularly for truck traffic, to bypass the busy intersection of SR 70 at US 17 in the downtown area of Arcadia. Additionally, the bypass would help to serve future traffic growth from developments in the area such as the Mosaic Arena in northeast Arcadia.

The following information was provided by District 1 staff:

- District 1 2018 Level of Service (LOS) Spreadsheet
- District 1 Regional Planning Model (D1RPM) files
- SR 31 Extension Technical Traffic Forecast Modeling Memorandum
- SR 31 Alternative Corridor Evaluation Report
- SR 70 Corridor Action Plan Subarea Travel Demand Model Validation Memo
- SR 70 Corridor Action Plan Travel Demand Model files
- SR 70 Corridor Action Plan Existing Conditions Report

Additional research was conducted by the team to review approved and planned developments in the area. The DeSoto County Comprehensive Plan Future Land Use Element was referenced for information on the West River Study Area, Community 1, and Community 2. These areas are depicted in Figure 18.

Per the DeSoto County Comprehensive Plan Future Land Use Element, the planned land uses and intensity for these developments are summarized in Table 2.

Table 2 | SR 70 Case Study Planned/Approved Developments

Planned/Approved Development	Description
West River Study Area	19,234 acres. Maximum density of one dwelling unit per five acres, with a conservation overlay of 6,422 acres
Community 1	5,702 acres. Maximum density of 0.6 floor area ratio for non-residential uses with specifications for regional, community, and neighborhood scale commercial centers. The maximum density for residential uses is eight dwelling units per acre.
Community 2	4,311 acres. Maximum density of 0.6 floor area ratio for non-residential uses with specifications for regional, community, and neighborhood scale commercial centers. The maximum density for residential uses is eight dwelling units per acre.

Figure 16 | SR 70 Case Study Overview Map

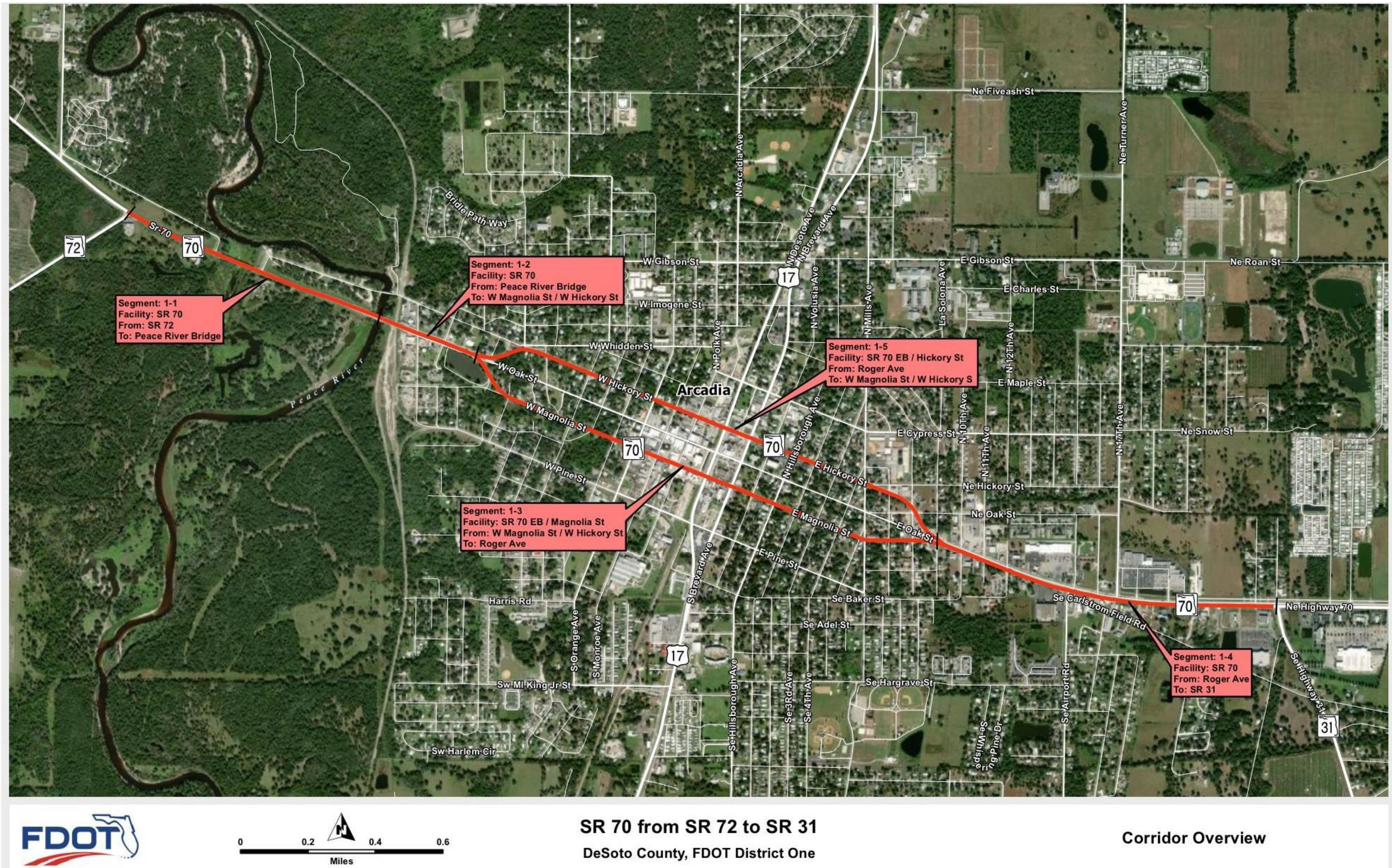


Figure 17 | SR 70 Case Study Existing Land Use

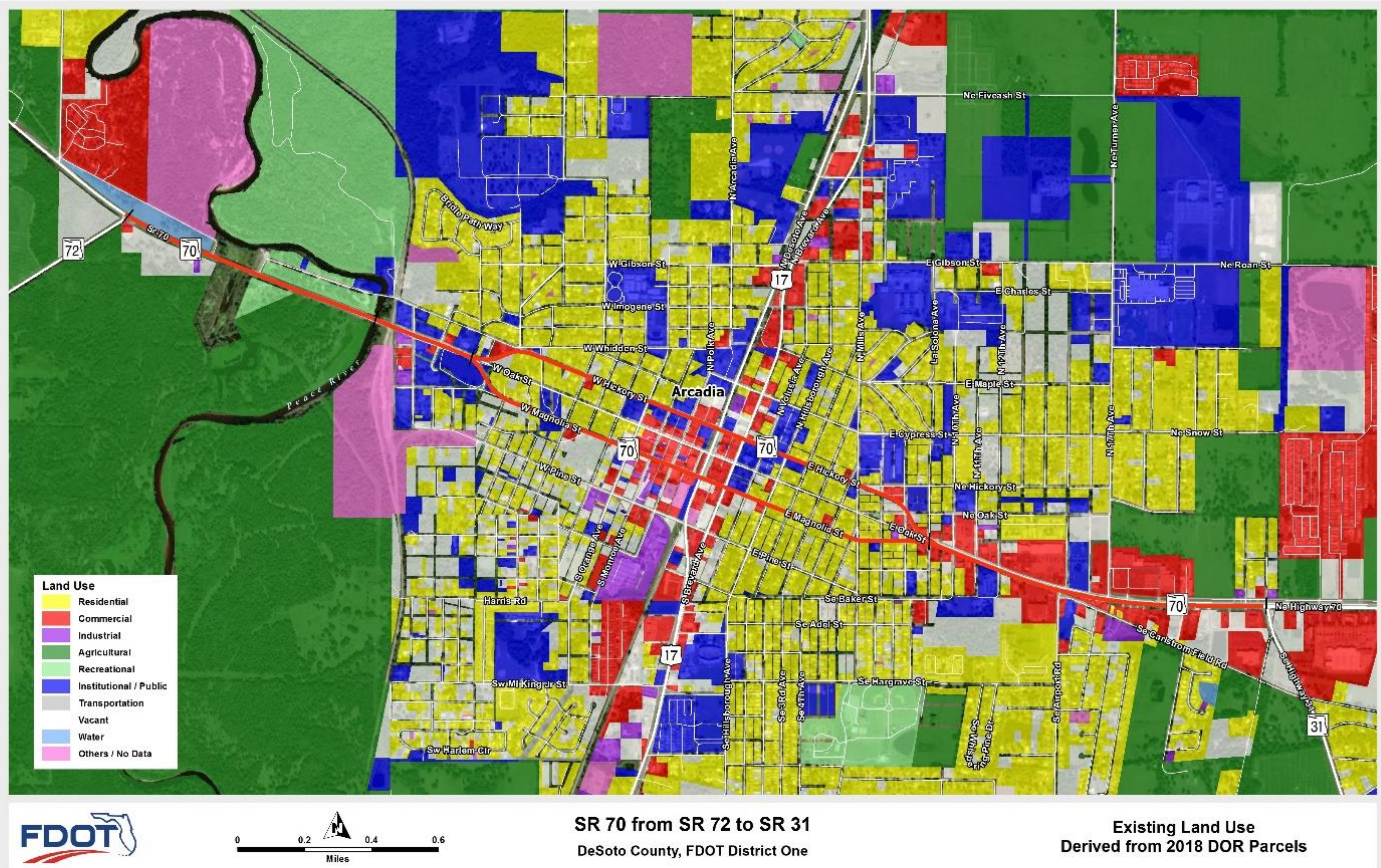
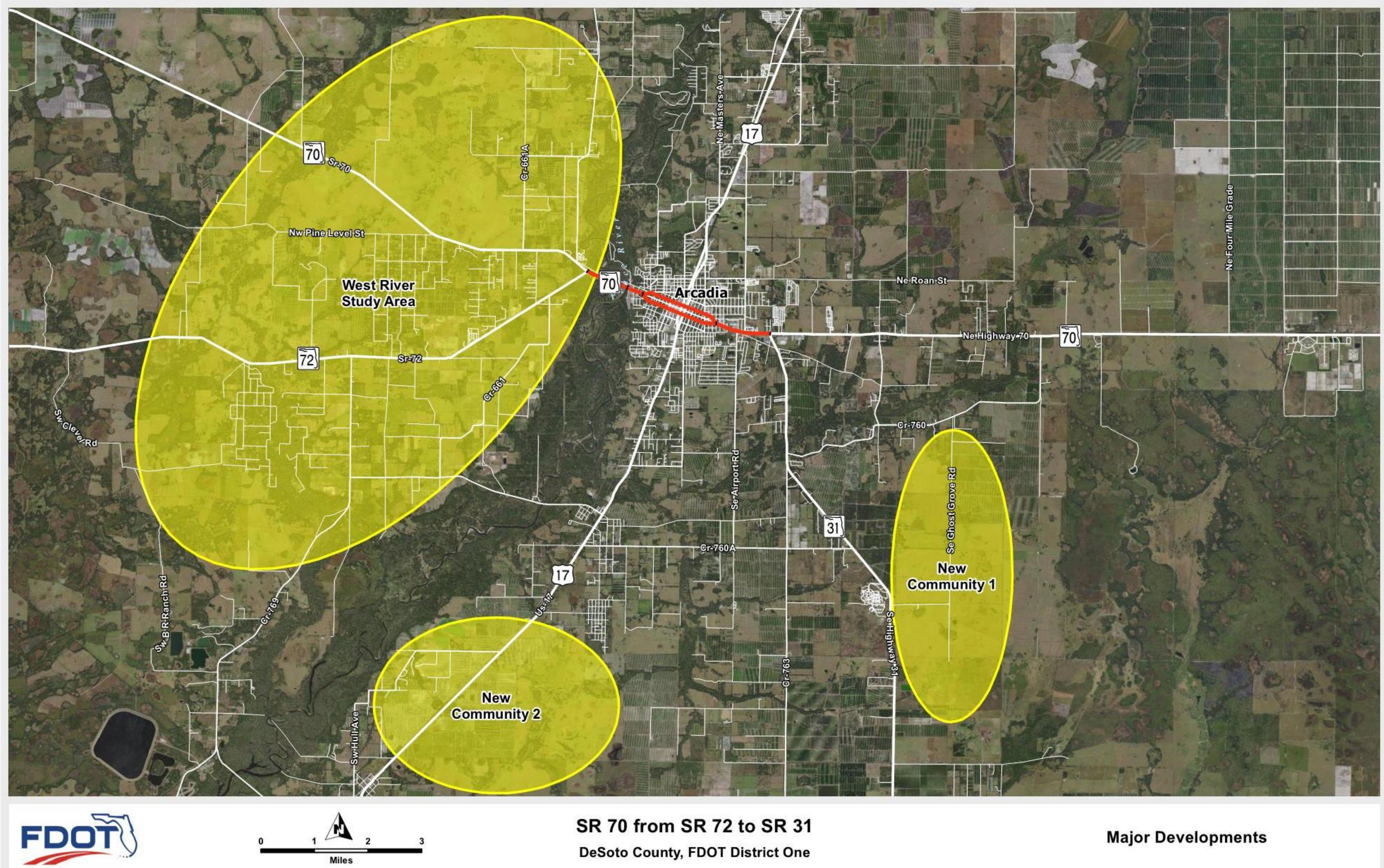


Figure 18 | SR 70 Case Study Planned/Approved Developments



4.2. SR 200 between Callahan and Yulee

The case study for SR 200 is located in Nassau County in District 2. The corridor extends approximately 11.6 miles between Callahan and Yulee from Griffin Road to Chester Road. Figure 19 provides an overview map of the study corridor. Corridor detail maps are provided in Appendix B.

Nassau County has a population of 88,625 (based on 2019 data) and a total land area of 648.64 square miles (based on 2010 values).

Figure 20 shows the existing land uses along the study corridor. Many areas along the corridor are surrounded by agricultural land use, as well as institutional/public, transportation, and residential uses.

The team discussed the corridor with District 2 staff on June 8, 2020 (via GoToMeeting), to learn about the existing conditions of the corridor, the known future developments, and concerns. District 2 staff discussed several known developments along or near the corridor including Three Rivers Development of Regional Impact (DRI), William Burgess Overlay District, and Governor's Park.

District 2 staff supplied the team with the following information:

- I-95 at SR 200 Interchange Modification Report, Highway Capacity Software (HCS), and Synchro files
- Three Rivers DRI Report, Synchro files, Approved Permit Package, Development Order, and site plan
- Three Rivers DRI Travel Demand Model files
- William Burgess District Context and Connectivity Blueprint Report and documentation
- Approved projects since 2015 spreadsheet
- SR 200 18-kip Equivalent Single Axle Loads (ESAL)
- SR A1A/SR 200 Corridor Study
- Western Nassau Heritage Preservation Vision Book
- Harper Chapel Road and Bobby Moore Circle Driveway Connection Permit

The information provided by the District contained the developments depicted in Figure 21 and listed in Table 3.

Table 3 | SR 200 Case Study Planned/Approved Developments

Planned/Approved Development	Description
Three Rivers DRI	500,000 square feet of retail, 250,000 square feet of industrial, 300 storage slips, 50,000 square feet of office, 3,200 residential dwelling units
William Burgess District	5,265 acre overlay district. Future Land Use Map (FLUM) build out includes 2,931,000 square feet of commercial, 964,000 square feet of industrial, 2,430,000 square feet of public facilities, 4,357 residential dwelling units
Market Street PDP	800-student elementary school, 917 residential dwelling units, 120-room hotel, 184,000 square feet of office, 200,000 square feet of retail
East Nassau Community Planning Area	25,000 residential dwelling units, 11,000,000 square feet of commercial
River Glen	452 residential dwelling units

Figure 19 | SR 200 Case Study Overview Map

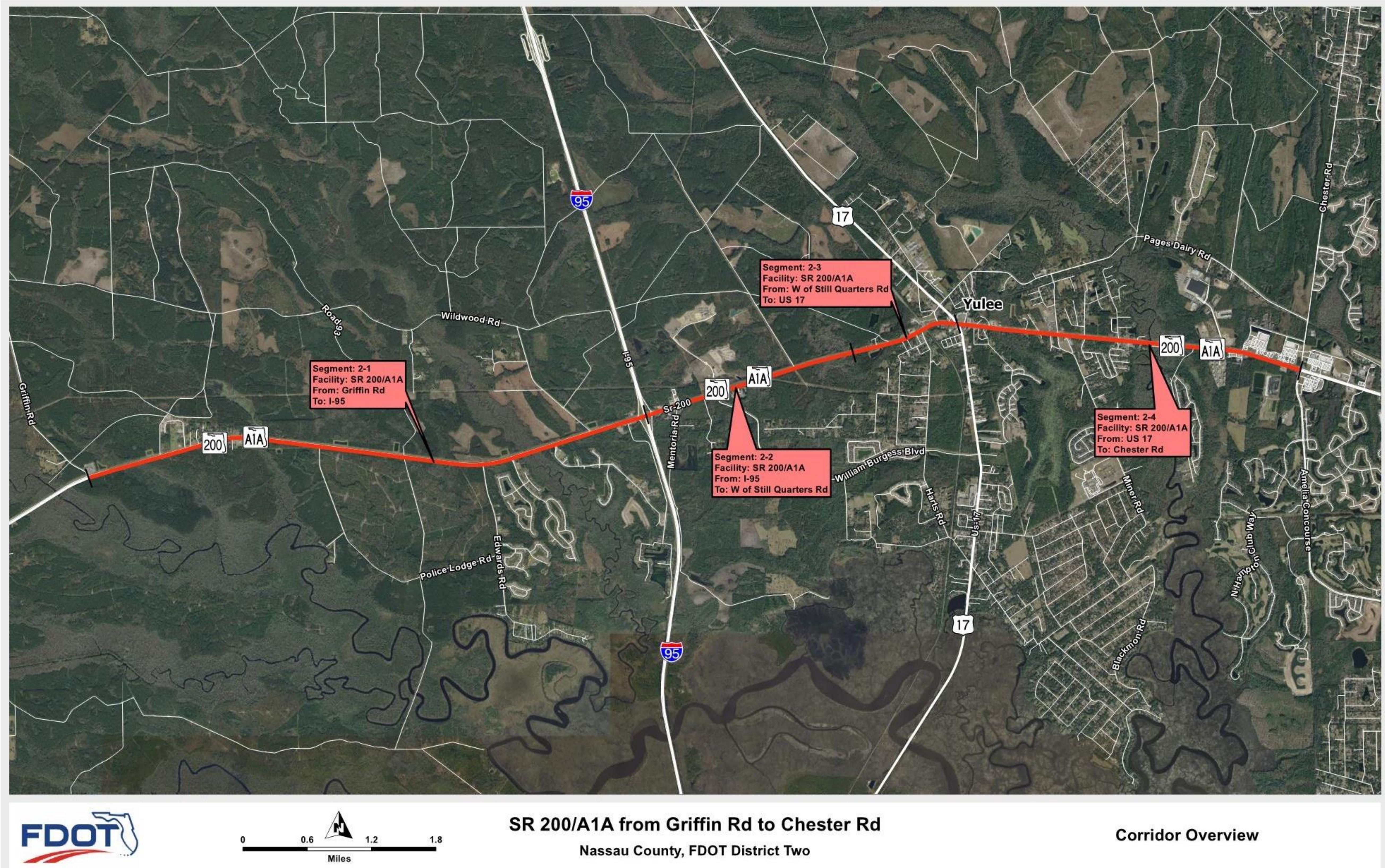


Figure 20 | SR 200 Case Study Existing Land Use

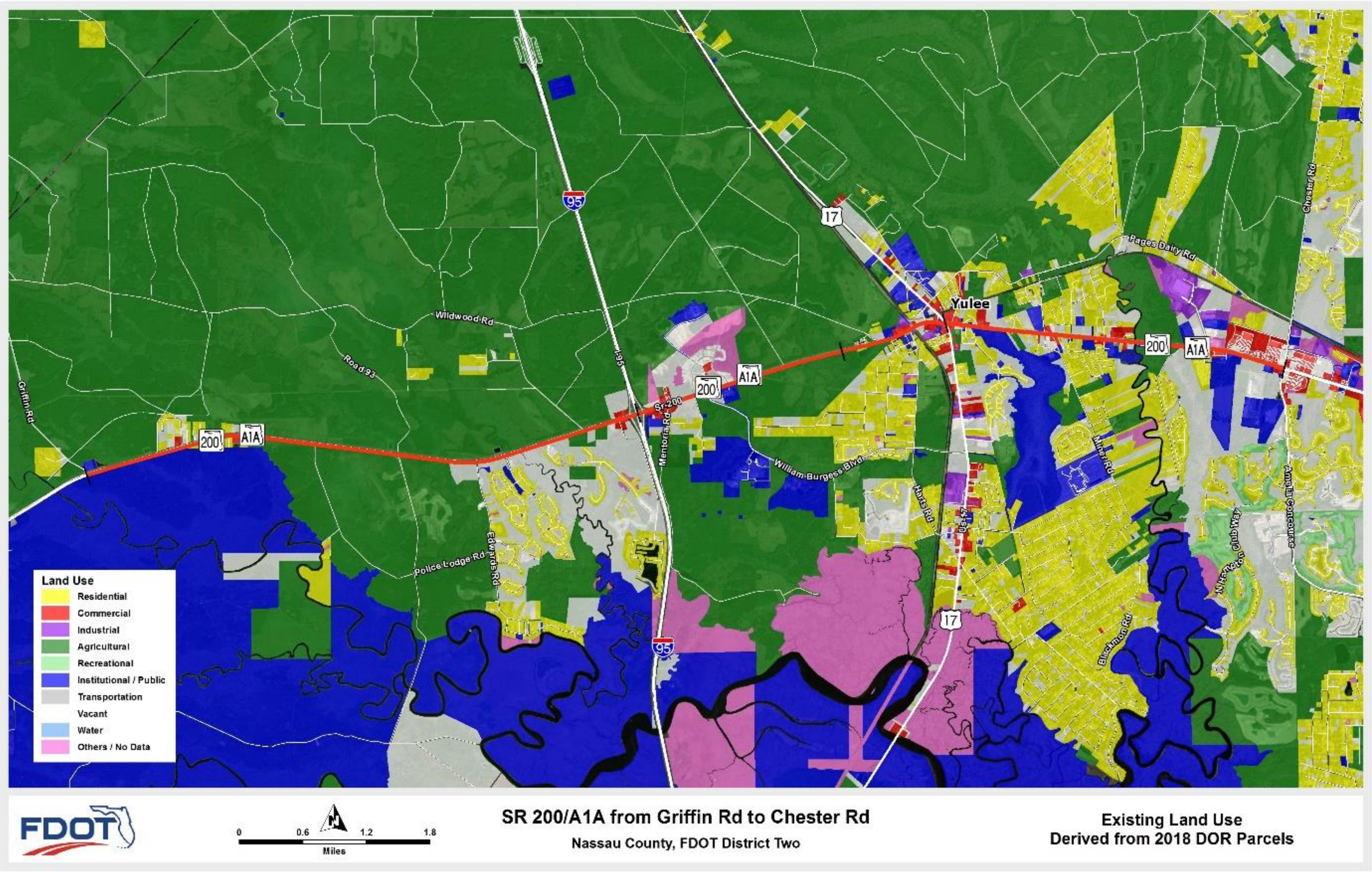
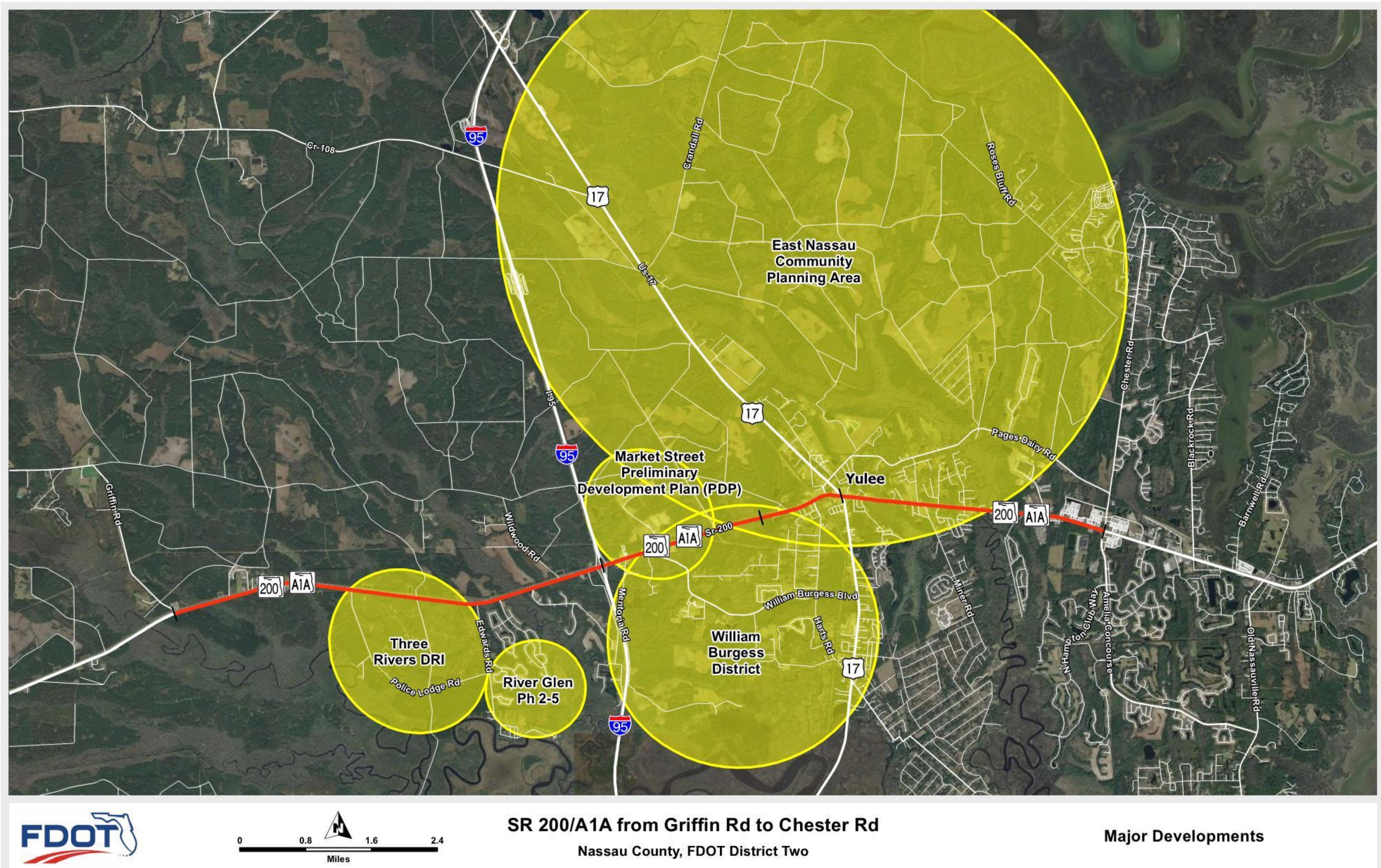


Figure 21 | SR 200 Case Study Planned/Approved Developments



4.3. US 27 south of Clermont

The case study for US 27 is located south of the City of Clermont in Lake County in District 5. The corridor extends approximately 11.2 miles from the Polk/Lake County Line to Hartwood Marsh Road. Figure 22 provides an overview map of the study corridor. Corridor detail maps are provided in Appendix B.

Clermont is located approximately 20 miles west of Orlando and is one of the fastest growing cities in Central Florida. The City has a population of 38,654 (based on 2019 data) and a total land area of 13.63 square miles (based on 2010 values).

As shown in Figure 23, the northern section of the corridor is primarily surrounded by agricultural and institutional/public land uses, while the southern area is surrounded by residential and commercial uses.

The study team met with District 5 staff on June 2, 2020 (via GoToMeeting) to learn about the corridor and to discuss potential development impacts along the corridor. District 5 staff explained that there is a large proposed development along US 27, Olympus Sports & Entertainment, which includes new roadways to create parallel routes and increase connectivity in the area. However, concerns remain over the timing of the new roadways and if they will be in place at the time the development is built to help serve the increased traffic demand.

Data needs were also discussed during the meeting and District 5 staff provided the following materials to the study team:

- The City of Clermont Adopted Comprehensive Plan Amendment Letter
- The Olympus Sports & Entertainment Proportionate Share and Network Review
- The Olympus Sports & Entertainment Traffic Impact Study (TIS) Submittal and Review Comments
- Central Florida Regional Planning Model (CFRPM) files for the Olympus Sports & Entertainment project
- District 5 LOS Spreadsheet
- The Wellness Way Sector Plan Transportation Master Plan Analysis

The materials provided by District 5 included information regarding developments near the study corridor, which are shown in Figure 24 and described in Table 4.

Table 4 | US 27 Case Study Planned/Approved Developments

Planned/Approved Development	Description
Olympus Sports & Entertainment	Multi-purpose 247.17-acre sports complex: - 1,088 residential units (multi-family townhomes, condominiums, and apartments) - 255,154 square feet retail-commercial, shopping center - 44,500 square feet restaurants (stand-alone, sit-down/high turnover) - 767,296 square feet general and medical/wellness office - 379,748 square feet indoor recreational uses (ice sports, aquatic center, fitness/health, tennis and EPIC center) - 5 outdoor recreational fields (soccer, track, and field) - 17.47 acres of parks (beach volleyball, skateboard park, and surf park) - 1,312 hotel rooms and convention facilities - 1,500 seat outdoor lawn with stage/theatre
Wellness Way Sector Plan	16,200 acres with 16,500 residential dwelling units, 12,000,000 square feet of commercial, 6,220-student schools

Figure 22 | US 27 Case Study Overview Map

Figure 23 | US 27 Case Study Existing Land Use

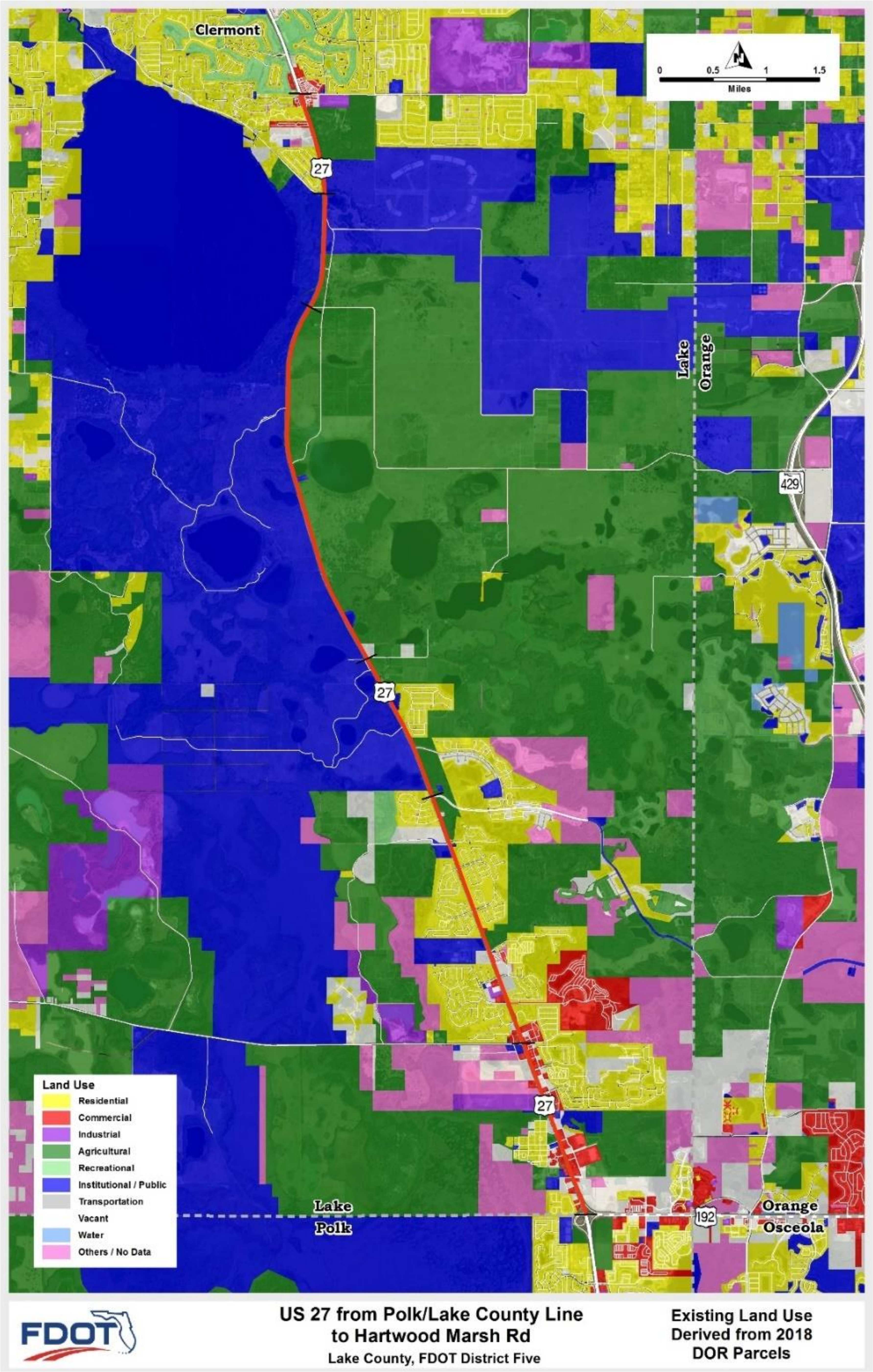
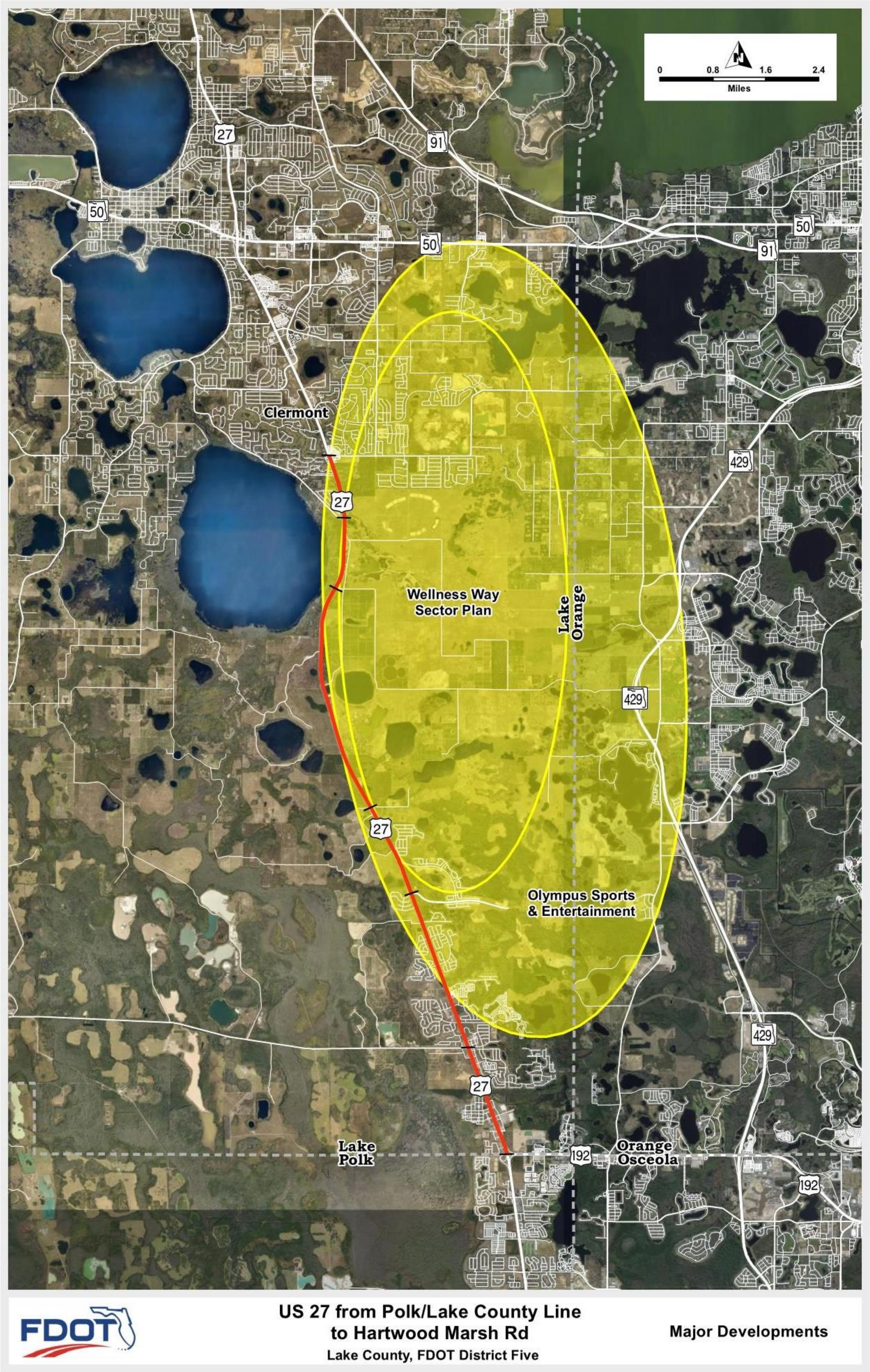


Figure 24 | US 27 Case Study Planned/Approved Developments



5. Cumulative Impact Analysis

The following case study corridors were analyzed as a part of this project to understand cumulative impacts on priority corridors:

- SR 70 in Arcadia, SR 72 to SR 31, 3.6 miles in District 1
- SR 200 between Callahan and Yulee, Griffin Road to Chester Road, 11.6 miles in District 2
- US 27 south of Clermont, Lake/Polk County Line to Hartwood Marsh Road, 11.2 miles in District 5

5.1. Cumulative Impact Analysis Elements & Methodology

Analysis was conducted for each study corridor to understand existing and future conditions that could dictate potential capacity issues along each segment. The following elements were analyzed to understand existing conditions:

- History of the study corridor area
- Existing land use
- Historic traffic volumes
- Historic growth rate
- Existing Level of Service (LOS)
- Existing Volume to Maximum Service Volume (v/MSV) Ratio

The Existing Volume to Maximum Service Volume (v/MSV) ratio was utilized for this analysis to compare the anticipated traffic volumes to the maximum service volume as per the FDOT 2020 Quality/Level of Service Handbook. The v/MSV was utilized instead of the volume to capacity (v/c) ratio because the v/c ratio compares traffic volumes to capacity, or the maximum volume that a roadway can accommodate. In contrast, the maximum service volume is the highest volume a roadway can accommodate at the adopted LOS standard or target. To understand the future LOS of SIS facilities, the v/MSV was utilized to provide a ratio that compares the traffic volumes to the LOS maximum service volume.

Future traffic volumes were projected by utilizing the following models:

- District 1 Regional Planning Model (D1RPM) – used for SR 70 in District 1
- Northeast Regional Planning Model (NERPM) – used for SR 200 in District 2
- Central Florida Regional Planning Model (CFRPM) – used for US 27 in District 5

For each model, No Build and Build scenarios were analyzed. The No Build scenario utilized the Cost Feasible (CF) Model for 2040/2045 for each respective model/area, which accounts for the projected future population and employment, as well as the cost feasible roadway improvement projects from the Long Range Transportation Plan. The Build scenario utilized the CF model with modifications to account for the approved and/or known developments in the area. This involved reviewing the specific population and employment projections by Traffic Analysis Zone (TAZ) along and in the vicinity of the study corridors in each regional model and then making adjustments to appropriately match the approved and planned development program totals.

The 2010 Base Year Model Annual Average Daily Traffic (AADT) and the 2040/2045 CF Model AADT were used to calculate model growth rates for both the No Build and Build scenarios. These growth rates were applied to existing measured 2019 AADT volumes to estimate future 2045 No Build and Build volumes.

Afterward, LOS and v/MSV were evaluated based on the generalized daily capacity tables contained in the FDOT 2020 Quality/Level of Service Handbook to determine how the proposed developments are anticipated to affect the study corridors.

5.2. Scenario Planning Methodology

After the future LOS and v/MSV were estimated in the cumulative impact analysis, engineering solutions were reviewed for segments anticipated to either not meet LOS targets or to operate above a v/MSV of 0.90. The following triggers were used for this analysis:

- 2045 Rural Segment over Target LOS C, or v/MSV ≥ 0.90
- 2045 Urban Segment over Target LOS D, or v/MSV ≥ 0.90

Table 5 shows a range of engineering solutions categorized by estimated percent increase in capacity with the improvement in place. Many of the solutions have multiple options; for instance, low-cost operational improvements include median treatments, signal retiming/coordination, turn lanes, etc. Based on the additional future capacity needed for each segment, as identified in the cumulative impact analysis, the potential engineering solutions were reviewed to determine viable options to carry forward for further review.

Table 5 | Engineering Solutions

Percent Increase in Capacity	Engineering Solution
<25%	Low-Cost Operational Improvements
	Technology to Increase Capacity
	Managed Lanes
	Increased Multimodal Options
	Innovative Intersection Control
	Network Enhancements
	Access Management
25-50%	Low-Cost Operational Improvements
	Adaptive Signals
	Managed Lanes
	Access Management
	Innovative Intersection Control
	Network Enhancements
50-75%	Service/Backage Roads
	Frontage Roads
	Multiway Boulevard
	Innovative Intersection Control
	Network Enhancements
75-100%	Innovative Intersection Control
	Network Enhancements
>100%	Additional Through Lanes
	Convert to Grade-Separated Intersection
	Convert to Limited Access
	Improved Parallel Routes

5.3. SR 70 in Arcadia

Cumulative Impact Analysis

The historical and future AADTs for the SR 70 study corridor are shown in Figure 25 and Figure 26, respectively. The historical AADT growth rate for the corridor from 1995 to 2019 is 3.14 percent per year. The future AADT average growth rate for the No Build scenario is 1.27 percent per year, while the rate for the Build (with the proposed developments) scenario is 2.65 percent per year.

Table 6 shows the number of lanes, AADT, v/MSV, and LOS for each segment of the SR 70 study corridor for analysis years 2010, 2019, 2045 No Build, and 2045 Build. Additional maps depicting LOS and v/MSV are provided in Appendix B. As shown, SR 72 to Peace River is anticipated to operate at LOS E in future No Build conditions and is expected to worsen to LOS F with the addition of proposed projects. Roger Avenue/Oak Street to SR 31 is anticipated to operate at LOS C without the proposed developments in 2045 No Build conditions but worsen to LOS F in future Build conditions. In contrast, the portions of the corridor that are located in downtown Arcadia, which features a one-way pair on SR 70 surrounded by a significant grid network of streets, shows that conditions in either the No Build or Build conditions will remain at LOS C with a maximum v/MSV of 0.77.

The v/MSV ratios along the study corridor also indicate more congested conditions with the proposed developments in the Build scenario, compared to the No Build scenario. For instance, Peace River to SR 70/Hickory Street/Magnolia Street has a v/MSV of 0.65 in No Build conditions which increases to 1.00 (at capacity) in Build conditions.

Figure 25 | SR 70 Case Study Historical AADT

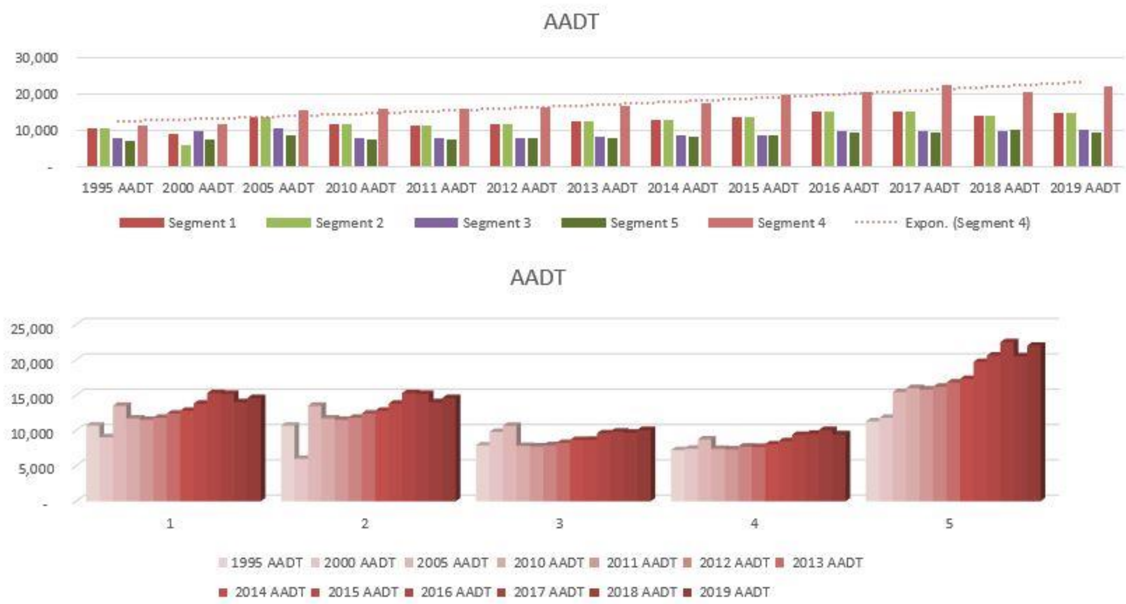


Figure 26 | SR 70 Case Study Future AADT

Table 6 | SR 70 Case Study Analysis Results

Segment	Year/Scenario	Lanes	AADT	v/MSV	LOS
SR 72 to Peace River	2010	2	11,700	0.75	C
	2019	2	14,600	0.93	C
	2045 No Build	2	21,800	1.39	E
	2045 Build	2	33,800	2.15	F
Peace River to SR 70/ Hickory St/ Magnolia St	2010	4	11,700	0.34	C
	2019	4	14,600	0.43	C
	2045 No Build	4	22,000	0.65	C
	2045 Build	4	34,000	1.00	D
SR 70/ Hickory St/ Magnolia St to Roger Ave/ SR 70 (one-way EB)	2010	2	7,825	0.37	C
	2019	2	10,075	0.47	C
	2045 No Build	2	13,000	0.61	C
	2045 Build	2	16,300	0.76	C
Roger Ave/ SR 70 to SR 70/ Hickory St/ Magnolia St (one-way WB)	2010	2	7,400	0.35	C
	2019	2	9,475	0.44	C
	2045 No Build	2	12,100	0.56	C
	2045 Build	2	16,400	0.77	C
Roger Ave / Oak St to SR 31	2010	4	16,000	0.45	C
	2019	4	22,000	0.62	C
	2045 No Build	4	30,700	0.86	C
	2045 Build	4	43,500	1.22	F

Scenario Planning

Scenario planning was conducted for the over-capacity segments to identify potential engineering solutions for further consideration. To estimate the portion of through traffic on SR 70 versus local traffic, D1RPM select link model runs were performed for 2045 Build conditions (included in Appendix C). Table 7 provides a summary of the scenario planning for SR 70, including a discussion of potential capacity enhancement options and how local versus regional traffic might influence decisions on potential engineering solutions.

The section from SR 72 to Peace River is anticipated to operate at LOS F with a v/MSV of 2.15 in future Build conditions. Since it is anticipated to be more than 100 percent over its maximum service volume, engineering solutions that provide over 100 percent increase in capacity were considered which include: additional through lanes, grade-separated intersections, limited access facility, and improved parallel routes. Based on a review of these options, additional through lanes could be considered since this section is currently only two lanes with no widening planned. A four-lane section would provide sufficient capacity for the anticipated future Build AADT. Additionally, improved parallel routes could be considered, although there may be limitations with crossing the Peace River.

The section from Peace River to Hickory Street/Magnolia Street is expected to operate at LOS D, however it is estimated to operate at the maximum service volume with a v/MSV of 1.00. Engineering solutions that provide approximately less than 25 percent increase in capacity were considered such as low-cost operational improvements, technology, managed lanes, multimodal, innovative intersection control, and network enhancements. Of these solutions, the addition of right-turn lanes, increased multimodal options, and/or network enhancements could be further considered to provide the needed capacity for future 2045 Build conditions.

The section of Roger Avenue/Oak Street to SR 31 is expected to operate at LOS F and a v/MSV of 1.22. Low-cost operational improvements, adaptive signals, managed lanes, access management, innovative intersection control, and network enhancements were considered for engineering solutions to provide additional capacity. Upon review, signal upgrades, frontage roads, backage roads, innovative intersection control, and network enhancements were identified as viable strategies for further consideration.

Table 7 | SR 70 Scenario Planning

Local Road Name	From	To	2045 Build AADT	2045 Build Thru Lanes	2045 Build LOS	2045 Build v/MSV	Preliminary Range of Engineering Solutions	Viable Strategy?	Discussion
SR 70 / Oak Street	SR 72	Peace River	33,800	2	F	2.15	Additional Through Lanes	Yes	This section is a 2-lane facility in 2045 Build conditions. Service volume with 4 lanes = 42,300, which is sufficient for projected 2045 Build AADT.
							Convert to Grade-Separated Intersection	No	Not applicable. No major intersections.
							Convert to Limited Access	No	Not applicable. No major intersections or driveways.
							Improved Parallel Routes	Yes	The regional model shows the majority of traffic on SR 70 is not interregional through traffic. A significant portion of the traffic is to/from other SIS facilities (US 17 and SR 31) in Arcadia, thus alternative routes or bypasses could alleviate the volume of traffic on this section of SR 70. However, there are limited crossings over the Peace River and new corridors would be difficult due to impacts to the river and surrounding wetlands. There is an existing substandard bridge over the river on American Legion Dr / Hickory St which runs parallel to SR 70. This route could be explored for its viability to serve as a parallel corridor to connect to destinations in Arcadia, as well as serve as a connection to/from US 17.
SR 70 / Oak Street	Peace River	SR 70/Hickory St/Magnolia St	34,000	4	D	1.00	Low-Cost Operational Improvements	Yes	Consider the addition of right turn lanes; the service volume would increase to 35,700 which is sufficient for the projected 2045 Build AADT.
							Technology to Increase Capacity	No	Not applicable. No signalized intersection in the segment.
							Managed Lanes	No	Reversible lanes: Based on FDOT Florida Traffic Online (FTO) data, there does not appear to be a strong directionality of traffic between AM/PM, as such reversible lanes may not be effective. Restricted lanes: likely not to increase capacity given freight and bus volumes compared to overall volumes. Contraflow left turn pockets: Left turn lanes already present and dual likely not needed.
							Increased Multimodal Options	Yes	A sidewalk is not present on the north side of SR 70. Bike facilities are also not present on the corridor. Multimodal trips can be encouraged given the proximity to downtown.
							Innovative Intersection Control	No	Not applicable. No major intersections.
							Network Enhancements	Yes	The regional model shows that the majority of traffic on SR 70 is not interregional through traffic. A significant portion of traffic is to/from other SIS facilities (US 17 and SR 31) in Arcadia, thus alternative routes or bypasses could alleviate the volume of traffic on this section of SR 70. However, there are limited crossings over the Peace River and new corridors would be difficult due to impacts to the river and surrounding wetlands. There is an existing substandard bridge over the river on American Legion Dr / Hickory St which runs parallel to SR 70. This route could be explored for its viability to serve as a parallel corridor to connect to destinations in Arcadia, as well as serve as a connection to/from US 17.
Magnolia St – One-way EB	SR 70/Hickory St/ Magnolia St	Roger Ave/ SR 70	16,300	2	C	0.76	-	-	
Hickory St – One-way WB	Roger Ave/ SR 70	SR 70/Hickory St/ Magnolia St	16,400	2	C	0.77	-	-	
SR 70	Roger Ave / Oak St	SR 31	43,500	4	F	1.22	Low-Cost Operational Improvements	Yes	Possible signal retiming/coordination upgrades could be reviewed. Median modifications could be explored to reroute left turns to u-turn locations.
							Adaptive Signals	Yes	Signal upgrades could be considered to increase capacity.
							Managed Lanes	No	Reversible lanes: Based on FTO data, there does not appear to be a strong directionality of traffic between AM/PM, as such reversible lanes may not be effective. Restricted lanes: likely not to increase capacity given freight and bus volumes compared to overall volumes. Contraflow left turn pockets: Left turn lanes already present and dual likely not needed.
							Access Management	Yes	Frontage roads, backage roads, and/or shared access could be considered to reduce driveways on SR 70 and remove local traffic from SR 70.
							Innovative Intersection Control	Yes	ICE could be explored for the signalized intersections at Airport Rd, Turner Ave, and SR 31.
							Network Enhancements	Yes	Improvements could be explored to better connect the surrounding roadway network. The regional model shows the majority of traffic on SR 70 is not interregional through traffic. A significant portion of the traffic is to/from other SIS facilities (US 17 and SR 31) in Arcadia, thus alternative routes or bypasses could alleviate the volume of traffic on this section of SR 70.

5.4. SR 200 between Callahan and Yulee

Cumulative Impact Analysis

The historical and future AADTs for the SR 200 study corridor are shown in Figure 27 and Figure 28, respectively. The historical AADT growth rate for the corridor from 1995 to 2019 is 2.09 percent per year. The future AADT average growth rate for the No Build scenario is 2.58 percent per year, while the rate for the Build scenario is 4.61 percent per year.

Figure 27 | SR 200 Case Study Historical AADT

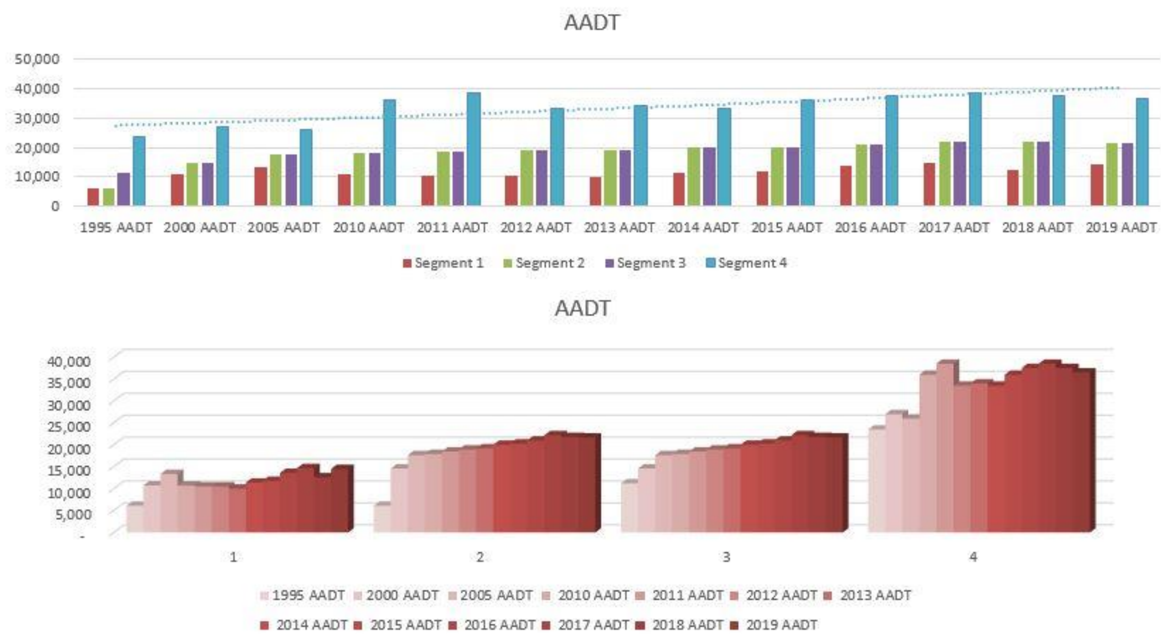
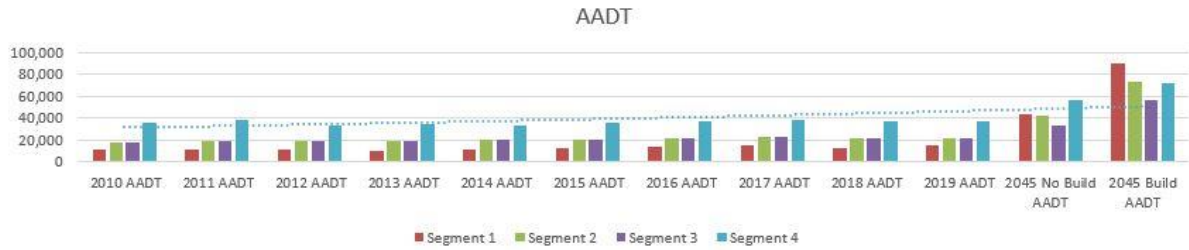


Figure 28 | SR 200 Case Study Future AADT



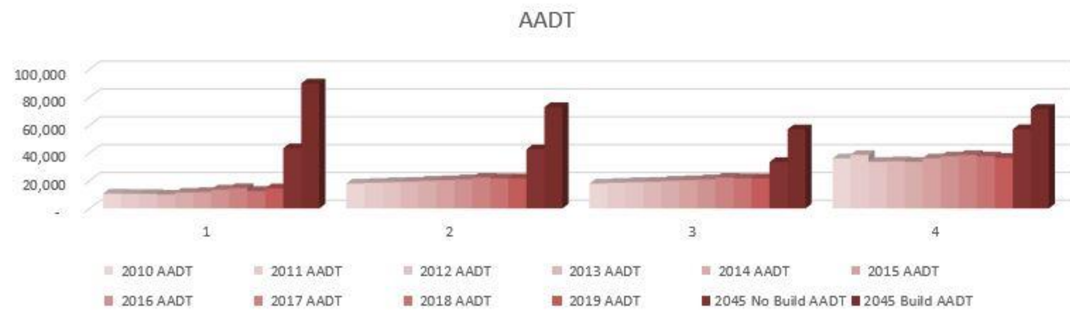


Table 8 shows the number of lanes, AADT, v/MSV, and LOS for each segment along the SR 200 study corridor for analysis years 2010, 2019, 2045 No Build, and 2045 Build. Additional maps depicting LOS and v/MSV are provided in Appendix B. As shown, the segments of Griffin Road to I-95, and US 17 to CR 107/Old Nassauville Road are expected to operate at LOS C in future 2045 No Build conditions without the proposed developments; however, these segments are expected to operate at LOS F with the addition of the proposed developments in future Build conditions. Similarly, the segment from West of Still Quarters Road to US 17 is expected to worsen from LOS D in No Build to LOS F in Build conditions.

The v/MSV ratios were also estimated which shows an increase with the addition of the proposed developments in the future Build conditions, compared to the No Build conditions. In particular, I-95 to West of Still Quarters Road has a v/MSV of 0.57 in No Build which increases to 0.97 (near capacity) in Build conditions. The eastern two segments (West of Still Quarters Road to US 17, and US 17 to CR 107/ Old Nassauville Road) are both projected to operate deficiently at LOS F and with v/MSVs greater than 1.0 in the 2045 Build condition as a six-lane arterial.

Table 8 | SR 200 Case Study Analysis Results

Segment	Year/Scenario	Lanes	AADT	v/MSV	LOS
Griffin Rd to I-95	2010	4	10,700	0.21	B
	2019	4	14,500	0.29	B
	2045 No Build	4	43,300	0.87	C
	2045 Build	4	89,900	1.80	F
I-95 to W of Still Quarters Rd	2010	4	17,934	0.36	B
	2019	4	21,666	0.43	B
	2045 No Build	6	42,600	0.57	B
	2045 Build	6	72,900	0.97	C
W of Still Quarters Rd to US 17	2010	4	17,934	0.55	D
	2019	6	21,666	0.43	C
	2045 No Build	6	33,400	0.67	D
	2045 Build	6	56,900	1.14	F
US 17 to CR 107 / Old Nassauville Rd	2010	4	36,000	0.86	C
	2019	6	36,500	0.58	C
	2045 No Build	6	57,000	0.91	C
	2045 Build	6	71,600	1.14	F

Scenario Planning

The SR 200 roadway segments expected to operate over capacity in future 2045 Build conditions were assessed for potential engineering solutions to provide additional capacity. NERPM select link model runs were performed for 2045 Build conditions to estimate the portion of through traffic on SR 200 versus local traffic (included in Appendix C). Table 9 provides a summary of the scenario planning for SR 200, including a discussion of potential capacity enhancement options and how local versus regional traffic might influence decisions on potential engineering solutions.

For the segment of SR 200 from Griffin Road to I-95, LOS F and v/MSV of 1.80 is expected in future 2045 Build conditions. Based on review of the potential engineering solutions, both innovative intersection control and network enhancements could be considered to increase the capacity to accommodate future traffic volumes. Innovative intersection control could be considered in the future as side street traffic continues to increase with development. Enhancements to existing parallel roadways could be considered, such as Yulee Road/Wildwood Road, as well as opportunities for a crossing over I-95 to serve as an alternative route for local traffic. Additionally, opportunities could be explored to provide connecting roadway/s between the developments to the south to provide alternate routes for development traffic.

The segment from I-95 to Still Quarters Road is anticipated to operate at LOS C and v/MSV of 0.97 in future Build conditions. Engineering solutions that provide approximately less than 25 percent increase in capacity were considered such as low-cost operational improvements, technology, managed lanes, multimodal, innovative intersection control, network enhancements, and access management. Of these solutions, TSM&O, ITS, increased multimodal options, innovative intersections, and network enhancements could be further considered to provide the needed capacity for future 2045 Build conditions.

The segment from Still Quarters Road to US 17 is estimated to operate at LOS F with a v/MSV of 1.14 in future Build conditions. Engineering solutions that provide approximately less than 25 percent increase in capacity were considered such as low-cost operational improvements, technology, managed lanes, multimodal, innovative intersection control, network enhancements, and access management. Based on review, TSM&O, ITS, increased multimodal options, innovative intersections, network enhancements, and access management were identified as viable options for further consideration.

Finally, US 17 to CR 107/Old Nassauville Road is expected to operate at LOS F with a v/MSV of 1.14. Engineering solutions that provide approximately less than 25 percent increase in capacity were considered such as low-cost operational improvements, technology, managed lanes, multimodal, innovative intersection control, network enhancements, and access management. Based on review, TSM&O, ITS, increased multimodal options, innovative intersections, network enhancements, and access management could be further considered to provide the needed capacity for future 2045 Build conditions.

Table 9 | SR 200 Scenario Planning

Local Road Name	From	To	2045 Build AADT	2045 Build Thru Lanes	2045 Build LOS	2045 Build v/MSV	Preliminary Range of Engineering Solutions	Viable Strategy?	Discussion
SR AIA/200	Griffin Rd	I-95	89,900	4	F	1.80	Innovative Intersection Control	Yes	Explore ICE alternatives as side street traffic increases with continued growth.
							Network Enhancements	Yes	Consider enhancements to existing parallel roadways, such as Yulee Rd/ Wildwood Rd, as well as opportunities for a crossing over I-95 to provide an alternative route for local traffic. Explore opportunities with planned developments to the south to provide connecting roadway/s between the developments to provide alternate routes for development traffic.
SR AIA/200	I-95	W of Still Quarters Rd	72,900	6	C	0.97	Low-Cost Operational Improvements	No	There is a widening project currently underway which includes a DDI at I-95, raised medians, signal upgrades.
							Technology to Increase Capacity	Yes	Additional TSM&O and ITS solutions beyond those included in the current widening project could be considered.
							Managed Lanes	No	Reversible lanes: Based on FTO data, there does not appear to be a strong directionality of traffic between AM/PM, as such reversible lanes may not be effective. Restricted lanes: likely not to increase capacity given freight and bus volumes compared to overall volumes. Contraflow left turn pockets: dual left turn lanes already proposed at William Burgess Blvd, no other major intersections.
							Increased Multimodal Options	Yes	There is a widening project currently underway which includes bicycle lanes, sidewalks, lighting. Efforts could be made to increase ridership on Nassau Transit services such as Nassau Transit and Nassau Express Select (an executive-style commuter service between SR A1A/200 and Downtown Jacksonville).
							Innovative Intersection Control	Yes	ICE can be considered for the intersection at William Burgess Blvd, and other side streets as traffic continues to increase.
							Network Enhancements	Yes	Consider enhancements to existing parallel roadways, such as Yulee Rd and William Burgess Rd to provide an alternative route for local traffic. Explore opportunities with planned developments north and south of SR 200 to provide connecting roadway/s between the developments to provide alternate routes for development traffic.
							Access Management	No	Not a high number of existing driveways along this section. The ongoing widening project incorporates a raised median.
SR AIA/200	W of Still Quarters Rd	US 17	56,900	6	F	1.14	Low-Cost Operational Improvements	No	Recent improvements included median modifications, turn lanes, and signal enhancements.
							Technology to Increase Capacity	Yes	TSM&O and ITS solutions could be considered.
							Managed Lanes	No	Reversible lanes: Based on FTO data, there does not appear to be a strong directionality of traffic between AM/PM, as such reversible lanes may not be effective. Restricted lanes: likely not to increase capacity given freight and bus volumes compared to overall volumes. Contraflow left turn pockets: dual left turn lanes already in place at US 17, no other major intersections.
							Increased Multimodal Options	Yes	Bike lanes and sidewalks are present. Efforts could be made to increase ridership on Nassau Transit services such as Nassau Transit and Nassau Express Select (an executive-style commuter service between SR A1A/200 and Downtown Jacksonville).
							Innovative Intersection Control	Yes	ICE could be considered for the intersection at US 17.
							Network Enhancements	Yes	Consider enhancements to existing parallel roadways, such as Yulee Rd and William Burgess Rd to provide an alternative route for local traffic.
							Access Management	Yes	Frontage roads, backage roads, and/or shared access could be considered to reduce driveways on SR 200 and remove local traffic from SR 200.

Local Road Name	From	To	2045 Build AADT	2045 Build Thru Lanes	2045 Build LOS	2045 Build v/MSV	Preliminary Range of Engineering Solutions	Viable Strategy?	Discussion
SR AIA/200	US 17	CR 107 / Old Nassauville Rd	71,600	6	F	1.14	Low-Cost Operational Improvements	No	Widening project underway includes raised medians, signal upgrades, etc.
							Technology to Increase Capacity	Yes	Additional TSM&O and ITS solutions beyond those included in the current widening project could be considered.
							Managed Lanes	No	Reversible lanes: Based on FTO data, there does not appear to be a strong directionality of traffic between AM/PM, as such reversible lanes may not be effective. Restricted lanes: likely not to increase capacity given freight and bus volumes compared to overall volumes. Contraflow left turn pockets: FTO data shows heavy volume in both directions for AM and PM peaks, as such thru lanes will be needed for thru capacity.
							Increased Multimodal Options	Yes	The widening project currently underway which includes bicycle lanes, sidewalks, lighting. Efforts could be made to increase ridership on Nassau Transit services such as Nassau Transit and Nassau Express Select (an executive-style commuter service between SR A1A/200 and Downtown Jacksonville).
							Innovative Intersection Control	Yes	ICE can be considered for signalized intersections along the segment.
							Network Enhancements	Yes	Consider enhancements to the surrounding roadway network to provide alternate routes for local traffic. Improvements could be considered for SR 200A with an extension to the east, and Miner Rd/Haddock Rd, and Harts Rd to provide an alternate route for traffic traveling to/from US 17.
							Access Management	Yes	Frontage roads, backage roads, and/or shared access could be considered to reduce driveways on SR 200 and remove local traffic from SR 200.

5.5. US 27 south of Clermont

Cumulative Impact Analysis

The historical and future AADTs for the US 27 study corridor are shown in Figure 29 and Figure 30, respectively. The historical AADT growth rate for the corridor from 1995 to 2019 is 2.44 percent per year. The future AADT average growth rate for the No Build scenario is 2.03 percent per year, while the rate for the Build scenario is 3.49 percent per year.

Figure 29 | US 27 Case Study Historical AADT

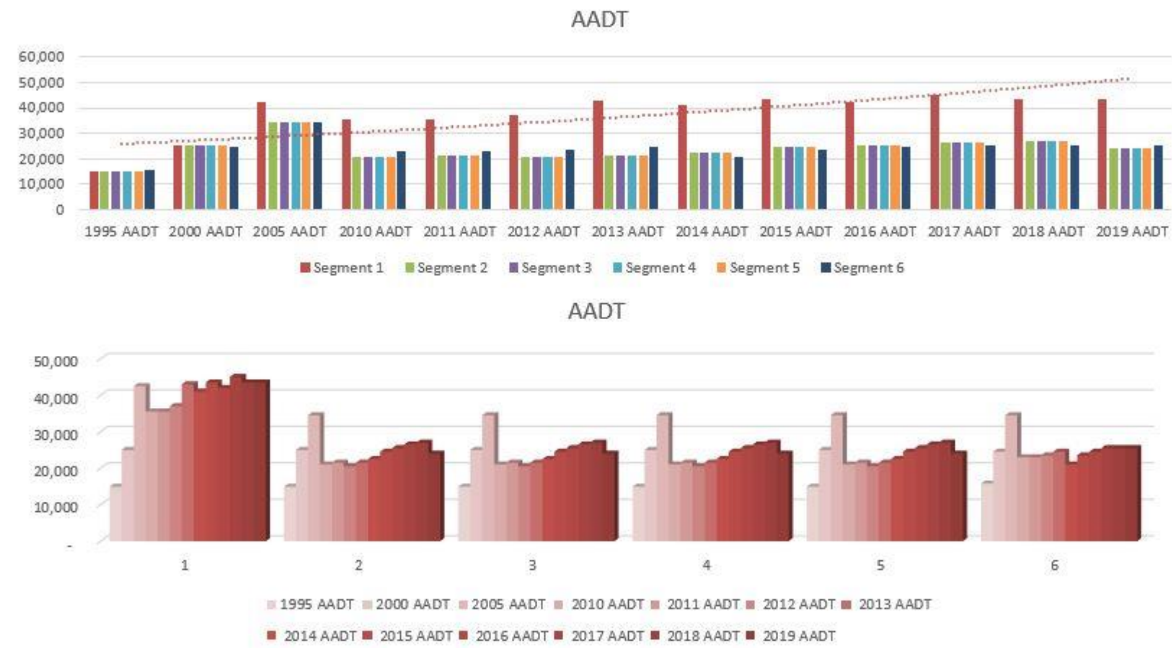


Figure 30 | US 27 Case Study Future AADT

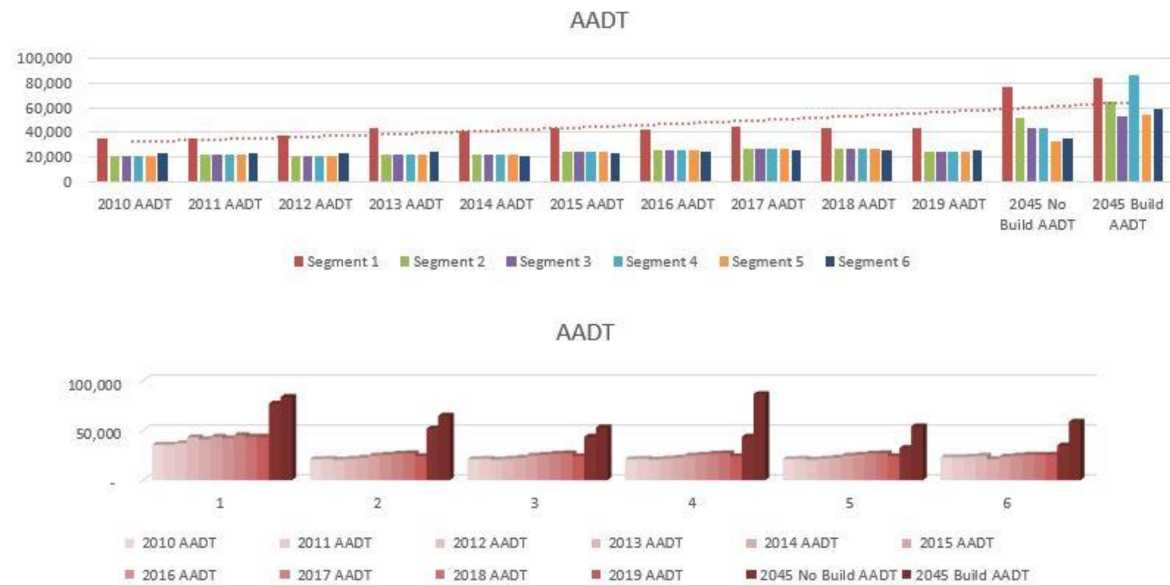


Table 10 shows the number of lanes, AADT, v/MSV, and LOS for each segment of the US 27 study corridor for analysis years 2010, 2019, 2045 No Build, and 2045 Build. Additional maps depicting LOS and v/MSV are provided in Appendix B. The segment from the Polk/Lake County Line to Glenbrook Boulevard is expected to operate at LOS F in future No Build conditions. The LOS will remain at LOS F in the Build conditions with the addition of the proposed projects, but conditions will worsen from a v/MSV of 1.22 to 1.33. Conditions between Glenbrook Boulevard and Sawgrass Bay Boulevard are expected to worsen with the addition of project traffic from LOS C in No Build to LOS F in Build. Similarly, the segment from Frank Jarrell Road to Schofield Road is anticipated to worsen from LOS B in No Build to LOS E in Build conditions. However, other segments such as Sawgrass Bay Boulevard to Frank Jarrell Road and Schofield Road to Lake Louisa Road, are projected to operate at LOS B with v/MSV ratios of 0.54 or better in 2045 Build conditions. These better performing segments are located in areas with a parallel roadway network serving the proposed new developments.

Furthermore, the v/MSV ratios indicate a consistent increase in the Build scenario with the addition of project traffic. For instance, Lake Louisa Road to Hartwood Marsh Road has a v/MSV of 0.55 in future No Build conditions, but a v/MSV of 0.93 in Build which indicates the segment is nearing capacity.

Table 10 | US 27 Case Study Analysis Results

Segment	Year/Scenario	Lanes	AADT	v/MSV	LOS
Polk/Lake County Line to Glenbrook Blvd	2010	6	35,500	0.56	C
	2019	6	43,500	0.69	C
	2045 No Build	6	76,600	1.22	F
	2045 Build	6	83,400	1.33	F
Glenbrook Blvd to Sawgrass Bay Blvd	2010	6	21,000	0.33	C
	2019	6	24,000	0.38	C
	2045 No Build	6	51,600	0.82	C
	2045 Build	6	64,700	1.03	F
Sawgrass Bay Blvd to Frank Jarrell Rd	2010	4	21,000	0.32	B
	2019	6	24,000	0.24	B
	2045 No Build	6	43,500	0.44	B
	2045 Build	6	52,800	0.53	B
Frank Jarrell Rd to Schofield Rd	2010	4	21,000	0.50	B
	2019	6	24,000	0.38	B
	2045 No Build	6	43,600	0.69	B
	2045 Build	6	86,200	1.36	E
Schofield Rd to Lake Louisa Rd	2010	4	21,000	0.32	B
	2019	6	24,000	0.24	B
	2045 No Build	6	32,200	0.32	B
	2045 Build	6	54,000	0.54	B
Lake Louisa Rd to Hartwood Marsh Rd	2010	4	23,000	0.55	C
	2019	6	25,500	0.41	C
	2045 No Build	6	34,800	0.55	C
	2045 Build	6	58,500	0.93	C

Scenario Planning

The US 27 segments anticipated to operate over capacity in future 2045 Build conditions were reviewed for potential engineering solutions. Select link model runs were performed using CFRPM for 2045 Build conditions to estimate the portion of through traffic on US 27 versus local traffic (included in Appendix C). Table 11 provides a summary of the scenario planning for SR 200, including a discussion of potential capacity enhancement options and how local versus regional traffic might influence decisions on potential engineering solutions.

The US 27 segment from the Polk/Lake County Line to Glenbrook Boulevard is anticipated to operate at LOS F with a v/MSV of 1.33 in future 2045 Build conditions. Low-cost operational improvements, technology improvements, managed lanes, access management, innovative intersection control, and network enhancements were considered for engineering solutions to provide additional capacity. Based on review, signal retiming and other TSM&O improvements could be considered to increase capacity. Additionally, frontage roads, backage roads, and/or shared access could be considered to reduce driveways on US 27 and remove local traffic from US 27. Innovative intersection control could be considered at signalized intersections. Network enhancements could be considered such as improvements and connections to Avalon Road to an alternative route to divert traffic away from US 27.

In future Build conditions, the segment from Glenbrook Boulevard to Sawgrass Bay Boulevard is expected to operate at LOS F with a v/MSV of 1.03. Engineering solutions that provide approximately less than 25 percent increase in capacity were considered such as low-cost operational improvements, technology, managed lanes, multimodal, innovative intersection control, network enhancements, and access management. Of these solutions, signal retiming, TSM&O, ITS, increased multimodal options, innovative intersections, network enhancements, and access management were identified as viable options to provide the needed capacity for future 2045 Build conditions. Network enhancements such as improvements to and connections from Avalon Road, Boggy Marsh Road, or Sawgrass Bay Boulevard could be considered to provide alternate routes for local traffic.

The segment of US 27 from Frank Jarrell Road to Schofield Road is estimated to operate at LOS E with a v/MSV of 1.36 in future Build conditions. Low-cost operational improvements, technology improvements, managed lanes, access management, innovative intersection control, and network enhancements were considered for engineering solutions to provide additional capacity. Based on review, TSM&O, ITS, access management, innovative intersection control, and network enhancements could be further considered as possible strategies.

The segment from Lake Louisa Road to Hartwood Marsh Road is anticipated to operate at LOS C, however the v/MSV is estimated to be 0.93. Engineering solutions that provide approximately less than 25 percent increase in capacity were considered such as low-cost operational improvements, technology, managed lanes, multimodal, innovative intersection control, network enhancements, and access management. Of these solutions, signal retiming, TSM&O, ITS, increased multimodal options, innovative intersections, network enhancements, and access management could be further considered to provide the needed capacity for future 2045 Build conditions.

Table 11 | US 27 Scenario Planning

Local Road Name	From	To	2045 Build AADT	2045 Build Thru Lanes	2045 Build LOS	2045 Build v/MSV	Preliminary Range of Engineering Solutions	Viable Strategy?	Discussion
SR 25/US 27	Polk/Lake County Line	Glenbrook Blvd	83,400	6	F	1.33	Low-Cost Operational Improvements	Yes	Consider signal retiming opportunities.
							Technology to Increase Capacity	Yes	Consider adaptive signals, TSM&O, and ITS upgrades.
							Managed Lanes	No	Reversible lanes: based on count data, there doesn't appear to be a strong directional split in traffic in the AM/PM. Thus reversible lanes may not be effective. Restricted lanes: likely not to increase capacity given freight and bus volumes compared to overall volumes. Contraflow left turn pockets: thru lanes needed for thru capacity.
							Access Management	Yes	Frontage roads, backage roads, and/or shared access could be considered to reduce driveways on US 27 and remove local traffic from US 27.
							Innovative Intersection Control	Yes	Consider ICE at signalized intersections.
							Network Enhancements	Yes	Consider enhancements to and connections from Avalon Rd to provide alternate routes for local traffic.
SR 25/US 27	Glenbrook Blvd	Sawgrass Bay Blvd	64,700	6	F	1.03	Low-Cost Operational Improvements	Yes	Consider signal retiming opportunities.
							Technology to Increase Capacity	Yes	Consider adaptive signals, TSM&O, and ITS upgrades.
							Managed Lanes	No	Reversible lanes: based on count data, there doesn't appear to be a strong directional split in traffic in the AM/PM. Thus reversible lanes may not be effective. Restricted lanes: likely not to increase capacity given freight and bus volumes compared to overall volumes. Contraflow left turn pockets: thru lanes needed for thru capacity.
							Increased Multimodal Options	Yes	Bike lanes and sidewalks currently present. Consider enhancing transit options as an alternate mode.
							Innovative Intersection Control	Yes	Consider ICE at signalized intersections.
							Network Enhancements	Yes	Consider enhancements to and connections from Avalon Rd, Boggy Marsh Rd, or Sawgrass Bay Blvd to provide alternate routes for local traffic.
							Access Management	Yes	Frontage roads, backage roads, and/or shared access could be considered to reduce driveways on US 27 and remove local traffic from US 27.
SR 25/US 27	Sawgrass Bay Blvd	Frank Jarrell Rd	52,800	6	B	0.53	-	-	
SR 25/US 27	Frank Jarrell Rd	Schofield Rd	86,200	6	E	1.36	Low-Cost Operational Improvements	No	No major intersections in existing conditions. Assumed that future intersections with developments will have turn lanes, adequate signal timing, etc.
							Technology to Increase Capacity	Yes	In future build conditions, consider adaptive signals, TSM&O, and ITS upgrades.
							Managed Lanes	No	Reversible lanes: based on count data, there doesn't appear to be a strong directional split in traffic in the AM/PM. Thus reversible lanes may not be effective. Restricted lanes: likely not to increase capacity given freight and bus volumes compared to overall volumes. Contraflow left turn pockets: thru lanes needed for thru capacity.
							Access Management	Yes	In future build conditions, consider frontage roads, backage roads, and/or shared access to reduce driveways on US 27 and remove local traffic from US 27.
							Innovative Intersection Control	Yes	Consider ICE at future signalized intersections.
							Network Enhancements	Yes	Consider enhancements to proposed roadways or additional routes beyond those assumed in the Wellness Way Framework Plan and proposed by the Olympus development. In particular, provide attractive routes to US 192, the Florida Turnpike, and SR 50.
SR 25/US 27	Schofield Rd	Lake Louisa Rd	54,000	6	B	0.54	-	-	

Local Road Name	From	To	2045 Build AADT	2045 Build Thru Lanes	2045 Build LOS	2045 Build v/MSV	Preliminary Range of Engineering Solutions	Viable Strategy?	Discussion
SR 25/US 27	Lake Louisa Rd	Hartwood Marsh Rd	58,500	6	C	0.93	Low-Cost Operational Improvements	Yes	Consider signal retiming opportunities.
							Technology to Increase Capacity	Yes	Consider adaptive signals, TSM&O, and ITS upgrades.
							Managed Lanes	No	Reversible lanes: based on count data, there doesn't appear to be a strong directional split in traffic in the AM/PM. Thus reversible lanes may not be effective. Restricted lanes: likely not to increase capacity given freight and bus volumes compared to overall volumes. Contraflow left turn pockets: thru lanes needed for thru capacity.
							Increased Multimodal Options	Yes	Bike lanes and sidewalks currently present. Consider enhancing transit options as an alternate mode.
							Innovative Intersection Control	Yes	Consider ICE at signalized intersections.
							Network Enhancements	Yes	Consider enhancements to proposed roadways or additional routes beyond those assumed in the Wellness Way Framework Plan and proposed by the Olympus development. In particular, provide attractive routes to US 192 and the Florida, and SR 50.
							Access Management	Yes	Frontage roads, backage roads, and/or shared access could be considered to reduce driveways on US 27 and remove local traffic from US 27.

5.6. Summary of Findings

The analyses that were conducted for segments of SR 70, SR 200, and US 27 identified an increased roadway demand with the anticipated growth from the nearby planned and approved developments, compared to the projected future population and employment based on the future year CF models. Table 12 summarizes the 2045 v/MSV for each corridor for the No Build and Build scenarios by segment. As shown, the v/MSV consistently increases in the Build scenario. In some cases, the addition of the proposed developments causes an under-capacity segment in the No Build condition to become over capacity in the Build condition. In other cases, the segment is already over capacity in No Build and is even more over capacity in Build conditions.

Table 12 | Cumulative Analysis v/MSV Comparison

SR 70		SR 200		US 27	
2045 No Build v/MSV	2045 Build v/MSV	2045 No Build v/MSV	2045 Build v/MSV	2045 No Build v/MSV	2045 Build v/MSV
1.39	2.15	0.87	1.80	1.22	1.33
0.65	1.00	0.57	0.97	0.82	1.03
0.61	0.76	0.67	1.14	0.44	0.53
0.56	0.77	0.91	1.14	0.69	1.36
0.86	1.22			0.32	0.54
				0.55	0.93

Table 13 summarizes the number of deficient segments per study corridor. As shown, there are more deficient segments in Build conditions with the addition of proposed developments compared to No Build. Additionally, the SR 200 and US 27 case studies analysis results each show one segment nearing capacity in Build conditions. This confirms that the regional CF models may not account for a substantial amount of proposed development, and also that the additional approved or planned development negatively impacts each case study corridor.

Table 13 | Cumulative Analysis of Segment Deficiencies

Corridor	Segments	Deficient Segments 2045 No Build	Deficient Segments 2045 Build	Segments Approaching Capacity 2045 Build
SR 70 (District 1)	5	1	3	0
SR 200 (District 2)	4	0	3	1
US 27 (District 5)	6	1	3	1

6. Recommendations

Based on input received from the Working Group, best practices from the literature review, and analysis of the three case studies, a list of recommendations was developed for preserving the capacity of SIS roadways.

Recommendations were categorized as follows and discussed below:

- Partnership
- Systems Approach
- Engineering Solutions
- Policy

1. Partnership

1.1 Establish stronger partnerships with local governments

a. Promote early engagement in planning stages between FDOT and local governments to coordinate land use/transportation decisions that impact SIS corridors.
   i. Create a formal structure and policy framework to guide early and continuous communication.
   ii. Coordinate with local governments when FDOT receives a permit application.
   iii. Attend/review local government development review committee meetings or have an FDOT representative participate as a part of the committee to learn about upcoming developments, as appropriate.
   iv. Encourage local governments to coordinate with FDOT early and throughout the private development planning and approval process.

b. Partner with local governments to develop collaborative strategies/plans in order to promote the community's vision and goals while preserving the capacity and safety of SIS corridors.
   i. Consider existing and future context classification.
   ii. Consider establishing Planning Studios and interagency corridor plans, similar to the District 1 Planning Studio Concept and the District 4 I-95 Corridor Mobility Planning Project.

c. Consider collaborative approaches with local governments to plan for and implement transportation/land use decisions. For instance, New Hampshire DOT has an MOU process which provides an agreement between the New Hampshire DOT and the community to coordinate the review and issuance of driveway permits to access state roads.

d. Establish a program to identify and enhance parallel corridors and connections, both state and local roadways, that can provide relief to SIS facilities with existing or anticipated capacity issues. For example, VDOT maintains state roads as well as a network of secondary streets. For a roadway to be accepted into the secondary street system for maintenance, it must meet certain criteria and ensure roadway and pedestrian connectivity with external connections and stub outs for future connections. These requirements are based on the state's recognition of a well-connected street network and its ability to lessen the demand on more significant state arterials.

2. Systems Approach

2.1 Incentivize and/or facilitate best practices at a local level

a Provide technical assistance to local government partners to coordinate land use/transportation decisions early (before comprehensive plan amendments), similar to the District 2 technical assistance program.

b Establish incentives and/or grant programs for local governments to implement livable communities, non-auto modes of transportation, well-connected local street network, transportation demand management, and coordinated land use and transportation planning. For example, the NJDOT Futures in Transportation (NJFIT) program is a similar incentives and grants program. NJDOT adopted a philosophy that the state's limited transportation funds should be prioritized for communities that adopt land use plans to preserve the utility of the state's investment. Incentives such as programs and grants are available to local governments for projects that promote livable communities, non-auto modes of transportation, and smart growth.

c Encourage and support smart zoning, designating targeted growth areas, reverse frontage development (service roads), coordination with FDOT during site plan review, etc.

2.2 Increase multimodal options on state-maintained facilities

d Base future requirements and discussion on future context classifications.

e Improve transit and bike/pedestrian amenities and connectivity within FDOT's ROW.

2.3 Develop a shared multi-agency database to track developments

f Create a central database to track developments and identify future capacity issues earlier to allow for proactive planning and improvements. Currently, FDOT does not have a standard system to track planned or approved developments. Without an effective way to track developments, it can be difficult to understand the cumulative impacts of all recent or planned developments when reviewing a single development. A central database to track developments can allow for future capacity issues to be identified earlier and promote proactive planning. The system can be maintained by FDOT and updated by FDOT, FDEO, and participating local governments.

2.4 Develop a systematic approach to identify at-risk SIS facilities

g Utilize multiple datasets to identify and project at-risk SIS facilities. For example, Washington State created a GIS tool to identify state facilities vulnerable to land development (adverse risks). Identifying land at risk for development along state routes can provide opportunities for proactive, collaborative planning to improve access, mobility, and safety while supporting economic development. This project provides tools to help turn adverse risks of land development into opportunities to make route improvements.

3. Engineering Solutions

3.1 Anticipate context-based design needs using current and future context classifications

a Consider the ultimate typical, based on future context classification and community visions, early in the design process.

b Consider the need for additional roadway network and connectivity in advance based on context classification, community needs, and capacity issues.

c Acquire right-of-way in advance, where feasible.

3.2 Establish thresholds for planning/implementing capacity management strategies

d Monitor at-risk SIS facilities - track V/C in addition to LOS to see the incremental increase as the SIS facility reaches the LOS threshold.

e Conduct scenario planning to evaluate a broad range of potential strategies when an established threshold trigger is reached.

   i Follow the scenario planning methodology described in the **Cumulative Impact Analysis** section.

   ii Utilize Engineering Toolbox and Screening Tool to determine the range of possible engineering solutions. These are further discussed in the

   iii **Engineering Toolbox and Screening** Tool section of this report.

4. Policy

4.1 Enhance the Access Management/Driveway Permit process

a Consider separate access class for SIS facilities. If implemented, update FAC 14-97 – State Highway System Access Control Classification System and Access Management Standards. For example, Indiana DOT has different access management standards for their three corridor classifications; strictest access management standards for their top-end Statewide Mobility Corridors with no direct private access allowed.

b Require that SIS roadway driveway permits, median modification, and signalization related to land development projects be reviewed and approved by the District SIS coordinators.

4.2 Provide SIS funding flexibility

c Expand funding eligibility for mobility projects within existing SIS statutory framework to provide the Districts the option to flex existing traditional and non-traditional SIS capacity funding to mobility projects (being discussed as part of Vital Few Initiative). These proposed changes will provide flexibility in the SIS program so the highest priority mobility projects of the Districts can be funded regardless of mode, while maintaining a statewide strategic focus. These changes will expand funding eligibility projects within the existing statutory framework and allow for the funding of projects such as premium transit or non-SIS highway capacity projects that provide relief to the SIS. Each District will have the option to put forth projects that best support their mobility needs. This recommendation strategy also allows the Department to make decisions using a holistic approach vs. the focus on highway or other modes.

4.3 Leverage existing statutes and/or request new legislative action

d Require local governments to identify any SIS facilities within the municipal boundaries in their Comprehensive Plan, as well as to project future growth (per Section 163.3177 F.S.), to identify projected deficiencies on the SIS facilities, and to determine how deficiencies will be corrected to meet the mobility needs of the SIS. A similar example is that localities in Virginia are required to identify Corridors of Statewide Significance in their comprehensive plans and on official maps (Code of Virginia, §§ 2.2-229 and 15.2-2232).

e Establish partnerships and coordination with local governments to effectively plan for and protect the state's critical SIS corridors. For example, Virginia DOT requires that developments be consistent with the Arterial Management Plan if located along a highway with one in place, or to coordinate with the Arterial Preservation Program Manager if an Arterial Management Plan is being developed.

6.1. Engineering Toolbox and Screening Tool

As part of the recommendations, the following tools were developed to identify potential engineering strategies to address capacity issues on SIS facilities:

- Engineering Strategies Screening Tool
- Engineering Toolbox

As previously discussed in the **Cumulative Impact Analysis** section, the three case studies provided an opportunity to develop and test a potential framework in which to proactively plan for appropriate corridor strategies and improvement options. Scenario planning was conducted for SIS roadway segments anticipated to operate over capacity with the following triggers:

- 2045 Rural Segment over Target LOS C, or v/MSV ≥ 0.90
- 2045 Urban Segment over Target LOS D, or v/MSV ≥ 0.90

Based on the anticipated percent increase in capacity needed to accommodate future traffic volumes, a range of potential engineering solutions can be reviewed at a high level to determine potential options to carry forward for further review.

The 'Engineering Strategies Screening Tool' (Engineering Strategies Screening Tool.xlsx) is an excel-based tool with the capability to screen and filter a broad range of potential engineering solutions. The engineering improvements can be filtered by a variety of specific project context and need characteristics, including of the following:

Percent Increase in Capacity	Project Cost	Needed ROW
▪ <25% ▪ 25-50% ▪ 50-75% ▪ 75-100% ▪ >100%	▪ Low ▪ Medium ▪ High	▪ Low ▪ Medium ▪ High
Driveway Access Level of Accommodation	**Pedestrian Level of Accommodation**	**Compatible Context Classification**
▪ Low ▪ Medium ▪ High	▪ Low ▪ Medium ▪ High	▪ C1 ▪ C2 ▪ C2T ▪ C3R ▪ C3C ▪ C4 ▪ C5 ▪ C6

For instance, if a SIS roadway segment is anticipated to require a capacity increase of approximately 50 percent to accommodate future traffic volumes and has a context classification of C2T, the tool can be filtered to provide potential engineering improvements with those conditions (50 percent increase in capacity or more and compatible with C2T). For this example, the tool yields improvement options such as multi-way boulevards, network enhancements, and technology improvements. The range of possible engineering solutions can then be reviewed to determine viable options to be carried forward for further consideration.

The 'Engineering Toolbox' is an interactive list of engineering solutions and provides a comprehensive summary of each specific improvement strategy with the following information:

- Description
- Application
- Benefits
- Context classification
- Cost
- ROW
- Considerations
- Examples
- References

The 'Engineering Toolbox' can be used to review each improvement option, to determine if it is a viable option for the corridor. The 'Engineering Toolbox' is provided in Appendix D.

7. Conclusion

The motivation of the Land Use Changes and Strategic Intermodal System (SIS) Functionality project is to understand cumulative development impacts on SIS facilities and to identify strategies for preserving the capacity of SIS roadways.

The project involved stakeholder engagement, a literature review, analysis of three case studies, and developing a list of recommendations for preserving the capacity of SIS roadways. The report provides a summary of these efforts, a description of the preliminary recommendations, and a toolbox of engineering solutions.

Based on input received from the Working Group, best practices from the literature review, and analysis of the three case studies, recommendations were developed for preserving the capacity of SIS roadways, as summarized below.

Partnership	▪ Establish stronger partnerships with local governments
Systems Approach	▪ Incentivize and/or facilitate best practices at a local level ▪ Increase multimodal options on state-maintained facilities ▪ Develop a shared multi-agency database to track developments ▪ Develop a systematic approach to identify at-risk SIS facilities
Engineering Solutions	▪ Anticipate context-based design needs using current and future context classifications ▪ Establish thresholds for planning/implementing capacity management strategies
Policy	▪ Enhance the Access Management/Driveway Permit process ▪ Provide SIS funding flexibility ▪ Leverage existing statutes and/or request new legislative action

This study found that identifying existing and potential future deficiencies along priority corridors offers an opportunity to proactively plan for mitigation strategies to maintain system efficiency. An ‘Engineering Toolbox’ and ‘Engineering Strategies Screening Tool’ were developed as a part of the recommendations to identify potential engineering strategies to address capacity issues on SIS facilities.

Appendix A: Literature Review References

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Appendix B: Case Study Corridor Maps

SR 70 in Arcadia

FDOT

0 300 600 900
Feet

SR 70 from SR 72 to SR 31

DeSoto County, FDOT District One

Corridor Details

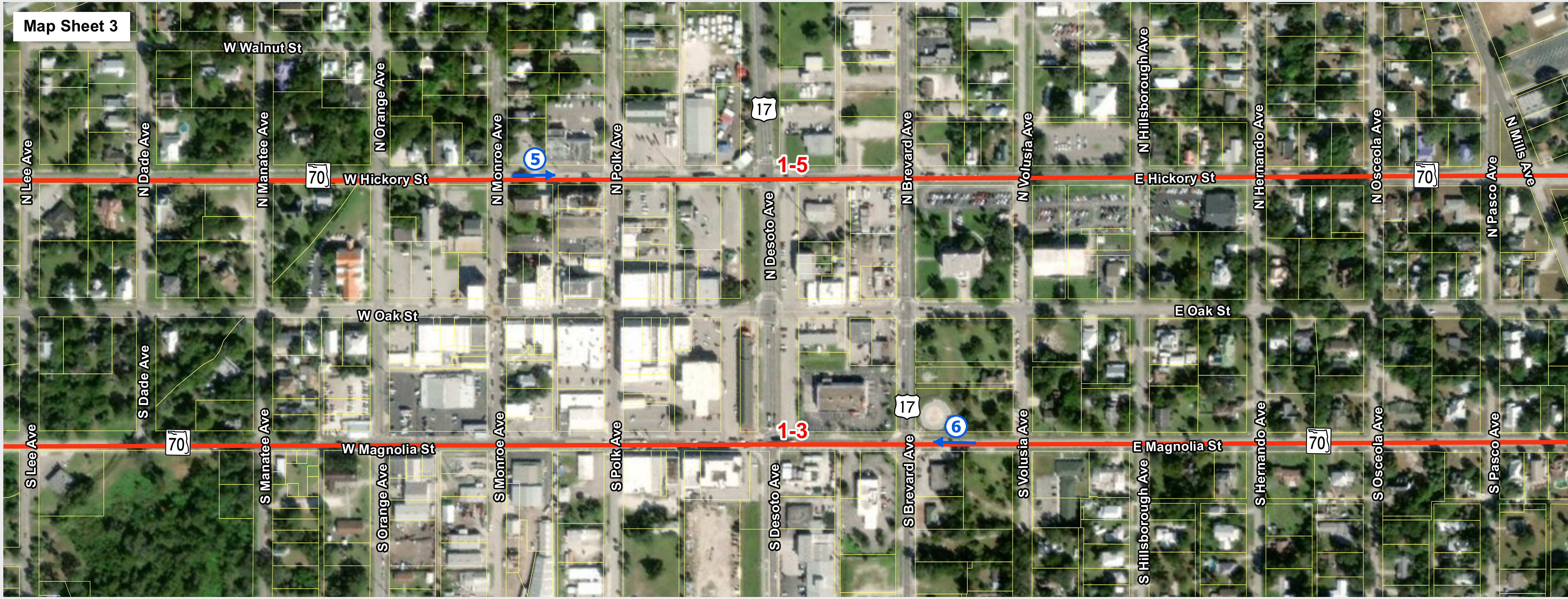
FDOT

0 300 600 900
Feet

SR 70 from SR 72 to SR 31

DeSoto County, FDOT District One

Corridor Details



FDOT

0 300 600 900
Feet

SR 70 from SR 72 to SR 31

DeSoto County, FDOT District One

Corridor Details

0 300 600 900
Feet

SR 70 from SR 72 to SR 31

DeSoto County, FDOT District One

Corridor Details

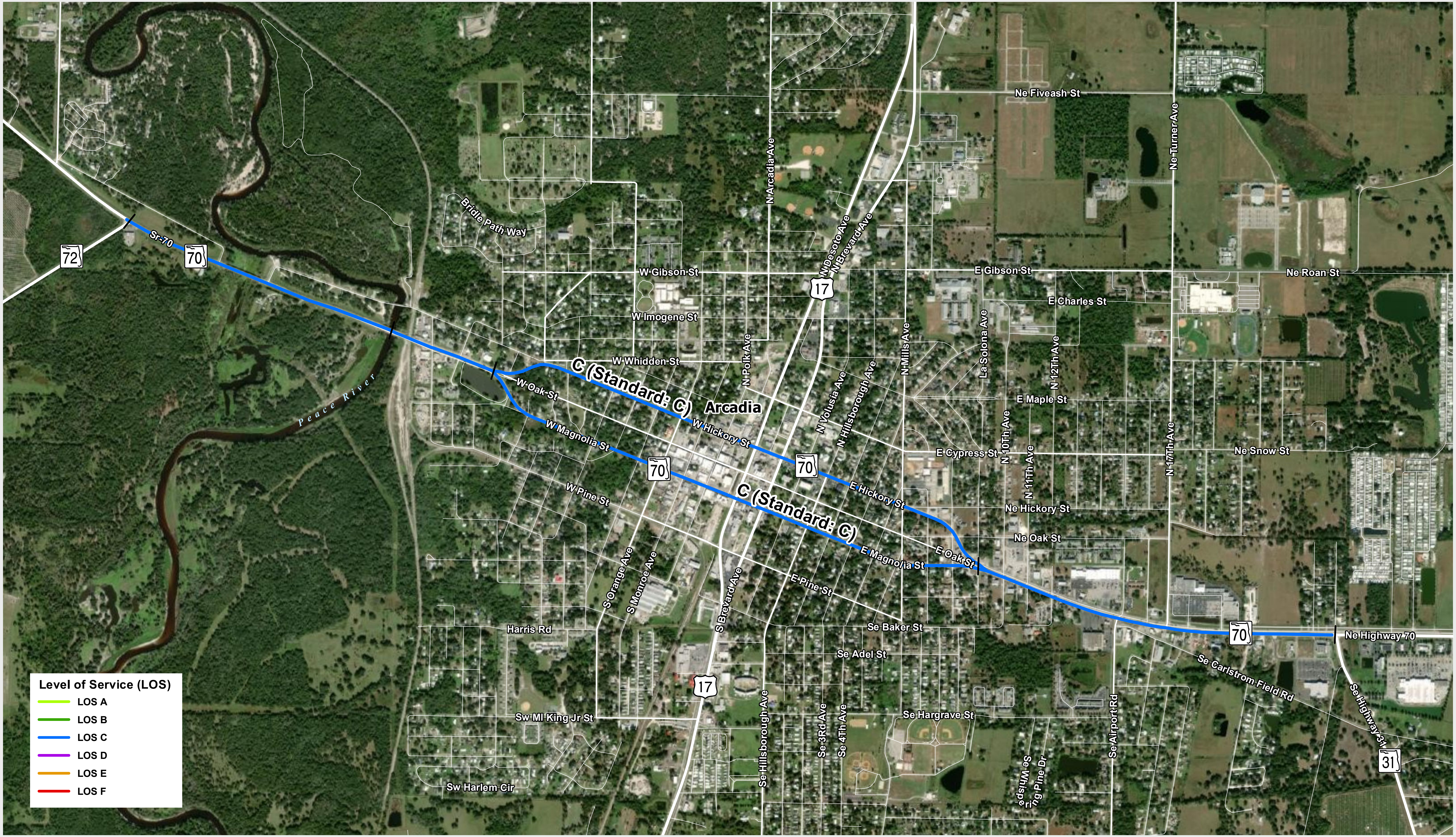
FDOT

0 300 600 900
Feet

SR 70 from SR 72 to SR 31

DeSoto County, FDOT District One

Corridor Details



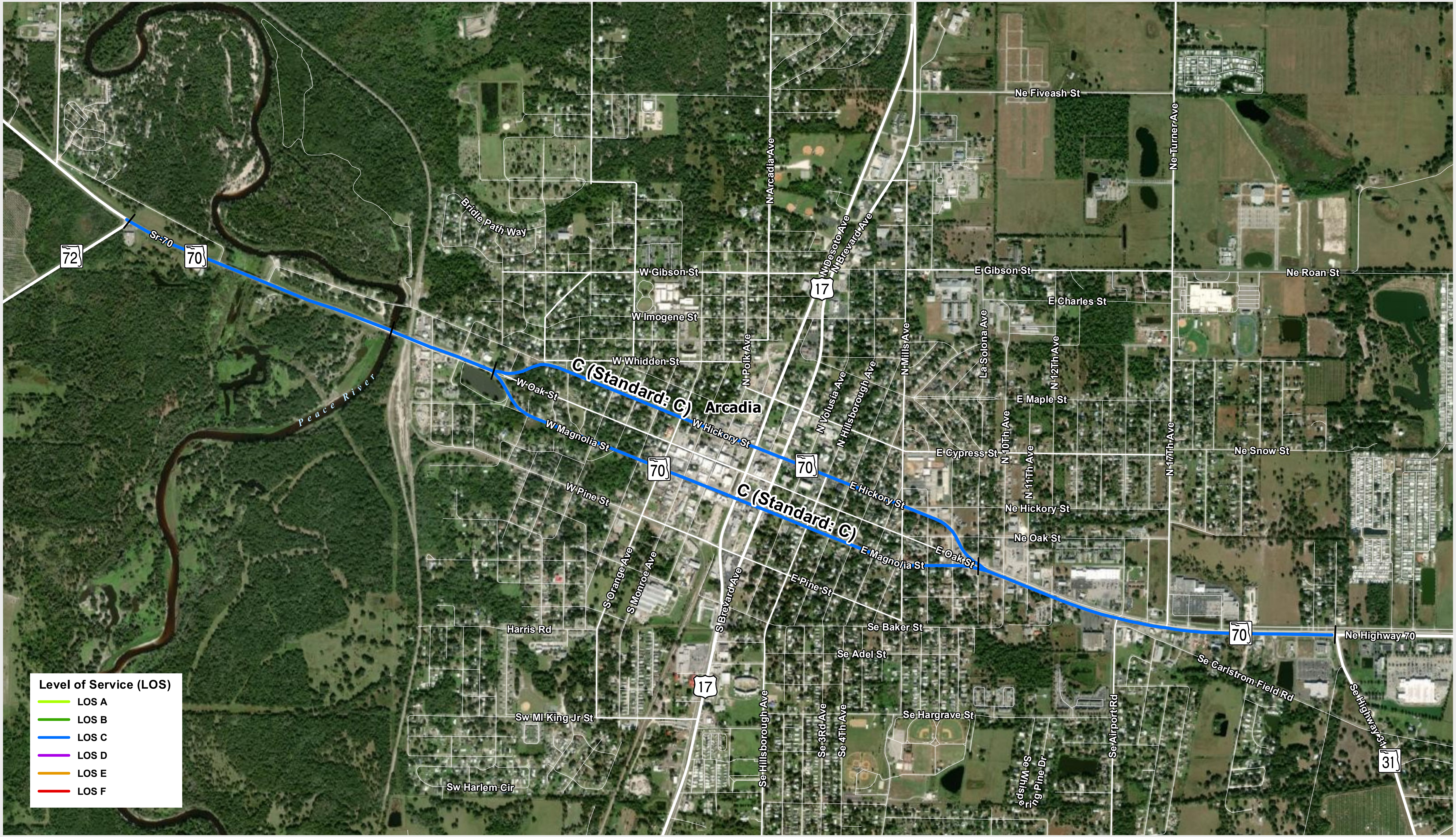
FDOT

0 0.2 0.4 0.6
Miles

SR 70 from SR 72 to SR 31

DeSoto County, FDOT District One

2010 Level of Service (LOS)

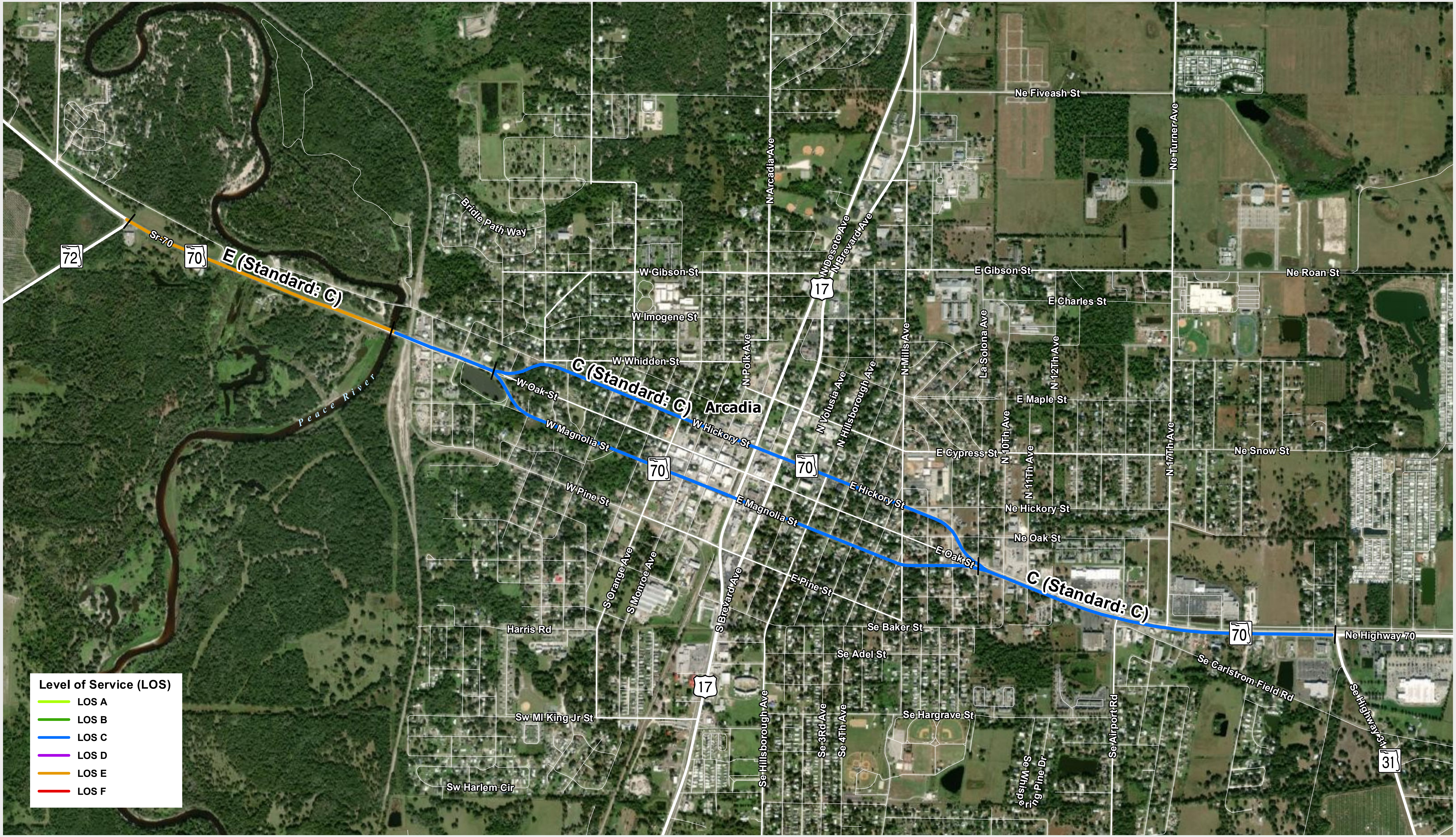


FDOT

SR 70 from SR 72 to SR 31

DeSoto County, FDOT District One

2019 Level of Service (LOS)

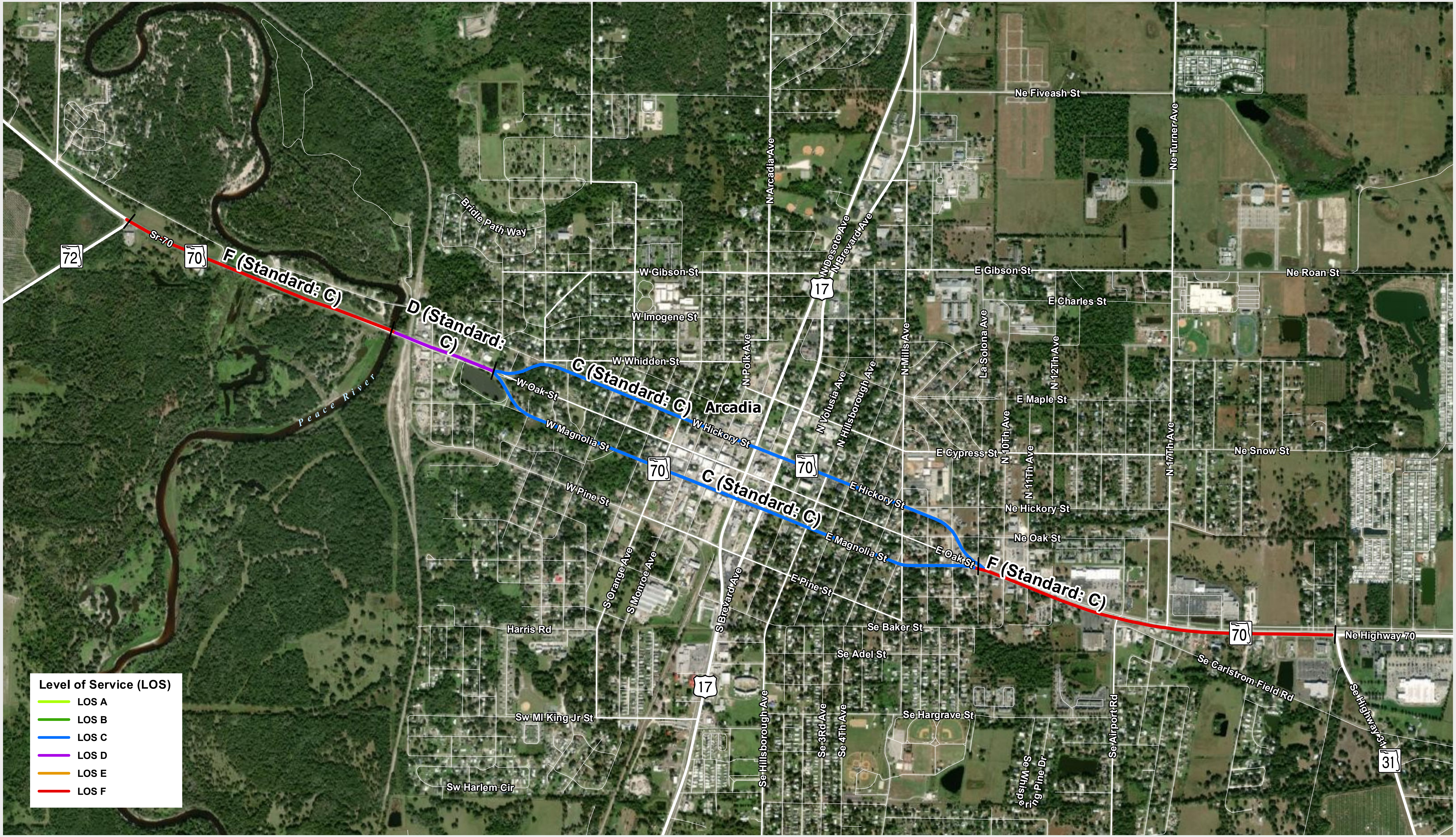


FDOT

SR 70 from SR 72 to SR 31

DeSoto County, FDOT District One

2045 Level of Service (LOS)
No Build

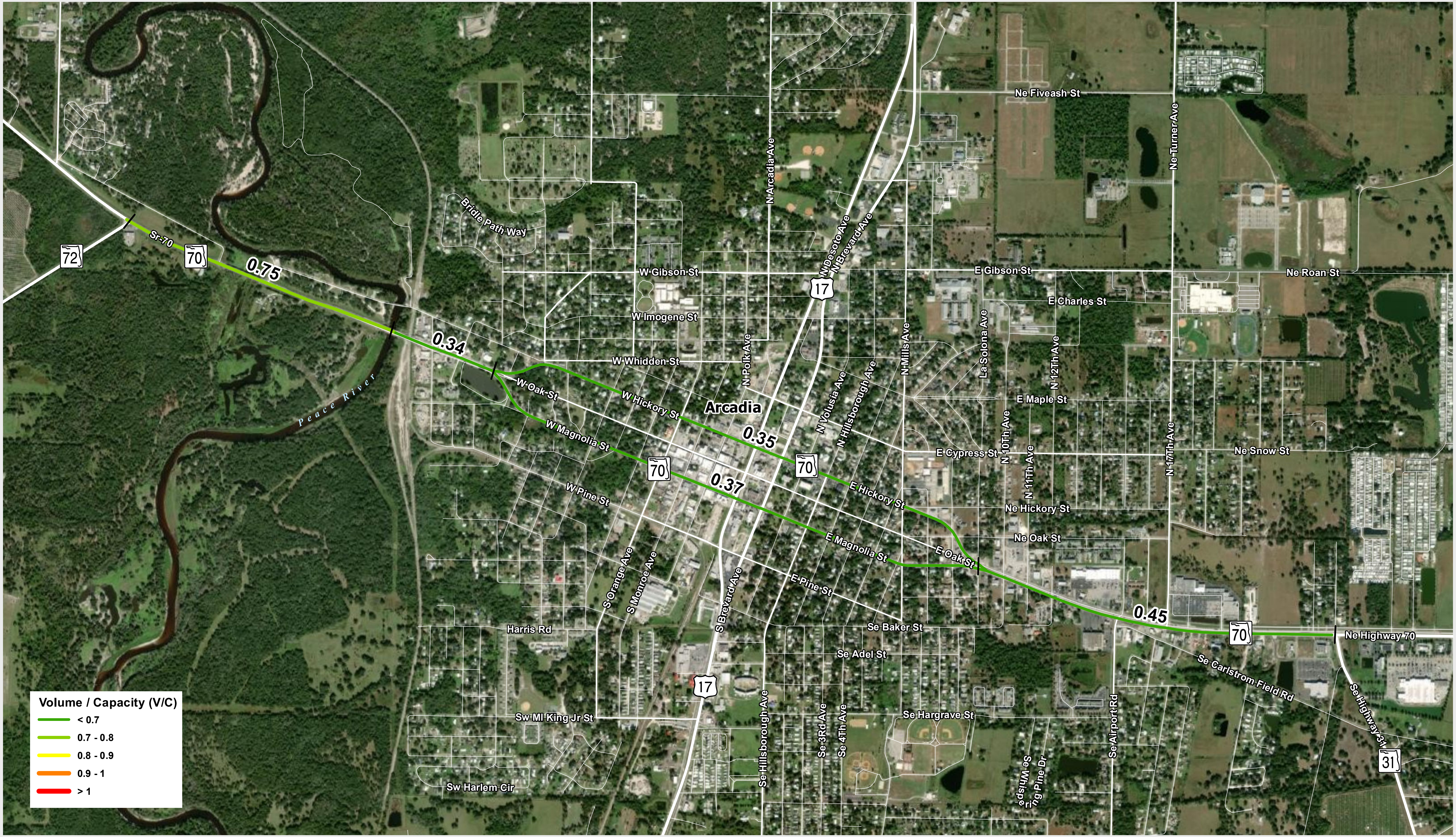


0 0.2 0.4 0.6
Miles

SR 70 from SR 72 to SR 31

DeSoto County, FDOT District One

2045 Level of Service (LOS)
Build

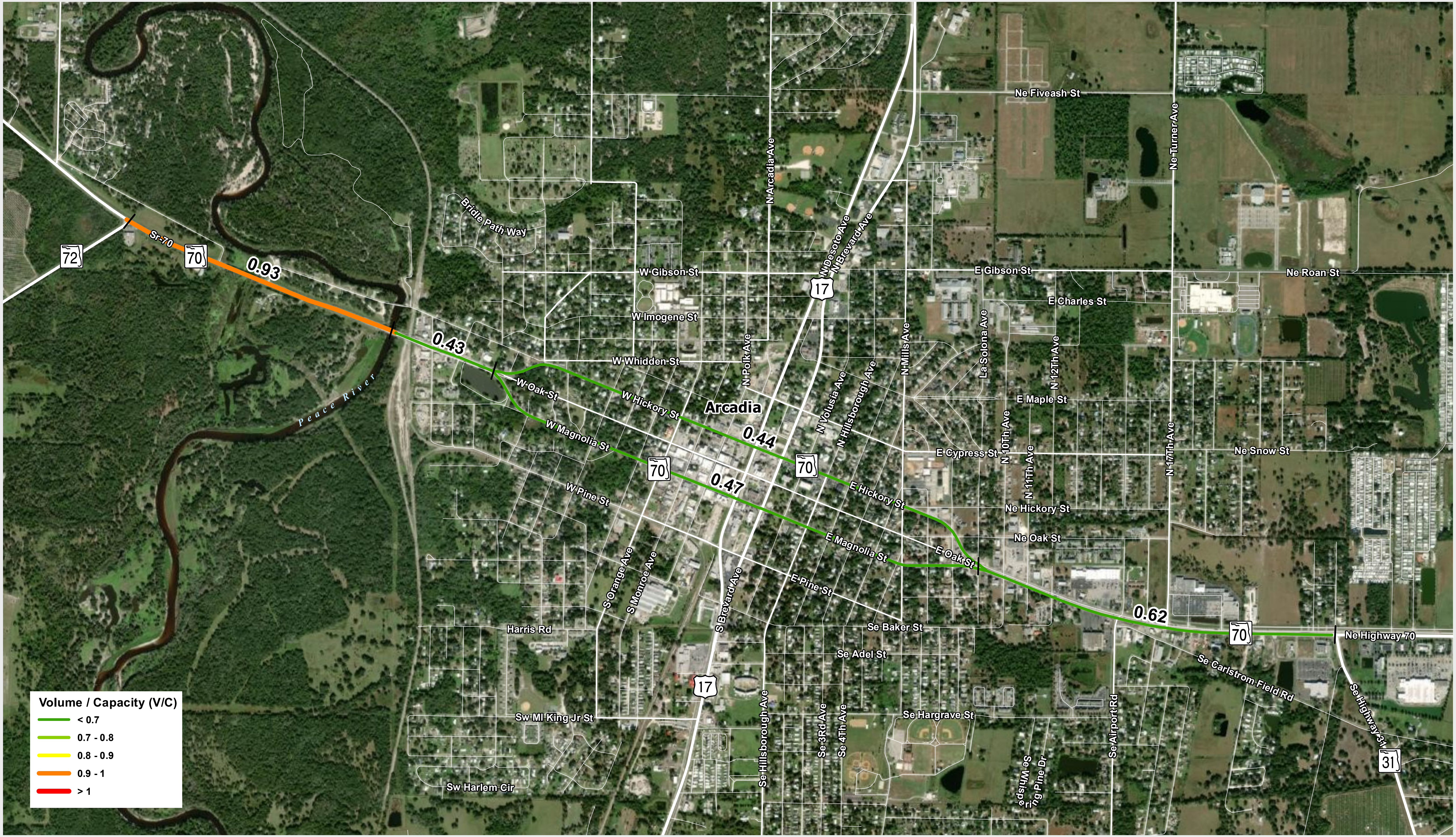


0 0.2 0.4 0.6
Miles

SR 70 from SR 72 to SR 31

DeSoto County, FDOT District One

2010 Volume / Capacity Ratio (V/C)



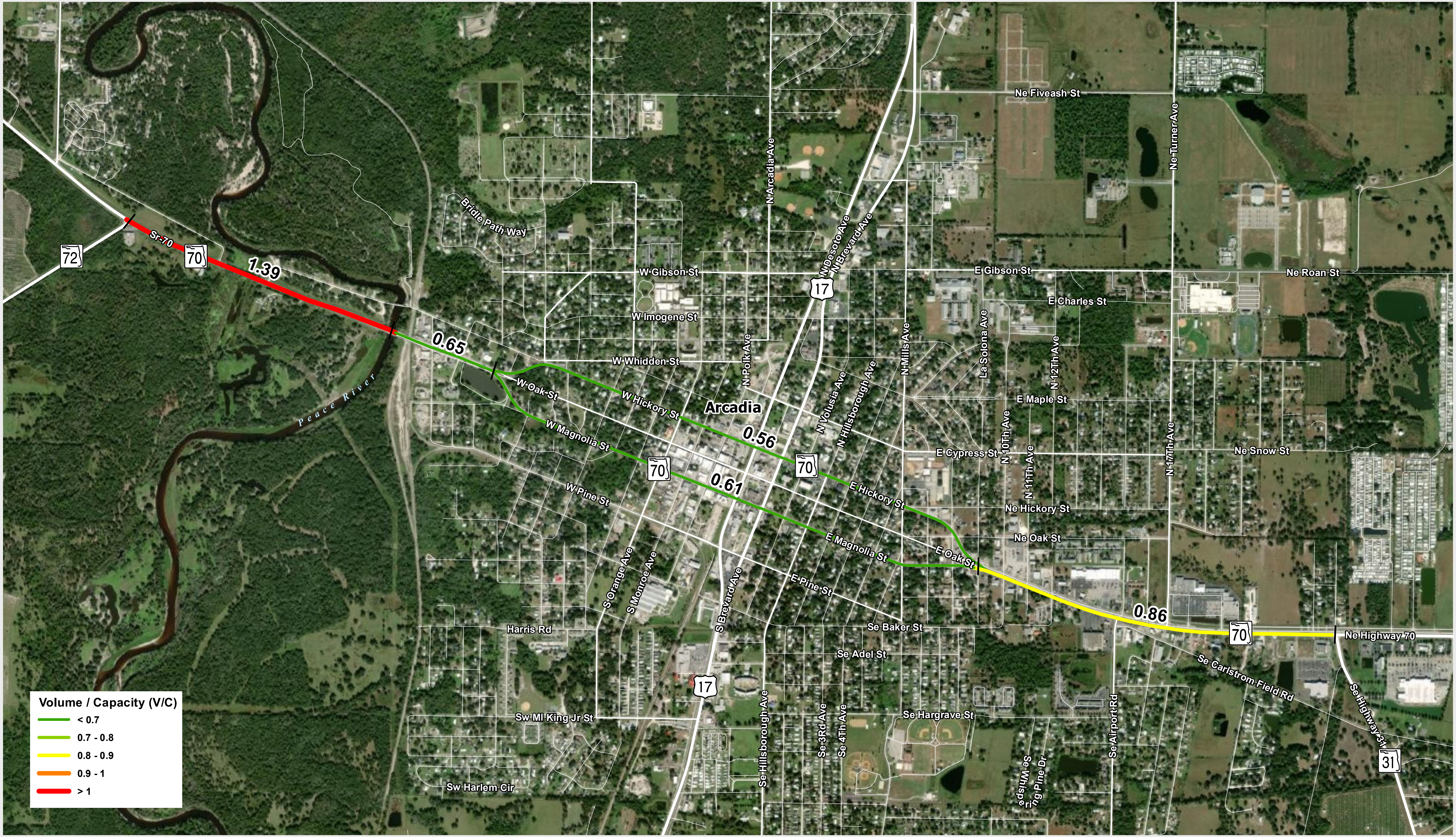
FDOT

0 0.2 0.4 0.6 Miles

SR 70 from SR 72 to SR 31

DeSoto County, FDOT District One

2019 Volume / Capacity Ratio (V/C)



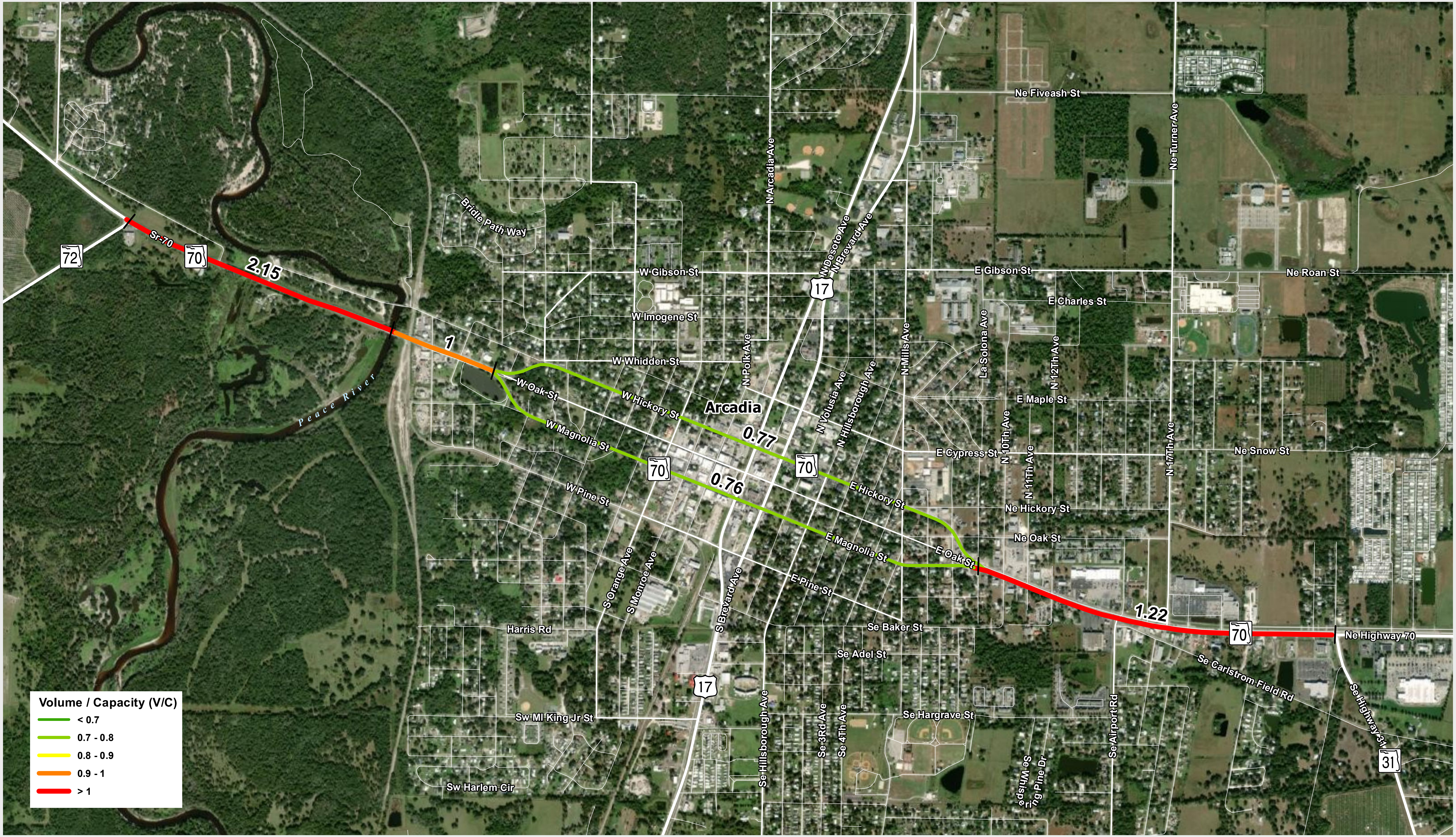
FDOT

0 0.2 0.4 0.6
Miles

SR 70 from SR 72 to SR 31

DeSoto County, FDOT District One

2045 Volume / Capacity Ratio (V/C)
No Build



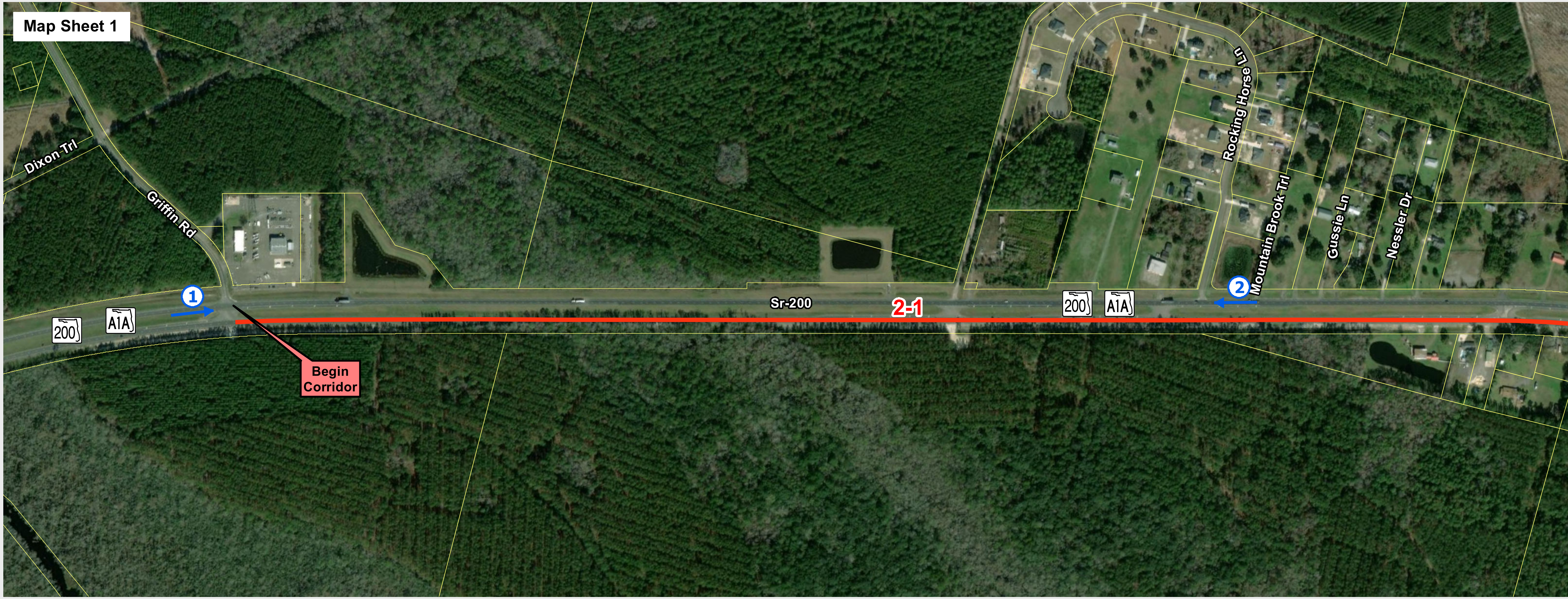
FDOT

SR 70 from SR 72 to SR 31

DeSoto County, FDOT District One

2045 Volume / Capacity Ratio (V/C)
Build

SR 200 between Callahan and Yulee



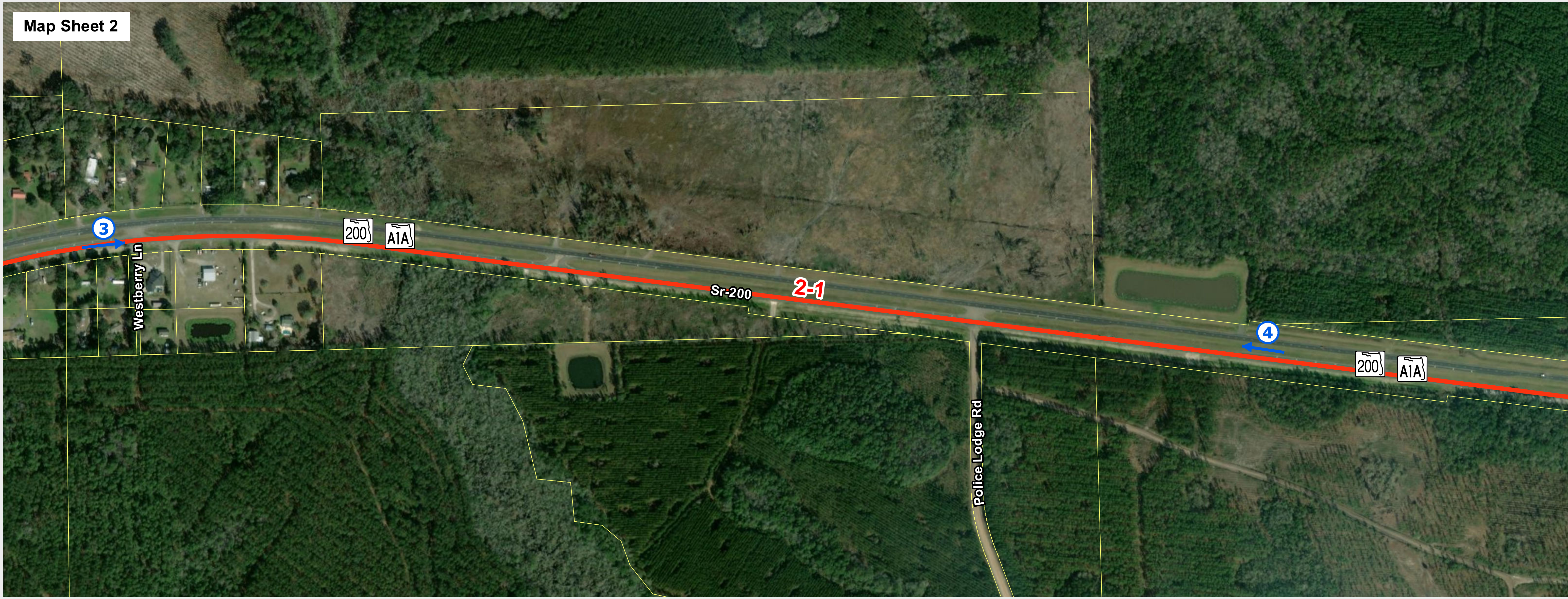
FDOT

0 500 1,000 1,500
Feet

SR 200/A1A from Griffin Rd to Chester Rd

Nassau County, FDOT District Two

Corridor Details



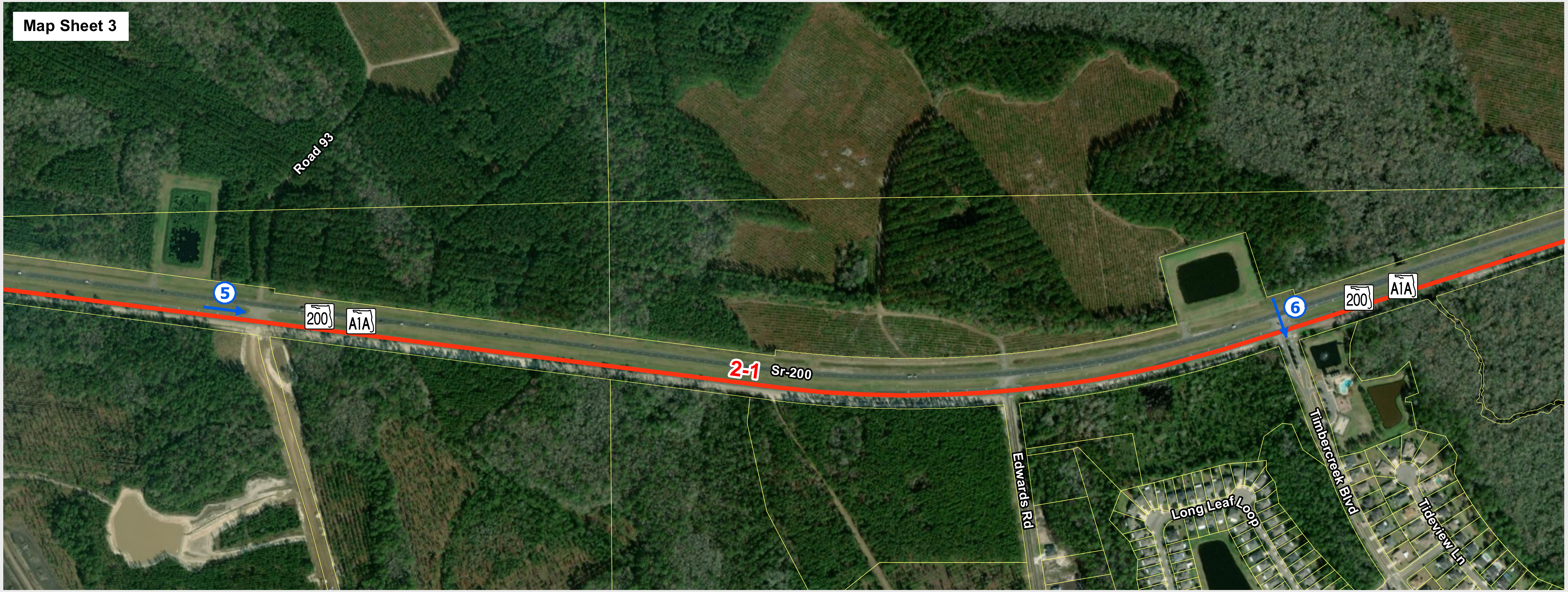
FDOT

0 500 1,000 1,500
Feet

SR 200/A1A from Griffin Rd to Chester Rd

Nassau County, FDOT District Two

Corridor Details

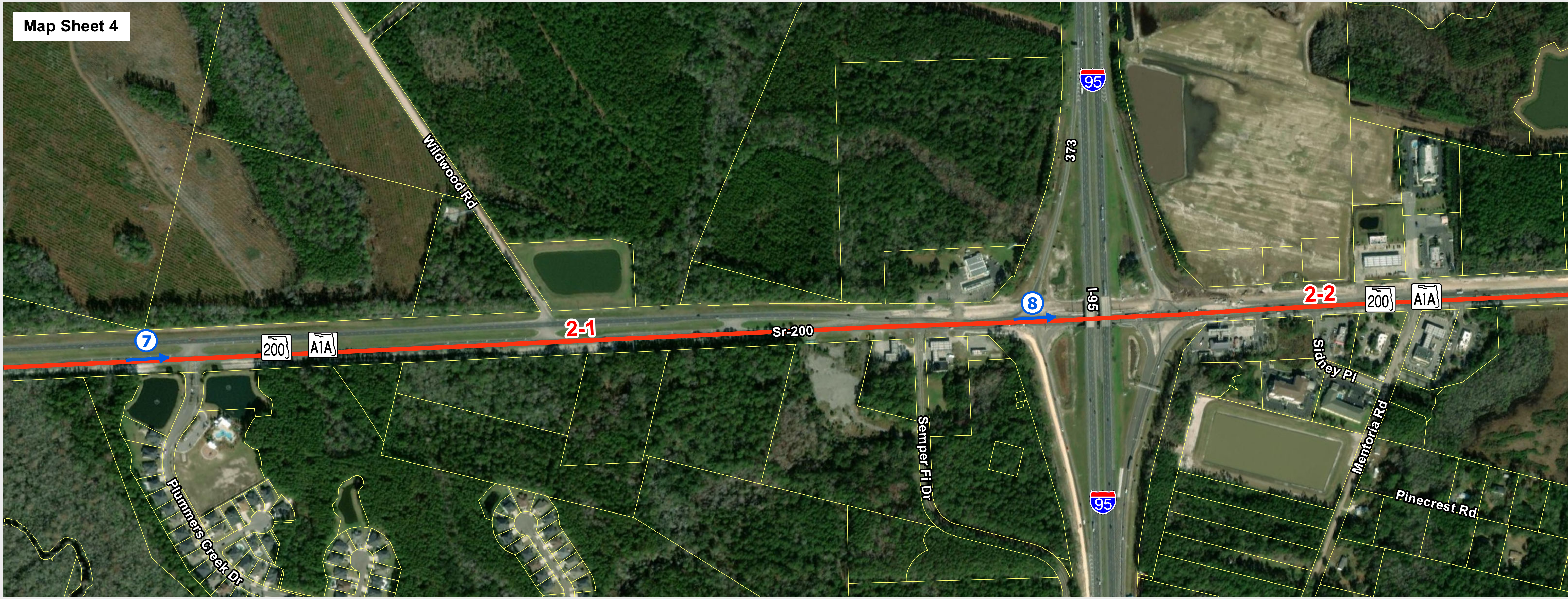


0 500 1,000 1,500
Feet

SR 200/A1A from Griffin Rd to Chester Rd

Nassau County, FDOT District Two

Corridor Details



FDOT

0 500 1,000 1,500
Feet

SR 200/A1A from Griffin Rd to Chester Rd

Nassau County, FDOT District Two

Corridor Details

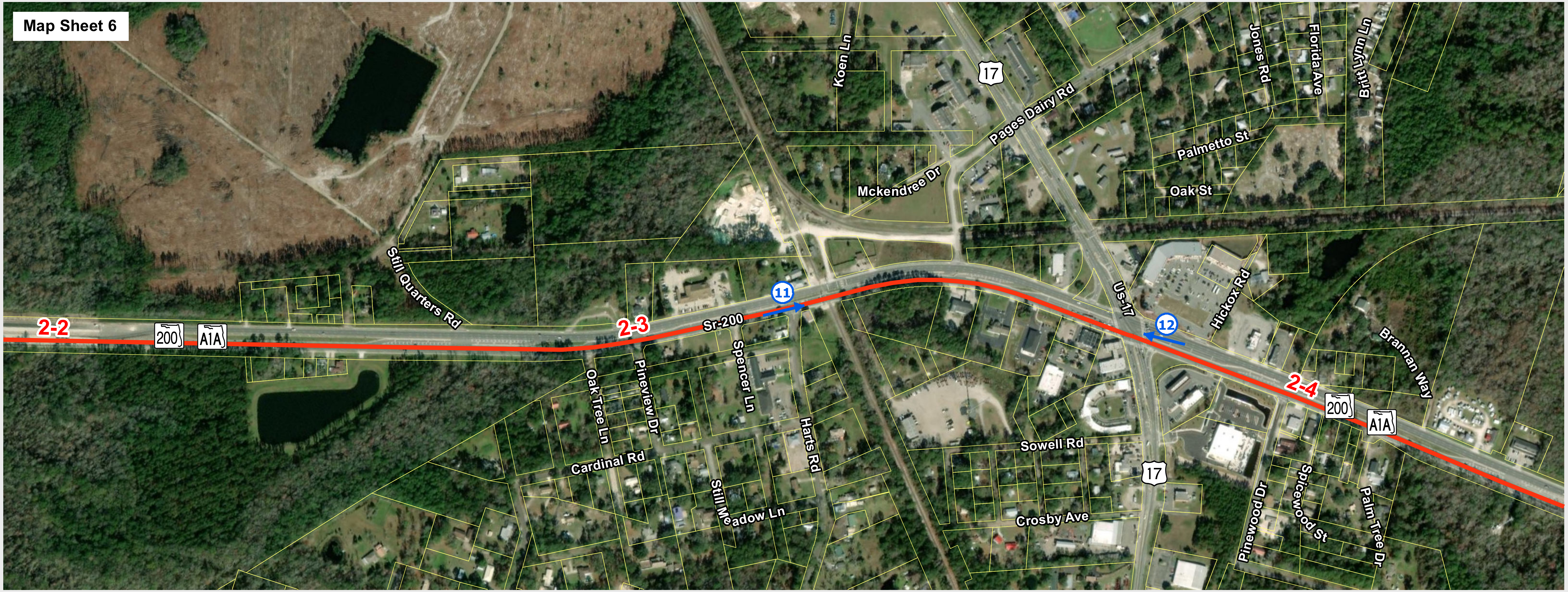
FDOT

0 500 1,000 1,500
Feet

SR 200/A1A from Griffin Rd to Chester Rd

Nassau County, FDOT District Two

Corridor Details



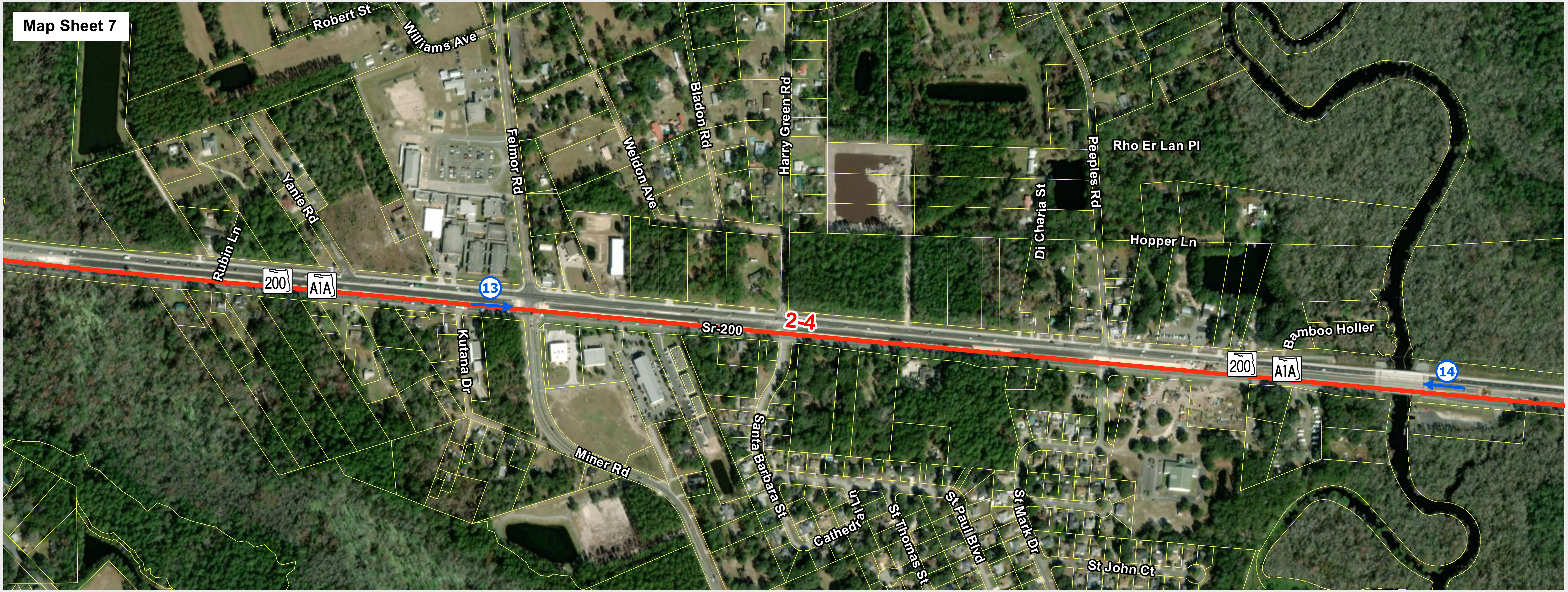
FDOT

0 500 1,000 1,500
Feet

SR 200/A1A from Griffin Rd to Chester Rd

Nassau County, FDOT District Two

Corridor Details



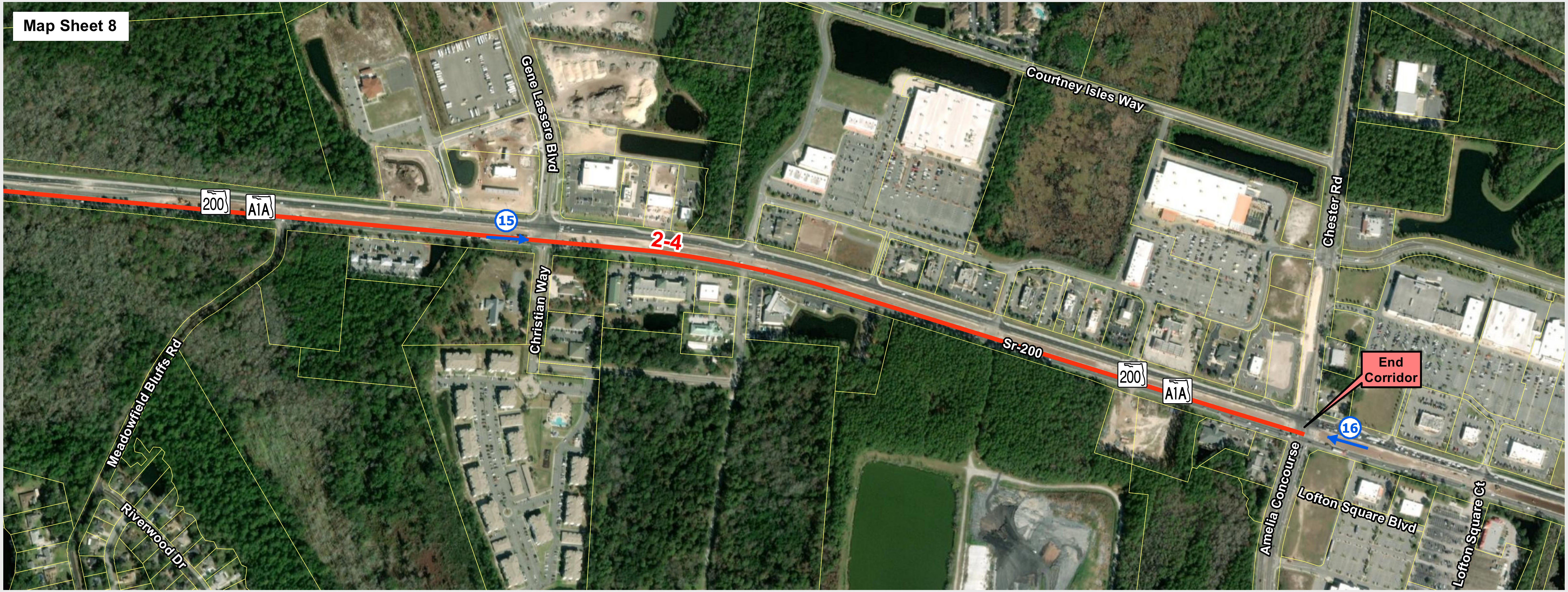
FDOT

0 500 1,000 1,500
Feet

SR 200/A1A from Griffin Rd to Chester Rd

Nassau County, FDOT District Two

Corridor Details



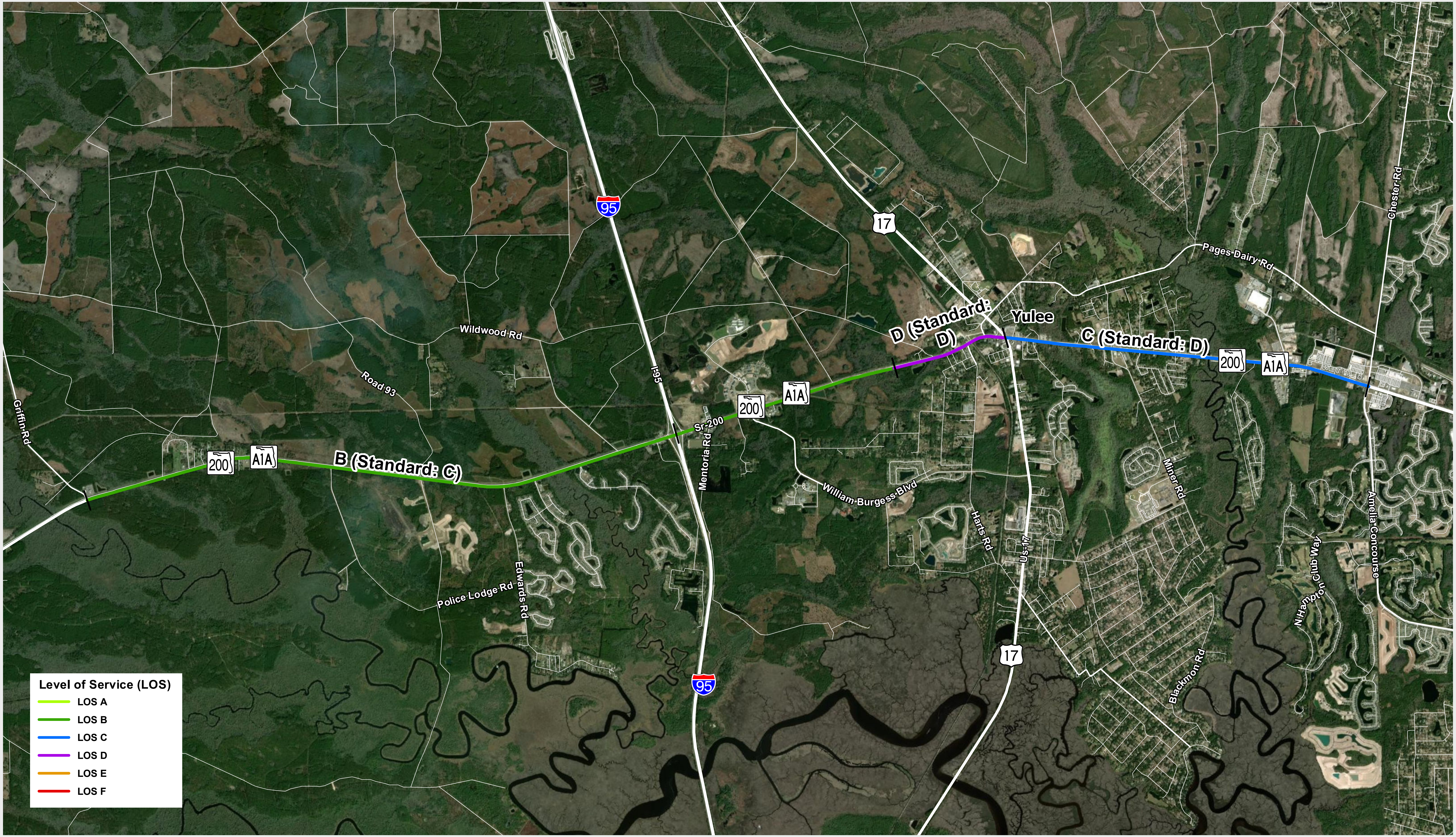
FDOT

0 500 1,000 1,500
Feet

SR 200/A1A from Griffin Rd to Chester Rd

Nassau County, FDOT District Two

Corridor Details



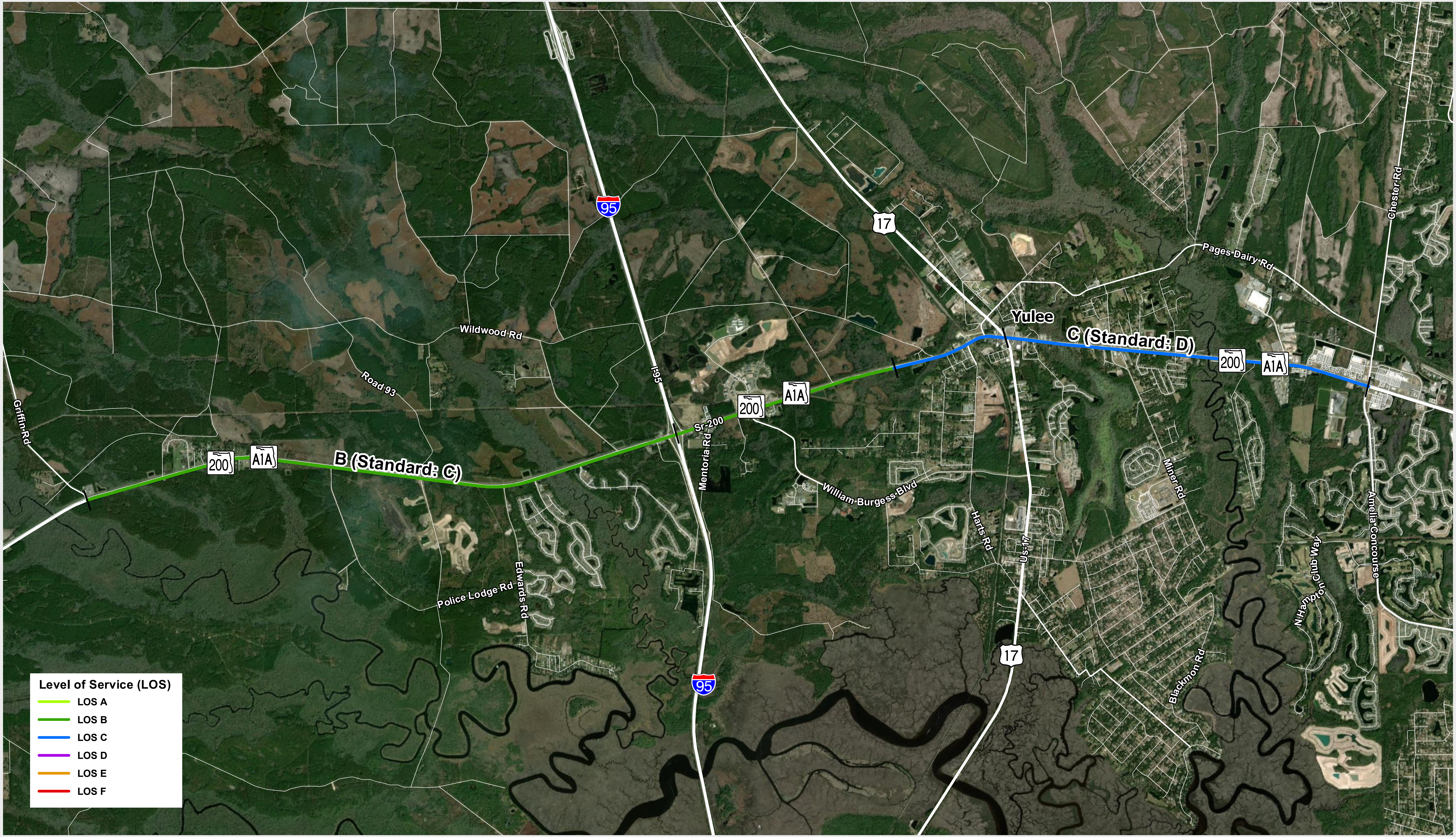
FDOT

0 0.6 1.2 1.8
Miles

SR 200/A1A from Griffin Rd to Chester Rd

Nassau County, FDOT District Two

2010 Level of Service (LOS)



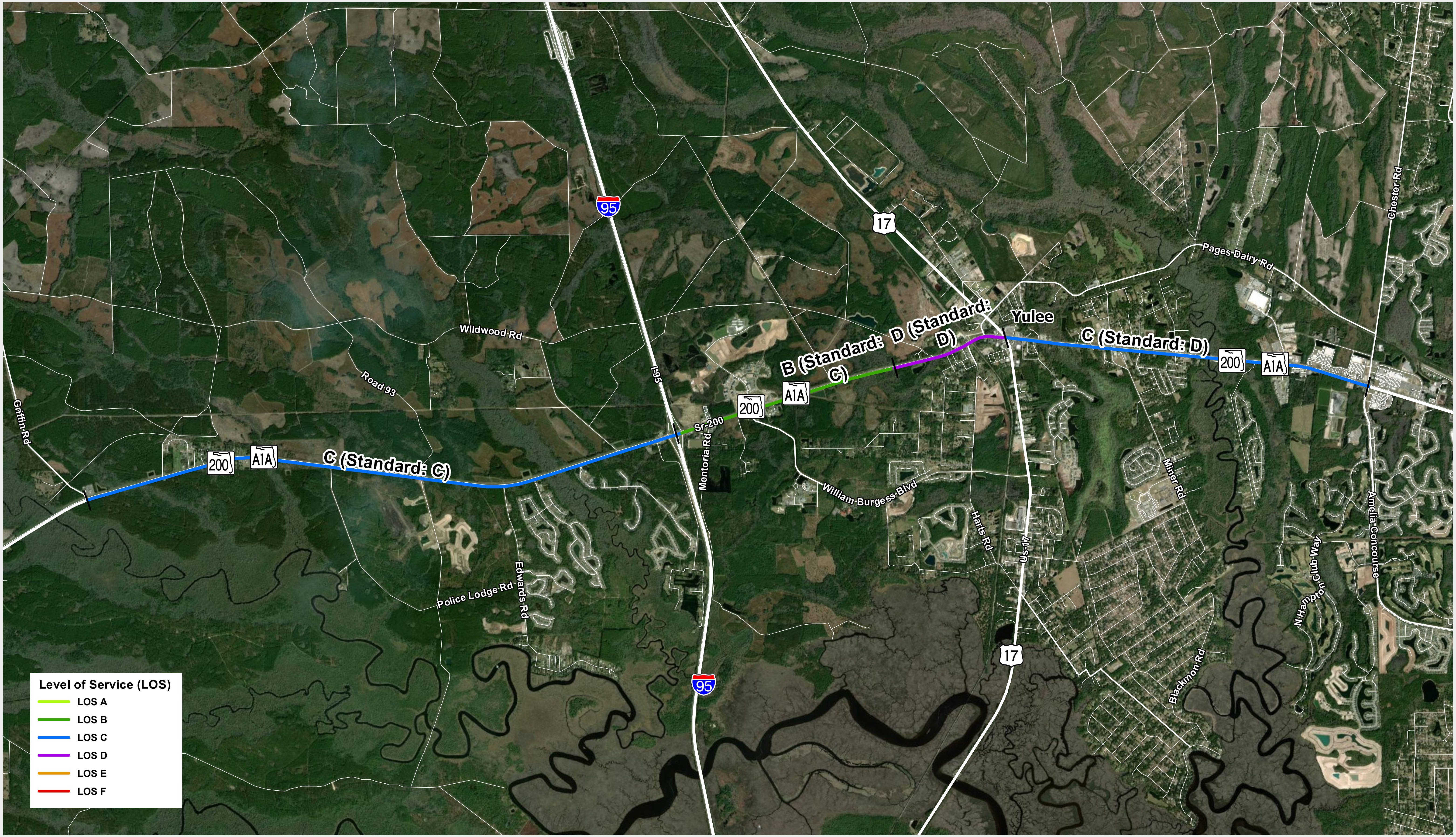
FDOT

0 0.6 1.2 1.8
Miles

SR 200/A1A from Griffin Rd to Chester Rd

Nassau County, FDOT District Two

2019 Level of Service (LOS)



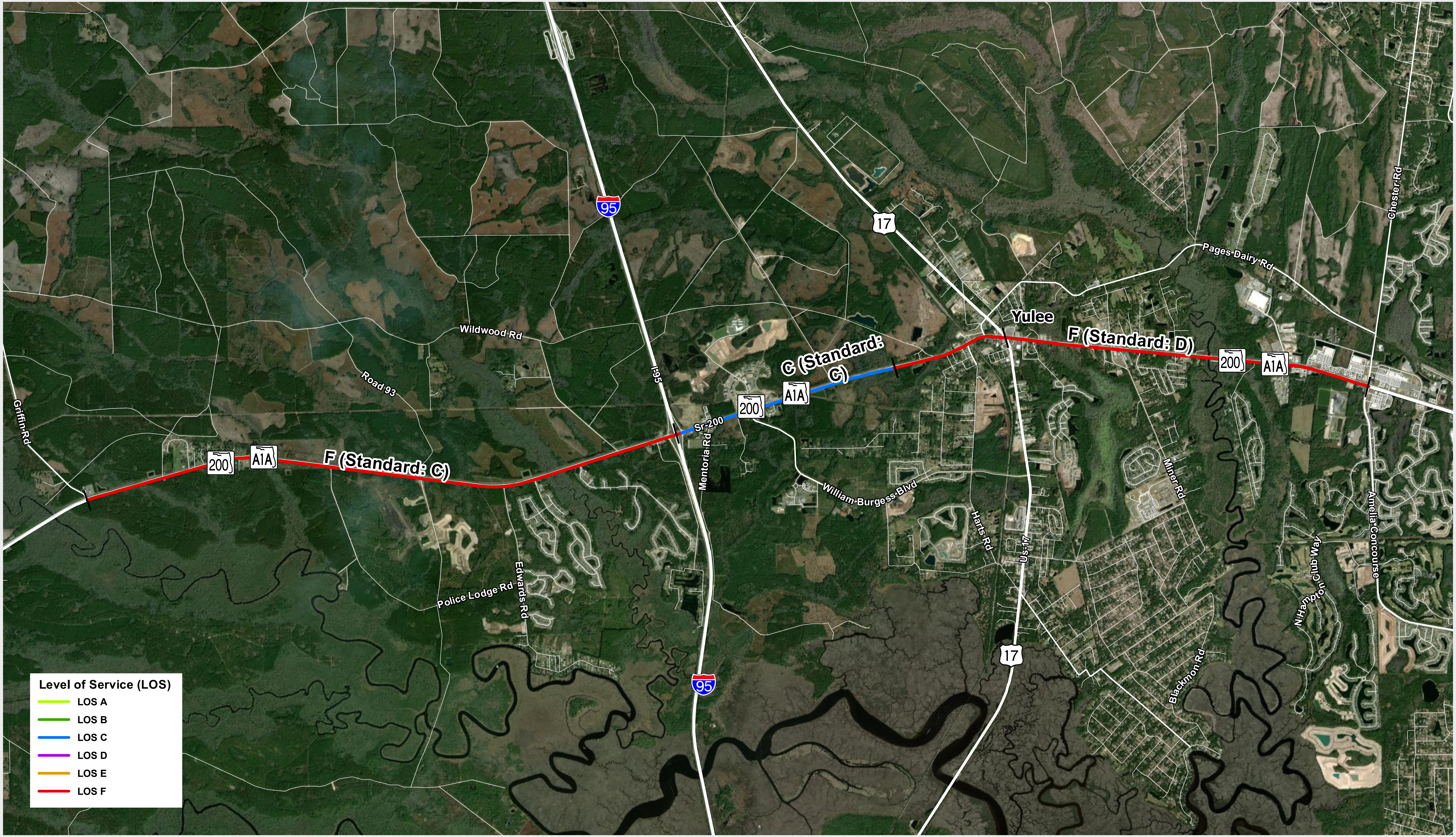
FDOT

0 0.6 1.2 1.8
Miles

SR 200/A1A from Griffin Rd to Chester Rd

Nassau County, FDOT District Two

2045 Level of Service (LOS)
No Build



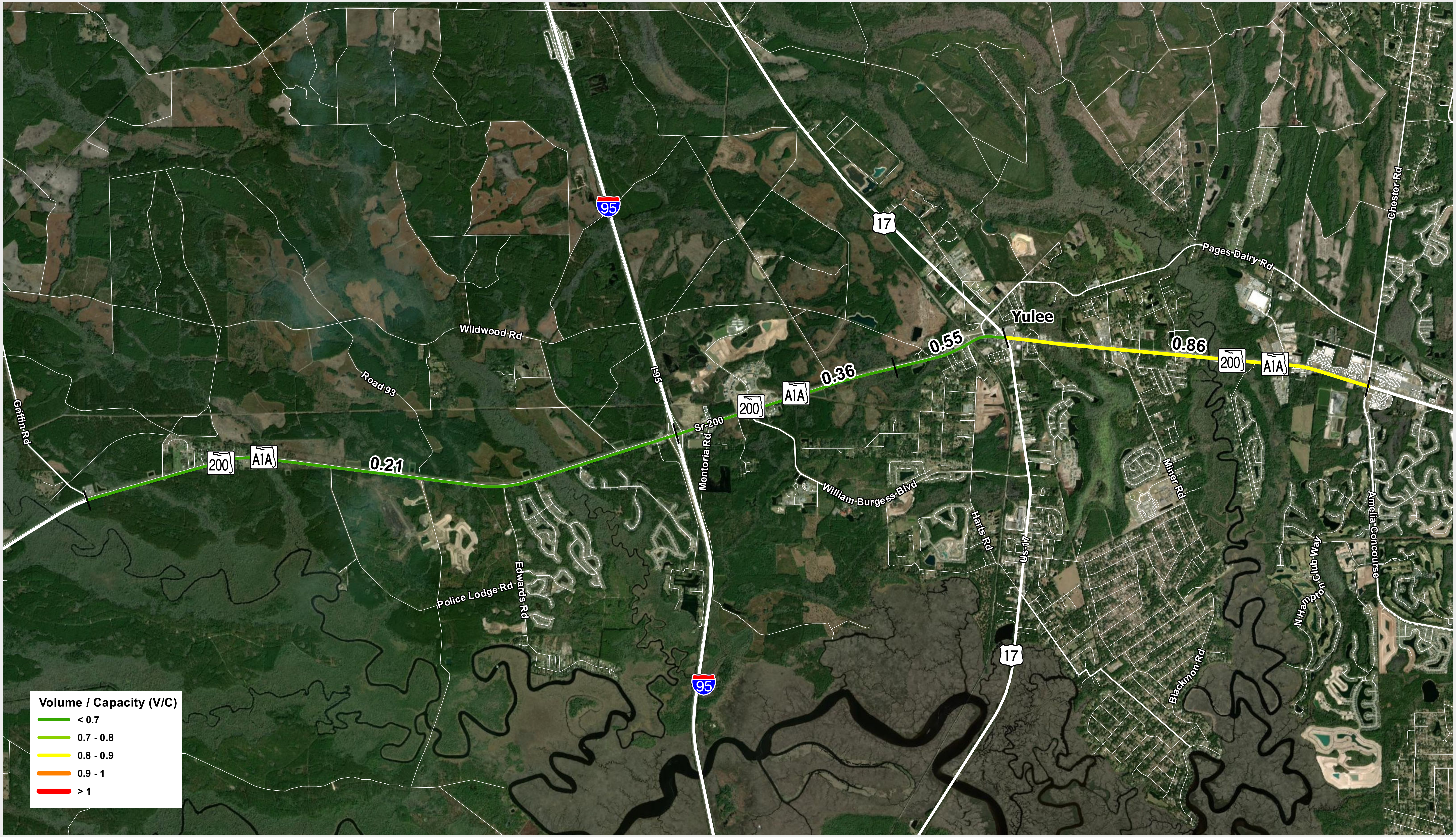
FDOT

0 0.6 1.2 1.8
Miles

SR 200/A1A from Griffin Rd to Chester Rd

Nassau County, FDOT District Two

2045 Level of Service (LOS)
Build

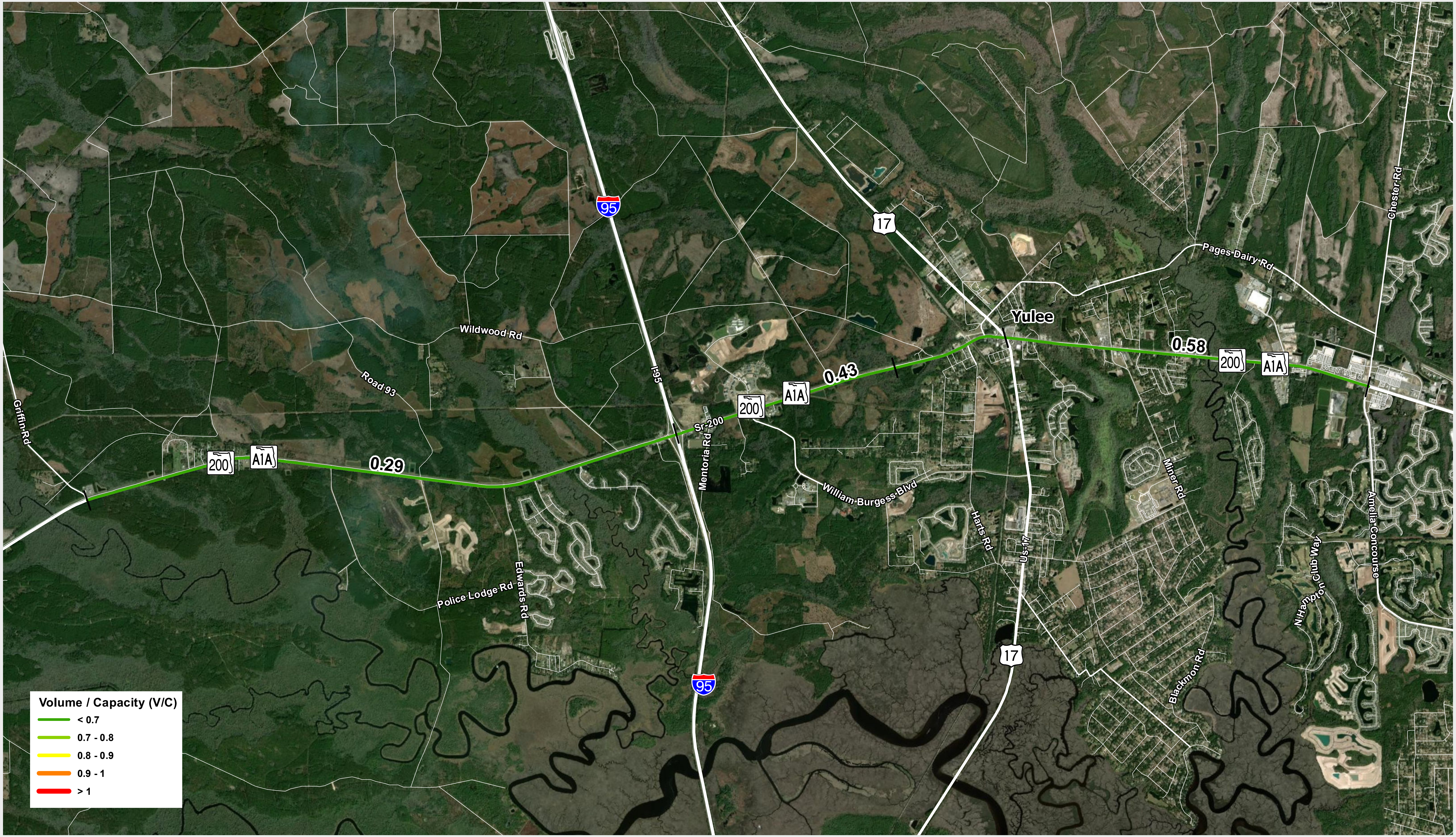


0 0.6 1.2 1.8
Miles

SR 200/A1A from Griffin Rd to Chester Rd

Nassau County, FDOT District Two

2010 Volume / Capacity Ratio (V/C)



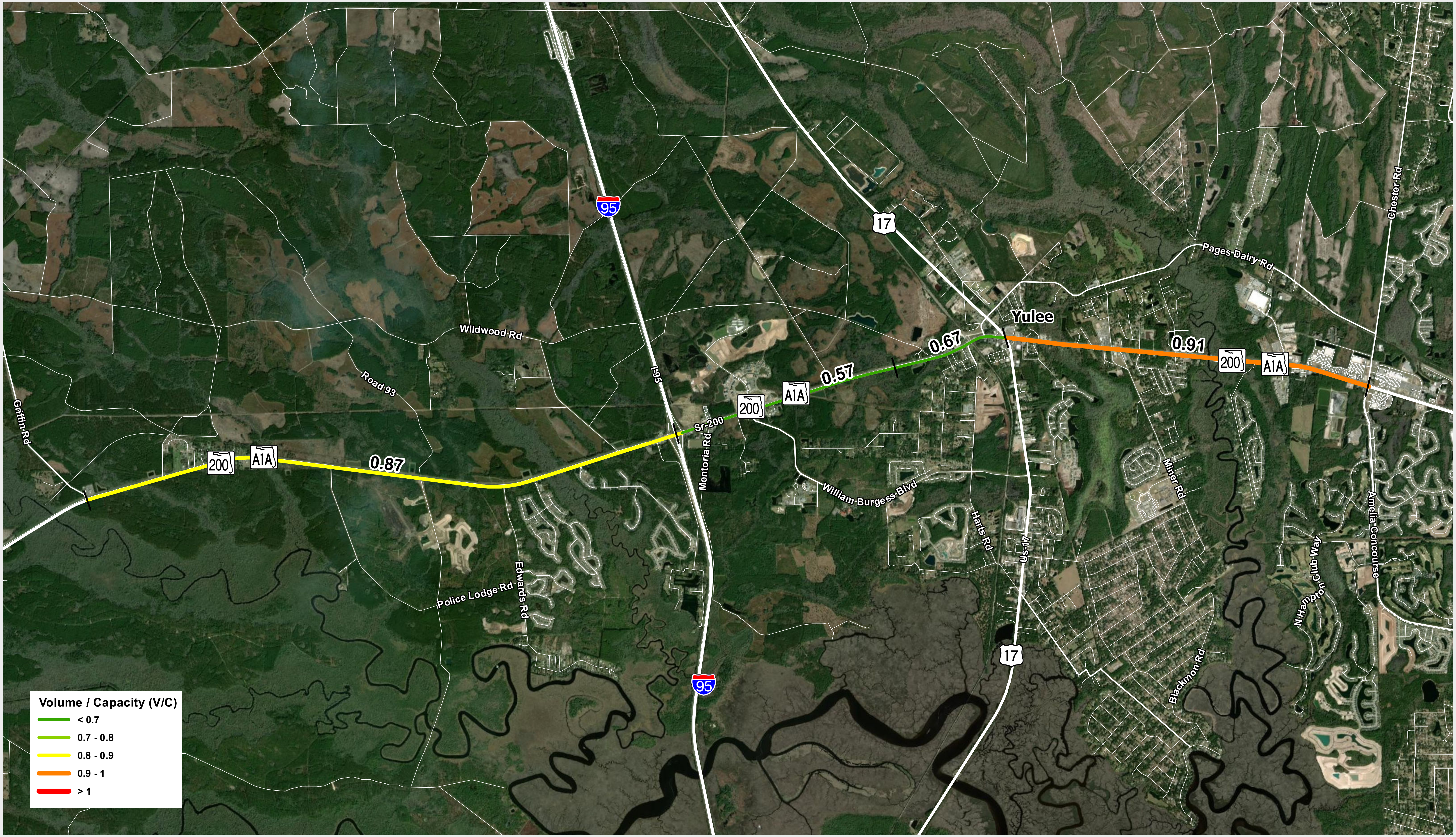
FDOT

0 0.6 1.2 1.8
Miles

SR 200/A1A from Griffin Rd to Chester Rd

Nassau County, FDOT District Two

2019 Volume / Capacity Ratio (V/C)

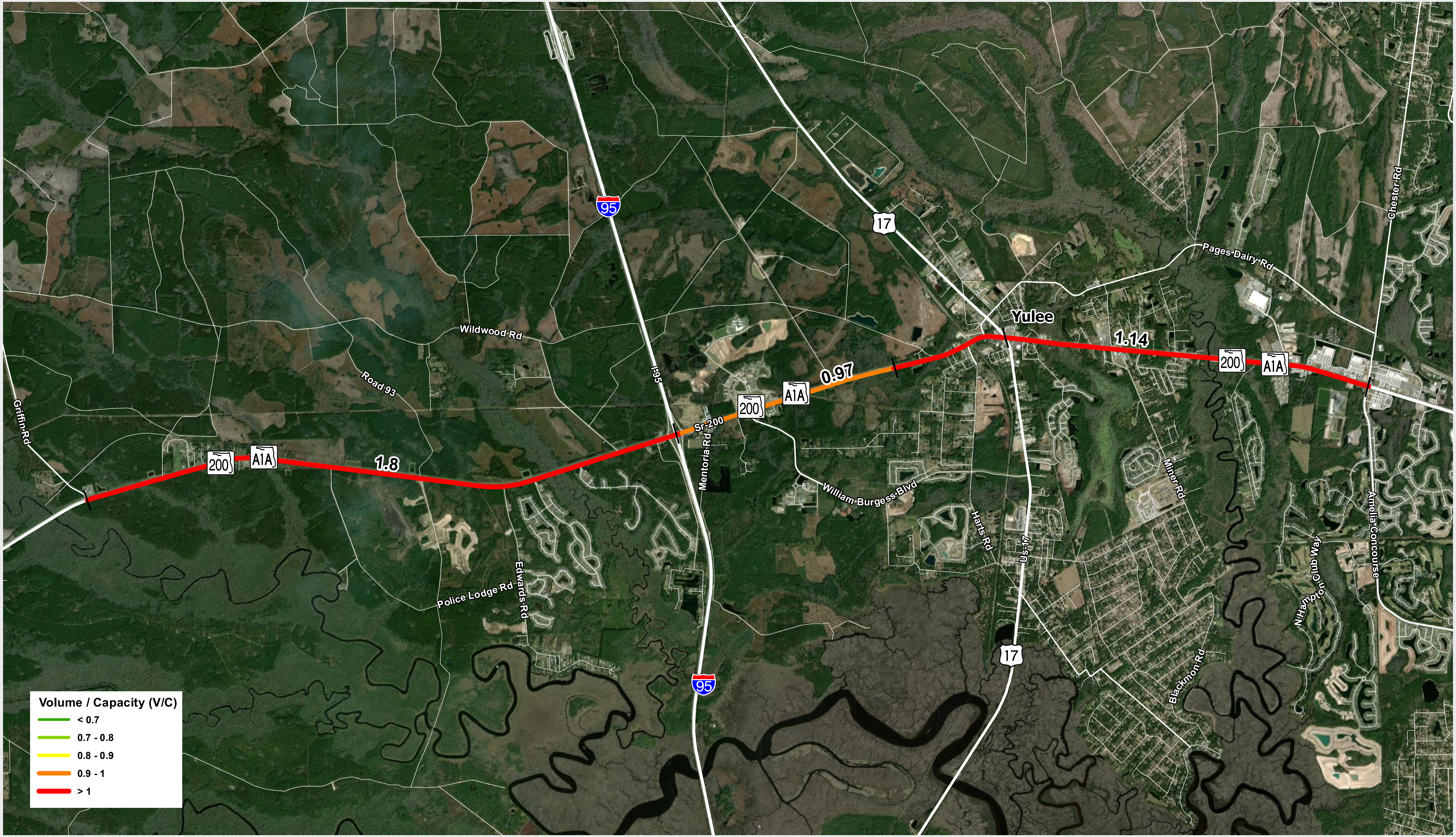


FDOT

SR 200/A1A from Griffin Rd to Chester Rd

Nassau County, FDOT District Two

2045 Volume / Capacity Ratio (V/C)
No Build



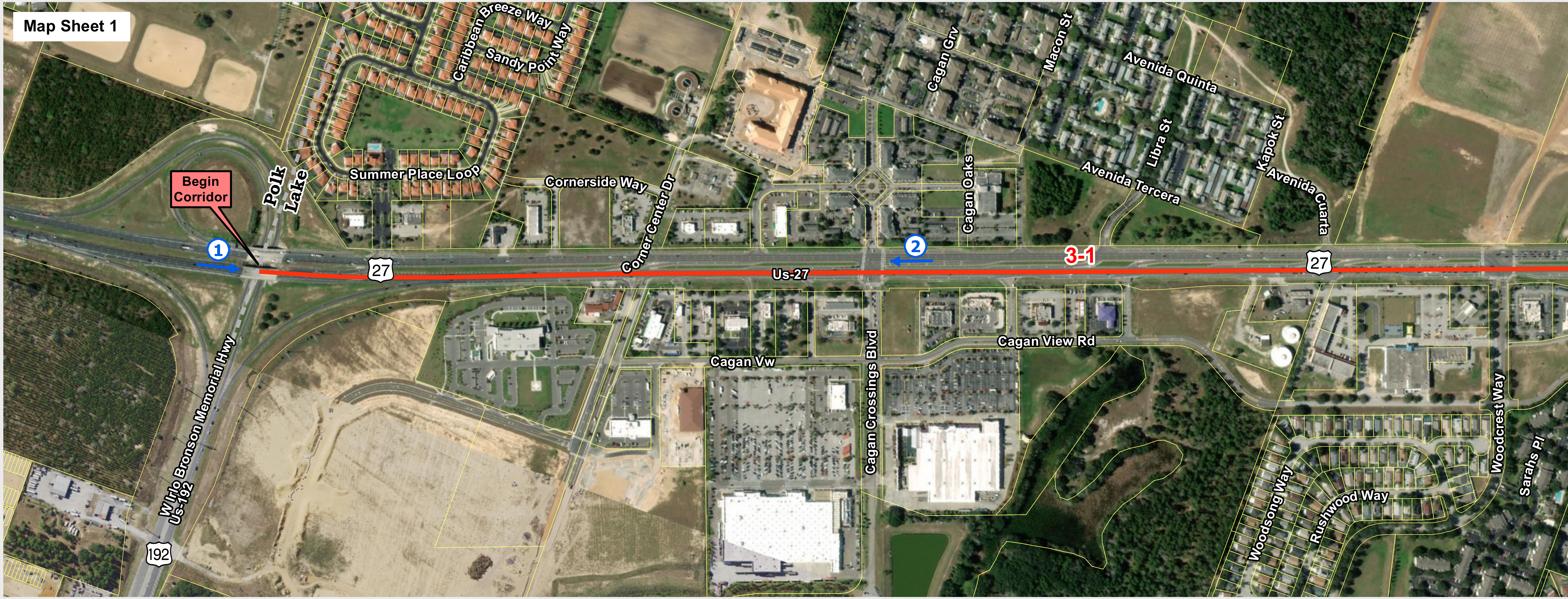
FDOT

SR 200/A1A from Griffin Rd to Chester Rd

Nassau County, FDOT District Two

2045 Volume / Capacity Ratio (V/C)
Build

US 27 south of Clermont



FDOT

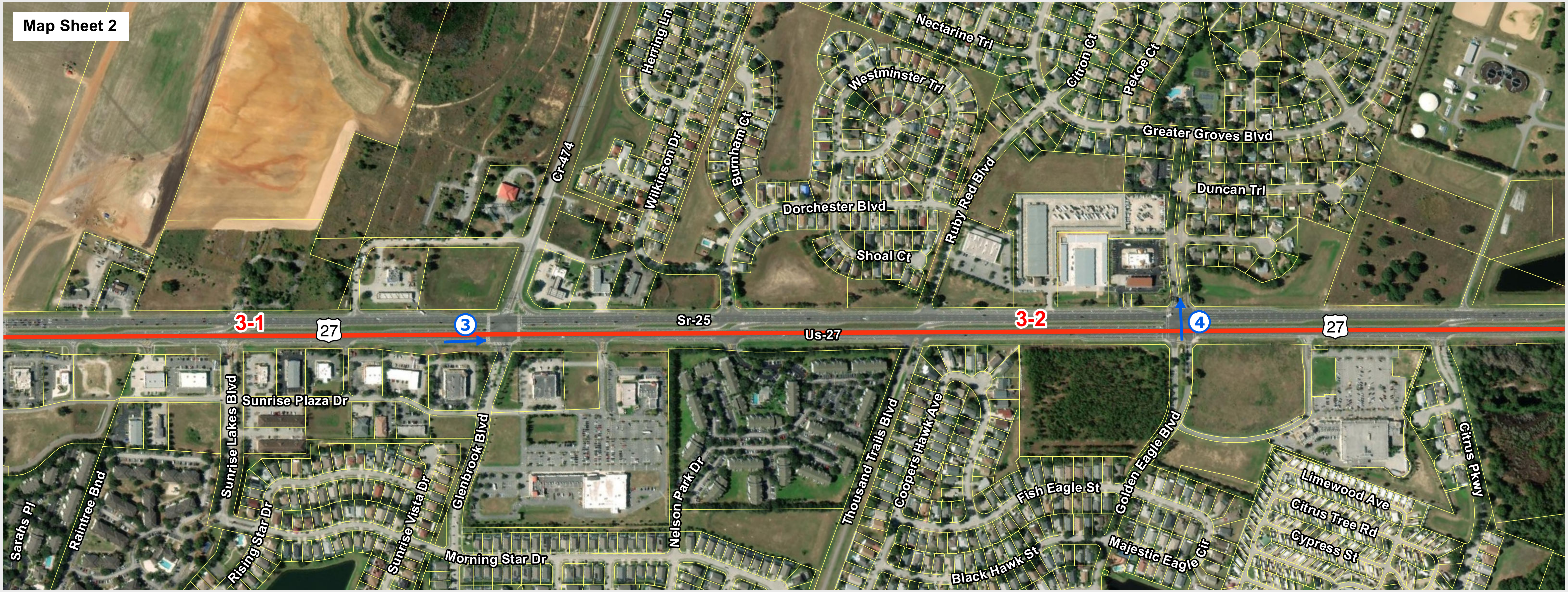
0 500 1,000 1,500
Feet

US 27 from Polk/Lake County Line to Hartwood Marsh Rd

Lake County, FDOT District Five

Corridor Details

Map Sheet 2

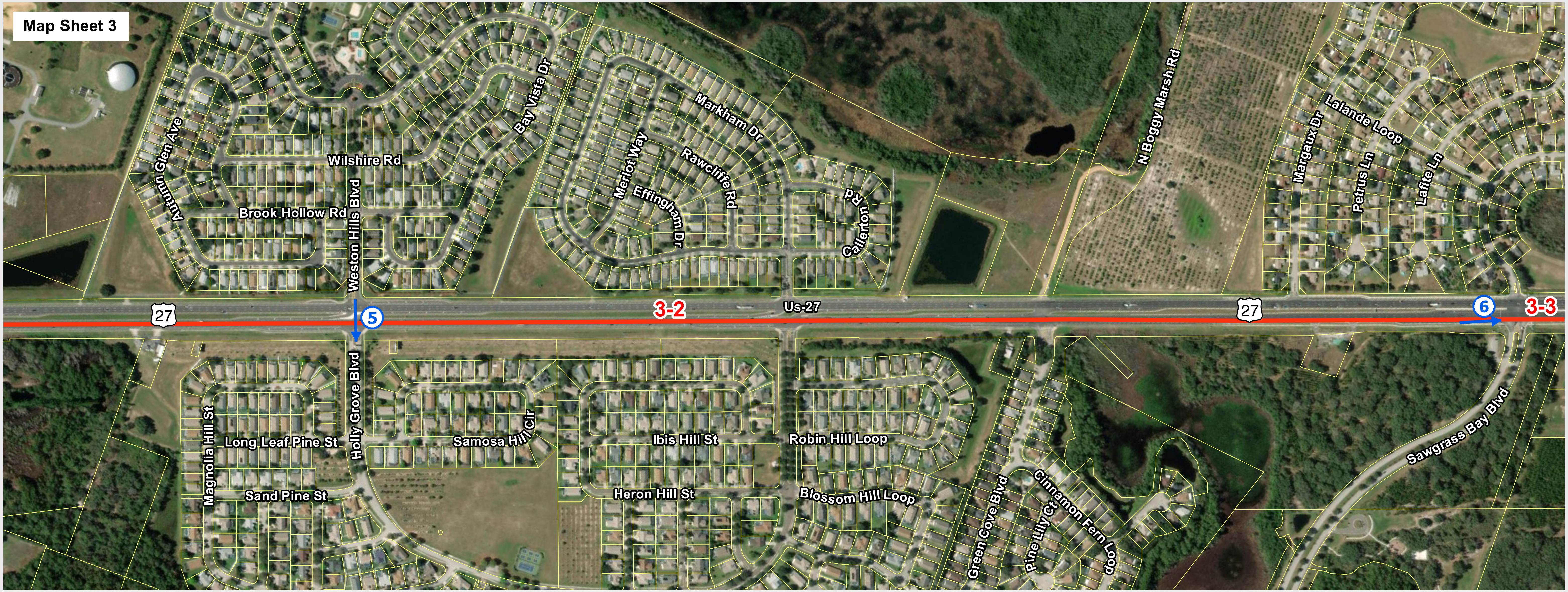


FDOT

0 500 1,000 1,500
Feet

US 27 from Polk/Lake County Line
to Hartwood Marsh Rd
Lake County, FDOT District Five

Corridor Details



FDOT

0 500 1,000 1,500
Feet

US 27 from Polk/Lake County Line to Hartwood Marsh Rd

Lake County, FDOT District Five

Corridor Details

FDOT

0 500 1,000 1,500
Feet

US 27 from Polk/Lake County Line to Hartwood Marsh Rd

Lake County, FDOT District Five

Corridor Details

FDOT

0 500 1,000 1,500
Feet

US 27 from Polk/Lake County Line to Hartwood Marsh Rd

Lake County, FDOT District Five

Corridor Details

FDOT

0 500 1,000 1,500
Feet

US 27 from Polk/Lake County Line to Hartwood Marsh Rd

Lake County, FDOT District Five

Corridor Details

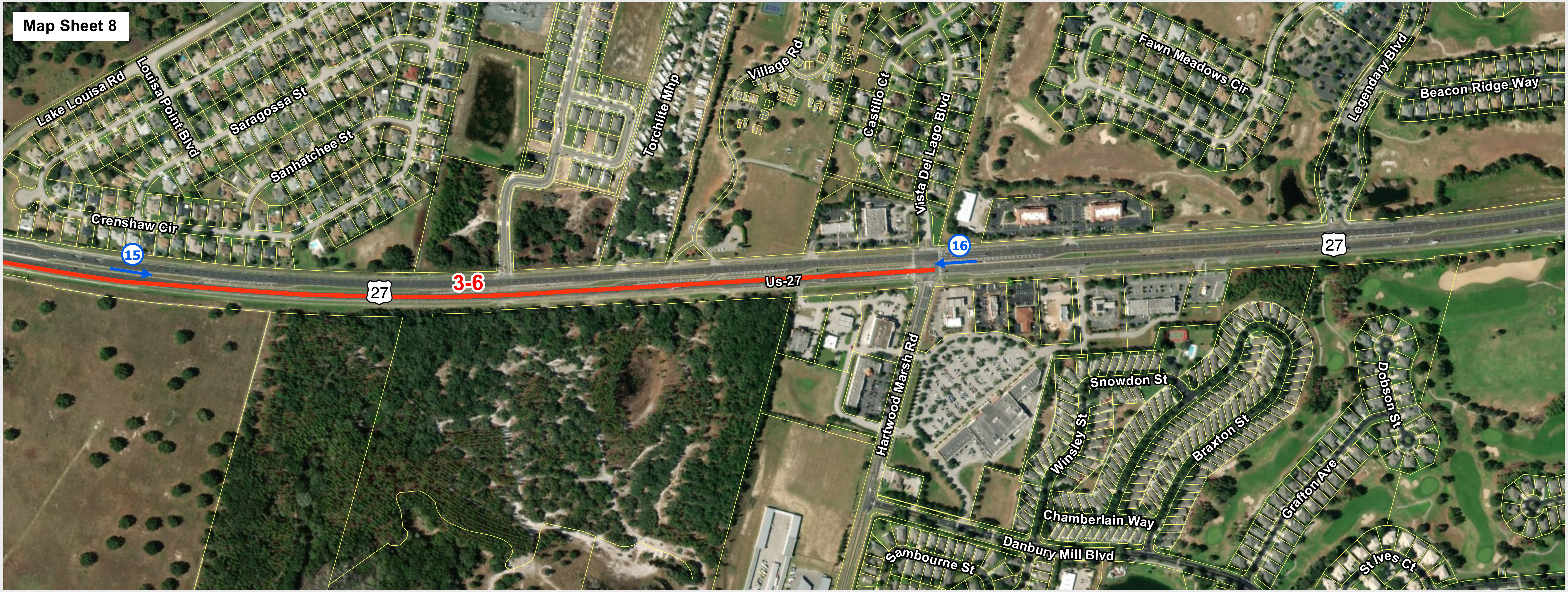
FDOT

0 500 1,000 1,500
Feet

US 27 from Polk/Lake County Line to Hartwood Marsh Rd

Lake County, FDOT District Five

Corridor Details

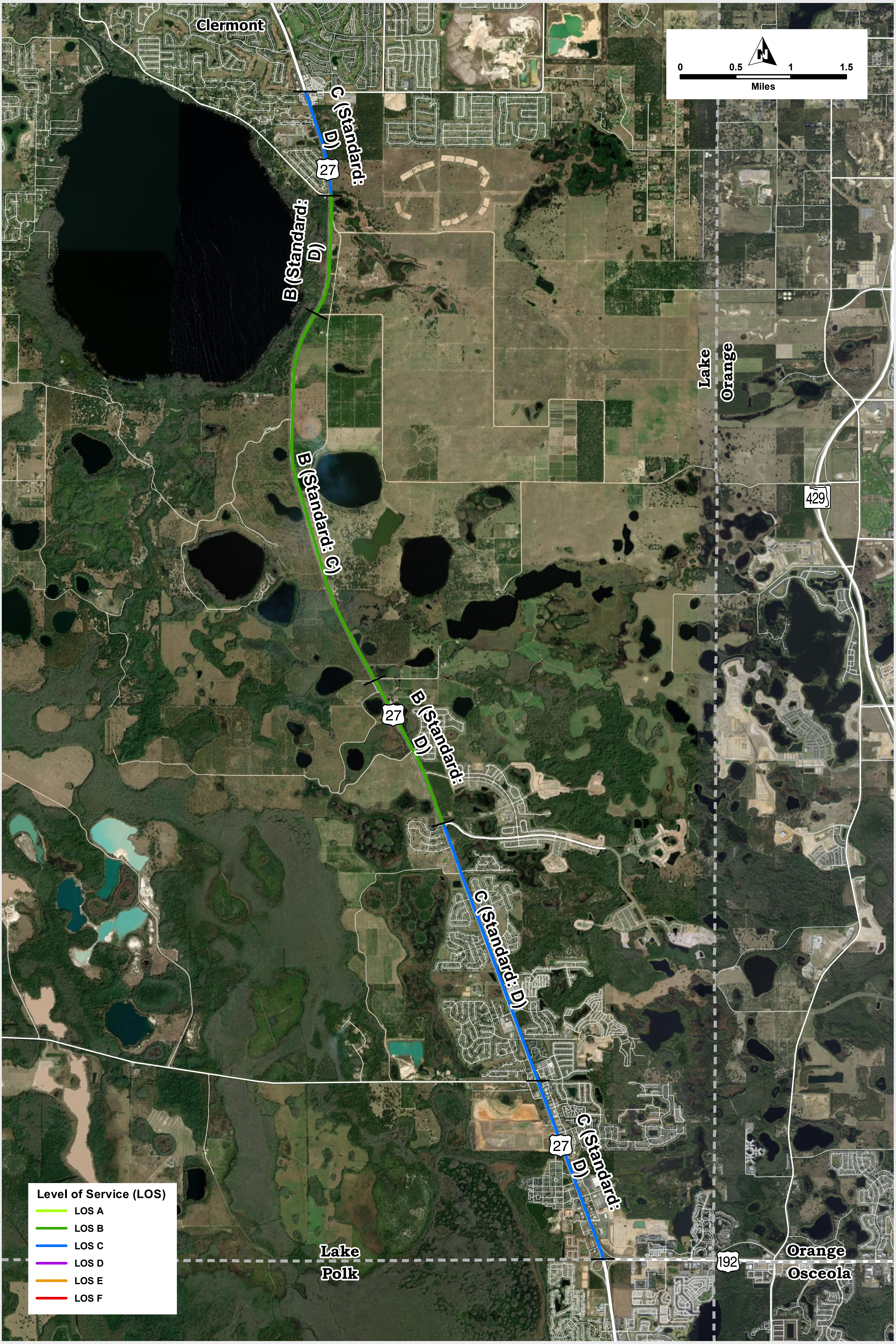


FDOT

0 500 1,000 1,500
Feet

US 27 from Polk/Lake County Line to Hartwood Marsh Rd
Lake County, FDOT District Five

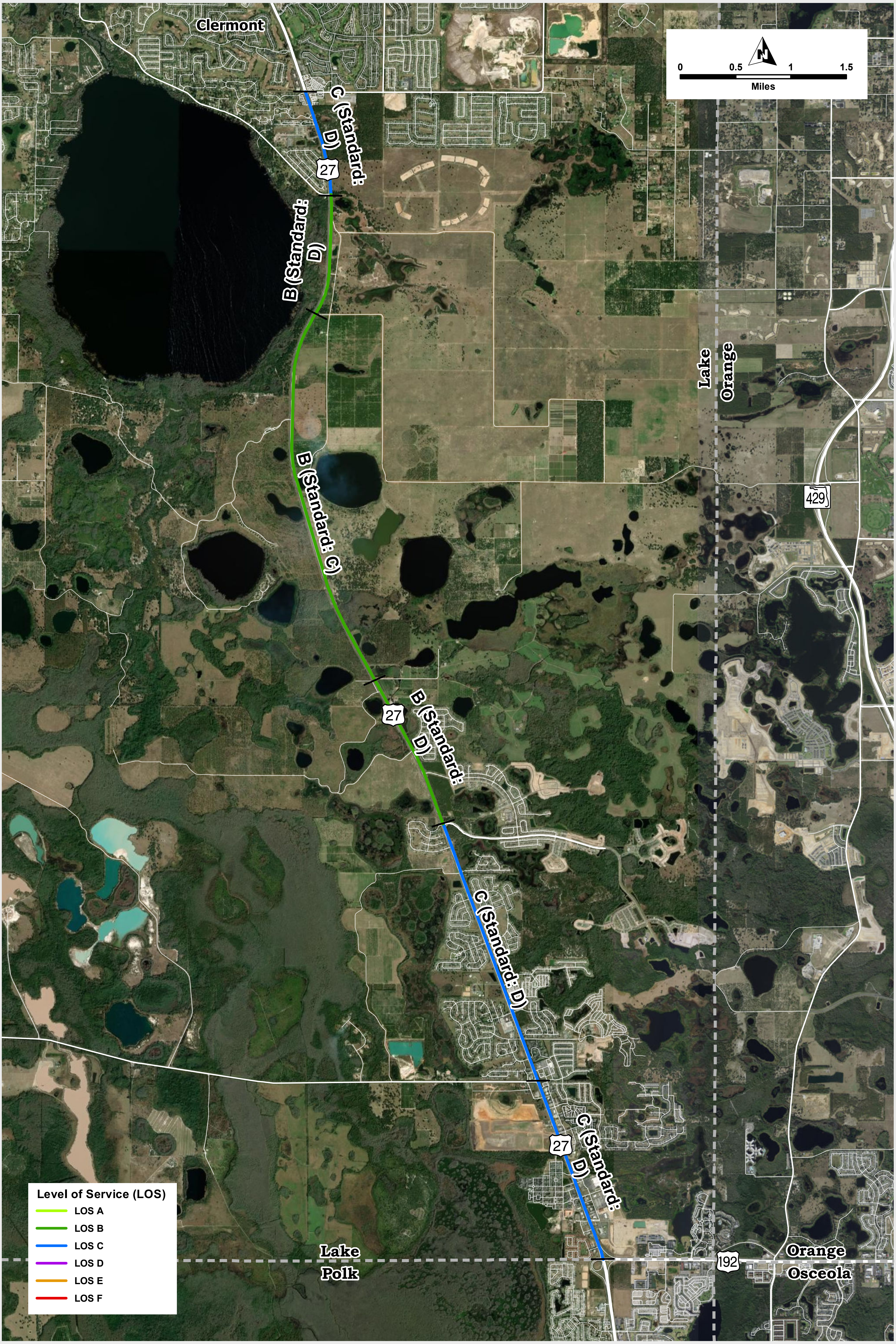
Corridor Details



FDOT

US 27 from Polk/Lake County Line
to Hartwood Marsh Rd
Lake County, FDOT District Five

2010 Level of Service (LOS)

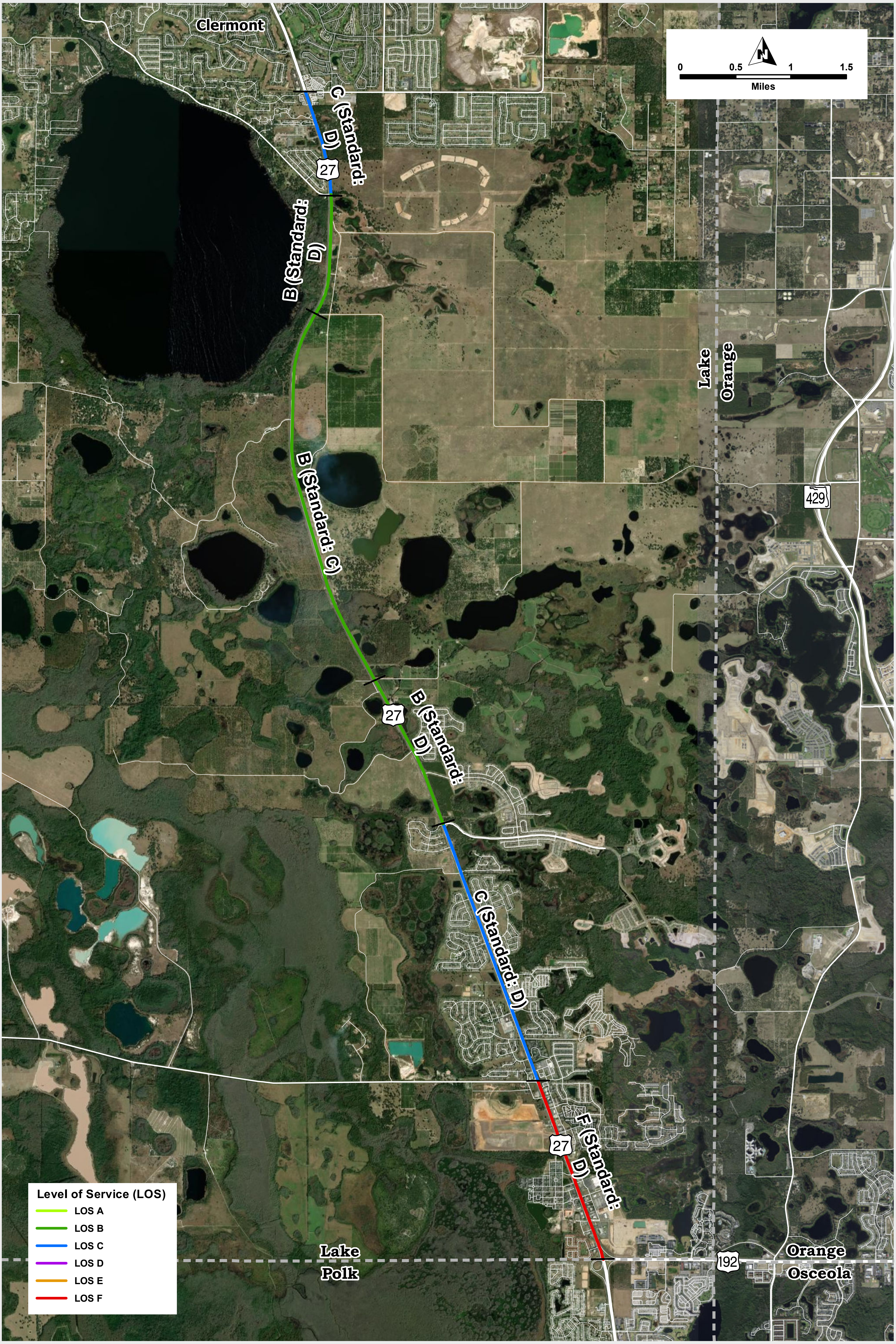


FDOT

US 27 from Polk/Lake County Line to Hartwood Marsh Rd

Lake County, FDOT District Five

2019 Level of Service (LOS)



FDOT

US 27 from Polk/Lake County Line to Hartwood Marsh Rd

Lake County, FDOT District Five

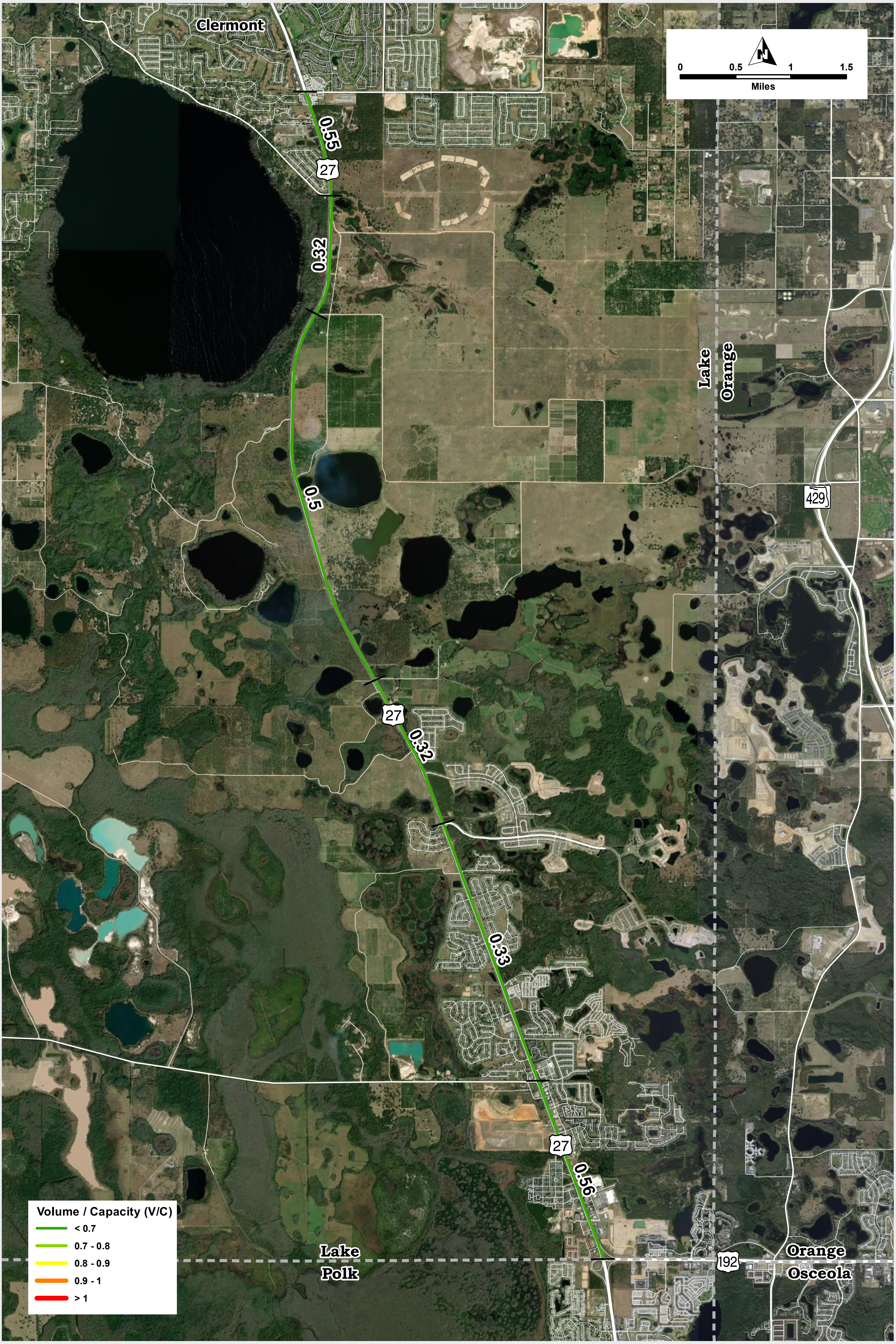
2045 Level of Service (LOS) No Build

FDOT

US 27 from Polk/Lake County Line to Hartwood Marsh Rd

Lake County, FDOT District Five

2045 Level of Service (LOS) Build

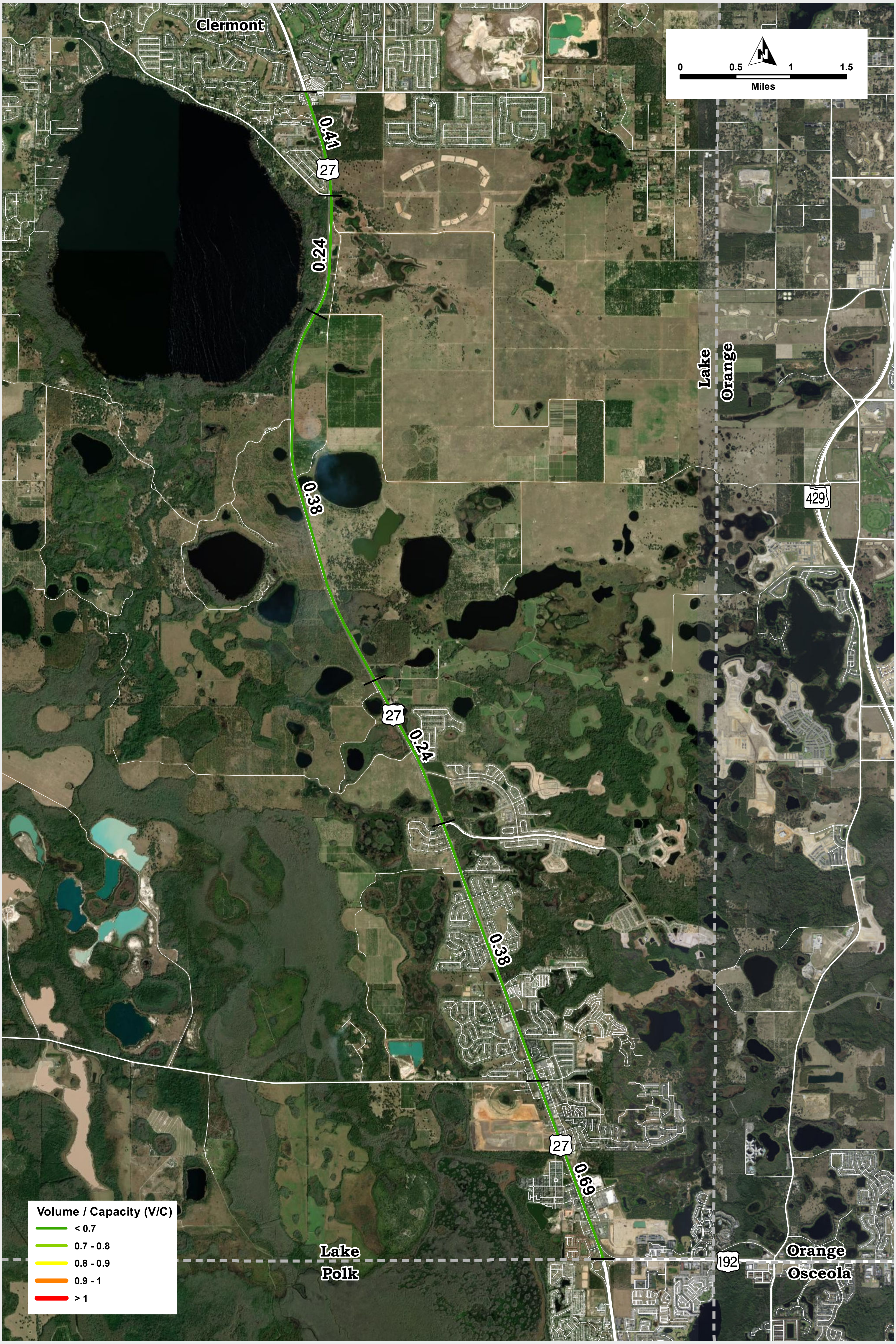


FDOT

US 27 from Polk/Lake County Line to Hartwood Marsh Rd

Lake County, FDOT District Five

2010 Volume / Capacity Ratio (V/C)

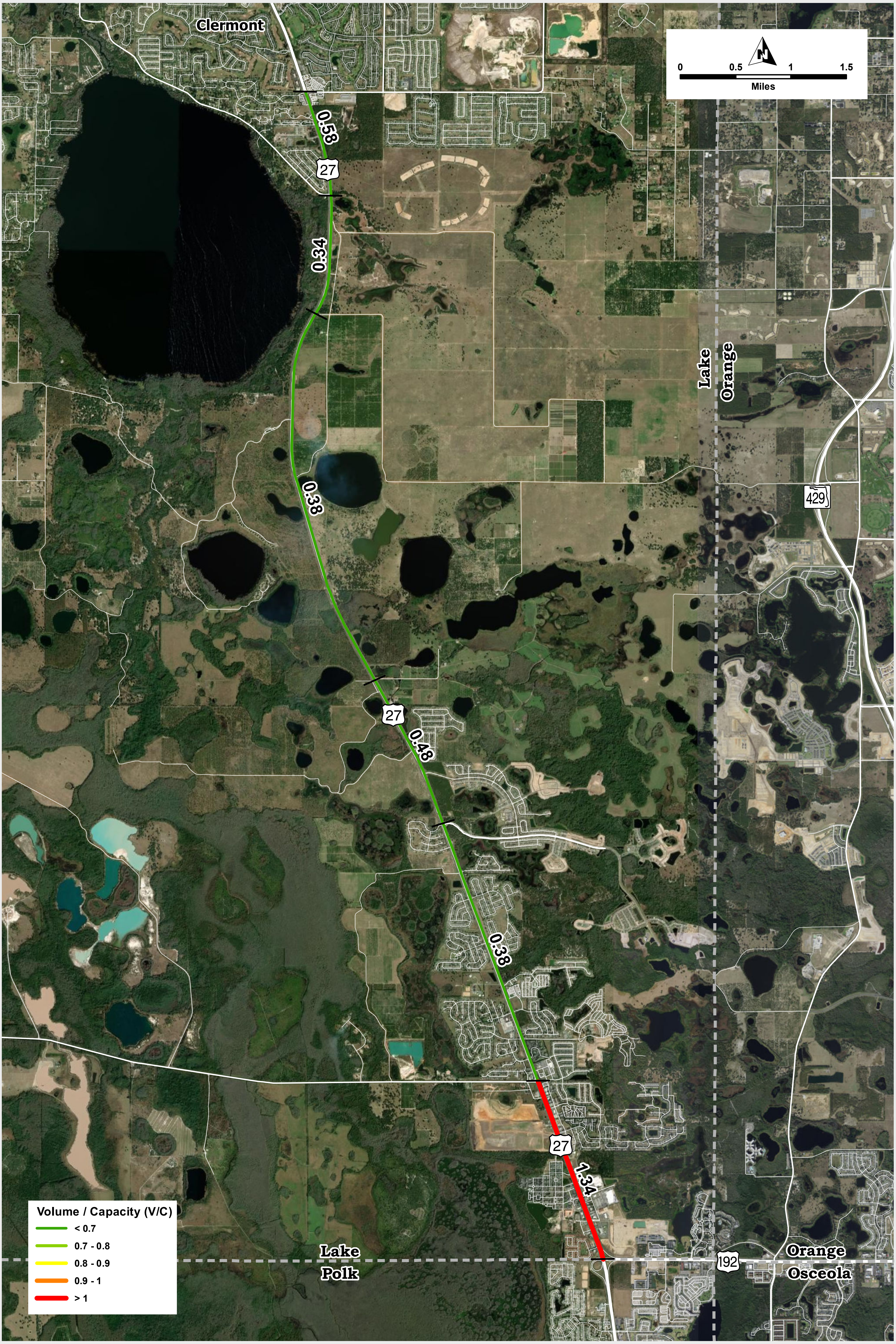


FDOT

US 27 from Polk/Lake County Line to Hartwood Marsh Rd

Lake County, FDOT District Five

2019 Volume / Capacity Ratio (V/C)

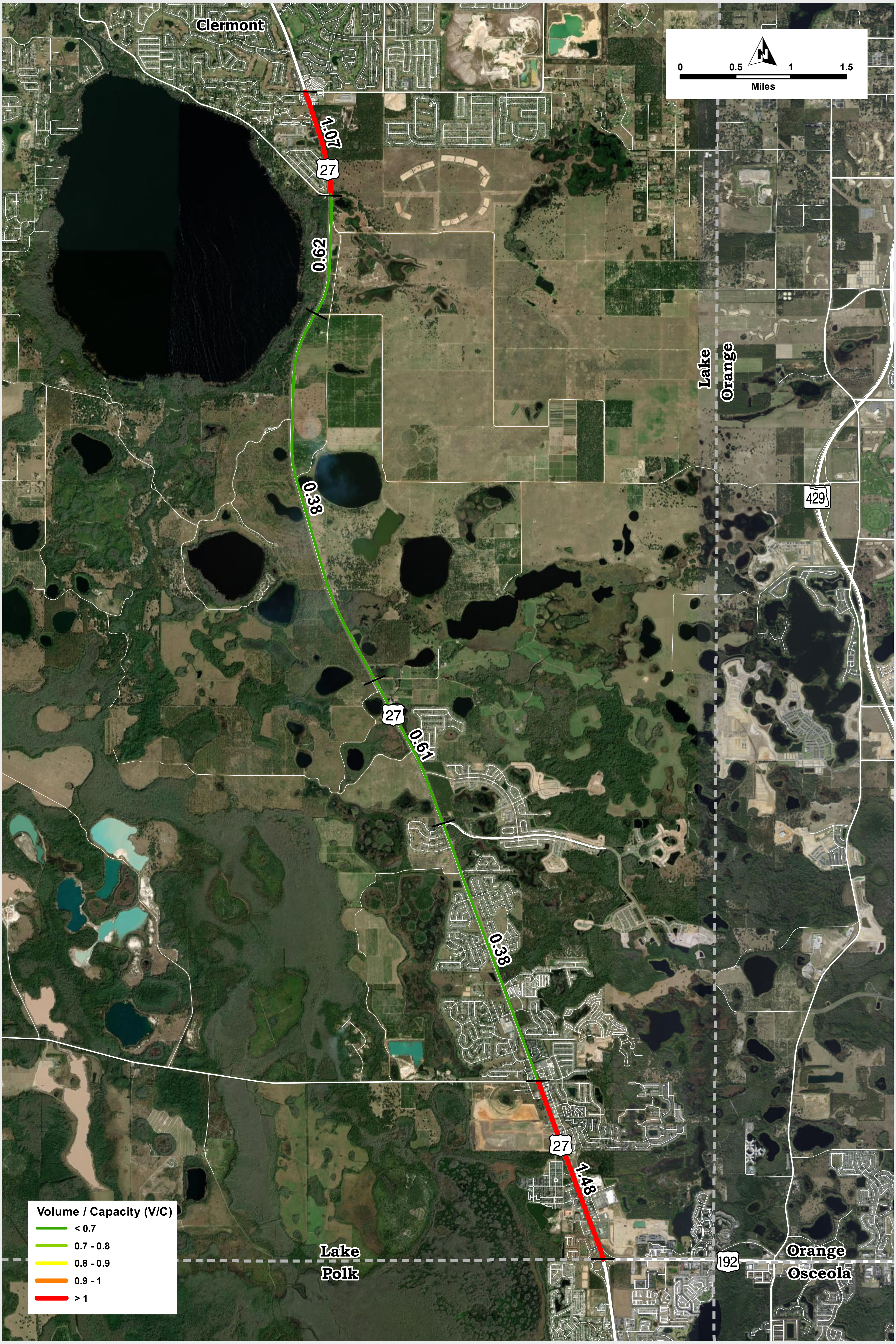


FDOT

US 27 from Polk/Lake County Line to Hartwood Marsh Rd

Lake County, FDOT District Five

2045 Volume / Capacity Ratio (V/C)
No Build



FDOT

US 27 from Polk/Lake County Line to Hartwood Marsh Rd

Lake County, FDOT District Five

2045 Volume / Capacity Ratio (V/C) Build

Appendix C: Select Link Model Plots


SR 70 - Select Link - East
SELECT3_DAY=2500
SELECT3_DAY=5000


SR 70 - Select Link - West
SELECT1_DAY=2500
SELECT1_DAY=5000
cube
(Licensed to HDR Engineering Inc)


SR 200 - Select Link - East
ALSL_VL_TOT_40C=2500
ALSL_VL_TOT_40C=5000


SR 200 - Select Link - West
ALSL_VL_TOT_40C=2500
ALSL_VL_TOT_40C=5000

US 27 - Select Link - North

- SEL_TOTAL=5000
- SEL_TOTAL=10000


US 27 - Select Link - South
SEL_TOTAL=5000
SEL_TOTAL=10000

Appendix D: Engineering Toolbox

Engineering Toolbox - Improvement Type Categories and Specific Strategies

Low-Cost Operational Improvements

- SIGNAL RETIMING / COORDINATION
- TURN LANES
- MEDIAN TREATMENTS
- PROHIBIT LEFT TURNS

Technology to Increase Capacity

- TRANSPORTATION SYSTEMS MANAGEMENT & OPERATIONS (TSM&O)
- INTELLIGENT TRANSPORTATION SYSTEMS (ITS)
- ACTIVE TRANSPORTATION AND DEMAND MANAGEMENT (ATDM)
- ADAPTIVE SIGNALS
- QUEUE MANAGEMENT
- CONNECTED/AUTONOMOUS VEHICLES

Arterial Managed Lanes

- REVERSIBLE LANES
- EXPRESS LANES
- RESTRICTED LANES
- MANAGED ARTERIAL
- CONTRAFLOW LEFT TURN POCKETS

Increased Multimodal Options

- SIDEWALKS
- BIKEWAY
- IMPROVED TRANSIT
- TRANSIT QUEUE JUMP LANES

Innovative Intersection Control

- MEDIAN U-TURN
- RESTRICTED CROSSING U-TURN
- JUGHANDLE
- DISPLACED LEFT TURN
- CONTINUOUS GREEN T
- QUADRANT ROADWAY
- MODERN ROUNDABOUT
- BOWTIE

Access Management

- ACCESS MANAGEMENT PLANS
- SHARED ACCESS DRIVEWAYS
- REAR SERVICE/BACKAGE ROADS
- FRONTAGE ROADS
- MULTI-WAY BOULEVARDS

Network Enhancements

- CONNECTIVITY ENHANCEMENTS
- IMPROVED PARALLEL ROUTES

Additional Through Lanes

Convert to Grade-Separated Intersection

- DIAMOND
- CLOVERLEAF
- DISPLACED LEFT-TURN INTERCHANGE
- DIVERGING DIAMOND
- SINGLE POINT
- ECHELON
- CENTER LEFT TURN OVERPASS
- MEDIAN U-TURN INTERCHANGE
- RAIN-DROP

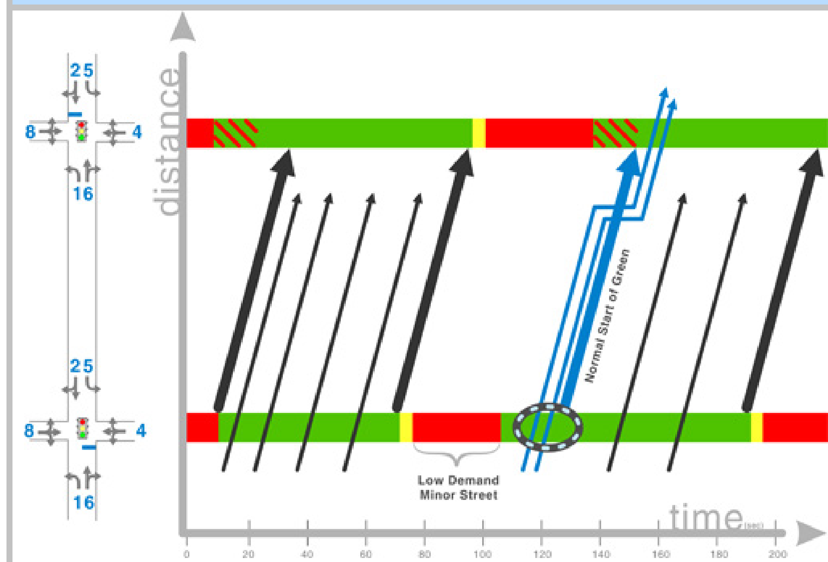
Convert to Limited Access

- LIMITED ACCESS
- COMMUTER/BYPASS LANE

Note: This Toolbox is intended to provide an overview of a variety of improvement types and assist with preliminary screening efforts. The assumptions listed for application, context classification, cost, right-of-way, benefits, and considerations may not apply to all situations and further evaluation may be needed to determine if an improvement is a viable option.

Low-Cost Operational Improvements

SIGNAL RETIMING / COORDINATION



Description

Coordinated signal timing synchronizes traffic movements to manage the speed of various transportation modes to achieve the desired traffic flow on a corridor.

When to Consider

Application

- Signal coordination is typically applied to vehicular traffic flow to reduce congestion during peak hours.
- Signal timing can also be used for low-speed transportation modes, such as bicycles or areas with pedestrian traffic.
- Signal retiming may also be used along transit routes to improve headways.
- Signal retiming/coordination should be considered in areas that have experienced a change in travel patterns, increase/decrease in traffic volumes, or areas that have not updated timing plans in several years.

Context Classification

C2T, C3R, C3C, C4, C5, C6

Cost

Low

ROW

Low

Benefits

- Signal coordination helps provide continuous traffic flow along a corridor based on the target speed with shorter travel times, reduced emissions, and reduction in certain crash types.
- Signal timing benefits outweigh the costs 40:1 (or more).
- Can be adapted to improve traffic flow for various modes of transportation.

Considerations

- Signal retiming should take into consideration off-peak signal timing plans and ensure the appropriate timing cycles are implemented during those traffic conditions.
- Similarly, weekend signal timing plans should also be designed in response to traffic flow within a particular context.

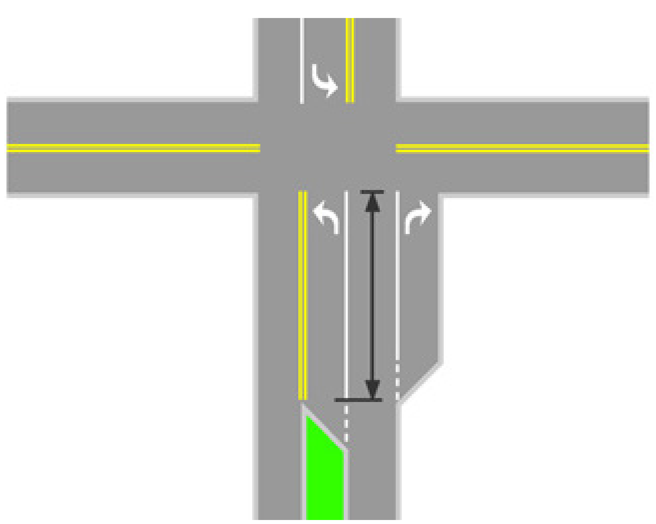
Examples & Supporting Information

Example

Reference Material

- Coordinated Signal Timing, National Association of City Transportation Officials (NACTO)
- Image – Traffic Signal Timing Manual, Federal Highway Administration (FHWA)
- Image – An Engineer's Thoughts

TURN LANES



Description

Left and right turning lanes help remove stopped/slowed vehicles from through traffic along a corridor, improving traffic flow and safety.

When to Consider

Application

- Intersections with a high volume of turning movements or other operational or safety concerns may warrant a dedicated turning lane.
- Dedicated turning lanes separate turning movements from through traffic and ultimately increases roadway capacity and safety.

Context Classification

C1, C2, C2T, C3R, C3C, C4, C5, C6

Cost

Low-Medium

ROW

Medium. Additional ROW may be needed to accommodate the width of the turning lanes.

Benefits

- Incorporating left turn lanes helps reduce the number of rear-end crashes by approximately 50 percent on average, and could improve capacity by 25 percent.
- Right turn lanes also reduce crashes and improve traffic flow along corridors.
- The cost of adding turn lanes is significantly less than widening a road.

Considerations

- In situations where an intersection has ROW or safety issues, adding a turning lane may not be possible. In these cases, considering Indirect Turns may be an option.

Examples & Supporting Information

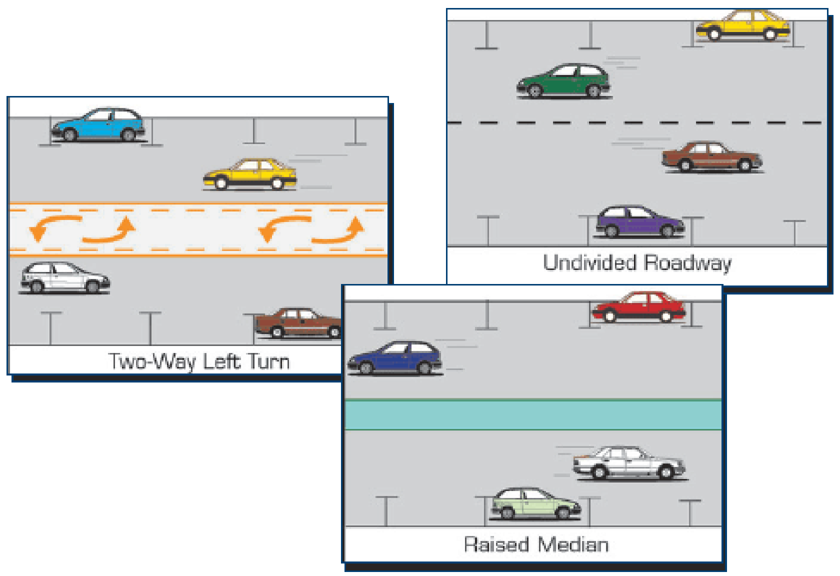
Example

Combined Bike Lane/Turn Lane with Shared Lane Markings in Billings, MT

Reference Material

- Turning Lanes, FHWA
- Image – Length of Exclusive Left Turn Lanes, FHWA
- Image – Combined Bike Lane/Turn Lane, NACTO
- Reducing Congestion on a Budget: Turn Lanes, Reason Foundation

MEDIAN TREATMENTS



Description

Medians are paved or landscaped areas in the middle of roadways that separate traffic traveling in opposite directions.

When to Consider

Application

- Medians reduce the number of conflict points along a roadway and therefore help reduce crashes and improve safety along corridors.
- Medians provide space for dedicated left-turn lanes, and therefore improve traffic flow by removing turning traffic from through lanes.
- Raised medians can be constructed to protect pedestrians crossing a street, add landscaping elements, or to reduce speeds by changing the characteristics of the corridor.

Context Classification

C1, C2, C2T, C3R, C3C, C4, C5, C6

Cost

Low-Medium

ROW

Low-Medium. Additional ROW may be needed to accommodate the median width.

Benefits

- Median improvements have shown to provide significant safety benefits by reducing the number of crashes along a corridor.
- Raised medians reduce the number of crashes by 40 percent in urban areas and more than 60 percent in rural areas, and also help protect pedestrians.

Considerations

- Some businesses may have concerns about the installation of raised medians because it could affect direct access to the site; however, many surveys conducted in multiple states have shown that the majority of business owners do not believe it negatively impacts sales, and some believe it improves sales.
- One study showed that corridors with access control improvements have an 18 percent increase in property values after the implementation.

Examples & Supporting Information

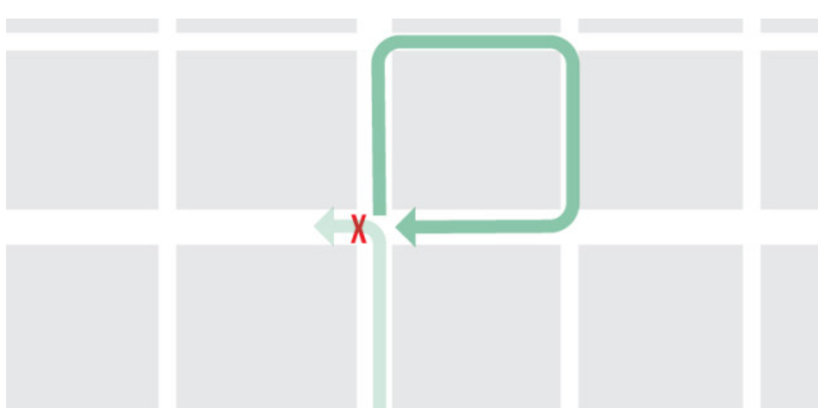
Example

E Colonial Dr, Google Earth

Reference Material

- Median Treatments, FHWA (including image)
- Raised Medians, FHWA
- FDOT Access Management Guidebook

PROHIBIT LEFT TURNS



Description

Prohibiting left turns at an intersection helps to redirect traffic, redistribute flow along adjacent corridors where they can be better accommodated, and allot extra green time to through traffic.

When to Consider

Application

- Prohibiting left turns are useful in dense, high-capacity areas that may also be supporting transit services.
- These restrictions are typically incorporated along multi-lane two-way streets, and may also be beneficial along two-way streets with one lane in each direction.

Context Classification

C1, C2, C2T, C3R, C3C, C4, C5, C6

Cost

Low

ROW

Low

Benefits

- Prohibiting left turns helps reduce congestion by allowing more green time to heavier movements.
- It helps improve transit headways when congestion is reduced.
- It improves safety along corridors by reducing certain crash types and the frequency of pedestrian and bicycle injuries.
- Prohibiting left turns has been shown to reduce rear-end collisions by 50 percent, reduce turning collisions by 50 percent, and reduce loss-of-control collisions by 50 percent.

Considerations

- Restricting left turns can increase travel distance and time for the rerouted left turns.
- Alternative routes to accommodate turns should be identified to ensure they can support the additional trips.

Examples & Supporting Information

Example

Reference Material

- Turn Restrictions, NACTO (including image)
- Signalized Intersections: Informational Guide, FHWA

Technology to Increase Capacity

TRANSPORTATION SYSTEMS MANAGEMENT & OPERATIONS (TSM&O)

Description

TSM&O is a set of strategies that looks at performance from a systems perspective that may encompass more than one strategy and more than one corridor. Examples include work zone management, traffic incident management, congestion pricing, traffic signal coordination, and connected/automated vehicle deployment.

When to Consider

Application

- TSM&O should be considered on corridors experiencing congestion.
- TSM&O can be used when funds are limited.
- It can encourage the use of transportation technology advancements.
- Helps cater to changing public needs across various modes of transportation.
- Provides alternative ways to understand the causes of congestion.

Context Classification

C1, C2, C2T, C3R, C3C, C4, C5, C6

Cost

Low. May depend on the strategy.

ROW

Low

Benefits

- Strategies include low-cost solutions without the need for added lanes.
- There may be opportunities to apply TSM&O solutions to quickly mitigate congestion issues.
- TSM&O provides tools so that agencies can manage existing infrastructure and mitigate issues to the extent possible before making infrastructure investments.

Considerations

- TSM&O should be considered at all stages of a project to explore low-cost solutions.

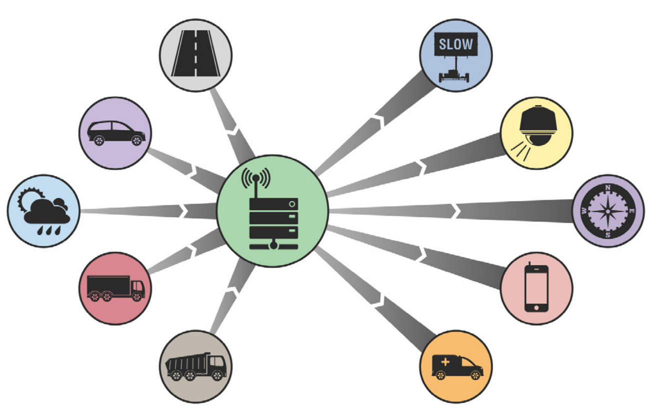
Examples & Supporting Information

Example

Reference Material

- What is TSMO?, FHWA
- TSM&O 2017 Strategic Plan, FDOT
- Image – Connected Vehicle Basics, USDOT
- Image – The Cloud-Connected Car Drives IoT Monetization, Aria

INTELLIGENT TRANSPORTATION SYSTEMS (ITS)



Description

ITS technologies are advanced communications technologies that are incorporated into vehicles and infrastructure to enhance safety and mobility along corridors. Examples of these technologies that have been deployed across the country include electronic toll collection, ramp meters, red-light cameras, traffic signal coordination, transit signal priority, and traveler information systems.

When to Consider

Application

- The purpose of ITS is to collect and disseminate information to maintain safe and efficient transportation infrastructure.
- ITS program categories include connected vehicles, automation, emerging capabilities, enterprise data, interoperability, and accelerating deployment.

Context Classification

C1, C2, C2T, C3R, C3C, C4, C5, C6

Cost

Low. May depend on the technology.

ROW

Low

Benefits

- ITS technologies help improve safety by reducing the number of crashes.
- Improves mobility and efficiency of corridors.
- Include sustainable, environmentally-friendly solutions.
- Safety, mobility, and environmental benefits contribute to better communities and improved livability.
- ITS promotes technological innovation.
- Supports transportation system information sharing.

Considerations

- There may be data or technological limitations depending on the type of ITS technology within a proposed context.
- Construction, operation, and maintenance costs.
- Location of the technology and interoperability with existing technologies.

Examples & Supporting Information

Example

Reference Material

- ITS Research Fact Sheets, USDOT
- ITS Strategic Plan 2015-2019, USDOT
- Arterial Management Plan Methodology – Toolbox of Alternatives, VDOT
- Image – What is ITS?, Wanco
- Image – ITS Project Management Design Manual, MnDOT

ACTIVE TRANSPORTATION AND DEMAND MANAGEMENT (ATDM)

Description

Per FHWA, "ATDM is the dynamic management, control, and influence of travel demand, traffic demand, and traffic flow of transportation facilities. Through the use of available tools and assets, traffic flow is managed and traveler behavior is influenced in real-time to achieve operational objectives, such as preventing or delaying breakdown conditions, improving safety, promoting sustainable travel modes, reducing emissions, or maximizing system efficiency."

When to Consider

Application

- ATDM can include multiple approaches which can include demand management, traffic management, parking management, as well as other modes and assets.
- Example applications include dynamic ridesharing, on-demand transit, predictive traveler information, dynamic lane use control, and queue warning.

Context Classification

C1, C2, C2T, C3R, C3C, C4, C5, C6

Cost

Low. May depend on the technology.

ROW

Low

Benefits

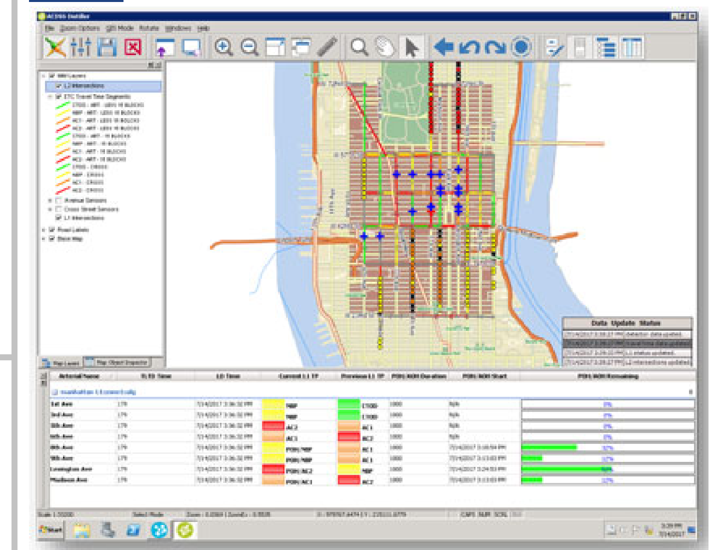
- ATDM can improve trip reliability, safety, and throughput.
- ATDM strategies allow agencies to leverage existing investments and technologies by building on to achieve a more advanced active management system.
- ATDM improves the efficiency of transportation existing systems.
- ATDM can extend the life of existing transportation systems.

Considerations

- A comprehensive approach should be applied for ATDM strategies. For instance, ramp metering at a freeway should also consider potential impacts on the connecting arterial.

Examples & Supporting Information

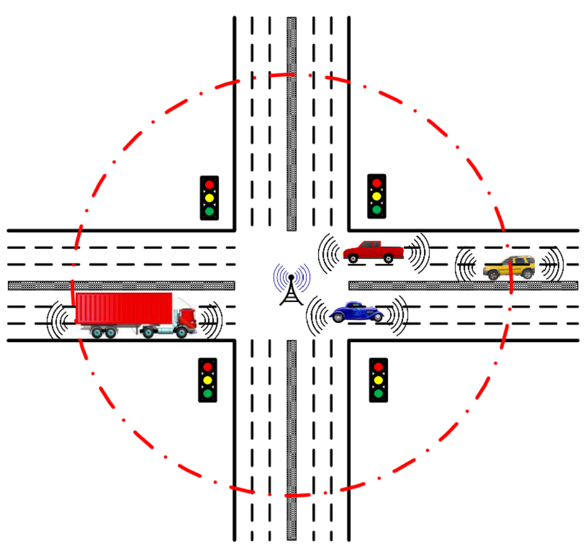
Example



Reference Material

- ATDM Program Brief https://ops.fhwa.dot.gov/atdm/index.htm
- ATM Implementation and Operations Guide https://ops.fhwa.dot.gov/publications/fhwahop17056/chap1.htm
- Image – https://ops.fhwa.dot.gov/atdm/index.htm
- Image – ATSC application in New York City (Source: https://ops.fhwa.dot.gov/publications/fhwahop17056/chap1.htm)

ADAPTIVE SIGNALS



Description

Adaptive signal control technology (ASCT) automatically adjusts the timing of signal lights in response to changes in traffic patterns and congestion.

When to Consider

Application

- Signal control technologies can be installed along corridors with poor traffic flow to reduce congestion and delays.
- Adaptive signal control technologies are best suited for arterials with unpredictable traffic demand.

Context Classification

C2T, C3R, C3C, C4, C5, C6

Cost

Low

ROW

Low

Benefits

- Adaptive signals improve traffic flow by moving vehicles through green lights in response to present traffic flow.
- Adaptive signals help reduce congestion and improve roadway efficiency.
- They reduce the number of unnecessary delays caused by traditional signals.
- Signal control technologies are better for the environment, as they reduce the amount of air toxins produced by vehicle idling.

Considerations

- In the US, adaptive signal controls are used on less than one percent of signalized intersections due to barriers related to cost, installation, and maintenance.
- It is important for signal management personnel to establish performance goals of roadways before deploying adaptive signal controls.

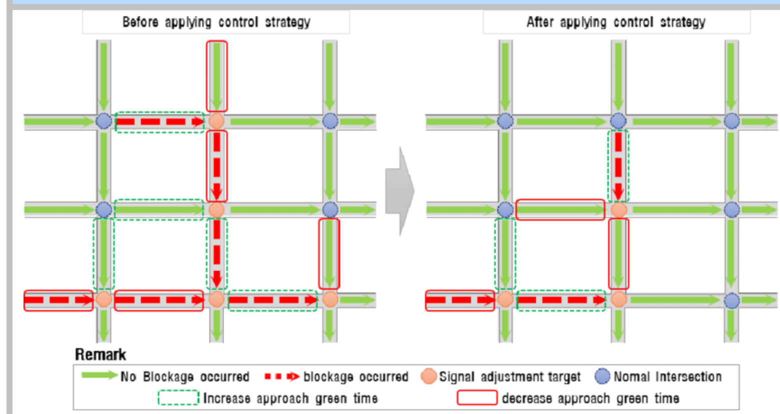
Examples & Supporting Information

Example

Reference Material

- Adaptive Signal Control Technology, FHWA
- Adaptive Signal Control Technologies Brochure, FHWA
- Image – Development of Agent-Based On-Line Adaptive Signal Control (Ask) Framework Using Connected Vehicle (CV) Technology, G. Wu, Xuewei Qi, M.Barth
- Image – 'Smart' Traffic Signals Should Ease Traffic on Harrisburg Pike, Lancaster Online

QUEUE MANAGEMENT



Description

Queue management uses signal timing to manage queues and reduce their negative impacts such as network gridlock.

Queue warning systems alert drivers to impending backups on roadways and provide an opportunity to change lanes or reroute as needed.

When to Consider

Application

- Queue management is employed when throughput has already been maximized and there is a need to manage the resulting queues in the network to prevent compounding issues such as network gridlock and safety issues.
- Queues can be strategically stored at major intersections spaced far enough away from other signals to not impact other intersection operations. Or queues can be stored outside of a network to meter the amount of traffic entering the grid network.

Context Classification

C2T, C3R, C3C, C4, C5, C6

Cost

Low

ROW

Low

Benefits

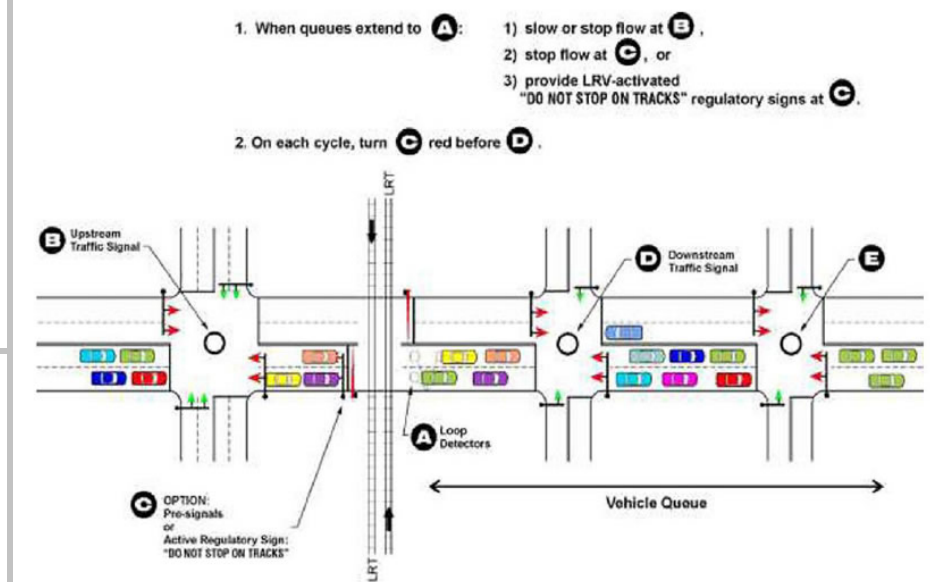
- Queue Management can prevent network gridlock conditions or potential safety issues where queue length is critical.
- Queue management can prolong the life of existing infrastructure by better managing congestion.

Considerations

- Queue management is considered more of a palliative approach to ease congestion, rather than solve it.
- Queue management can create congestion at some intersections; however, it improves the overall operation, delay, and queuing over the network.
- Potential issues that make queue management difficult to implement include longer vehicle clearances, pedestrian clearances, and too much dependence on detection.

Examples & Supporting Information

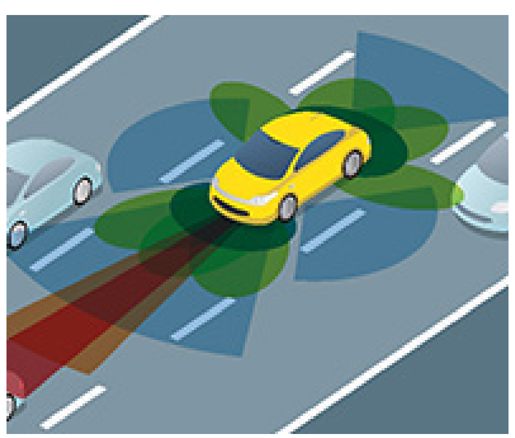
Example



Reference Material

- https://ops.fhwa.dot.gov/publications/fhwahop09008/guidance.htm
- Image - Development of Network-wide Traffic Signal Control Strategy for Preventing Blockage at Intersection
- Image - Highway-Rail Crossing Handbook - Third Edition - Safety | Federal Highway Administration

CONNECTED/AUTONOMOUS VEHICLES



Description

Autonomous vehicles (AVs) take partial or full control of dynamic driving for a particular amount of time, and connected vehicles (CVs) have technologies that connect them to other vehicles and the surrounding environment. Examples of these technologies may include vehicle-to-vehicle (V2V) or vehicle-to-infrastructure (V2I) communication.

When to Consider

Application

- New and emerging technologies can be used to improve transportation system management and mobility.
- V2I technology may consist of several applications, such as red-light violation warnings, curve speed warnings, and work zone warnings.
- V2V applications can include forward-collision warnings, intersection movement assist, left-turn assist, and do-not-pass warnings.

Context Classification

C1, C2, C2T, C3R, C3C, C4, C5, C6

Cost

Medium-High

ROW

Low

Benefits

- They can reduce congestion by driving closer to other vehicles, increasing roadway capacity, and improving traffic flow.
- AV/CVs have the potential to improve safety by reducing the number of crashes.
- AV/CVs may also help reduce emissions from improved traffic flow and reduced idling.
- Advanced AVs (level 4 or 5) could also provide improved mobility for older adults, children, and people with disabilities.

Considerations

- AV/CV benefits and convenience could lead to an increase in VMT.
- Some technologies require additional testing and may not be available for full deployment.
- Some technologies would require additional infrastructure considerations.
- May require additional policies to be in place.

Examples & Supporting Information

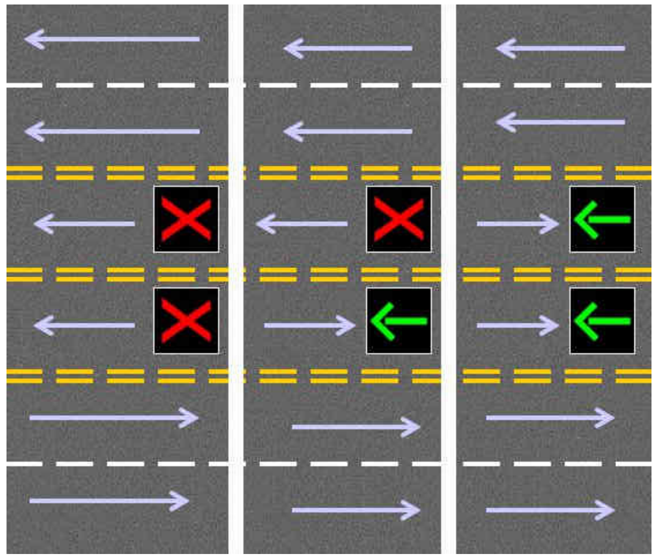
Example

Reference Material

- Strategies to Advance Automated and Connected Vehicles: A Primer for State and Local Decision Makers, TRB
- Image – Autonomous Vehicles, American Planning Association
- Image – Oxbotica and Cisco Partner to Resolve Autonomous Fleet Data Challenges, Smart Cities World

Arterial Managed Lanes

REVERSIBLE LANES



Description

Reversible lanes help decrease congestion by borrowing lanes in the off-peak direction to accommodate added traffic in the peak direction.

When to Consider

Application

- Reversible lanes can be deployed along corridors with directional congestion.
- The strategy can be used to accommodate congestion and postpone the need to add capacity by adding additional lanes.

Context Classification

C2T, C3R, C3C, C4, C5, C6

Cost

Low-Medium

ROW

Low

Benefits

- Reversible lanes help reduce congestion that may occur due to special events, morning/evening peak hours, accidents, or work zones.
- Reversible lanes could help accommodate traffic in areas that cannot be widened, such as bridges, tunnels, and toll booths.
- Reversible lanes could be used to alleviate congestion due to special events.
- Reversible lanes could help improve traffic flow during emergency events, such as hurricane evacuation.

Considerations

- Reversible lanes require proper communication with the public to prevent confusion and maintain a safe environment.
- May require complex signals, signal timing, and signage to communicate the design properly.
- Traffic counts should be conducted to understand the traffic volumes and to determine the length of the segment that would need reversible lanes.

Examples & Supporting Information

Example

SR 173, Salt Lake City, UT

Reference Material

- Reversible Traffic Lanes, TTI
- Image – Atlanta's Reversible Express Lanes Project Opens, R. Cenzano

EXPRESS LANES

Description

Express lanes are optional travel lanes that the public can use to bypass potential congestion and get to their destination in a timelier manner.

When to Consider

Application

- Potential projects would need to be identified in coordination with MPOs.
- Congestion levels along corridors, trip purposes, and traffic mix are all factors that would need to be considered in the planning stages of constructing express lanes.

Context Classification

C1, C2, C3R, C3C

Cost

Low-Medium

ROW

Low. Additional ROW may be needed to accommodate the added express lanes.

Benefits

- Express lanes provide more travel options to get to a destination on time.
- They help manage and reduce traffic congestion.
- They reduce fuel consumption due to increased traffic flow, which also decreases emissions.

Considerations

- Express lanes have a limited number of entrance and exit locations, which will need to be planned and should be communicated to the public to avoid confusion.
- Express lane projects can be more extensive than a typical roadway improvement project, and require additional technical, organizational, financial, and outreach requirements.

Examples & Supporting Information

Example

Zipper HOV lane for commuters traveling to downtown Honolulu, HI. Source: Google Earth

Reference Material

- About Express Lanes, FDOT (Including Image)
- Express Lanes Handbook, FDOT
- Image – Arterial with central median, restricted left turns, and dedicated bus lane. Source: https://publications.wri.org/citiessafer/#c4

RESTRICTED LANES

Description

Restricted lanes are types of managed lanes that are limited to a particular type of vehicle. Examples may include high-occupancy vehicle (HOV) lanes, bus, or truck lanes.

When to Consider

Application

- HOV lanes may consist of one or more lanes that require at least one passenger (in addition to the driver) to encourage ridesharing.
- Truck lanes may include lane restrictions, separated roadways, dedicated roadways, interchange bypass lanes, or climbing lanes.
- Bus lanes would provide a lane dedicated to provide high-quality bus service and encourage travelers to use the bus instead of the car.
- Lane restrictions around construction zones increase safety for workers.
- Other types of lane restrictions could also be considered (e.g. time of day or speed restrictions).

Context Classification

C1, C2, C2T, C3R, C3C, C4, C5, C6

Cost

Low

ROW

Low. Additional ROW may be required to accommodate added lanes.

Benefits

- Truck lanes improve safety and preserve traffic flow, reducing congestion.
- Truck lanes increase the public perception of safety.
- HOV lanes incentivize ridesharing since HOV lanes typically have less congestion and are more efficient.
- HOV lanes remove congestion from other lanes.
- Since restricted lanes improve traffic flow, they in turn improve air quality and reduce emissions.

Considerations

- Unless traffic can be handled in the non-managed lanes or enough traffic can be redirected to the managed lane (e.g. convert to bus trips and reduce vehicle trips for a bus-only lane), congestion can occur on the non-managed lanes.
- Construction of new lanes to accommodate managed lanes can be high-cost.
- Treatment and consideration needed for conflicting left or right turns.

Examples & Supporting Information

Example

HOV lane in Honolulu, Hawaii

Reference Material

- Managed Lanes, FHWA
- High-Occupancy Vehicle Lanes, USDOT
- Image – Google Street View
- Image – Travel Lanes, Global Designing Cities Initiative

MANAGED ARTERIAL

Description

Managed arterials are typically tolled facilities that bypass signalized intersections with grade-separation either underpass or overpass.

When to Consider

Application

- Managed arterials are similar to tolled express lanes in that they provide commuters and the option to bypass congestion in exchange for a fee.
- They can be effective at intersections that would improve with the addition of a grade-separated intersection.

Context Classification

C3R, C3C

Cost

High

ROW

High

Benefits

- Managed arterials can relieve traffic congestion and improve transit service.
- The cost to implement can be paid for through tolls.

Considerations

- Cost feasibility and public acceptance could be issues to overcome.
- Potential impacts to adjacent properties to construct over/underpasses.

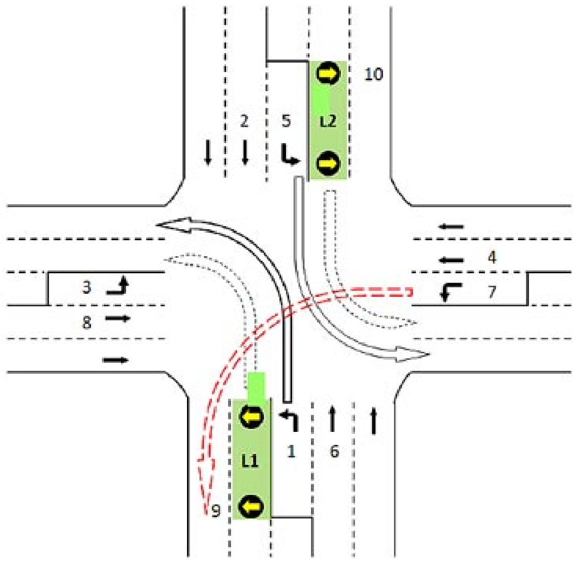
Examples & Supporting Information

Example

Reference Material

- "Bus Rapid Transit and Managed Lanes"
- Image: https://reason.org/wp-content/uploads/files/bus_rapid_transit_managed_lanes.pdf
- Image: Managed Arterials, New Application of Managed Lanes Concept

CONTRAFLOW LEFT TURN POCKETS



Description

This strategy utilizes lanes in the opposing direction to create additional left-turn lanes to increase capacity for left-turning movements, thus minimizes the left-turn green time and reallocating to through movement, during peak times.

When to Consider

Application

- Can be considered for locations with significant left-turning volumes that impact the overall intersection's delay and/or queuing.
- Can be considered for locations with directional peak hour traffic flow to allow for reduced capacity in the opposing direction.

Context Classification

C1, C2, C2T, C3R, C3C, C4, C5, C6

Cost

Low

ROW

Low

Benefits

- Reduced delay due to additional capacity for heavy left-turn movement and additional green time to other movements.
- Cost-effective strategy given no additional pavement or ROW required.

Considerations

- The treatment can result in additional delay to the opposing through movement.
- Would require proper signage and communication with the public to avoid confusion.

Examples & Supporting Information

Example

Reference Material

- Traffic Bottlenecks: Identification and Solutions, FHWA (Including Image)
- Image – A Capacity Estimation Model for a Contraflow Left-Turn Pocket Lane at Signalized Intersections, TRB

Increased Multimodal Options

SIDEWALKS

Description

Sidewalks are paved pedestrian facilities that are separated from roadways.

When to Consider

Application

- Adding sidewalks near areas with pedestrian activity, such as schools and transit hubs, improves connectivity between destinations and provides a safe mobility option.
- Sidewalks are the preferred option for accommodating pedestrians in urban areas.
- Rural areas may consider adding walkable shoulders for pedestrian use.

Context Classification

C2T, C3R, C3C, C4, C5, C6

Cost

Low-Medium

ROW

Low-Medium. Additional ROW may be needed to meet design requirements.

Benefits

- Sidewalks provide separation from roadways which increases safety for pedestrians and reduces pedestrian-related crashes.
- They encourage physical activity, which contributes to overall well-being.
- Sidewalks provide connectivity to different locations and can help reduce the number of vehicle trips in an area.
- They can encourage transit use and provide connectivity to first- and last-mile trips.

Considerations

- Wider sidewalks and separation from roadways increases the public perception of safety and increases the likelihood of its use.
- Providing walkways can reduce pedestrian crashes by as much as 88 percent.

Examples & Supporting Information

Example

Reference Material

- Safety Benefits of Walkways, Sidewalks, and Paved Shoulders, FHWA (Including Image)
- Image – Local Municipalities Implement Complete Streets, Winter Park Health Foundation

BIKEWAY

Description

Appropriate bikeway treatments can be applied based on corridor-specific factors such as traffic volume, speed, intersection design, land use, and context. Options include shared lanes, bike boulevards, bike lanes, separated bike lanes, and shared-use paths.

When to Consider

Application

- Generally, a more protective bikeway is recommended as the speed and volume of a roadway increase.
- Shared lane or bike boulevards can be considered with low speeds under 30 miles per hour (mph) and low volumes under 3,000 vehicles per day (vpd).
- Conventional bike lanes can be considered along roadways where the posted speed is less than 35 mph and where there are 6,500 vehicles per hour (vph) or less.
- Separated bike lanes or shared-use paths are typically recommended with volumes above 6,500 vpd and speeds at or above 35 mph.

Context Classification

C2T, C3R, C3C, C4, C5, C6

Cost

Low-Medium

ROW

Low-Medium. Additional ROW for bike lanes may be required to meet design requirements.

Benefits

- They promote physical activity which makes communities healthier.
- Adding dedicated bicycle infrastructure has the potential to reduce congestion by removing vehicle trips on roadways.
- Bikeways are useful in areas with transit, and can be used to navigate first- and last-mile trips.
- They reduce the cost of roadway and parking infrastructure.

Considerations

- Sufficient space and design standards should be provided to prevent conflicts (e.g. preventing conflicts with parked car doors).
- Infrastructure designs may need to be altered to accommodate bike characteristics (e.g. drainage and utility covers should be flushed with the ground to prevent conflicts with bike tires).
- The design user should be considered and must consider the needs of the 'Interested but Concerned' cyclist.

Examples & Supporting Information

Example

Reference Material

- 7 Reasons to Fund Bicycle Infrastructure, Smart Cities Dive
- Conventional Bike Lanes, NACTO
- FHWA Bikeway Selection Guide
- Image – Bike Lanes are for Cars, Seattle Bike Blog
- Image – Colored Bike Facilities, NACTO

IMPROVED TRANSIT

Description

Enhanced transit systems can increase ridership and remove vehicles on the roadway.

When to Consider

Application

• Improved transit strategies include expanded transit or Bus Rapid Transit (BRT), transit signal priority, shelters and seating, real-time transit information, scheduling and reliability improvements, and bicycle sharing stations.

Context Classification

C2T, C3R, C3C, C4, C5, C6

Cost

Low-Medium

ROW

Low. Additional ROW may be needed to accommodate exclusive lane transit infrastructure or stops/stations.

Benefits

• Transit services expand the person-trip capacity along a corridor and have the potential to reduce vehicular traffic volumes.
• Buses complement other mobility options, such as walking and biking.
• Buses can reduce overall vehicle emissions and be an environmentally-friendly option compared to single-occupancy vehicles.

Considerations

• Bus lanes need to be designed in harmony with other infrastructure needs, such as bike lanes, pedestrian sidewalks/crosswalks, and other types of motorized vehicles.
• Land planning decisions must also be made in harmony with transit service, either existing or planned, to provide appropriate and supportive development around transit stations.

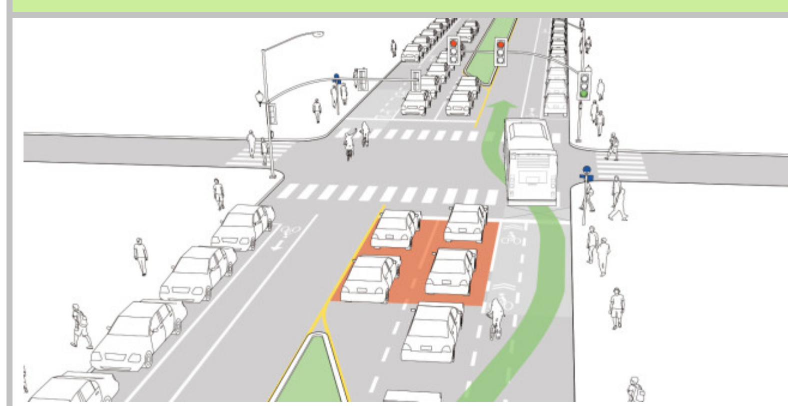
Examples & Supporting Information

Example

Reference Material

• https://ops.fhwa.dot.gov/publications/fhwahop12004/c4.htm
Images: https://nacto.org/wp-content/uploads/2015/04/service_design_guidelines_vta.pdf

TRANSIT QUEUE JUMP LANES



Description

Queue jump lanes are short dedicated lanes that allow buses to easily enter or bypass traffic with priority by using either a leading bus interval or active signal priority.

When to Consider

Application

• Can be provided with either a shared transit/turn lane or an exclusive transit lane.
• Queue jumps can be considered on signalized arterials with low or moderately frequent bus routes, especially where transit operates in a right lane with high peak hour volumes but relatively low right turns.
• Queue jumps become more effective as congestion increases.

Context Classification

C2T, C3R, C3C, C4, C5, C6

Cost

Low-Medium

ROW

Low-Medium. An additional lane may be needed if the existing lane cannot be shared or is not available.

Benefits

• Queue jumps can improve transit performance and run-times by allowing the bus to “skip ahead” of queued vehicles at a signalized intersection.
• Improved bus operations can encourage transit as a mode of transportation over cars.

Considerations

• In order to be effective, buses must be able to access the queue jump lane and reach the front of the queue by the beginning of the signal cycle.
• Separate transit signals needed to indicate when buses proceed before general traffic.
• Right turning movements should be considered and high right turning volumes should be accommodated separately in a turn pocket.
• In some locations, implementing restrictions may be necessary.

Examples & Supporting Information

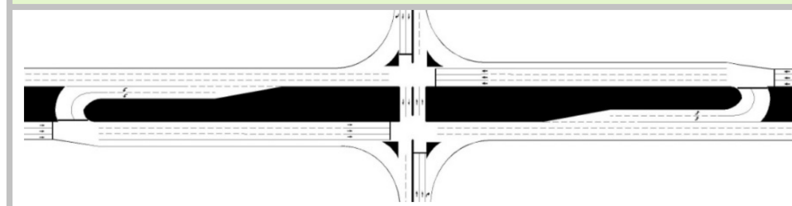
Example

Reference Material

• https://nacto.org/publication/transit-street-design-guide/intersections/intersection-design/queue-jump-lanes/
• Image: https://nacto.org/publication/transit-street-design-guide/intersections/intersection-design/queue-jump-lanes/
Image: https://madison.com/wsj/news/local/govt-and-politics/madison-installs-queue-jump-signals-for-buses-a-first-step-for-bus-rapid-transit/article_3fcba844-58b8-5f4a-870f-7434712ef655.html

Innovative Intersection Control

MEDIAN U-TURN



Description

A median U-turn is an intersection treatment that eliminates direct left-turns at signalized intersections from major and minor approaches and replaces them with U-turns on the major or minor road. A partial median U-turn allows left-turns from either the major or minor road.

When to Consider

Application

- Can be considered when there is a history of angle crashes, especially far-side and involving the major road left-turn movements.
- Can be applied on a high-speed, divided facility.
- Can be applied in a relatively rural area with significant intersection spacing.
- Can be applied at intersections with heavy through traffic volumes and moderate left-turn traffic volumes.

Context Classification

C2, C3R, C3C

Cost

Medium

ROW

- Low-Medium
- Large medians greater than 40 feet are typically required to accommodate U-turn movements. Alternatively, a "bulb-out" at the U-turn may be required to accommodate the turning path of vehicles.

Benefits

- Crossing conflicts are reduced, so overall safety is improved.
- Fewer signal phases at the main intersection, allowing for more green time for heavy through movements, and shorter cycle lengths, which permit more flexibility in traffic signal progression.
- Reduces delay on the major road and increases capacity at the main intersection.
- Better progression on the major road.

Considerations

- Requires out-of-direction travel for left-turn movements.
- Requires a wide median or outside ROW at U-turn crossover.
- May require a longer, two-stage pedestrian crossing.
- Direct access to the major road between the main intersection and the U-turns is typically removed.
- Trucks with a heavy load can have difficulty getting up to speed following a U-turn before an opposing vehicle within sight distance has caught up to them.

Examples & Supporting Information

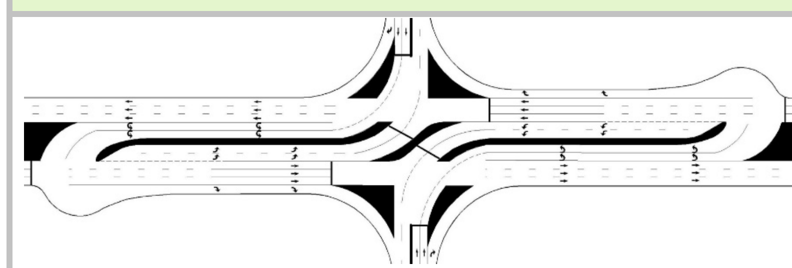
Example

MUT intersection with water retention ponds in New Orleans, Louisiana

Reference Material

- Highway Capacity Manual (HCM)
- FDOT Intersection Control Evaluation (ICE)
- *Median U-Turn Intersection Informational Guide (FHWA-SA-14-069)*
- *Synthesis of the Median U-Turn Intersection Treatment (FHWA-HRT-07-033)*
- *Alternative Intersections Informational Report (AIIR)*
- Image – Median U-Turn Intersection, FHWA

RESTRICTED CROSSING U-TURN



Description

A signalized intersection design that restricts left-turn and through movements out of the minor road and redirects them downstream on the major road to make a U-turn in the median opening. There are other variations of RCUT intersections such as no direct left turns from any approach, reverse RCUT with minor street lefts allowed but major street lefts and minor through traffic rerouted.

When to Consider

Application

- Can be considered when there is a history of angle crashes, especially far-side.
- Can be applied to suburban or rural roads.
- Can be applied at intersections with low minor road through and left-turn volumes and heavy major road through and left-turn volumes.
- May not be suitable for an intersection of two major arterials.
- Can be considered for minor road two-way volume ≤ 25,000 vpd (or 2,250 vph).

Context Classification

C2, C3R, C3C

Cost

Medium

ROW

- Low-Medium
- Large medians greater than 40 feet are typically required to accommodate U-turn movements. Alternatively, a "bulb-out" at the U-turn may be required to accommodate the turning path of larger vehicles.

Benefits

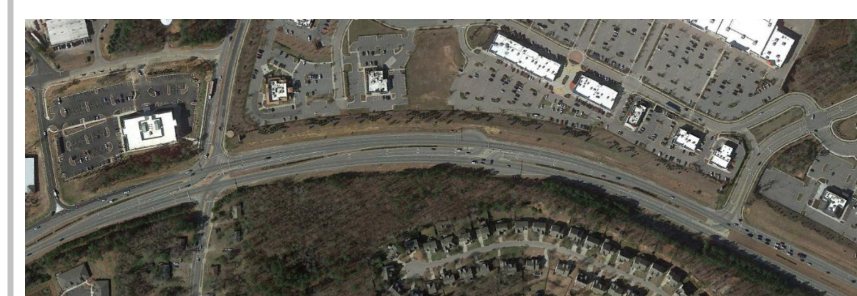
- Crossing conflicts are significantly reduced, so overall safety is improved.
- Fewer signal phases at the main intersection, allowing for more green time for heavy through movements, and shorter cycle lengths, which permit more flexibility in traffic signal progression.
- Traffic signals can run separate cycle lengths for each direction of the major road.
- Reduces delay on the major road and increases capacity at the main intersection.

Considerations

- Out-of-direction travel for side road left-turn and through movements.
- Requires a wide median or outside ROW at U-turn crossover.
- Requires a longer, two-stage pedestrian crossing with potential for pedestrian wayfinding challenges.
- Direct access to the major road between the main intersection and the U-turns is typically removed.
- Trucks with a heavy load can have difficulty getting up to speed following a U-turn before an opposing vehicle within sight distance has caught up to them.

Examples & Supporting Information

Example

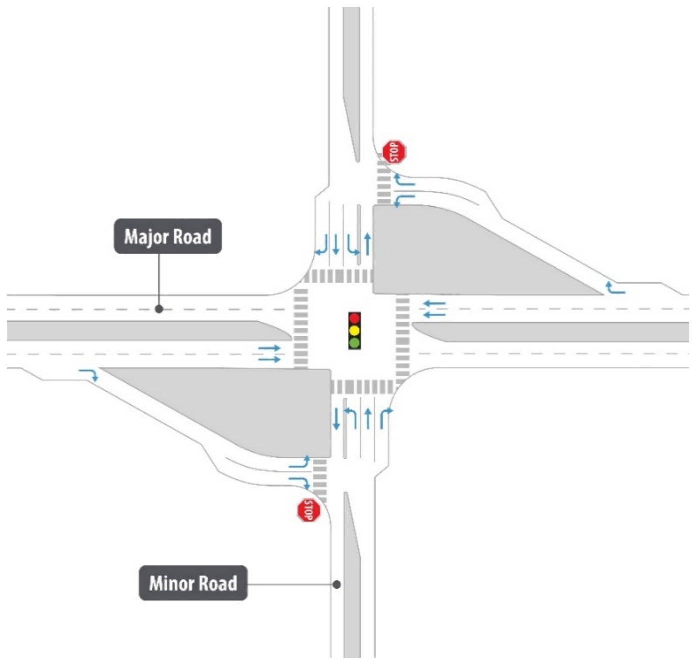


NC 55 Bypass Corridor, Holly Springs, NC

Reference Material

- Highway Capacity Manual (HCM)
- FDOT Intersection Control Evaluation (ICE)
- *Restricted Crossing U-Turn Intersection (FHWA-HRT-09-059)*
- *Restricted Crossing U-Turn Intersection Informational Guide (FHWA-SA-14-070)*
- *Synthesis of the Median U-Turn Intersection Treatment (FHWA-HRT-07-033)*
- *Alternative Intersections Informational Report (AIIR)*

JUGHANDLE



Description

Jughandles are signalized intersections that have ramp connectors between the roadways to enable indirect left turns and U-turns.

When to Consider

Application

- Jughandles can be constructed if there is a high volume of through movements and left turns.
- May be considered at large, congested intersections to distribute trips to the adjacent connectors.

Context Classification

C2, C3R, C3C

Cost

Medium-High

ROW

- Medium-High
- A large amount of ROW could be required to accommodate ramps.

Benefits

- Jughandle intersections can increase roadway capacity with the added connectors.
- They can reduce congestion by distributing some of the vehicle trips to the connectors.
- Can improve efficiency by reducing the number of signal phases at the main intersection allowing for more green time for heavy through traffic.

Considerations

- May require pedestrians and bicyclists to cross an additional intersection and could create conflicts.
- Appropriate signage would need to be added to communicate turning movements to the public.
- Vehicles making left turns are subjected to out-of-direction travel, which may add time to their trip.

Examples & Supporting Information

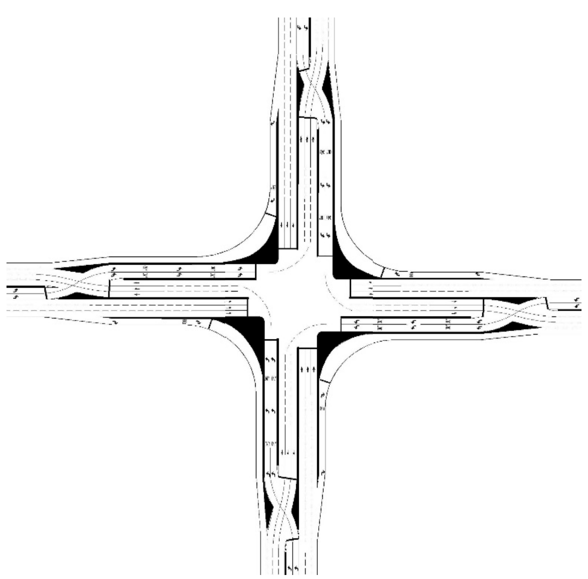
Example

Forward/reverse Jughandle Intersection on Jackson Avenue in Pequannock Township, New Jersey

Reference Material

- Highway Capacity Manual (HCM)
- FDOT Intersection Control Evaluation (ICE)
- Image – Traffic Performance of Three Typical Designs of New Jersey Jughandle Intersections, FHWA

DISPLACED LEFT TURN



Description

Displaced Left Turns (DLTs) are signalized intersections where a turning movement is relocated to the other side of the roadway, traveling parallel to opposing traffic lanes before completing the left-turn movement.

When to Consider

Application

- Displaced left turns may be considered at intersections that have large traffic volumes and/or left-turn volumes.
- They help increase traffic flow and reduce congestion and would be most effective at intersections that have reached capacity.
- They can be used in urban or suburban contexts.

Context Classification

C2, C3R, C3C

Cost

High

ROW

- High
- A greater amount of ROW is required to accommodate the larger footprint.

Benefits

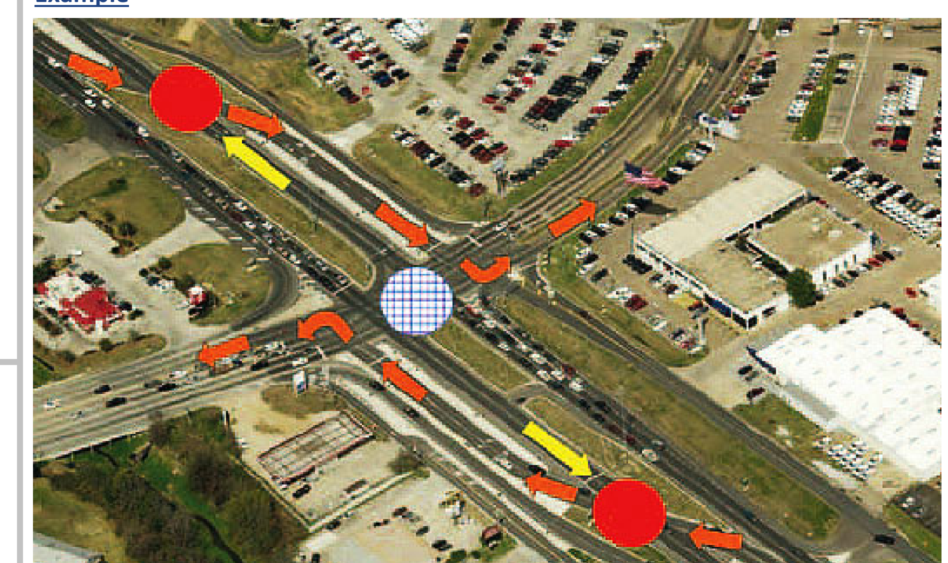
- Since the left turn lanes are moved, through movements have more green time, increasing traffic flow overall.
- DLTs allow for additional capacity for through traffic movements.
- The separation of left turns creates fewer conflict points, ultimately creating a safer intersection.
- DLTs are less expensive and faster to construct than grade-separated interchanges, saving time and money.

Considerations

- Driveway access near the intersection would be limited to accommodate the DLT configuration.
- Appropriate signage would need to be implemented to communicate movement properly.
- Additional signals would be needed.
- Pedestrian crossings would be more complex and it would take longer to cross the intersection.

Examples & Supporting Information

Example

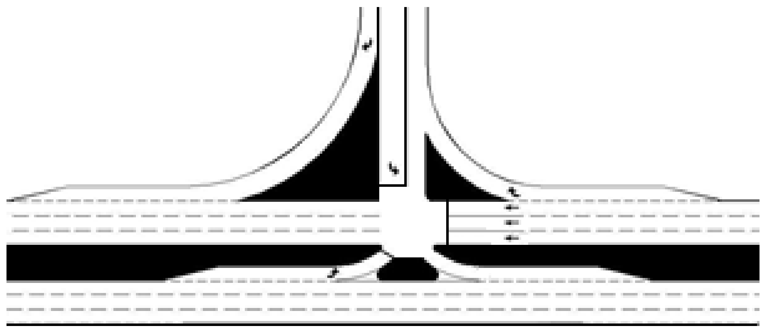


Left-turn crossover movement at a partial DLT intersection in Baton Rouge, Louisiana

Reference Material

- Highway Capacity Manual (HCM)
- FDOT Intersection Control Evaluation (ICE)
- Image – Displaced Left-Turn Intersection, FHWA

CONTINUOUS GREEN T



Description

Continuous Green T intersections are signalized, 3-leg intersections that use channelization to separate traffic movements, and allows the major through movement along the top of the "T" to be free-flowing.

When to Consider

Application

- Continuous Green T intersections are typically applied to 3-leg intersections that have two major road approaches and one minor road approach.
- Can be considered at intersections with high traffic volumes as a way to reduce congestion.
- Can be applied at intersections with low left-turn traffic volumes on the minor road to ensure that traffic flow is maintained on the major road.
- Best applied in locations with very low or negligible pedestrian crossing demand across the major roadway.

Context Classification

C1, C2, C3R, C3C

Cost

Low

ROW

- Low
- Additional ROW may be required.

Benefits

- Continuous Green T intersections ensure that one of the major road movements will be free-flowing, reducing congestion at the intersection.
- Decreased congestion improves signal timing, ultimately improving the overall efficiency of the corridor.

Considerations

- Left-turn movements from the minor road onto the major road would require merging, which could cause delay.
- Pedestrian crossings can be provided along the minor road, but the major road may require crossings along adjacent intersections or at mid-blocks to preserve free-flowing traffic.

Examples & Supporting Information

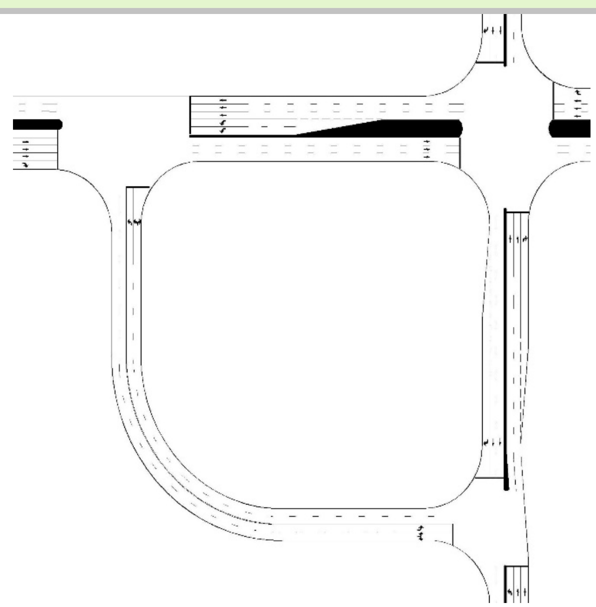
Example

Continuous Green T-Intersection in Arlington, Virginia

Reference Material

- Highway Capacity Manual (HCM)
- FDOT Intersection Control Evaluation (ICE)
- Image – Alternative Intersections/Interchanges: Informational Report (AIIR), FHWA

QUADRANT ROADWAY



Description

Quadrant roadway intersections are used to remove direct left-turn movements from the major intersection. Left-turn movements are rerouted to a connector in one of the intersection quadrants.

When to Consider

Application

- Quadrant roadways are used at intersections with large volumes of through movements, and low left-turn volumes.
- This design may be considered at single intersections that are large, congested, and located centrally as part of a larger coordinated signal system.
- Quadrant intersections may also be considered at skewed intersections.
- Could be used as a temporary solution if there are plans to construct a grade-separated interchange.
- Could be especially considered where a potential quadrant roadway is already present.

Context Classification

C3R, C3C, C4, C5, C6

Cost

Low-High

ROW

- Low-High
- Sufficient ROW would need to be available to construct the connector (if a roadway is not already present).
- Additional connectors would require additional ROW, as well as additional costs.

Benefits

- The left-turn connector roadway removes left-turn trips from the major roadway, which increases capacity and reduces congestion on the major roadway.
- Reduced congestion improves signal timing and improves traffic flow.
- Rerouting traffic on the major corridor reduces the number of conflict points and improves overall safety.
- Quadrant roadways require the coordination of three signalized intersections, which improves traffic flow on all roadways in the area.

Considerations

- As turning movements become more complex, it may confuse some drivers.
- The intersections may require additional signage to communicate vehicle movements adequately.
- Rerouting turning movements may create out-of-direction travel for some drivers.

Examples & Supporting Information

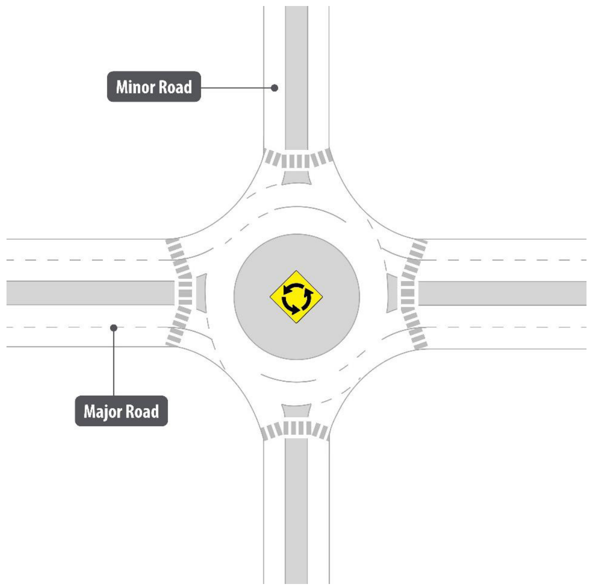
Example

Quadrant Intersection in Bend, Oregon

Reference Material

- Highway Capacity Manual (HCM)
- FDOT Intersection Control Evaluation (ICE)
- Image – Quadrant Roadway, TTI

MODERN ROUNDABOUT



Description

A modern roundabout is a circular intersection where vehicles travel counterclockwise. Since there are no traffic signals, drivers yield to circulating traffic, as well as bicyclists and pedestrians crossing at intersection approaches and exits.

When to Consider

Application

- Can be considered when intersections have high left-turn or U-turn volumes, or when traffic is relatively balanced from all sides.
- Roundabouts may be useful at intersections with five or more legs or have high skew angles.
- They can be used as traffic calming devices or to reduce speed.
- May be used if the intersection has a high crash history.

Context Classification

C1, C2, C2T, C3R, C3C, C4, C5, C6

Cost

Medium-High

ROW

- Medium-High
- Roundabouts may require additional ROW to accommodate the center island and lanes for all mobility types.
- Alternatively, they can reduce the number of approach lanes, reducing the required approach width and other requirements.

Benefits

- The geometry and traffic calming design can reduce the number of serious crashes.
- Since there are no traffic signals, stopping and idling are reduced, leading to lower vehicle emissions.
- Roundabouts can accommodate intersections that are close together.
- Without signals, roundabouts can reduce delay and ultimately increase traffic flow.
- Pedestrian crossings are shorter than other intersection options.

Considerations

- Without signals, coordination is not possible and could negatively affect traffic flow in some cases.
- As approaching vehicles slow down to enter the roundabout, it could cause congestion during peak hours.
- Pedestrian crossings are uncontrolled, which could make crossing more difficult during peak hours.
- Roundabouts typically require additional design elements, such as landscaping, lighting, and truck aprons.
- Accommodating larger vehicles may present design challenges.
- Traffic queues from nearby intersections should be considered to prevent circulatory lockup.

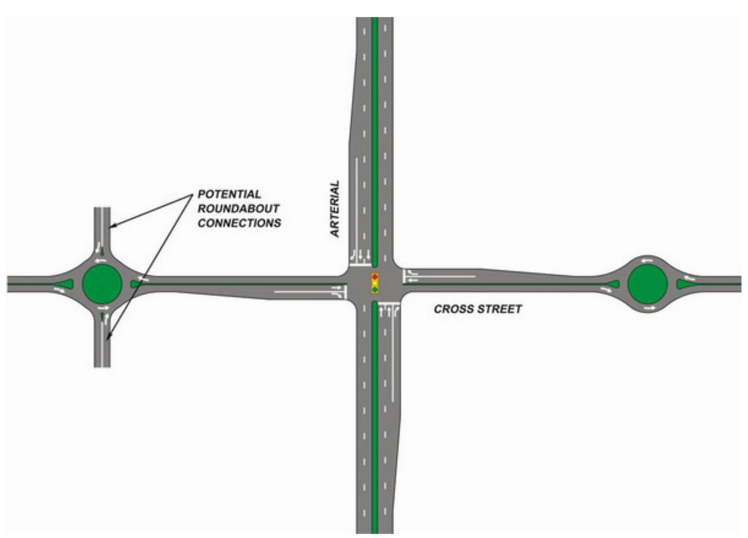
Examples & Supporting Information

Example

Reference Material

- Highway Capacity Manual (HCM)
- FDOT Intersection Control Evaluation (ICE)
- What is a roundabout? WSDOT (Including Image)

BOWTIE



Description

Bowtie intersections redirect left-turn movements from the main intersection to the adjacent roundabouts located along the minor roadways.

When to Consider

Application

- Bowties may be considered when a corridor experiences heavy traffic volumes and low left-turn vehicle movements.
- May be considered for corridors that have limited ROW for expansion.
- Bowties are seen as an improvement to the median U-turn (MUT) design.

Context Classification

C2, C3R, C3C

Cost

Medium-High

ROW

- Medium-High
- The sizes of the roundabouts will vary based on speed, volume, vehicle size, and the number of legs.

Benefits

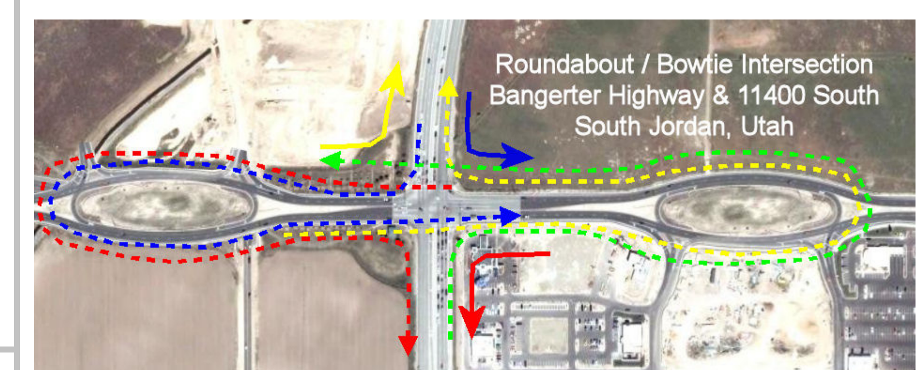
- Bowties improve safety by reducing the number of conflict points on the major road, and also by requiring vehicles to slow down at the roundabout entry point.
- Since there are no left-turning movements at the main intersection, this design increases traffic flow and overall efficiency.
- They create shorter wait times at the main intersection without left-turn phasing.
- Bowties are a more cost-effective way to increase roadway capacity than other methods, such as adding lanes.

Considerations

- Travel times for left-turn movements may increase with out-of-direction travel.
- There are very few existing bowties, therefore case studies are limited.

Examples & Supporting Information

Example



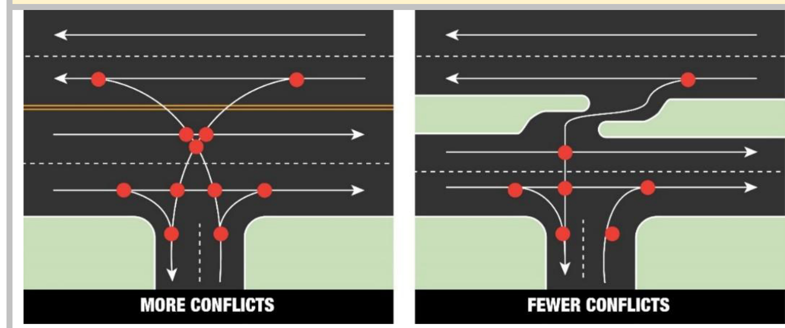
Bangerter Highway and 11400 South in South Jordan, Utah

Reference Material

- Innovative Intersections and Interchanges: Bowtie, VDOT
- Innovative Intersections: Overview and Implementation Guidelines, Community Planning Association of Southwest Idaho (Including Images)

Access Management

ACCESS MANAGEMENT PLANS



Description

Access management is a set of techniques used by state and local governments to control how vehicles access various roadways. An Access Management Plan defines site-specific access management and traffic control features for a corridor and is developed in coordination with the local government.

When to Consider

Application

- Access Management Plans can be adopted by FDOT in coordination with the local government and are based on analysis to provide corridor specific access management strategies.
- Designating the appropriate levels of access control for different facility types helps ensure that those networks are operating efficiently.
- Access management policies help state, regional, and local governments preserve the functionality and efficiency of their roadway networks.

Context Classification

C2, C3R, C3C, C4

Cost

Low-Medium. Dependent on the access management technique.

ROW

Low. May depend on the access management technique.

Benefits

- Access management techniques improve traffic flow, reduce the number of vehicle conflict points, and have been proven to reduce the number of crashes.
- Signal spacing reduces congestion and improves traffic flow on major arterials.
- Appropriate driveway spacing can create fewer conflict points and improve safety.
- Turning lanes at intersections reduce rear-end crashes.
- Medians reduce the number of conflict points, help reduce crashes, and improve safety along corridors.

Considerations

- Some businesses may have concerns that access management techniques are reducing their revenue by limiting direct access to their site.
- Some access management topics require additional research, and there may not be sufficient evidence to show their benefits (e.g. frontage roads).
- Access management programs should discuss how land use dictates the development of adjacent roadways.
- Some land use and zoning codes limit the number of access points and reserve space for median improvements, which can save money later on.

Examples & Supporting Information

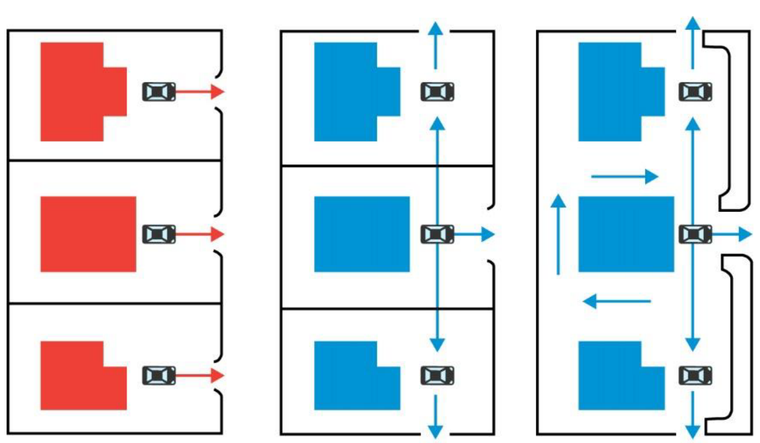
Example

Dual Directional Median Opening in Clearwater, Florida

Reference Material

- Access Management Guidebook, FDOT (Including Images)
- Benefits of Access Management Brochure, FHWA

SHARED ACCESS DRIVEWAYS



Description

Shared driveways provide single access points from primary roadways to multiple developments.

When to Consider

Application

- Shared access should be considered where practical along corridors to minimize driveways and increase corridor capacity.
- Unsignalized driveways that have a high number of crashes may consider shared access driveways to reroute vehicles to a signalized intersection to ensure safety.
- Shared access may be considered near parcels with complex geometry that may miss pass-by trips (e.g. corner lots and outparcels).

Context Classification

C2, C3R, C3C, C4

Cost

Low

ROW

Low. Additional ROW may be needed to meet design standards.

Benefits

- Shared driveways help to minimize the number of driveways on an arterial road, which reduces congestion caused by frequent stops.
- They also provide cross access between various developments, which increases accessibility and reduces the number of trips on major roads.
- Fewer driveways reduce the number of conflict points for vehicles, bicyclists, and pedestrians, and creates a safer environment for all modes.

Considerations

- Many local governments address accessibility and related issues in their land development regulations.
- May be challenging to implement shared access driveways in retrofit projects due to existing parking lot layouts.

Examples & Supporting Information

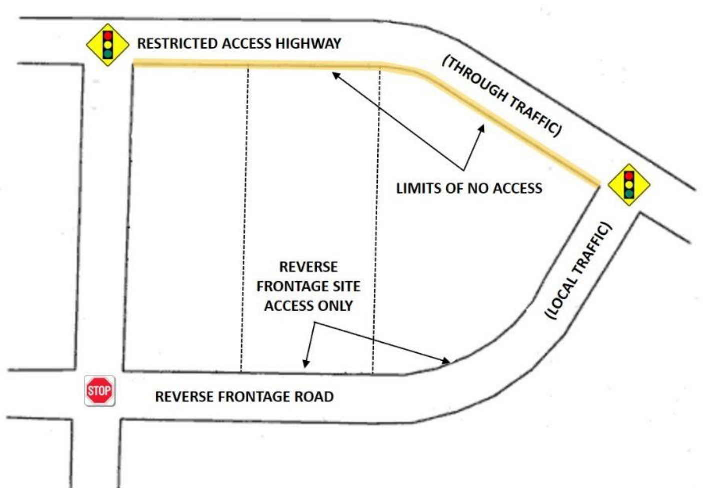
Example

Shared access near a continuous flow intersection (CFI)

Reference Material

- Image - Innovative Intersections: Overview and Implementation Guidelines, Community Planning Association of Southwest Idaho
- Access Management Guidebook, FDOT (Including Image)
- Safe Access is Good for Business, FHWA

REAR SERVICE/BACKAGE ROADS



Description

Backage roads, which are also called "reverse frontage roads" or "reverse access" roads, serve a similar purpose to frontage roads, but are located behind business properties that front the main roadway.

When to Consider

Application

- Backage roads can provide access to businesses on both sides of the road.
- They can be used to remove traffic from major roadways and increase traffic flow.
- They help reduce traffic speed, improving safety along the corridor.
- Backage and frontage roads can be designed for one-way or two-way operations.

Context Classification

C2, C3R, C3C, C4

Cost

Medium-High

ROW

- Medium-High
- Additional ROW may be needed for the construction of the backage road, as well as any connecting service roads.

Benefits

- Backage roads can help reduce congestion on main roadways and increase efficiency.
- They reduce the number of conflict points on primary roadways and contribute to a safer network.
- Backage roads are typically less disruptive to surrounding businesses compared to frontage roads.
- Backage roads cost less than frontage roads.
- They have better functionality compared to frontage roads and can operate safely in both directions.

Considerations

- Studies analyzing the safety of property access strategies using frontage/backage roads may be complex due to the surrounding roadway networks.
- Signage should be provided to communicate points of entry to businesses.

Examples & Supporting Information

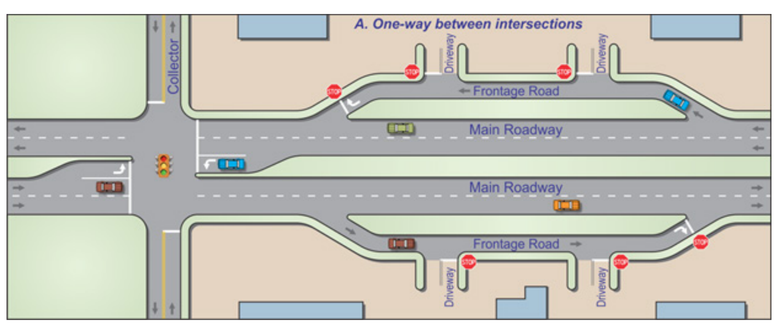
Example

Reverse Frontage Road in Rolla, Missouri

Reference Material

- Safe Access is Good for Business, FHWA
- Safety Evaluation of Access Management Policies and Techniques, FHWA
- Image – TDD Endorses University Drive Realignment, Phelps County Focus
- Image – Unified Development Ordinance, City of Manhattan, Kansas

FRONTAGE ROADS



Description

Frontage roads are a type of service road that generally run parallel to the main road, and are located between the ROW of the main road and the front building setback line.

When to Consider

Application

- Frontage roads provide access to commercial sites at a lower speed.
- They can help separate local traffic for commercial businesses from high-speed traffic to maximize efficiency along corridors.
- Frontage roads provide direct access to businesses fronting major roads.

Context Classification

C2, C3R, C3C

Cost

High

ROW

- High
- Additional ROW is needed for the construction of the frontage road, as well as connecting service roads to the major road or other side streets.

Benefits

- Using frontage roads to separate through traffic from access-related traffic reduces traffic delays.
- Separating the traffic reduces the frequency and severity of conflicts along major roadways, which improves traffic flow.
- The spacing between intersections along the major roadway enables the design of auxiliary lanes used for acceleration/deceleration, which further improves safety and traffic operations.

Considerations

- Connections between frontage roads to other streets should provide ample spacing between signalized intersections to avoid queuing conflicts.
- For businesses that may not be visible from the frontage road or side streets, providing signage at those locations may be helpful.
- They are safer when they are designed for one-way traffic.
- Businesses may need to coordinate with local agencies to mitigate any adverse effects (e.g. complying with setback regulations).

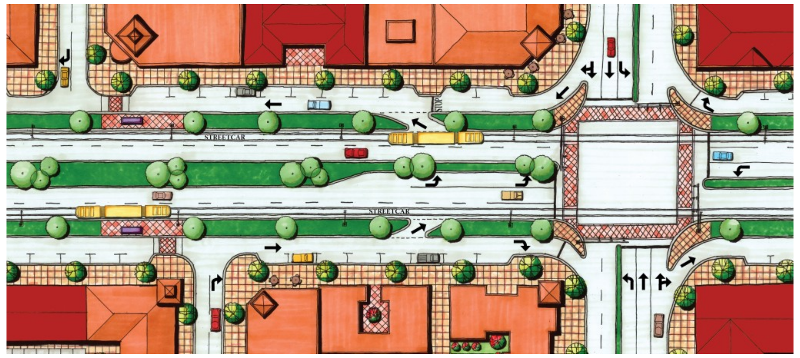
Examples & Supporting Information

Example

Reference Material

- Safe Access is Good for Business, FHWA (Including Image)
- Safety Evaluation of Access Management Policies and Techniques, FHWA (Including Image)

MULTI-WAY BOULEVARDS



Description

Multi-way boulevards are streets that can accommodate multiple types of mobility options. They consist of three characteristics: central through lanes, parallel frontage lanes, and landscaped buffers. Accommodations for transit, pedestrian, and bicycle facilities are typically included, although designs may vary.

When to Consider

Application

- Multi-way boulevards may be considered along corridors to accommodate high traffic volumes, as well as multi-modal infrastructure.
- The central through lanes in multi-way boulevards can be designed to accommodate traffic volumes in the area.

Context Classification

C2T, C3R, C3C, C4, C5, C6

Cost

High

ROW

- High
- Additional ROW required to accommodate vehicle, transit, pedestrian, and bicycle facilities.

Benefits

- The parallel frontage lanes are designed to create a comfortable pedestrian environment.
- Multi-way boulevards are designed to facilitate commercial and mixed-use development.
- They are aesthetically pleasing and promote livability for the surrounding community.
- They provide on-street parking for cars without delaying through traffic and limiting congestion.
- Businesses benefit from being close together and generate pass-by trips.

Considerations

- It may be challenging to design a corridor that meets transportation goals while also creating a safe environment for all mobility types.
- There is a lack of existing engineering design standards for multi-way boulevards, and they may require additional expertise to design them properly.

Examples & Supporting Information

Example

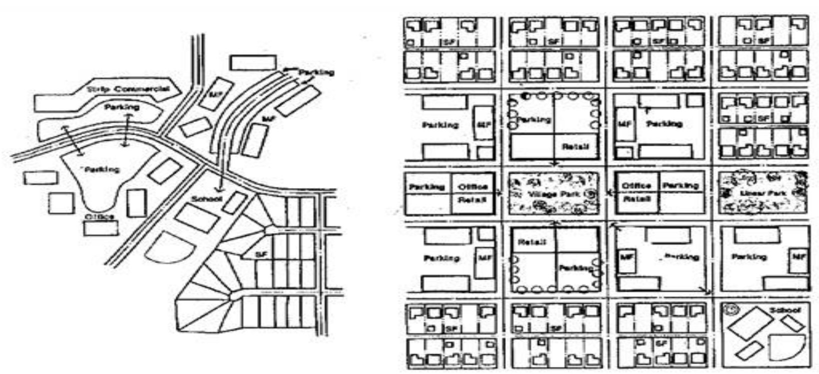
Pendleton Multi-Way Boulevard at Joint Base Lewis-McChord, Washington

Reference Material

- A Brief Look: What is a Multi-Way Boulevard? Canin Associates (Including Image)
- Image – Pendleton Multi-Way Boulevard, Cascade Design Collaborative

Network Enhancements

CONNECTIVITY ENHANCEMENTS



Description

Connectivity is the number of roadway connections that exist in an area between different points of interest. Well-connected networks consist of many short segments and intersections, while a poorly connected network may consist of long segments and few intersections.

When to Consider

Application

- Connectivity may be considered at smaller scales (e.g. within a neighborhood) or larger scales (across a city).
- Connectivity enhancements may be beneficial in areas experiencing congestion to provide drivers with alternative options.
- It may be considered in areas with high transit, pedestrian, or bicycle traffic to provide additional connections to destinations and potentially reduce travel time.

Context Classification

C2, C2T, C3R, C3C, C4, C5, C6

Cost

Low-High. May be dependent on the scale of the project.

ROW

- Low-High
- Additional ROW may be required to construct connected roadways, but could be offset by reducing street widths.

Benefits

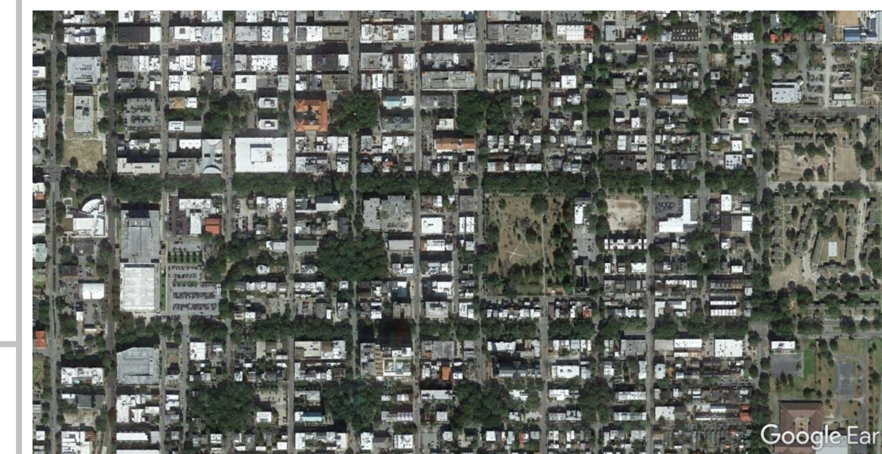
- Connectivity helps reduce travel distances and increases the number of travel routes for drivers, making destinations more accessible.
- Connected networks allow traffic to be dispersed across more roads over a larger area, improving circulation.
- Connectivity enhancements for pedestrians and bicyclists can increase safety and improve accessibility to points of interest.
- Communities with more connectivity can improve overall livability.

Considerations

- Roadways with higher speeds are typically less connected to maintain efficiency, but can create barriers for non-motorized travelers.
- Alternative design strategies may be considered to improve connectivity across barriers (e.g. rivers, highways, major arterials).
- Increased connectivity may require lower traffic speeds.
- Connectivity can improve travel options for transportation disadvantaged populations and increase accessibility.

Examples & Supporting Information

Example

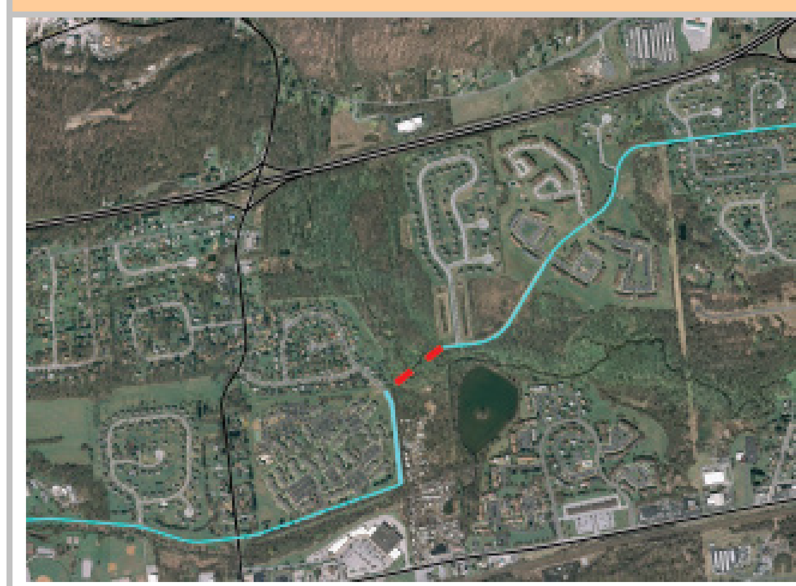


Connected Urban Grid in Savannah, Georgia

Reference Material

- Roadway Connectivity, VTPI (Including Image)
- Image – Google Earth

IMPROVED PARALLEL ROUTES



Description

Parallel routes are used to remove traffic from congested roads to underutilized roads to improve roadway functionality within a particular area.

When to Consider

Application

- Parallel routes can be used to reduce congestion on major roadways.
- Parallel routes can help to remove local traffic from interregional roadways (e.g. SIS facilities).
- They may be considered to accommodate traffic from emergencies or other unplanned events.
- The utilization of parallel routes can be improved by increasing their capacity.
- Coordinated signal timing can be used to better integrate parallel routes with primary roadways.

Context Classification

C2, C2T, C3R, C3C, C4, C5, C6

Cost

Low-High

ROW

- Low-High
- Additional ROW may be needed at intersections to accommodate turning maneuvers by larger vehicles.

Benefits

- Parallel routes that have extra capacity can help remove congestion on major routes, improving travel times, and increasing traffic flow.
- Traveler information systems can be used to communicate alternate routes to drivers and improve travel times.
- Parallel routes provide other route options during times of congestion or if there is an incident on the other route.

Considerations

- The use of local residential streets for traffic re-routing from parallel major streets should be carefully considered due to the differing function of the local street, adjacent residences, and low speeds.
- A traffic monitoring system can be in place to determine the status of a roadway (e.g. traffic detection and/or a regional traffic management center (TMC)).

Examples & Supporting Information

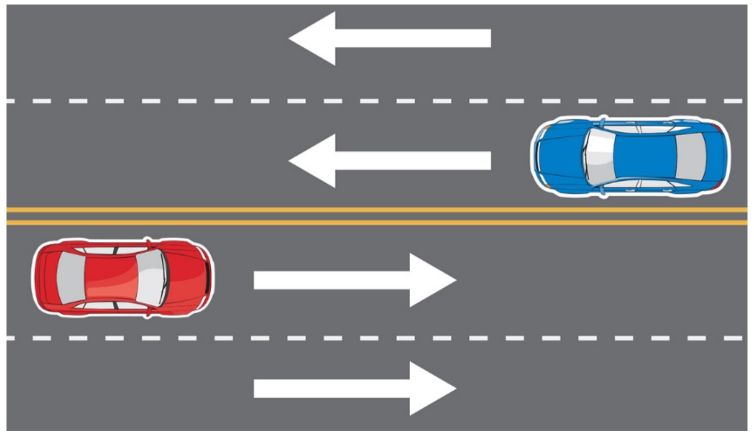
Example

Reference Material

- Parallel Route Usage & Improvements, WSDOT
- Image – Highway 75, MnDOT
- Image – https://www.chescoplanning.org/MuniCorner/Tools/connectivity.cfm

Additional Through Lanes

ADDITIONAL THROUGH LANES



Description

Adding through lanes to a corridor is typically done to increase capacity and reduce congestion.

When to Consider

Application

- Through lanes can be added along corridors to mitigate congestion.
- New lanes and roads can be constructed to encourage the development of surrounding land, which promotes economic growth.
- Adding lanes is most beneficial along corridors that already have the required ROW for construction.

Context Classification

C1, C2, C3R, C3C

Cost

High

ROW

- High
- Additional ROW is required.

Benefits

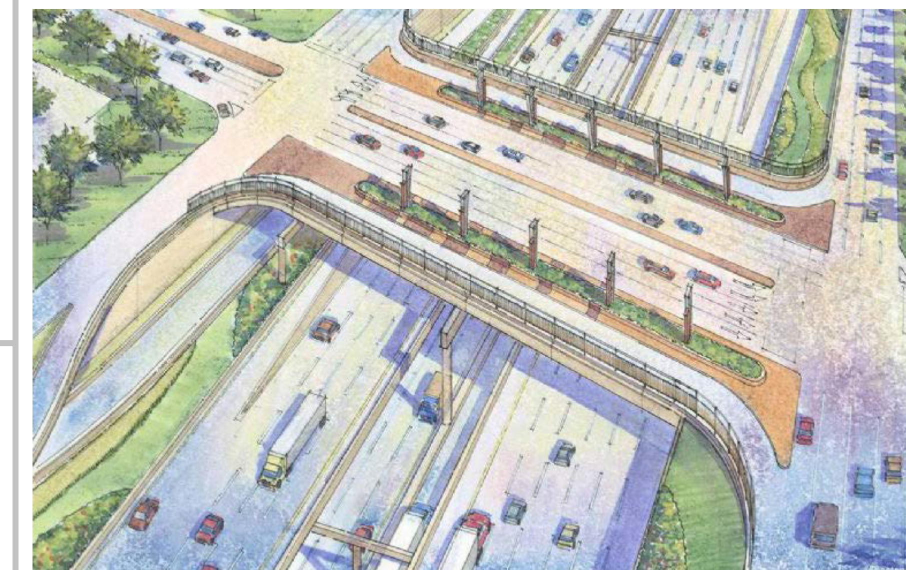
- Added lanes can decrease congestion and provide alternate routes for drivers.
- Roadways with less congestion increase travel speeds and efficiency for drivers, including ones with freight or delivery schedules.
- Reduced congestion also reduces emissions and fuel consumption, which is better for the environment.
- New roadways can improve traffic flow for the surrounding network.

Considerations

- Constructing additional lanes requires significant funding and time to implement.
- Studies have shown that adding new lanes or roadways can reduce the rate of congestion increases.
- Existing and projected levels of demand should be considered before constructing new lanes or roadways.
- Local and state governments will need to coordinate to ensure that expansions will not negatively impact the surrounding context.
- Additional travel lanes can induce additional travel demand or new or more intensive development, leading to increased congestion.

Examples & Supporting Information

Example

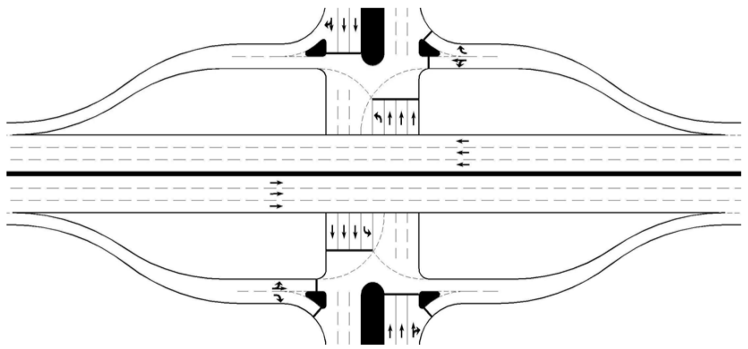


Reference Material

- Adding New Lanes or Roads, TTI (Including Image)
- Image – Pavement Markings are Key to Safety but can be Confusing, AARP

Convert to Grade-Separated Intersection

DIAMOND



Description

A diamond interchange has four one-way ramps that are used to enter and exit the highway. This design is considered to be the most common, simplest type of grade-separated intersection between two roadways.

When to Consider

Application

- Diamond interchanges are considered to be an economical option since they require less land and materials compared to other interchange designs.
- This design is suitable at locations where left-turn volumes are low.
- Diamond interchanges are suitable for urban and rural intersections.

Context Classification

C1, C2, C3C, C4

Cost

High

ROW

- High
- Requires some additional ROW, but less than other interchange designs.

Benefits

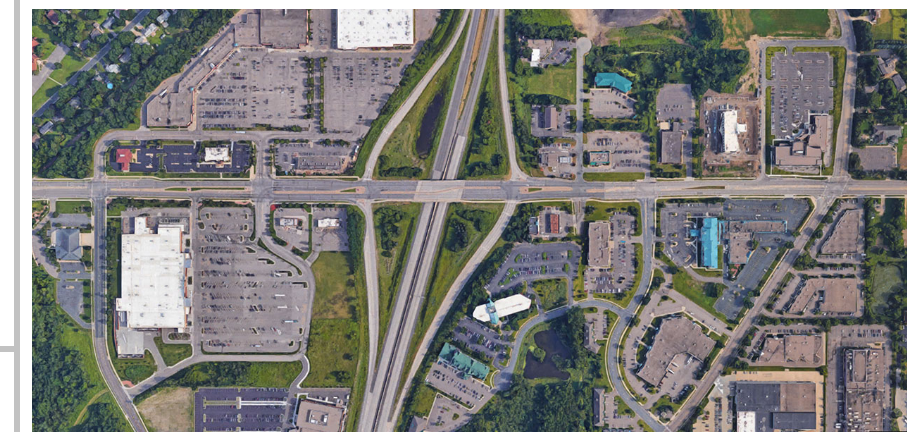
- The grade separation reduces the total number of conflicts, which improves safety.
- Diamond interchanges require less out-of-direction travel compared to other designs, which makes it a more efficient option for drivers.
- Minimal signage is required.
- Diamond interchanges allow for free-flowing traffic along major highways, while the ramps intersect with the minor roadway.

Considerations

- Conflicts may occur where ramps and cross streets meet and may need to be addressed to accommodate high volumes.
- Signal timing at cross streets should be planned according to hourly demands to accommodate traffic and maximize flow.
- If not planned properly to accommodate traffic volumes, this design could cause congestion if traffic becomes backed up along ramps or cross streets.

Examples & Supporting Information

Example

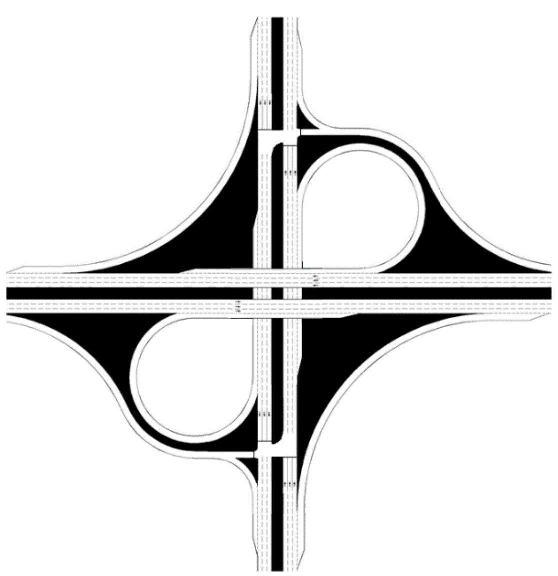


Diamond interchange in Vadnais Heights, Minnesota

Reference Material

- The Amazing World of: Interchange Designs, SEH (Including Image)
- Grade Separated Intersection, Mathew, T.
- Cloverleaf and Diamond Interchanges: Advantages and Disadvantages, School of PE

CLOVERLEAF



Description

Cloverleaf interchanges preserve traffic flow by eliminating the need for traffic signals by using weaving sections.

When to Consider

Application

- Cloverleaf interchanges may be considered along roadways with low capacity.
- These interchanges are typically constructed in rural areas.
- Partial cloverleaf designs may be more beneficial than full cloverleaf designs, which are now seen as being outdated.
- Collector/distributor (C/D) roads can be added to cloverleaf interchanges to improve traffic flow.

Context Classification

C1, C2, C3C

Cost

High

ROW

- High
- Additional ROW may be required to provide enough length and capacity for seamless driving operations along the interchange, as well as accommodating radii.

Benefits

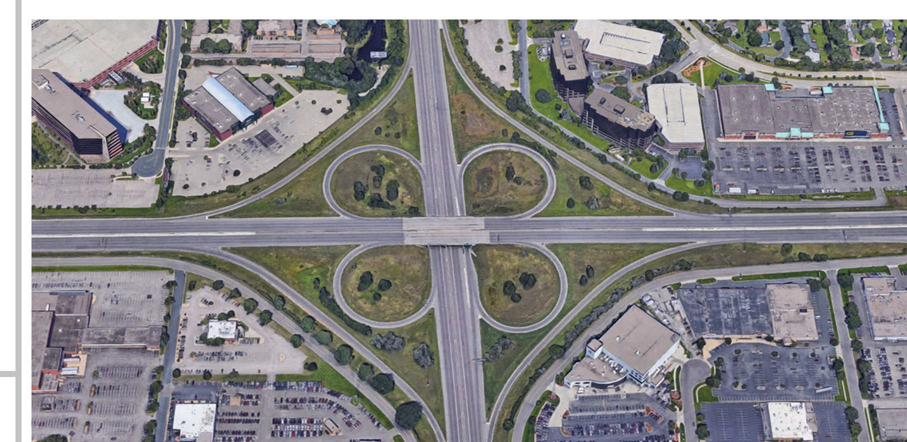
- The weaving section in a cloverleaf interchange replaces crossing conflicts with merging, and then a diverging conflict.
- The construction of cloverleaf interchanges is relatively inexpensive since it only requires one bridge between roadways.
- The cloverleaf design allows for “second chances”, where if you miss the first ramp, you can use the other ramps to get back on track, or even make a U-turn.

Considerations

- The cloverleaf design is relatively inexpensive since it only requires one bridge, and crossing maneuvers are eliminated at grade; however, they have higher operating costs.
- They have greater travel distances compared to other interchange designs.
- Cloverleaf interchanges have more difficult merging sections, which could cause conflicts.
- Turning movements could confuse unfamiliar drivers (e.g. turning right to go left).

Examples & Supporting Information

Example

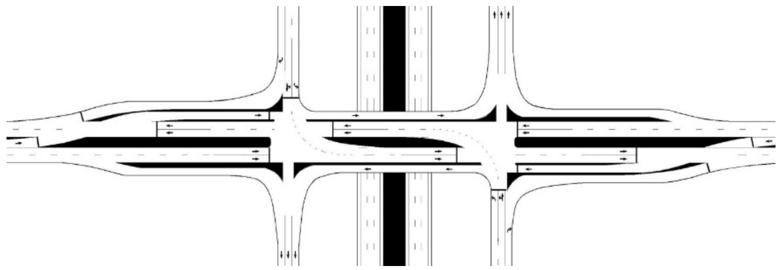


Cloverleaf interchange in Bloomington, Minnesota

Reference Material

- The Amazing World of: Interchange Designs, SEH (Including Image)
- Grade Separated Intersection, Mathew, T.
- Cloverleaf and Diamond Interchanges: Advantages and Disadvantages, School of PE
- The Full Cloverleaf, Kurumi

DISPLACED LEFT-TURN INTERCHANGE



Description

A displaced left-turn (DLT) interchange is a signalized intersection design where the left-turn movements cross to the other side of the opposing traffic lanes. Vehicles travel on a roadway parallel to the opposing lanes and then turn left simultaneously with the through traffic.

When to Consider

Application

- DLTs may be considered along roadways with high traffic volumes, especially high left-turn volumes.
- DLTs can be constructed in either urban or suburban settings.
- They may be considered at interchanges where signal warrants are being met.

Context Classification

C1, C2, C3C, C4

Cost

High

ROW

- High
- Additional ROW may be required to accommodate the area of the turning movements.

Benefits

- DLT interchanges eliminate left-turn phases at the main intersection, which improves efficiency.
- They improve traffic flow by separating left-turn movements.
- DLTs can improve capacity by relocated left-turn movements.
- This design reduces the number of conflict points, which creates a safer intersection.

Considerations

- Grade-separated DLTs will cost more than non-grade-separated DLTs.
- Drivers may not be familiar with the design of DLTs, and it could cause confusion.
- DLTs may cause issues with signal coordination, and additional signals may be needed.
- U-turn movements may be removed, which could increase out-of-direction travel for some drivers.

Examples & Supporting Information

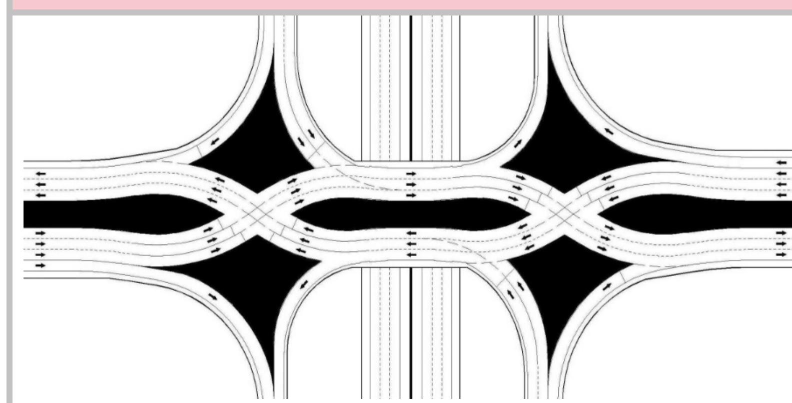
Example

DLT Intersection in San Antonio, Texas

Reference Material

- Highway Capacity Manual (HCM)
- FDOT Intersection Control Evaluation (ICE)
- Image – Google Earth

DIVERGING DIAMOND



Description

A diverging diamond interchange (DDI), also known as a double crossover diamond (DCD), is designed to allow two directions of traffic to cross to the left side of the road.

When to Consider

Application

- DDIs may be considered along roadways with high traffic where there may be challenges for drivers accessing the interstate.
- DDIs may be used to reduce congestion and improve traffic flow.
- It may be considered in a high-crash area to reduce the number of crashes, as well as crash severity.

Context Classification

C1, C2, C3C, C4

Cost

High

ROW

- Medium-High
- May require additional ROW if the structural framework is not already in place.

Benefits

- DDIs help move traffic through an intersection without requiring added lanes or signals.
- The interchange design gives drivers easier access to the interstate.
- DDIs allow for free-flowing turns when vehicles are entering or exiting an interstate, which eliminates left turns against oncoming traffic, and also reduces signal phases.
- The design helps reduce the number of crashes, ultimately improving safety across the interchange.
- If a DDI is being used to improve an existing interchange, costs may be low as existing bridge structures and ROW can be used.

Considerations

- The design may be confusing for drivers since they have to drive on the opposite side of the road.
- Pavement markings and signage are needed to direct traffic.
- Pedestrian accommodations are typically in the median of the DDI with crossings required on the ends.

Examples & Supporting Information

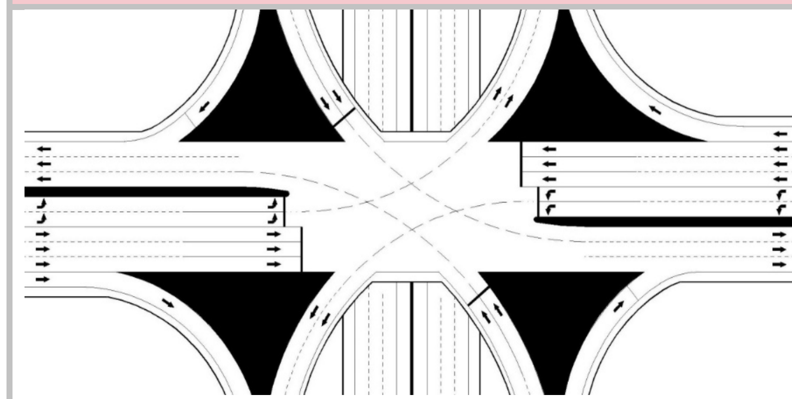
Example

A DDI in Arden Hills, Minnesota

Reference Material

- The Amazing World of: Interchange Designs, SEH (Including Image)
- Diverging Diamond Interchanges, NCDOT

SINGLE POINT



Description

A single point urban interchange (SPUI) is designed so that all highway ramps begin or end at a single signalized intersection on the arterial roadway. Right-turn movements onto or off the highway may be made at separate unsignalized intersections.

When to Consider

Application

- An SPUI can be designed as an overpass or underpass.
- This design may be considered at intersections with limited ROW.
- SPUIs may be beneficial at interchanges with heavy left-turn traffic volumes.
- SPUIs may be considered at interchanges experiencing congestion.

Context Classification

C1, C2, C3C, C4

Cost

High

ROW

- Medium-High
- May require less ROW acquisition than other interchange designs.

Benefits

- SPUIs may improve safety since there is only one signalized intersection, reducing the number of conflict points.
- Fewer signal phases reduce delay and increases efficiency.
- The SPUI design allows left turn to be completed at higher speeds, which reduces congestion and increases capacity.
- Having only one signalized intersection improves travel times on the arterial.

Considerations

- Additional space may be required to accommodate the width of the SPUI design.
- SPUIs do not incorporate crosswalks across the intersecting roadway (although crosswalks across the entering and exit ramps are very common), and pedestrians may experience added travel times to find neighboring crosswalks.
- SPUIs are may be more efficient than standard diamond interchanges, but have more conflict points than diamond interchanges.

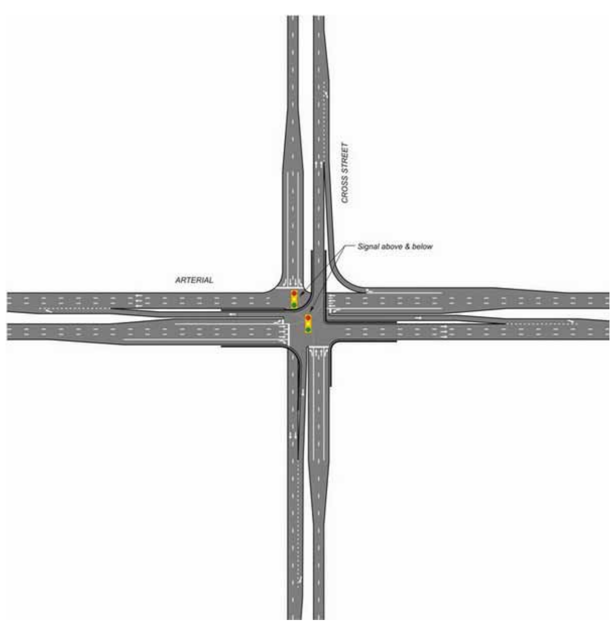
Examples & Supporting Information

Example

Reference Material

- Single-Point Urban Interchange (SPUI), VDOT
- Single Point Urban Interchange, Kentucky Transportation Cabinet (Including Image)

ECHELON



Description

An echelon interchange has one approach on both the arterial and cross streets that are elevated as they intersect, while the other approaches intersect at-grade.

When to Consider

Application

- Echelon interchanges may be considered if traffic is heavy and volumes are similar on major and minor roadways.
- This design may be beneficial if conventional at-grade intersection designs cannot accommodate the traffic volumes.
- Could be a good option if ROW is limited.

Context Classification

C1, C2, C3C, C4

Cost

High

ROW

- Medium-High
- May require less ROW acquisition than other interchange designs.

Benefits

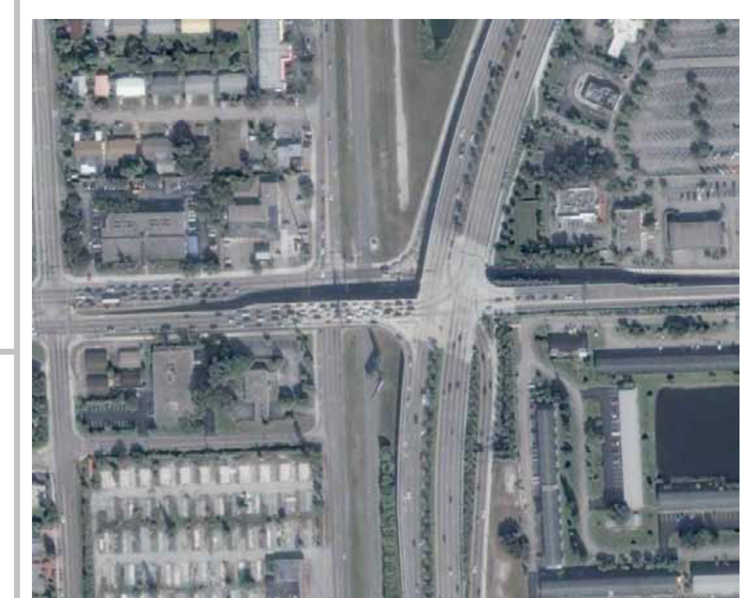
- The echelon design reduces the number of conflict points, improving safety along the corridor.
- Each signalized intersection only has two signal phases, which reduces delay and increases capacity.
- Shorter signal phases improve travel time and efficiency.
- The echelon design may be more cost-effective than the diamond interchange.

Considerations

- Both intersections in an echelon interchange are signalized.
- The intersections operate similar to one-way street intersections.
- The echelon design does not incorporate any free-flowing traffic movements.
- The portion of the roadway that is elevated uses retaining walls, while the other portion operates at-grade.
- Pedestrian facilities typically operate at-grade, but stairs or ramps may be required depending on design elements.

Examples & Supporting Information

Example

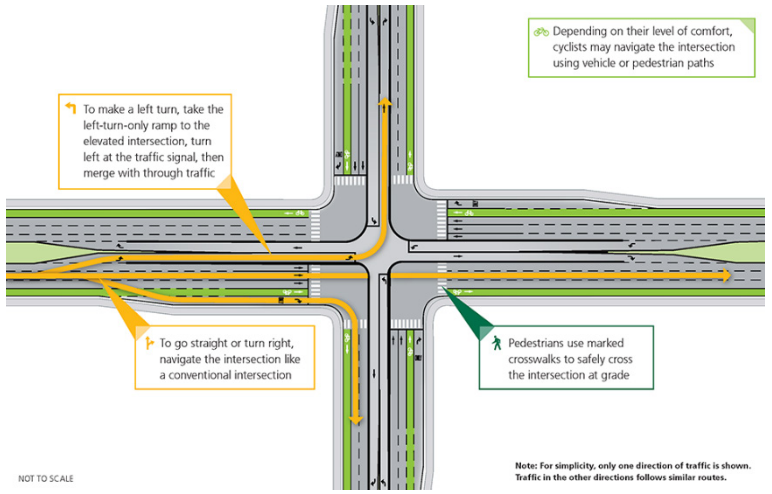


Echelon Interchange in Aventura, Florida

Reference Material

- Echelon, VDOT
- Images – Alternative Intersections/Interchanges: Informational Report (AIIR), FHWA

CENTER LEFT TURN OVERPASS



Description

A center left turn overpass interchange elevates all left-turn movements using ramps in the median, while the main intersection remains at-grade.

When to Consider

Application

• A center left turn overpass may be considered if an intersection has heavy left-turn traffic volumes in all directions.
• It may be considered if the major street already has six or more lanes.
• Both signalized intersections are synchronized, which can help improve travel times on major and minor streets.
• Left-turning volumes use a lane to accelerate and merge with through traffic.

Context Classification

C1, C2, C3C, C4

Cost

High

ROW

• Medium-High
• May require less ROW acquisition than other interchange designs.

Benefits

• The operating principles of a center left-turn overpass are the same as traditional intersections, which reduces driver confusion.
• Center left turn overpasses reduce the number of conflict points at the intersection, creating a safer environment.
• Since left-turn movements are removed from the main intersection, signal phases are reduced, increasing efficiency.
• All pedestrian facilities are at-grade and there are no conflicts with left-turning movements, improving safety.

Considerations

• It could be difficult to implement the design if the streets are not perpendicular.
• The design could block the visibility of businesses due to the structures.
• Costs for rights to design (patented design).

Examples & Supporting Information

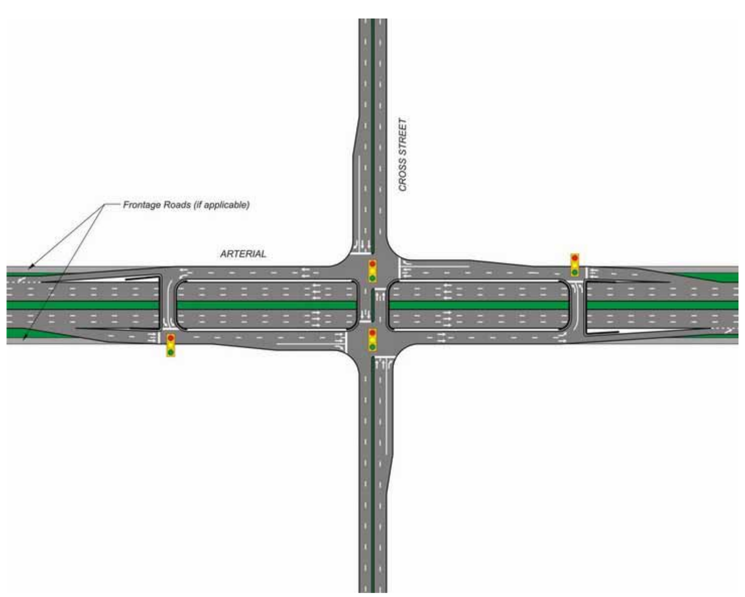
Example


Conceptual rendering of a center turn overpass

Reference Material

• Center Turn Overpass, VDOT (Including Images)
• FHWA Alternative Intersections/Interchanges: Informational Report

MEDIAN U-TURN INTERCHANGE



Description

A median U-turn (MUT) interchange, also known as the Michigan urban diamond interchange (MUDI), is similar to a traditional MUT intersection but modified as a grade-separated intersection.

When to Consider

Application

• The MUDI design may be considered as a grade-separated intersection where ROW acquisition may not be possible.
• This interchange may be considered for a grade-separated option that needs improved accessibility to surrounding developments.
• MUDIs use directional crossovers on either side of the main intersection to accommodate left-turn movements.
• Arterial turn movements are made along frontage roads, which are located on either side of the grade-separated through lanes.
• Right turns can be made at the main intersection.

Context Classification

C1, C2, C3C, C4

Cost

High

ROW

• Medium-High
• May require less ROW acquisition than other interchange designs.

Benefits

• MUDI intersections only have two signal phases, which reduces congestion and improves traffic flow.
• The MUDI design promotes access management concepts.
• This design improves access to adjacent developments via the frontage roads compared to other grade-separated intersections.
• Traffic analyses have shown that MUDI designs perform better than traditional diamond interchanges.

Considerations

• Out-of-direction travel for left-turn movements.
• Requires the construction of frontage roads to serve as ramps and accommodate crossroad turn movements.

Examples & Supporting Information

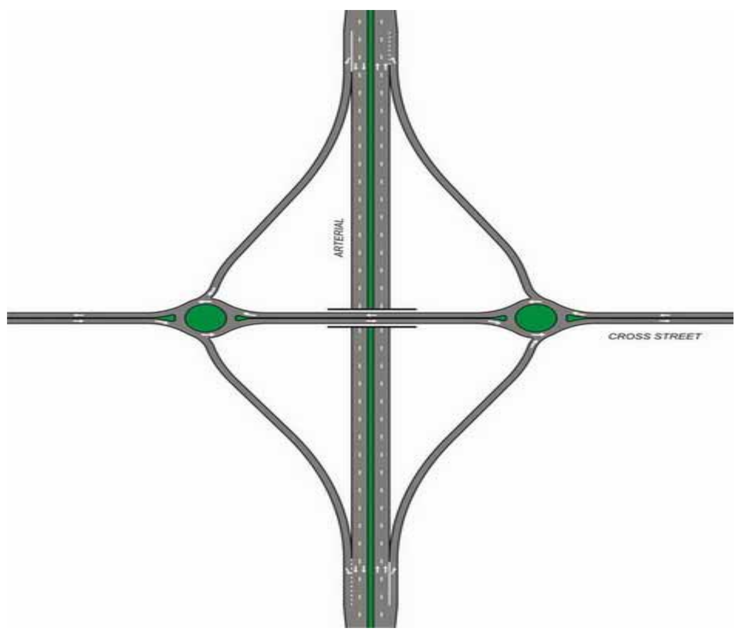
Example

Reference Material

• Alternative Intersections/Interchanges: Informational Report (AIIR), FHWA (Including Image)
• Image – Michigan Urban Diamond, ATTAP

RAIN-DROP	When to Consider		Examples & Supporting Information

RAIN-DROP



Description

A rain-drop interchange, also known as a double roundabout, is designed so that all freeway ramps are connected to one of the two roundabouts on either side of the main roadway. Raindrop interchanges can also be configured with a single roundabout.

When to Consider

Application

• Rain-drop interchanges may be considered if there are heavy left-turn volumes onto the freeway.
• This design may be beneficial if there is limited space for vehicles to wait at traffic signals.
• They may be considered to prevent vehicles from causing back up onto the freeway.

Context Classification

C1, C2, C3C, C4

Cost

High

ROW

• High
• Requires less ROW acquisition than other interchange designs.

Benefits

• Rain-drop interchanges improve safety by reducing conflict points and eliminating potential right-angle and head-on crashes.
• Eliminating signals improves traffic flow and reduces congestion along ramps.
• The roundabouts promote continuous traffic flow and minimizes backup onto the freeway, improving safety and efficiency.
• Rain-drop interchanges can be constructed with a narrower bridge and can eliminate turning lanes, making it a cost-effective option.
• Crosswalks are marked across the interchange, allowing for safe pedestrian crossings.

Considerations

• Without signals, coordination is not possible and could negatively affect traffic flow on the crossroad in some cases.
• As approaching vehicles slow down to enter the roundabout, it could cause congestion during peak hours.
• Pedestrian crossings are uncontrolled, which could make crossing more difficult during peak hours.
• Roundabouts typically require additional design elements, such as landscaping, lighting, and truck aprons.
• Accommodating larger vehicles may present design challenges.
• Traffic queues from nearby intersections should be considered to prevent circulatory lockup.

Examples & Supporting Information

Example

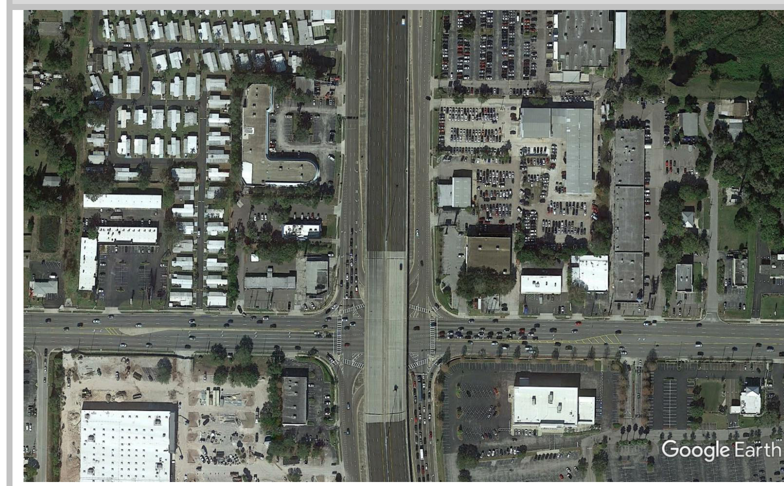
Double Roundabout in Loudoun County, Virginia

Reference Material

• Alternative Intersections/Interchanges: Informational Report (AIIR), FHWA (Including Image)
• Double Roundabout, VDOT (Including Image)

Convert to Limited Access

LIMITED ACCESS



Description

Limited access facilities (also known as controlled access facilities) are roadways that are designed for high-speed vehicular traffic. Vehicles can only access these facilities by highway ramps.

When to Consider

Application

- Limited access facilities may be considered along corridors that experience extreme congestion.
- They may be beneficial for improving connectivity to other limited access facilities.

Context Classification

C1, C2, C3C

Cost

High

ROW

High

Benefits

- Limited access facilities do not have intersections or traffic signals, which promote uninterrupted traffic flow.
- These facilities do not intersect with other at-grade facilities, such as other roadways, railways, bicycle lanes, or pedestrian facilities, which preserves the efficiency of the roadways.
- Limited access facilities contribute to the delivery of goods, supporting local and regional economies.

Considerations

- Other types of transportation facilities (such as roadways, railways, bike lanes, and pedestrian facilities) will need to cross limited access facilities using overpasses or underpasses.
- Interchanges connect limited access facilities to other major highways, frontage roads, arterials, and collectors.
- Limited access facilities may disrupt connected roadway networks and create a physical barrier between communities.
- Higher posted speed limits on limited access facilities may increase the severity of crashes.

Examples & Supporting Information

Example

Reference Material

- Productivity and the Highway Network, FHWA
- Image: https://www.dallasnews.com/news/2017/03/14/easing-congestion-on-u-s-highway-380-not-always-about-the-bottom-line-and-the-dollar/

COMMUTER/BYPASS LANE

Description

Commuter lanes are limited-access lanes for through traffic that travel over or under crossroads to avoid traffic signals.

When to Consider

Application

- Commuter lanes can be applied along arterials to prioritize through traffic by allowing them to bypass signalized intersection with underpasses or overpasses.

Context Classification

C1, C2, C3R, C3C

Cost

High

ROW

High

Benefits

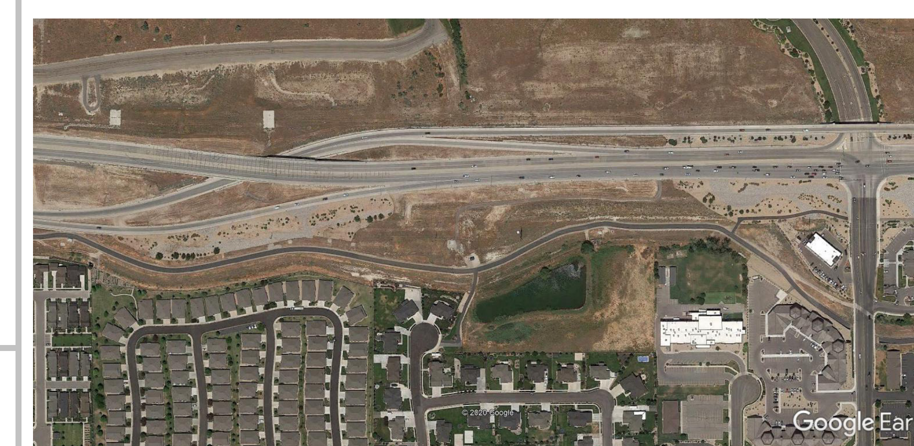
- Grade-separated intersections can significantly increase capacity and reduce delay for through traffic.
- Local traffic can remain on the non-bypass lanes to access crossroads and driveways.

Considerations

- Design considerations for ramp areas for the commuter lane traffic entering and exiting the arterials.
- Bike/pedestrian accommodations can be provided as the at-grade non-commuter lane intersection.

Examples & Supporting Information

Example



Utah Timpanogos Highway Commuter Lanes

Reference Material

- Image: https://smyrnasplost.com/windy-hill-boulevard-concept/

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