



I-95 Crash Methodology Technical Report

SKETCH INTERSTATE PLAN (SIP) FOR INTERSTATE 95 (I-95)

From the Indian River / Brevard County Line to the Florida / Georgia State Line

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Prepared for:



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I-95 Sketch Interstate Plan (SIP)

From the Indian River / Brevard County Line to the Florida / Georgia State Line

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I.0 Introduction

TranSystems has been contracted by the Florida Department of Transportation (FDOT) to conduct a Sketch Interstate Plan (SIP) for I-95 from the Brevard County/Indian River County line north to the Florida/Georgia state line. The study area has been provided as **Figure I**. As part the SIP, TranSystems was asked to perform a safety review of the corridor in order to identify high crash segments within the study area. This review will investigate crash data provided by FDOT in Microsoft Excel and GIS formats for the I-95 study corridor. The data provided includes information for all available crashes along I-95 for the years 2003 through 2007.

Based on the historical crash experience, planning-level decisions pertaining to the need for additional capacity, to improve geometrics, or to modify access points can potentially be identified and prioritized. This document is a summary of the findings identified by the safety review process.

2.0 US and Florida Crash Statistics

Summary tables from the US Department of Transportation's Bureau of Transportation Statistics note that in 2006 (the most recent data available), there were an estimated 5,973,000 vehicle collisions in the United States; of those approximately 2,575,000 (43% of total US crashes) resulted in one or more injuries and 42,642 (0.7% of total US crashes) included at least one fatality. The Florida Department of Highway Safety and Motor Vehicles (DHSMV) has also posted data pertaining to 2006 crash frequencies. According to DHSMV's data set, 4.3% or 1-in-23 (256,200 crashes) of the nation's crashes occurred in the state of Florida. The severity of the crashes occurring in the state of Florida appears to be higher than the national average with 137,282 crashes (54% of total Florida crashes) involving at least one injury, and 3,084 crashes (1.2% of total Florida crashes) experiencing a fatality. This record indicates that there needs to be safety improvements made to the state's infrastructure to reduce the number of crashes and their severity.

3.0 Terminology

Crash Rate: The frequency of crashes which occur on a freeway segment relative to the exposure of traffic on that freeway segment. The crash rates discussed in this document are segment crash rates and are presented as crashes per million vehicle miles traveled (MVMT).

- **Average District Crash Rate** – The average district crash rate is based on district, urban/rural character, and roadway classification. There are different crash rates for urban and rural freeway segments in each FDOT district.
- **Statewide Average Crash** – The crash rate is an average for the entire state based on specified criteria, i.e., urban versus rural.

Frequency: The number of crash occurrences in a set period of time for a specified location. For purposes of this report, frequencies are for a five year period.

High Crash Segment: Any crash segment, as identified by FDOT, which includes a minimum frequency of 8 crashes during the five year period.

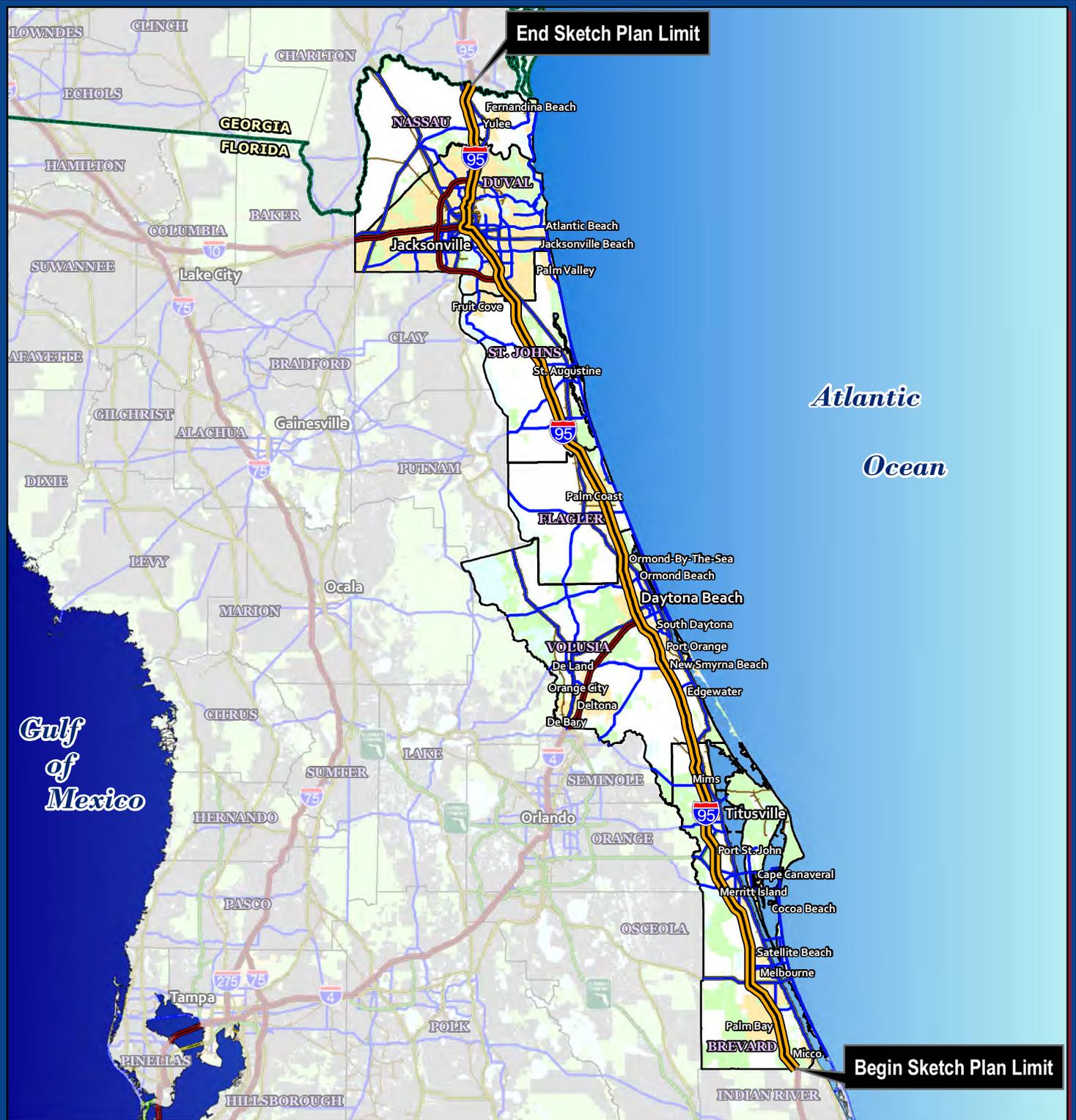
Severity: Crashes can be identified by one of three severities:



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- Property Damage Only (PDO) – The crash resulted in no injuries or fatalities.
- Injury Crash – The crash resulted in at least one person injured, but no fatalities.
- Fatal Crash – The crash resulted in at least one fatality and may or may not have included injuries.



LEGEND

- | | | | |
|-------------------------------|---|---------------------|----------------------|
| | I-95 Sketch Interstate Plan Project Limit | Other Layers | |
| Transportation Network | | | City and Town Limits |
| | Interstate Highway | | Ocean |
| | Toll Road | | Lakes and Rivers |
| | U.S. Highway | | County Boundary |
| | State Route | | State Boundary |
| | Railroad | | Public Lands |
| | | | I-95 SIP Study Area |

Figure 1 - Project Limits
I-95 Sketch Interstate Plan (SIP)

NOTES:

- 68 Interchanges within I-95 SIP Project Limits
- 222.1 Centerline Miles for I-95 SIP Project Limits

This map is intended for planning purposes only.

Source: FDOT, and TranSystems.





4.0 Data Sources

Crash Data Spreadsheets: Spreadsheets in Microsoft Excel were provided by FDOT which include a summary of collected data for each recorded crash on I-95 within the study counties. Also provided in Excel format was a list of the high crash segment locations within FDOT Districts 2 and 5.

ArcGIS Shapefiles: Polyline shapefiles were provided by FDOT locating the reported crashes geographically. Other spreadsheet databases were created as point event layers for actual milepost crash locations and referenced into a high crash segments layer.

Straight Line Diagrams: Straight line diagrams of roadway inventories including horizontal alignment, structure information, functional classification, lane details and county mile marker information prepared for the study area counties were provided by FDOT.

FDOT Staff: Members of FDOT's State Safety Office provided statewide crash rate information.

5.0 Analysis Technique / Methodology

FDOT provided the High Crash Roadway Segment listing and crash report summaries for the six counties in the study area, for the five-year period beginning in 2003 and ending in 2007. To be classified as a high crash segment based on FDOT methodology, a roadway segment must include a minimum of eight crashes during the analysis period. High crash segment lengths and locations were also identified by FDOT using standard practices. TranSystems filtered and sorted the provided data by route, county, section and mile post to locate the high crash segments and determine the existence of any trends that would indicate the potential for specific system improvements or regulation changes as part of the alternatives development.

The High Crash Roadway Segment information included total number of crashes, injured persons, and fatalities on the segment. TranSystems used this data to analyze crash and injury frequencies along the corridor. FDOT calculated a crash rate for each segment based on the exposure, in million vehicle miles traveled (MVMT), of the section. These crash rates were reviewed, checked using the standard equation for calculating segment crash rates (listed below), and updated when data was found to be in error in the spreadsheet. TranSystems compared the corridor crash rates to FDOT's statewide average and the calculated district average rate for rural or urban interstates, depending on the functional classification of the particular segment. This comparison determined how much the segment's crash rate exceeded the average rate for its functional classification. In addition, the crash rates for the study corridor were analyzed to identify freeway segments where crash rates were exceptionally high. TranSystems reviewed the straight line diagrams, and aerial photography of the identified peak crash rate locations to determine if there are geometric features that may be related to these high crash rates. In locations without obvious geometric concerns, TranSystems reviewed individual crash records for the specific segment to define a common contributing factor in the crash history.



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$$\text{Crash Rate} = \frac{\text{Number of Crashes} \times 1,000,000}{\text{AADT} \times 365 \text{ days/year} \times \text{Number Years} \times \text{Segment Length}}$$

FDOT reports AADT volumes for each crash which occurs on a roadway segment based on the historical count data. These count volumes are then averaged for use in computing high crash segment crash rates. For purposes of this study, all reported AADT volumes will represent the average for that segment over the 5 year period.

6.0 Key Findings

Table I contains corridor level, high crash segment, and statewide statistics for the overall corridor that extends from the Brevard County/Indian River County border north to the Florida/Georgia state line. The crash rates presented for the project area are based on crash data for the years 2003 through 2007, while the statewide statistics are based on 2007 crash data.

Table I- Crash Statistics

A. Overall Study Area Statistics

| Category | Corridor | Rural Interstate | Urban Interstate |
|---------------------|----------|------------------|------------------|
| Length (miles) | 222.18 | 93.85 | 128.33 |
| Corridor Crash Rate | 0.312 | | |
| Crashes | 10,404 | | |
| Fatalities | 300 | | |
| Injuries | 10,155 | | |
| Vehicles | 19,754 | | |

B. Study Area High Crash Segment Statistics

| Category | Corridor | Rural Interstate | Urban Interstate |
|---------------------------------|--------------|------------------|------------------|
| Length (miles) | 37.88 | 19.94 | 17.94 |
| Crashes | 5,002 | 1,436 | 3,566 |
| AADT ^{1,3} | 59,043 | 47,816 | 72,860 |
| Average Crash Rate ¹ | 0.995 | 0.879 | 1.149 |
| Fatalities | 106 | 39 | 67 |
| Injuries | 4,693 | 1,220 | 3,473 |

C. Statewide and District Statistics

| Category | Corridor | Rural Interstate | Urban Interstate |
|----------------------------------|----------|------------------|------------------|
| District Crash Rate ² | 0.417 | 0.359 | 0.488 |
| Statewide Crash Rate | | 0.361 | 0.711 |

¹average of high crash segments,

²average of Average District Crash rates for Interstate classifications

³Year 2005



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The State of Florida interstate system is divided into Rural and Urban classifications. The average statewide crash rate per million vehicle miles traveled is 0.361 crashes/MVMT for Rural Interstates and 0.711 crashes/MVMT for Urban Interstates, as provided by FDOT State Safety Office personnel. FDOT also provides district crash rates that are based on the functional classification of the facility and are specific for each FDOT District; corridor-wide averages of these rates are provided in comparison to the statewide average. The average crash rates for the rural and urban high crash segments are higher than both the statewide average and the corridor-wide average, which allows the conclusion that these locations are truly high crash segments. The calculated crash rate for the entire I-95 study area was found to be 0.312 crashes/MVMT, less than even the rural statewide and district crash rates; this implies that while the high crash segments are problematic, the study area as a whole is experiencing a better than average crash rate.

Crash frequency and crash rate are two related factors to consider when evaluating safety issues on a corridor. **Figure 2** shows the frequency of total crashes from 2003-2007. **Figure 3** depicts the high crash segments along the corridor and **Figure 4** depicts the total injuries for the high crash segments along the corridor. With the exception of Duval County, the number of crashes on any segment in the corridor is less than 100. In fact, outside of Duval County and an area comprising northern Volusia County and Flagler County, the crash frequencies are less than 50 for any high crash segment. However, there are 969 crashes in Duval County on a 2-mile segment of I-95 in the heart of downtown Jacksonville.

The length of the roadway segment has an impact on the crash rate, in that shorter segments will have a higher crash rate than longer segments with the same number of crashes. **Figure 5** demonstrates the crash rates for the high crash segments along the corridor, as well as the District "Average" crash rates along the I-95 corridor. The highest crash rate, 2.364 crashes/MVMT, does not occur in the location with the highest crash frequency; instead, it is located on a 0.1-mile segment of Flagler County that has an ADT of 62,580 vehicles per day. This segment had 27 crashes during the study period, and is the only segment with a crash rate greater than 2.0. The highest crash frequency segment, located in downtown Jacksonville, has the second highest crash rate of 1.842 crashes/MVMT over 2 miles. Traffic volume on this segment averages 144,080 vehicles per day.

The information presented in both Figures 2 and 4 indicate the following areas of safety concern:

- Duval County, downtown Jacksonville
- Flagler County between Flagler Beach and Palm Coast, state mile post 287.5 to 287.6
- Brevard County, state mile post 228.7 to 228.8
- St. Johns County, state mile post 314.5 to 314.6

Duval County – Location A

The section of I-95 going through downtown Jacksonville is 10.567 miles long; of this, 5.8 miles are considered high crash segments. The longest high crash segment within this section, 2.0 miles, has the largest frequency of crashes and the second highest crash rate in the study corridor; additionally, it is the highest crash rate in the county. The segment begins at state mile post 351.9. This segment has the second highest high crash segment ADT (144,080 vehicles per day) of the entire study corridor, which is double the average urban high crash segment ADT for the study corridor. It is located just north of the St. Johns River and includes 14 local street ramps in addition to the I-10/I-95 systems interchange. At least four of the local street ramps are left side entrance or exit ramps which can be problematic for driver expectancy. The sheer volume of traffic combined with the number of access points creates a safety issue, which is then made worse by creating merge/diverge areas on both sides of the freeway.



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It is TranSystems' understanding that construction is currently ongoing in this area which will add capacity to I-95 and develop collector-distributor systems to reduce the number of conflict points on the mainline. These improvements will presumably reduce the crash rates within the improvement area. Future evaluations should be completed once these improvements have been in place and traffic adjusts to determine if any further improvements should be recommended to address safety.

Flagler County – Location B

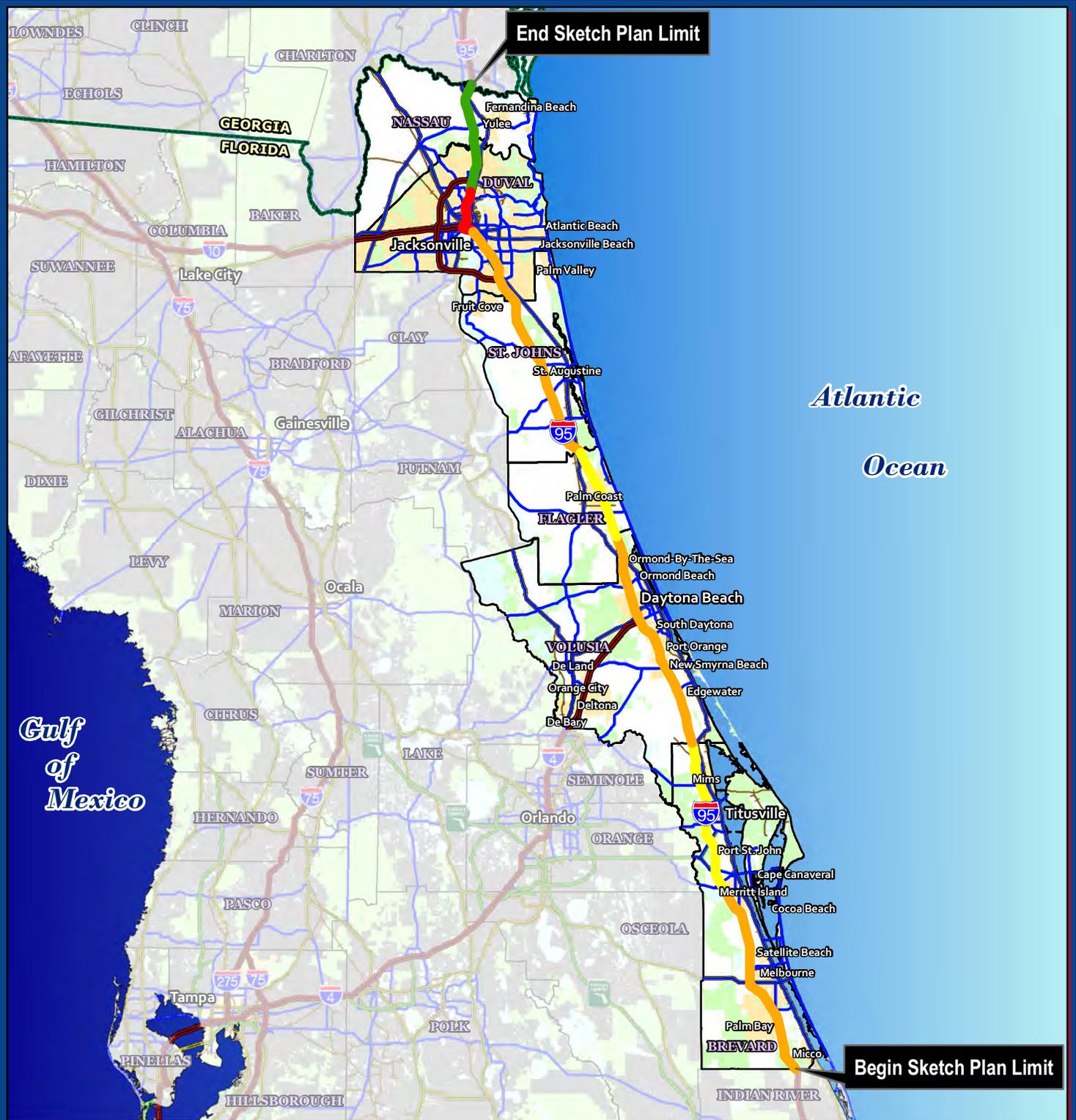
The highest crash rate in the study corridor is in the area of I-95 between Flagler Beach and Palm Coast in Flagler County beginning at state mile post 287.5. One evident reason for the high rate is that the segment is only 0.1 mile long; however, 27 crashes occurring in such a small area is noteworthy, especially considering that the ADT is only 62,580 vehicles per day. This segment of I-95 is a flat, tangent section with no ramps in the vicinity. There is a 6'x4'x174' concrete box culvert in the segment, but otherwise there are no significant structures. A closer review of the crash reports for this section shows seven sideswipe crashes and six crashes that were either a vehicle overturning, run-off-road into water, or run into ditch type crash. The high crash rate for this segment and the percentage of crashes that appear to involve a loss of vehicular control indicate a need to further analyze the area to determine if there is a common factor among these crashes. Besides having the segment with the highest crash rate, Flagler County is the only one other than Duval County that has crash frequencies greater than 50, even though it has the lowest county-wide Urban ADT in the study corridor. The resources used for this study do not provide an explanation for this increase. Further review of the police crash reports is recommended to resolve this concern.

Brevard County – Location C

The third highest crash rate in the study area is located in Brevard County at state mile post 228.7 between the Main Street and SR 46 interchanges, north of rest area #105. The high crash segment is in the vicinity of a railroad overpass, but the crash types do not seem to be related to the overpass. The segment falls on a 1°50' curve with a deflection of 29°50'. The crash trends appear to support that the curve is relevant as half of the 40 crashes on this segment were overturned vehicles and another five hit guardrail or went into a ditch. A further review of this area should be performed to determine what aspects of this curve are causing the high number of crashes on this freeway segment.

St. Johns County – Location D

The fourth highest high crash segment crash rate occurred in St Johns County just south of the CR 210 interchange beginning at state mile post 328.15. The segment of I-95 is a tangent portion of freeway between reverse curves. The crash experience in the vicinity indicates that of the twenty crashes reported on this segment of I-95, six were sideswipe crashes and five involved the at-fault driver leaving the travel way. The combination of these crash types imply the drivers are losing control of their vehicles, and the likely causes would be the reverse curves and nearby interchange. A further review of the detailed crash reports could provide more insight into what could be done to address these crashes.



LEGEND

Total Crashes (2003-2007)

- █ 2,001 - 2,564
- █ 1,001 - 2,000
- █ 501 - 1,000
- █ 212 - 500

Transportation Network

- Interstate Highway
- Toll Road
- U.S. Highway
- State Route
- Railroad

Other Layers

- █ City and Town Limits
- █ Ocean
- █ Lakes and Rivers
- █ County Boundary
- █ State Boundary
- █ Public Lands
- █ I-95 SIP Study Area

**Figure 2 - Total Crashes (2003-2007)
I-95 Sketch Interstate Plan (SIP)**

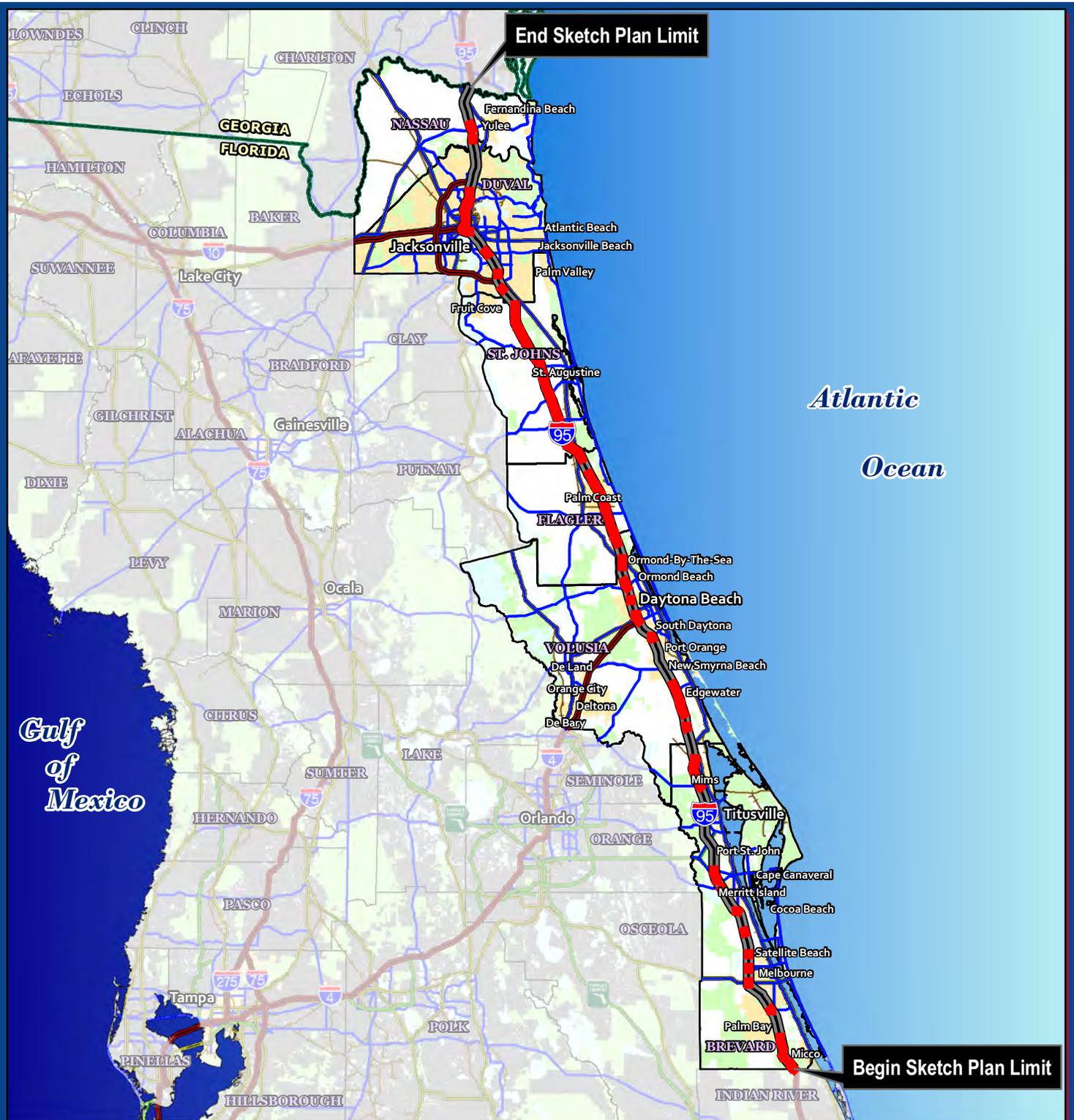
NOTES:

- 1) 10,404 Crashes occurred within I-95 SIP Study Area
- 2) 10,155 Injuries and 300 Fatalities occurred within I-95 SIP Study Area.

This map is intended for planning purposes only.

Source: FDOT, and TranSystems.





LEGEND

- High Crash Segments (2003-2007)
- I-95 SIP Study Area
- Transportation Network**
- Interstate Highway
- Toll Road
- U.S. Highway
- State Route
- Railroad
- Other Layers**
- City and Town Limits
- Ocean
- Lakes and Rivers
- County Boundary
- State Boundary
- Public Lands
- I-95 SIP Study Area

**Figure 3 - High Crash Segments
I-95 Sketch Interstate Plan (SIP)**

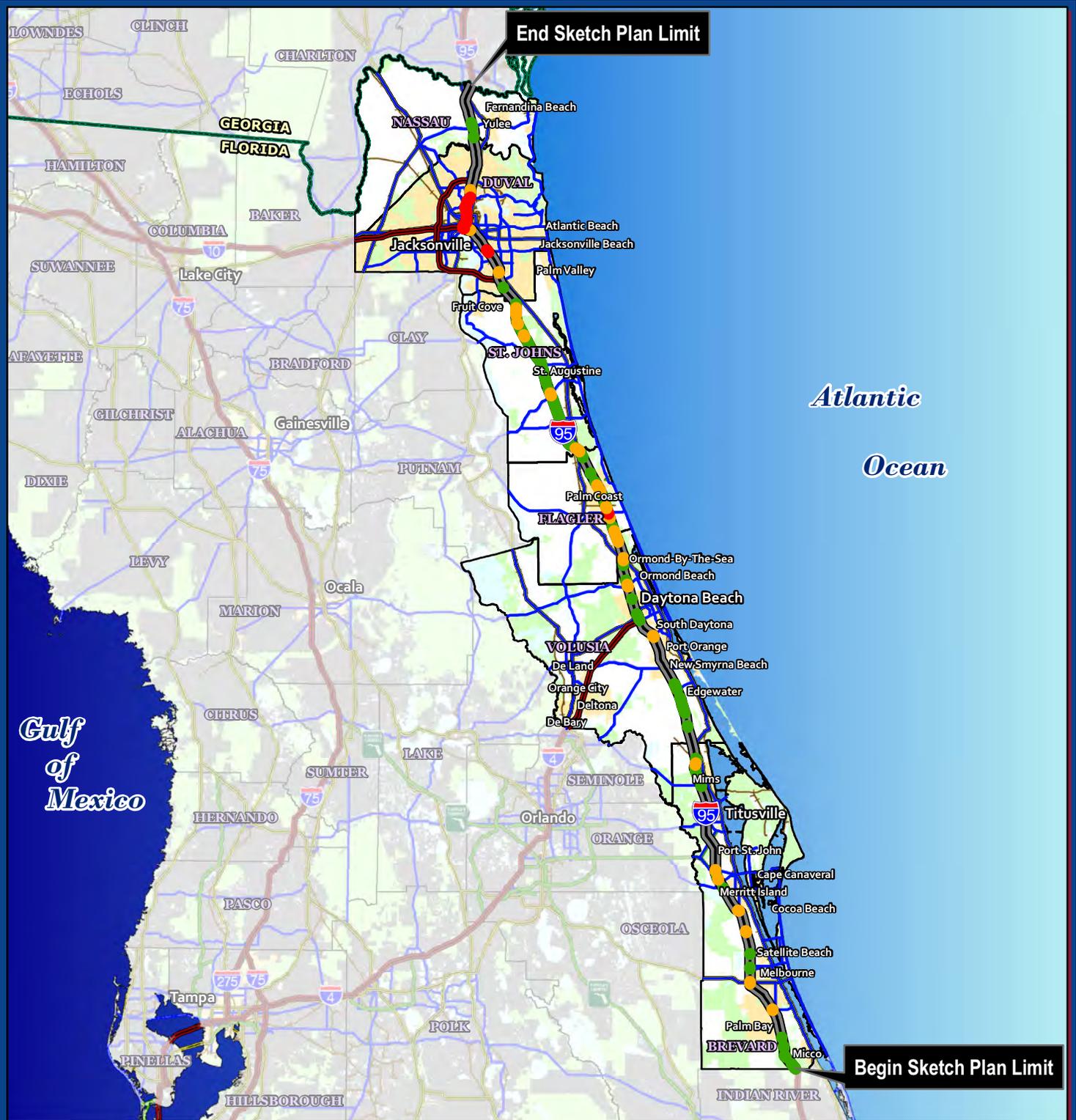
NOTES:

1) 5,002 Crashes occurred within I-95 SIP Study Area High Crash Segments

This map is intended for planning purposes only.

Source: FDOT, and TranSystems.





LEGEND

Total Injuries (2003-2007) Along High Crash Segments

- █ 92 - 504
- █ 34 - 92
- █ 0 - 33

Transportation Network

- Interstate Highway
- Toll Road
- U.S. Highway
- State Route
- Railroad

I-95 SIP Study Area
Other Layers

- City and Town Limits
- Ocean
- Lakes and Rivers
- County Boundary
- State Boundary
- Public Lands
- I-95 SIP Study Area

**Figure 4 - Total Injuries (2003-2007)
I-95 Sketch Interstate Plan (SIP)**

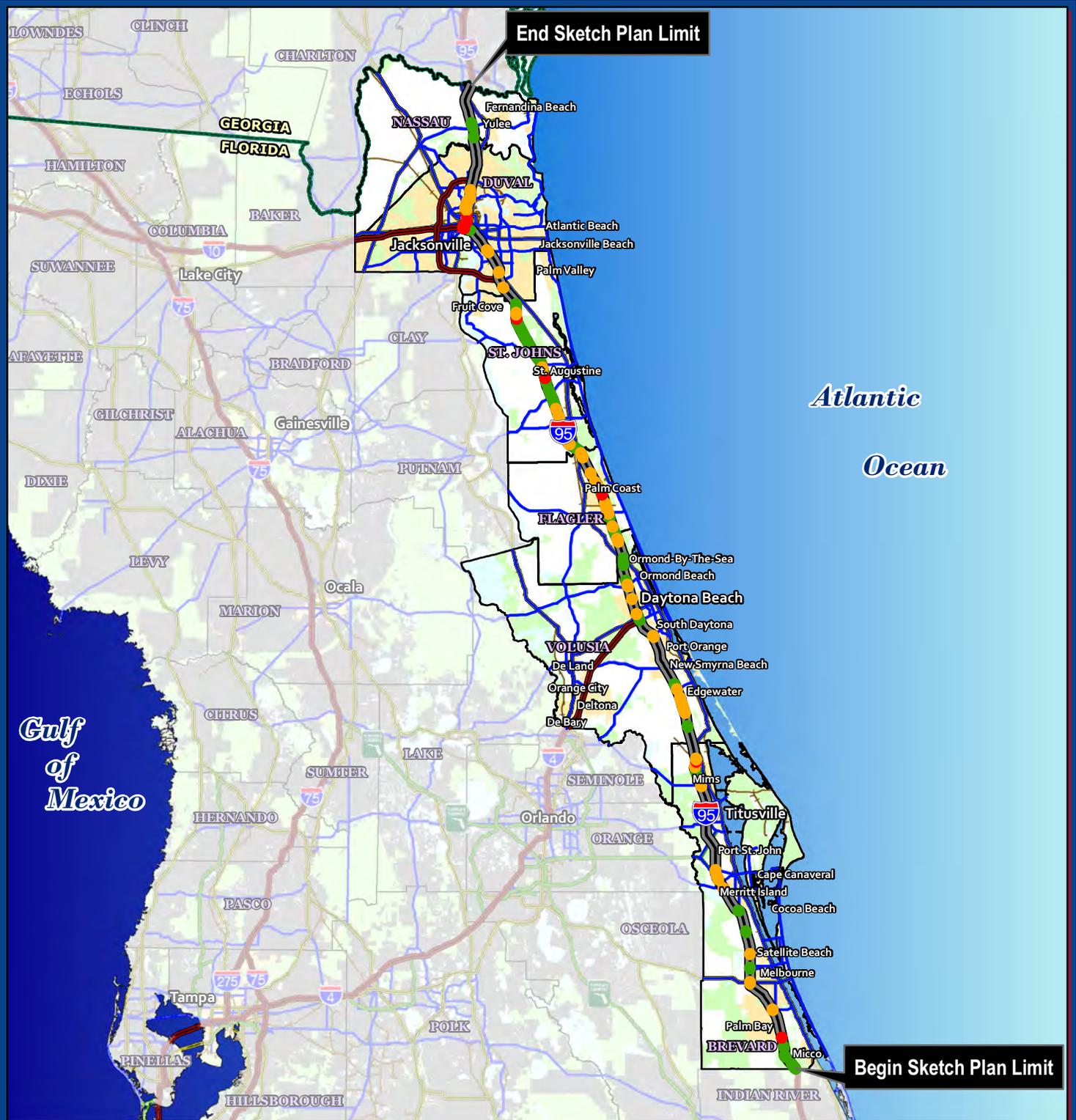
NOTES:

1) 4,693 Injuries occurred within High Crash Segments

This map is intended for planning purposes only.

Source: FDOT, and TranSystems.





LEGEND

Crash Rates (2003-2007) Along High Crash Segments

- █ 1.53 - 2.36
- █ 0.96 - 1.52
- █ 0.54 - 0.95

Transportation Network

- Interstate Highway
- Toll Road
- U.S. Highway
- State Route
- Railroad

- Other Layers**
- I-95 I-95 SIP Study Area
 - City and Town Limits
 - Ocean
 - Lakes and Rivers
 - County Boundary
 - State Boundary
 - Public Lands
 - I-95 SIP Study Area

**Figure 5 - Crash Rates (2003-2007)
I-95 Sketch Interstate Plan (SIP)**

NOTES:

- 1) FDOT District Average Crash Rate for the I-95 SIP Study Area = 0.417. Therefore all high crash segments within the I-95 SIP Study Area are exceeding the FDOT District average
- 2) Average Crash Rate within the High Crash Roadway Segments = 0.995

This map is intended for planning purposes only.

Source: FDOT, and TranSystems.





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7.0 Crash Costs

Within the study area, 300 fatalities (**Figure 6**) and 10,155 injuries (**Figure 7**) were recorded on I-95 between 2003 and 2007. The Federal Highway Administration issued crash costs in a 2005 document titled “Crash Cost Estimates by Maximum Police-Reported Severity within Selected Crash Geometries. The report listed human capital costs and comprehensive societal costs of crashes by severity using 2001 dollars. Human capital costs are defined as medical care, emergency services, property damage, and lost productivity. Comprehensive societal costs include not only the human capital costs but also the nonmonetary costs associated with the reduction in quality of life. The 2001 costs were updated using 2001 and 2008 consumer price indices (human capital cost) and employment cost indices (remainder of the comprehensive societal costs). Based on these figures, the crash history within the segment has cost society approximately \$1.8 billion, or \$363 million per year.

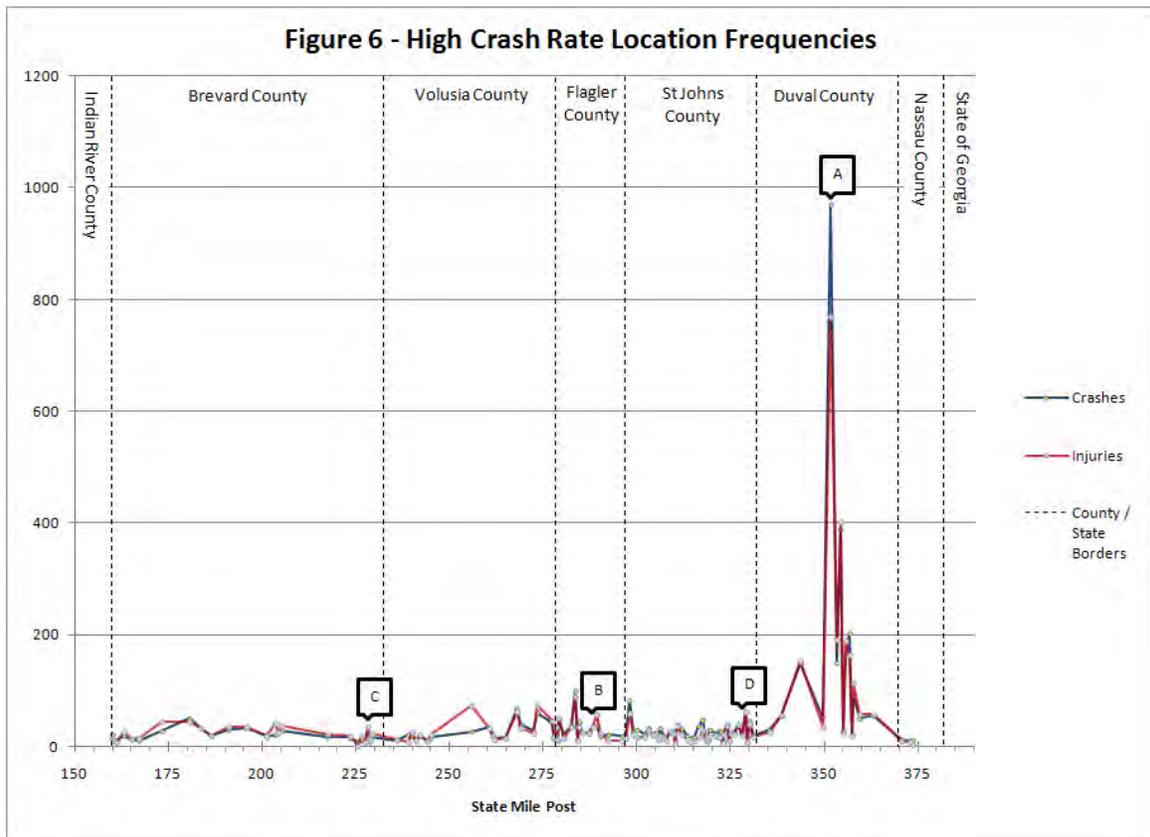


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Table 2. Study Area Crash Costs (5 Years, 2008 dollars)

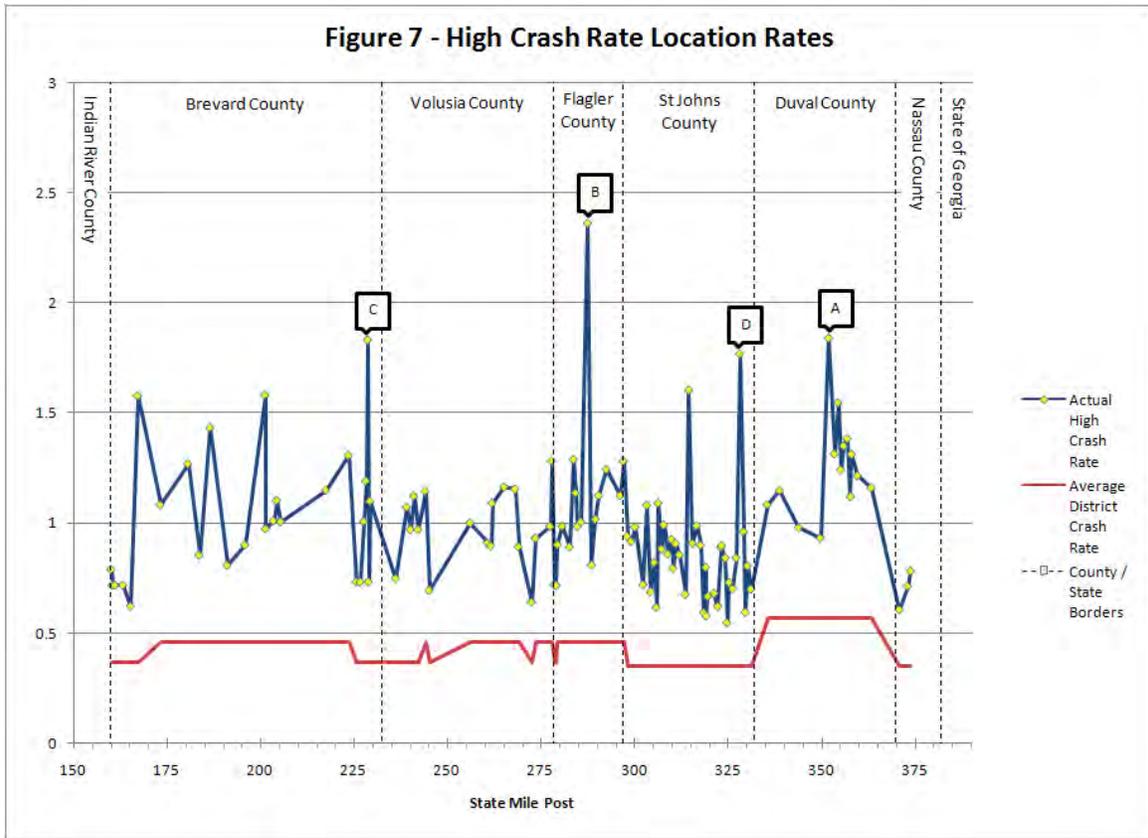
| Category | Frequency | Human Capital Cost Per Crash | Comprehensive Societal Cost Per Crash | Human Capital Total Cost | Comprehensive Societal Total Cost |
|------------------------------|-----------|------------------------------|---------------------------------------|--------------------------|-----------------------------------|
| Fatality Crashes | 259 | \$1,514,300 | \$4,828,300 | \$392,203,700 | \$1,250,529,700 |
| Injury Crashes | 5,487 | \$50,900 | \$95,400 | \$279,288,300 | \$523,459,800 |
| Property Damage Only Crashes | 4,657 | \$7,800 | \$9,000 | \$36,324,600 | \$41,913,000 |
| Total | | | | \$707,816,600 | \$1,815,902,500 |





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8.0 Conclusions

The purpose of this study was to analyze, on a macroscopic level, crash data reported on I-95 between the Brevard/Indian River County line and the Florida/Georgia state line. The crash statistics indicate that while the crash rate for the overall corridor is low, a large portion of the corridor is above the statewide and district crash rates. The high number of crashes has resulted in a comprehensive societal cost over five years of nearly \$2 billion. When reviewing the crash statistics for the entire corridor, four locations stood out as possible safety concerns:

- Duval County in downtown Jacksonville: High crash numbers and the second highest crash rate may be attributed to closely-spaced access points and left-side merge/diverge areas, combined with a very high volume of traffic.
- Flagler County between Flagler Beach and Palm Coast: The highest crash rate may be attributed in part to drivers losing vehicular control in a very short segment of highway. Further analysis of detailed crash reports are needed to confirm the specific cause. In general, the county has higher crash frequencies than most of the other counties in the corridor, but a review of geometric features and traffic volumes does not provide a clear explanation for this.
- Brevard County between Main Street and SR 46: The third highest crash rate segment falls on a curve near a railroad bridge. The crash history shows a large portion of the crashes being an overturned vehicle implying that there are deficiencies in the curve.
- St. Johns County south of CR 210: The high crash segment with the fourth highest crash rate falls between reverse curves. The crash history implies loss of control likely caused by the curves. Further study should be performed.