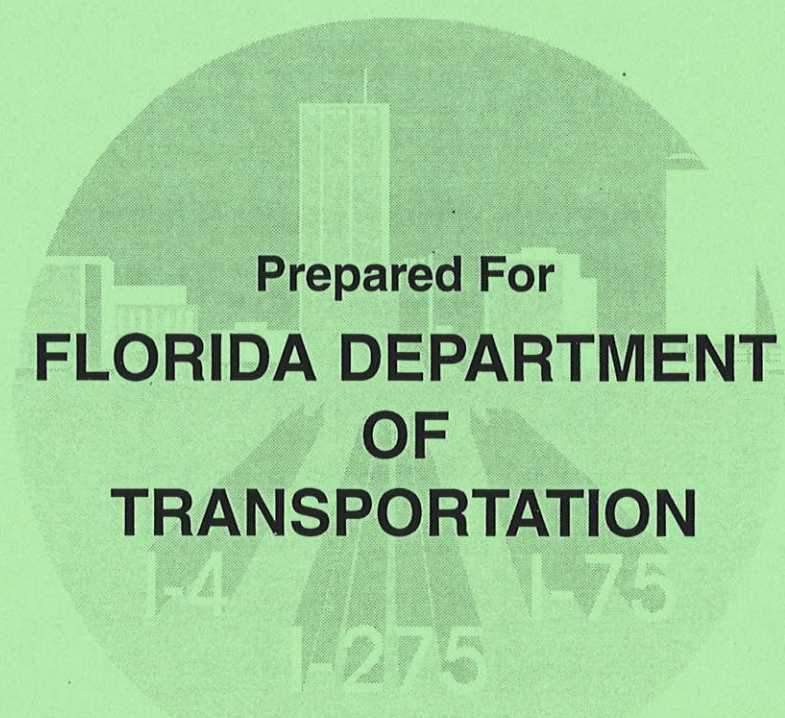


I-275/I-4 INTERCHANGE OPERATIONAL/SAFETY IMPROVEMENTS TECHNICAL MEMORANDUM TAMPA INTERSTATE STUDY

WPI No. 7140004, State Project No. 99007-1402, FAP No. IR-9999(43)

Interstate 275 (I-275) from the Hillsborough River to Floribruska Avenue and Interstate 4 (I-4) from the I-275/I-4 merge to east of 22nd Street (Section 10320-MP 0.0 to MP 0.7 and Section 10190-MP 6.389 to MP 8.49) approximately 4.5 kilometers (2.8 miles) in length.



Prepared For
**FLORIDA DEPARTMENT
OF
TRANSPORTATION**

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I-275/I-4 Interchange Operational/Safety Improvements

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EXECUTIVE SUMMARY

I-275/I-4 Interchange Operational/Safety Improvements

The I-275/I-4 interchange is located immediately to the north of the Tampa Central Business District and provides direct access to/from the downtown area. This interchange was designed and constructed in the early 1960s. The existing interchange was designed to accommodate traffic volumes in the range of 40,000 to 60,000 vehicles per day (vpd), however, current traffic volumes range between 134,000 and 182,000 vpd. Since there have been no improvements to this interchange over the last 30 years and the current travel demand is more than three times the original design year volume, safety throughout the interchange area has become a serious problem.

Interstate 275 and Interstate 4 are two of the most vital components of Hillsborough County's surface transportation system. A Master Plan for these facilities was approved by the FHWA in August 1989 and adopted by the Hillsborough County Metropolitan Planning Organization (MPO) in November 1989. As a part of the overall plan to improve the quality of travel on I-275 and I-4, the Florida Department of Transportation (FDOT) has earmarked \$80 million (for construction and right-of-way acquisition) to improve the safety and operations in the I-275/I-4 interchange area.

The I-275/I-4 interchange study limits are I-275 from the Hillsborough River northward to Floribaska Avenue and I-4 from the I-275/I-4 junction to just east of 22nd Street. The total length of the study area is approximately 4.5 kilometers (2.8 miles).

The existing interchange laneage and ramp configuration has been a major contributing factor to the high frequency of vehicular accidents during both peak and non-peak hours. The lack of adequate acceleration lane lengths, the presence of left-side on-ramps and right-side off-ramps and the diverge areas located immediately downstream of sharp curves cause problems for drivers entering and exiting the interchange area. These existing problem areas are characterized by a high level of vehicle turbulence resulting from a high frequency of lane-changing maneuvers (i.e., weaving) and significant disparities in vehicle densities and speeds across adjacent lanes. The improvements proposed for the I-275/I-4 interchange are expected to alleviate the current operational problems occurring at these merge/diverge and weaving areas.

The lack of continuous adequate width shoulders within the interchange study area limits the lateral clearance available to the driver which, in turn, increases the potential for accidents to occur. The minimal existing lateral clearance greatly reduces the driver's ability to avoid objects in the travel lane and collisions with other vehicles. The existing shoulder widths also have a negative impact on traffic flow since disabled vehicles often encroach into the actual travel lanes due to insufficient shoulder width for vehicle refuge.

Due to the high volume of traffic traveling through the I-275/I-4 interchange, there is a large number of multiple vehicle accidents occurring. In addition, even when relatively

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minor accidents occur, long vehicular queues develop and stop-and-go conditions exist for several hours.

To determine the specific improvements required to increase the overall safety and hence improve the overall operations in the study area, the following tasks were conducted:

- Existing daily and peak hour traffic counts were conducted for all on-/off-ramps and selected mainline locations;
- Video surveillance (both moving vehicle and stationary locations) of traffic flow at key merge/diverge and weaving locations was conducted during the a.m. and p.m. peak periods;
- Historic accident data was reviewed and categorized to identify the most prevalent types of accidents by location; and
- An inventory of existing interchange geometrics (e.g., shoulder widths, degree of curvature, vertical clearance) was conducted and compared to current FDOT and AASHTO standards.

The results of these tasks confirmed that the locations experiencing the most turbulent traffic flow and congestion were also experiencing the highest number of accidents. Over the last five years, 982

accidents (approximately 200 accidents per year) have taken place over a total roadway length of approximately two miles. In addition, a majority of these same locations also have shoulder widths of four feet or less.

Based on these results, it was determined that the following locations should be improved:

- Northbound I-275 in the vicinity of the Ashley Street on-ramp (merge problem);
- Eastbound I-4 between the southbound I-275 flyover ramp and the 21st Street off-ramp (lane continuity and weave problems);
- Southbound I-275 between the I-275/I-4 merge and the Ashley Street off-ramp (merge and weave problems); and
- Westbound I-4 east of the I-275/I-4 merge (merge and weave problems).

In general, the improvements proposed for the I-275/I-4 interchange area include revising the geometry at merge areas, providing auxiliary lanes, replacing left-side on-ramps with right-side on-ramps, providing better lane continuity, providing lane balance at exit gore areas, relocating major diverges from the mainline to a local collector/distributor roadway, and providing standard shoulders in areas where improvements are proposed.

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A comparison of the existing traffic operations and the traffic operations anticipated to occur with the proposed improvements indicates that the improvements are expected to result in a more uniform distribution of volume across the travel lanes, higher overall travel speeds, smaller disparities in vehicle speeds across the travel lanes and in adjacent roadway segments, and fewer numbers of weaving vehicles. These improvements will provide drivers with increased horizontal sight distance, as well as increased time and distance to execute merge, diverge, and weaving maneuvers. Consequently, these improvements are expected to reduce the frequency of accidents and improve driver safety. The proposed improvements are also expected to reduce the turbulence experienced by mainline through vehicles as a result of merging/diverging and weaving vehicles which, in turn, will improve the overall quality of flow through the entire interchange area. Lastly, the construction of standard shoulders, where economically feasible, will provide a safer refuge area for use by disabled vehicles.

1.0 INTRODUCTION

I-275/I-4 Interchange Operational/Safety Improvements

The I-275/I-4 interchange is located immediately to the north of the Tampa Central Business District (CBD) and provides direct access to/from the downtown area. This interchange was designed and constructed in the early 1960s. The existing interchange was designed to accommodate traffic volumes in the range of 40,000 to 60,000 vehicles per day (vpd), however, current traffic volumes are over three times the original design year volumes. Since there have been no improvements to this interchange over the last 30 years, safety has become a serious problem.

Due to the high volume of traffic traveling through the I-275/I-4 interchange and the existing ramp configuration/geometrics, there has been a large number of accidents occurring in recent years. Many of these accidents have involved multiple vehicles and, often times, these accidents have resulted in temporary lane closures. Even when relatively minor accidents occur, long vehicular queues develop and stop-and-go traffic flow exists for several hours. These situations result in excessive vehicle delays, increased vehicle emissions and fuel consumption, and a high driver frustration level. Consequently, there exists a need to improve the operations and safety in the I-275/I-4 interchange area.

I-275 and I-4 are two of the most vital components of Hillsborough County's surface transportation system. A Master Plan for these facilities was approved by the FHWA in August 1989 and adopted by the Hillsborough County Metropolitan Planning Organization

(MPO) in November 1989. As a part of the overall plan to improve the quality of travel on I-275 and I-4, the Florida Department of Transportation (FDOT) has earmarked \$80 million (for construction and right-of-way acquisition) to improve the safety and operations in the I-275/I-4 interchange area.

This technical memorandum summarizes the existing conditions in the interchange study area, including the laneage and ramp configuration, existing operational problem areas, and recent accident history. For the purpose of this study, the I-275/I-4 interchange study limits are I-275 from the Hillsborough River northward to Floribaska Avenue and I-4 from the I-275/I-4 junction to just east of 22nd Street. The project study limits are illustrated on Exhibit 1.1. The total length of the study area is approximately 4.5 kilometers (2.8 miles).

This document also summarizes the specific operational and safety improvements recommended for the I-275/I-4 interchange and discusses the benefits anticipated to occur with the implementation of these improvements. A detailed discussion of the alternative improvements that were considered and rejected and the specific engineering elements associated with the preferred alternative (e.g., horizontal and vertical geometry, structures, design exceptions/variances preliminary cost estimate) is provided in the August 1996 Engineering Summary Report, published separately.

2.0 EXISTING CONDITIONS

I-275/I-4 Interchange Operations Safety Improvements

The existing interchange laneage and ramp configuration has been a major contributing factor to the high frequency of vehicular accidents occurring during both peak and non-peak hours. The lack of adequate acceleration lane lengths, the presence of left-side on-ramps and right-side off-ramps and the diverge areas located immediately downstream of sharp curves cause problems for drivers entering and exiting the interchange area. These existing problem areas are characterized by a high level of vehicle turbulence resulting from a high frequency of lane-changing maneuvers (i.e., weaving) and significant disparities in vehicle densities and speeds across adjacent lanes.

The lack of continuous adequate width shoulders within the interchange study area limits the lateral clearance available to the driver which, in turn, increases the potential for accidents to occur. The minimal existing lateral clearance greatly reduces the driver's ability to avoid objects in the travel lane and collisions with other vehicles. The existing shoulder widths also have a negative impact on traffic flow, since disabled vehicles often encroach into the actual travel lanes due to insufficient shoulder width for vehicle refuge.

The remaining portion of this section documents the existing conditions in the interchange study area. The existing conditions that are discussed include the following:

- Mainline laneage, ramp configuration, and ramp spacing;

- Demand and peak hour traffic volumes;
- Operational problem areas;
- Recent accident history; and
- Shoulder widths.

2.1 Mainline Laneage, Ramp Configuration and Ramp Spacing

Access to/from I-275 within the study area is currently provided at Ashley Street/Scott Street, Kay Street/Tampa Street, Scott Street/Orange Street, Floribrasca Avenue, and I-4. Access to/from I-4 within the study area is currently provided at 21st/22nd Streets and I-275. A lane line diagram depicting the existing mainline and ramp laneage along with critical distances is provided on Exhibit 2.1

Four northbound lanes are provided on I-275 at the south end of the Hillsborough River Bridge. Three of these four lanes are basic lanes that continue along either I-275 or I-4 throughout the entire interchange study area while the fourth lane is an auxiliary lane that originates at the Howard/Armenia Avenue interchange (the adjacent interchange to the south of the Ashley Street interchange). At the north end of the Hillsborough River Bridge, the auxiliary lane is terminated as an off-ramp to Ashley Street and Scott Street. The three basic lanes continue northward on structure and cross over Tampa Street, Franklin Street, Florida Avenue, Marion Street, and Morgan Street. An on-ramp from Ashley Street merges with the three

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northbound I-275 lanes in the vicinity of Tampa Street and Florida Avenue.

North of Morgan Street (the northern end of the viaduct section), two single-lane on-ramps join I-275 adding one lane to both the right-side and left-side of the roadway for a total of five northbound lanes. Both of these on-ramps provide access from Orange Street and Scott Street. The left-side on-ramp is signed for northbound I-275 while the right-side on-ramp is signed for eastbound I-4. This geometric configuration eliminates the need for any on-ramp vehicles to change lanes on I-275 prior to the I-275/I-4 diverge.

Immediately north of the Palm Avenue overpass, the five lanes diverge with three lanes continuing northward along I-275 and the other two lanes continuing to the east as the beginning of I-4. The three northbound I-275 lanes pass underneath the two-lane westbound I-4 structure and the one-lane flyover ramp from southbound I-275 to eastbound I-4. These lanes are joined by a single-lane ramp from westbound I-4 in the vicinity of the Columbus Drive overpass, and four lanes are provided on northbound I-275 from this ramp to north of the single-lane on-ramp from Floribaska Avenue.

East of the I-275/I-4 diverge, the two eastbound I-4 lanes are joined on the left side by a single lane flyover ramp from southbound I-275. Three lanes are provided from this on-ramp gore eastward over 14th and 15th Streets to the 21st Street off-ramp. The outside lane (which is the lane added by the right-side I-4 on-ramp from Orange/Scott Streets) is then terminated as the off-ramp to

21st Street while the other two lanes continue eastward past the 22nd Street on-ramp. With this existing configuration, there is only one basic lane that extends from south of the Hillsborough River to east of the 21st/22nd Street interchange.

Four southbound lanes are provided on I-275 from north of the Floribaska Avenue off-ramp to the eastbound I-4 off-ramp. The outside lane is an auxiliary lane that originates at the Dr. Martin Luther King, Jr. Boulevard interchange (the adjacent interchange to the north of the Floribaska Avenue interchange) and is terminated as the single-lane off-ramp to eastbound I-4. Three lanes continue southbound on I-275 until just south of the Columbus Drive overpass, where another lane is terminated as an off-ramp to the Tampa CBD (via Orange Street and Kay Street). The remaining two southbound I-275 lanes pass underneath the two-lane westbound I-4 structure and the one-lane flyover ramp from southbound I-275 to eastbound I-4.

South of the Palm Avenue overpass (in the vicinity of the 7th Avenue/Henderson Street overpasses), these two lanes are joined on the right-hand side by two lanes from westbound I-4. Approximately 398 meters (1,305 feet) south of the I-275/I-4 junction, the outside (i.e., fourth) lane is tapered out and three lanes continue southward over Morgan Street, Marion Street, Florida Avenue, Franklin Street, and Tampa Street. A single lane off-ramp to Ashley Street is provided at the southern end of the viaduct section (in the vicinity of the Tampa Street overpass). This off-ramp is located

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I-275/I-4 Interchange Operational/Safety Improvements

approximately 563 meters (1,845 feet) south of the point where the outside lane from westbound I-4 is tapered out. Three lanes continue south of this diverge area.

A two-lane on-ramp formed by the combination of the one-lane loop ramp from Ashley Street and the one-lane slip ramp from Kay Street/Tampa Street joins southbound I-275 at the north end of the Hillsborough River Bridge. The outside ramp lane is tapered out while the inside ramp lane is added as an auxiliary lane providing four lanes on southbound I-275 at the south end of the Hillsborough River Bridge. (This auxiliary lane is subsequently terminated at the Howard/Armenia Avenue interchange located to the south of the Hillsborough River.)

On I-4 east of the 21st/22nd Street interchange, two lanes are provided in the westbound direction. These two lanes continue across 22nd Street and 21st Street and are then joined by a one-lane on-ramp from 21st Street. This on-ramp is added as an auxiliary lane and three westbound lanes are provided from this on-ramp gore to the northbound I-275 off-ramp gore located just east of the Nebraska Avenue bridge. The auxiliary lane is terminated at this off-ramp and the other two lanes continue in a southwesterly direction towards the southbound I-275 roadway. North of Palm Avenue, a one-lane off-ramp diverges from I-4, while the two I-4 lanes continue across Palm Avenue and join with southbound I-275 in the vicinity of 7th Avenue. The one-lane off-ramp from westbound I-4 joins with the one-lane off-ramp from southbound I-275 just

south of Palm Avenue. These two lanes widen to three lanes and function as a collector-distribution (C-D) roadway, providing access to the Tampa CBD. Approximately 390 meters (1,280 feet) downstream from the location where the southbound I-275 and westbound I-4 ramps join together, the C-D roadway diverges with two lanes continuing south to Orange Street and two lanes continuing west to Kay Street.

2.2 Daily and Peak Hour Traffic Volumes

To quantify the existing travel demand in the study area, traffic counts were conducted between July 18, 1995 and August 3, 1995. The traffic counts included 24-hour machine counts (directional volumes in 15-minute increments) on selected mainline I-275 and I-4 locations, as well as on all on/off-ramps within the project study limits. The traffic counts were adjusted using weekly adjustment factors provided by the FDOT. The existing daily traffic volumes for I-275 and I-4 are illustrated on Exhibit 2.2.

As indicated on Exhibit 2.2, the existing daily traffic volumes on I-275 range from approximately 136,000 vehicles per day (vpd) south of the Floribraska Avenue on/off-ramps to 182,000 vpd across the Hillsborough River (i.e., west of the Ashley Street interchange). The existing daily traffic volume on I-4 between I-275 and the 21st/22nd Street interchange is approximately 134,000 vpd.

Since the 24-hour machine counts were conducted in 15-minute increments, the peak

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hour volumes could be identified through review of the machine count data. Although the exact beginning and ending times of the peak hours varies based on the specific ramp location, the morning and evening peak periods generally occur from 7:00 a.m. to 9:00 a.m. and from 4:00 p.m. to 6:00 p.m., respectively. A majority of the locations within the interchange study area experience their highest traffic volumes between 7:00 a.m. and 8:00 a.m. and between 4:30 p.m. and 5:30 p.m. The existing peak hour volumes for the study area are provided on Exhibit 2.3.

Exhibit 2.3 indicates that, during the a.m. and p.m. peak hours, the northbound and southbound volumes on I-275 south of the Ashley Street interchange are approximately equal. This same situation occurs on I-4 immediately east of I-275. In contrast, the peak hour traffic volumes on I-275 north of I-4 and on the ramps to/from the Tampa CBD are highly directional. In the a.m. peak hour, the peak traffic flow is oriented southbound on I-275 into the CBD, while in the p.m. peak hour, the peak traffic flow is out of the CBD and northbound on I-275.

There are currently 15 single-lane ramps in the interchange study area. Six of the 15 single-lane ramps have a.m. and/or p.m. peak hour volumes greater than 1,000 vehicles/hour and three of these ramps have a.m. and/or p.m. peak hour volumes greater than 1,500 vehicles/hour. The three single-lane ramps with the highest peak hour volumes are as follows:

- Northbound I-275 off-ramp to Ashley Street/Scott Street (2,207 vehicles in the a.m. peak hour)
- Southbound I-275 off-ramp to eastbound I-4 (1,594 vehicles in the a.m. peak hour)
- Southbound I-275 off-ramp to the southbound C-D roadway (1,837 vehicles in the a.m. peak hour)

2.3 Operational Problem Areas

Video surveillance of the traffic flow on I-275 and I-4 was conducted at several stationary locations and from inside moving vehicles during the morning and evening peak periods. The purpose of this video surveillance was to identify the locations within the study area that are currently experiencing operational problems and determine the specific cause(s) of the operational problems. Reviews of the videotape along with the on-site observations recorded by field personnel revealed the following primary problem areas:

- Northbound I-275 in the vicinity of the Ashley Street on-ramp;
- Eastbound I-4 between the southbound I-275 on-ramp and the 21st Street off-ramp;
- Southbound I-275 between the I-275/I-4 junction and the Ashley Street off-ramp; and

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- Westbound I-4 between the 14th/15th Street overpass and the I-275/I-4 junction.

The specific type of problem occurring at each of these locations is discussed in the following paragraphs.

Northbound I-275 in the Vicinity of the Ashley Street On-Ramp

As stated earlier in Section 2.1 of this report, there is only one basic (i.e., through) lane on northbound I-275 south of the Hillsborough River that continues to eastbound I-4. Consequently, most of the northbound I-275 to eastbound I-4 vehicles are traveling in this lane upstream of the Ashley Street on-ramp. The large number of vehicles traveling in this lane and the close vehicle spacings severely limit the size and the number of vehicle gaps that are available for Ashley Street on-ramp vehicles to merge into. The vehicles using the Ashley Street on-ramp to access northbound I-275 must travel on a sharp curve which currently has a design speed of 40 kilometers per hour (25 miles per hour) and merge with the vehicles in the outside lane in a distance of approximately 142 meters (465 feet). The length of the acceleration lane provided at this on-ramp is approximately 75 meters (245 feet) while the length of the taper is approximately 67 meters (220 feet).

These factors combine to create a difficult merge maneuver for the Ashley Street on-ramp vehicles. The horizontal

curvature and grade of the on-ramp requires the on-ramp vehicles to travel at relatively low rates of speed (compared to the mainline vehicle speeds) as they approach the beginning of the merge area. The high speed of the mainline vehicles requires that the on-ramp vehicles accelerate rapidly to be able to merge into the mainline traffic stream. The short acceleration lane/taper does not provide adequate time/distance for the ramp vehicles to accelerate to the appropriate merge speed. Consequently, one of the following situations often occurs:

- Vehicles stop suddenly in the merge area because they are not able to "find" an acceptable gap to merge into in the available distance; or
- Vehicles merge into a gap in the outside mainline lane traveling at a low rate of speed; or
- Vehicles travel on the ramp at speeds higher than the design speed of the ramp and select the first gap that occurs in the outside freeway lane (regardless of the size of the gap) since they do not have sufficient distance to stop safely on the acceleration lane.

All of these situations create a potential accident problem (depending on the reactions of the drivers of the adjacent vehicles) and both the second and third situations cause increased turbulence in

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the merge area due to the disparity in vehicle speeds in the outside lane. In addition, mainline vehicles traveling in the outside lane in the vicinity of the merge area often change lanes suddenly and enter the center lane to avoid the on-ramp vehicles. These sudden lane changes further increase the turbulence in this section of northbound I-275. Finally, it should be noted that during the peak hours, the on-ramp merge maneuver usually occurs at relatively low speeds (often as a stop-and-go forced merge) due to the density of vehicles traveling in the outside mainline lane and the negative impact of the ramp geometrics is not as significant as it is before and after the peak hours.

Eastbound I-4 Between the Southbound I-275 On-Ramp and the 21st Street Off-Ramp

A majority of the vehicles traveling on the two eastbound I-4 lanes upstream of the southbound I-275 flyover ramp are destined for locations east of the 21st/22nd Street interchange. Since the outside (right) lane is actually an auxiliary lane that originates as the right-side on-ramp from Orange Street and terminates at 21st Street, there is a highly skewed distribution of vehicles in these two lanes with over 2,000 vehicles traveling in the inside (left) lane. This lane configuration and uneven traffic volume distribution results in through vehicles using the outside auxiliary lane as a "high-speed bypass lane" to avoid traveling in the heavily congested through lane.

However, these vehicles must move over into the adjacent through lane to continue traveling on I-4 east of the 21st/22nd Street interchange. During the a.m. peak period, most of this lane-changing occurs prior to the 14th/15th Street overpasses. During the p.m. peak period, a significant portion of the vehicles move into the adjacent lane in the vicinity of the 21st Street off-ramp and some vehicles change lanes in the actual exit gore area.

As stated earlier in this section, the southbound I-275 flyover ramp joins the two eastbound I-4 lanes on the left side and adds one lane to the roadway. Since the number of vehicles traveling in the center lane of eastbound I-4 (east of the southbound I-275 flyover ramp) is greater than the number of vehicles traveling in the inside (left) lane (i.e., the lane added from the southbound I-275 on-ramp), some of the vehicles move from the center lane to the inside lane. The movement of vehicles from the outside lane to the center lane that was discussed previously also causes some vehicles traveling in the center lane to move over to the inside lane. This shift of vehicles into the inside lane alters the operational characteristics of the southbound I-275 flyover. From a geometric standpoint, the flyover ramp adds a lane to the Interstate; consequently, the on-ramp vehicles should enter I-4 unimpeded. However, the lane-changing that occurs results in a situation where the add-lane vehicles must "merge" with the mainline vehicles that are shifting over.

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A secondary problem is caused by the vehicles on the southbound I-275 flyover ramp that exit at 21st Street. Based on the videotaped observations, approximately 12 percent of the vehicles traveling on the southbound I-275 flyover ramp in the a.m. peak hour exit at the 21st Street off-ramp. In the p.m. peak hour, approximately 15 percent of the southbound I-275 flyover ramp volume was observed to exit at 21st Street. This maneuver requires that vehicles change two lanes and weave across the entire I-4 roadway from left to right, thus, impacting the through vehicles. This weaving movement tends to occur prior to the 14th/15th Street overpasses and is further complicated by the previously discussed weaving maneuvers that are occurring from the right side of I-4 to the left side of I-4 and the relatively high volume of trucks traveling over this portion of I-4. The presence of trucks in this area also tends to increase the frequency of lane changing maneuvers, since passenger vehicles change lanes to pass these slower moving trucks.

Southbound I-275 Between the I-275/I-4 Junction and the Ashley Street Off-Ramp

Vehicles traveling in the outside (right) lane of westbound I-4 must merge into the adjacent lane in a distance of approximately 398 meters (1,305 feet), since the outside lane is tapered out after joining southbound I-275. All vehicles from westbound I-4 that exit at the Ashley Street off-ramp remain in the inside lane,

since this lane becomes the outside lane of southbound I-275 after the merge with I-4 is completed. Vehicles traveling in the outside (right) lane of southbound I-275 must change one lane to the right to exit at the Ashley Street off-ramp. The extremely high concentration of vehicles in the outside lane of southbound I-275 (downstream from the I-4 merge) tends to reduce the operating speed of vehicles in this lane. Since the operating speed of the vehicles in the outside lane is lower than the operating speeds of the vehicles traveling in the center and inside lanes, some of the vehicles from I-4 that are not destined for Ashley Street weave from the outside lane to the center lane in an attempt to increase their speed and reduce the turbulence they are experiencing. Consequently, weaving maneuvers are occurring from both sides of the roadway into or across the lane carrying the Ashley Street off-ramp traffic. A significant portion of the weaving occurs after the outside lane from westbound I-4 has been tapered out in the curved section of I-4 between the Central Avenue bridge and the Marion Street bridge.

Westbound I-4 Between the 14th/15th Street Overpasses and the I-275/I-4 Junction

The operational problems occurring in this section of roadway result from the merging of the westbound I-4 outside lane at the I-275/I-4 junction. The high peak hour traffic volumes on westbound I-4 just north of the junction, coupled with the

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short distance available for the vehicles in the outside lane to merge into the adjacent lane, causes stop-and-go merge conditions. Long vehicle queues often occur on westbound I-4 and extend back beyond the 14th/15th Street overpasses. Since the vehicle speeds in the inside and center lanes on westbound I-4 are low and the vehicle densities are high, some of the I-4 vehicles destined for southbound I-275 use the outside auxiliary lane to bypass a portion of the queued vehicles. These vehicles then "force" their way into the immediately adjacent lane (i.e., the outside lane of the two I-4 lanes that join southbound I-275) in the vicinity of the northbound I-275 exit gore.

A graphical summary of the primary operational problems (locations and causes) occurring in the I-275/I-4 interchange is provided on Exhibit 2.4.

One other location within the interchange study area—southbound I-275 between the off-ramp to eastbound I-4 and the off-ramp to the southbound C-D roadway—is also included in this section. North of the study area, four lanes are provided on southbound I-275. Three of the lanes are through lanes that extend north of the Dr. Martin Luther King, Jr. Boulevard interchange while the fourth lane is an auxiliary lane that is added to southbound I-275 at the Dr. Martin Luther King, Jr. Boulevard on-ramp. This auxiliary lane continues south of the Floribanks Avenue off-ramp and is terminated at the off-ramp to eastbound I-4. Three lanes are provided south of the I-4 off-ramp, however,

one I-275 mainline lane is terminated approximately 223 meters (730 feet) south of this location at the C-D road off-ramp gore area. Although this area is not currently experiencing any significant operational problems, the short distance between successive diverge areas does not provide the driver with adequate decision sight distance. Since both of these off-ramps involve lane reductions, there exists a potential for operational and/or safety problems to occur in the vicinity of these gore areas due to abrupt lane-changing maneuvers.

2.4 Recent Accident History

An evaluation of the recent accident history of the I-275/I-4 interchange was conducted to identify the locations, frequency, and types of accidents that have been occurring. Initially, the interchange study area was divided into ten segments based on the locations of the on-/off-ramps and bridge limits. The length of these segments ranged between 0.32 kilometers (0.2 miles) and 1.13 kilometers (0.7 miles). Accident data for the years 1990 - 1994 were obtained from the Florida Department of Transportation for each of the ten segments. Average safety ratios were calculated for this five-year period to identify those locations that have been experiencing unusually high accident frequencies. The safety ratio is a ratio of the actual accident rate to the critical accident rate. The critical accident rate is a statewide average accident rate that is based on the specific type of roadway, number of lanes, type of area, and average daily traffic volume. Safety ratios greater than 1.0 indicate that a particular

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location has been experiencing an above-average number of accidents (i.e., more accidents than would normally be expected to occur on a particular type of roadway based on historic statewide experience).

Four of the ten segments had five-year average safety ratios greater than 1.0, while two other segments had average safety ratios equal to 0.93 and 0.99. Although these two segments had five-year average safety ratios slightly less than 1.0, both of these segments had safety ratios greater than 1.0 for one or more individual years during the five-year overall period. Consequently, it was decided that a more detailed accident analysis should be conducted on all six of these segments. The individual segments and the five-year average safety ratios for the high accident segments are graphically illustrated on Exhibit 2.5. Also included on this exhibit are the number of accidents that occurred between 1990 and 1994 on the six segments with safety ratios greater than 0.90. The total number of accidents associated with each of these segments was disaggregated by the direction of travel. The 12 directional roadway segments are labeled on Exhibit 2.5. The total number of accidents were also disaggregated into peak hour accidents and non-peak hour accidents. For the purposes of this evaluation, the peak hours were defined to be from 7:00 a.m. to 9:00 a.m. and from 4:00 p.m. to 6:00 p.m.

Table 1 also provides information regarding the number of peak hour, non-peak hour, and total accidents that have occurred between 1990 and 1994 for these same mainline segments. The number of vehicles and the

number of injuries associated with these accidents are also listed in Table 1.

Between 1990 and 1994, 982 accidents were recorded for the six mainline segments with average safety ratios greater than 0.90. These 982 accidents involved a total of 2,240 vehicles and resulted in 743 injuries. Approximately 30 percent of the total accidents occurred during the four peak hours of the day. Three locations had a significantly higher than average peak hour accident total and these were as follows:

- Southbound I-275 from the Ashley Street/Tampa Street on-ramp to the north end of the Hillsborough River Bridge (62 percent);
- Eastbound I-4 from the northbound I-275 diverge gore to the southbound I-275 on-ramp gore (44 percent); and
- Eastbound I-4 between the 21st Street off-ramp and the 22nd Street on-ramp (43 percent).

The 982 accidents have occurred over a total roadway length of 3.12 kilometers (1.94 miles), which illustrates the highly concentrated distribution of the accidents. It should also be noted that 280 of the 434 accidents that occurred in Segments 1N, 2N, 3N, 1S, 2S, and 3S (approximately 65 percent) took place between the Ashley Street on-/off-ramp gores—a distance of approximately 0.32 kilometers (0.2 miles). Similarly, 244 of the 548 accidents that were reported for Segments 4E, 5E, 6E, 4W, 5W, and 6W (approximately 45 percent) occurred

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in a total distance of only 0.64 kilometers (0.4 miles). These locations involved the portion of I-4 immediately east of the I-4/I-275 junction, the portion of I-4 between the 14th/15th Street overpasses, and the portion of I-4 between the 21st Street on-/off-ramp gores and the west end of the 21st/22nd Street bridge.

Additional analysis of the accident data was conducted to identify the most prevalent types of accidents that have been occurring. Separate analyses were conducted for the peak hour accidents and non-peak hour accidents to determine whether or not different accident patterns were occurring. The key results of this analysis are provided in Table 2. A review of the information presented in this table indicates that although rear-end collisions are usually the most frequently occurring accidents during both peak and non-peak hours (typically ranging between 40 percent and 80 percent), there has also been a large percentage of accidents involving improper lane changing, sideswipe collisions, and/or angle collisions. The most noteworthy examples of this are as follows:

- 33 percent of the accidents occurring in the peak hours on northbound I-275 between the Ashley Street on-ramp and the Morgan Street overpass were sideswipe collisions and 27 percent involved improper lane changing;
- 29 percent of the accidents occurring in the peak hours on eastbound I-4 between the I-275/I-4 diverge and the

southbound I-275 flyover ramp were sideswipe collisions and 21 percent involved improper lane changing. In addition, 36 percent of the peak hour accidents and 33 percent of the non-peak hour accidents occurred in the vicinity of the on-ramp gore area.

- 24 percent of the accidents occurring in the peak hours on eastbound I-4 between the southbound I-275 flyover ramp and the 21st Street off-ramp involved improper lane changing, 21 percent were sideswipe collisions, and 17 percent were angle collisions. In the non-peak hours, 23 percent of the accidents involved improper lane changing and 18 percent involved sideswipe collisions.
- 18 percent of the peak hour accidents and 13 percent of the non-peak hour accidents occurring on westbound I-4 between the 21st Street on-ramp and the northbound I-275 off-ramp involved improper lane changing.
- 21 percent of the non-peak hour accidents occurring on southbound I-275 between the Morgan Street overpass and the Ashley Street off-ramp involved sideswipe collisions and 17 percent involved improper lane changing.

A similar analysis was conducted for all of the on-/off-ramps within the study area. Table 3 summarizes the total number of accidents, as well as the total number of vehicles and fatalities involved in the accidents. In

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addition, the number of accidents, vehicles, and injuries occurring on the ramps during the non-peak hours is also provided in Table 3. As indicated in this table, there have been 164 accidents recorded at 14 on-/off-ramps during the period between 1990 and 1994. There were 289 vehicles and 82 injuries associated with these accidents. Approximately 82 percent of the total ramp accidents occurred during non-peak hours.

The largest number of accidents (47) has occurred at the northbound I-275 on-ramp from Ashley Street, while the second largest number of accidents (23) has occurred at the northbound I-275 off-ramp to Ashley Street/Scott Street. These two ramps comprise approximately 43 percent of the total number of accidents recorded at all of the ramps and approximately 59 percent of the total injuries recorded at all of the ramps. There was also one fatality recorded at the Ashley Street on-ramp.

A review of the specific types of accidents that were recorded at these two Ashley Street ramps revealed a distinctly different accident pattern. As indicated in Table 4, approximately 64 percent of the accidents at the Ashley Street on-ramp were rear-end collisions caused by vehicles stopping suddenly in the merge area. As discussed earlier in Section 2.3 of this report, the short acceleration lane/ramp taper restricts the ability of ramp vehicles to accelerate and merge into the outside lane of northbound I-275. As a result, many of the on-ramp vehicles are forced to stop at the end of the merge area (often times abruptly) and wait for an acceptable gap in the outside lane traffic

stream. Almost half of the accidents (47 percent) occurred on the straight/level portion of the ramp (i.e., in the merge area).

Approximately 19 percent of the accidents occurring at the Ashley Street on-ramp involved hitting some type of fixed object (e.g., guardrail, barrier wall, etc.) and approximately 13 percent involved some type of sideswipe collision. These types of accidents are also directly related to the on-ramp geometrics since most of these accidents involved on-ramp vehicles that were unable to find an acceptable gap to merge into and either hit the barrier wall at the end of the on-ramp or sideswiped a vehicle in the outside lane while attempting to force their way into the outside lane.

A majority of the accidents that have occurred at the northbound I-275 off-ramp to Ashley Street/Scott Street (52 percent) have involved vehicles hitting some type of fixed object (e.g., pole, guardrail, barrier wall, or crash attenuator). An additional 22 percent of the accidents at this ramp have involved an angle or sideswipe collision. Most of the accidents at this ramp can be attributed to the short distance [approximately 137 meters (450 feet)] between the northbound I-275 exit gore and the Ashley Street/Scott Street exit gore. The one lane off-ramp from northbound I-275 (which is the termination of the auxiliary lane that originates at the Howard Avenue on-ramp) begins transitioning to two lanes just prior to the first diverge and often creates a situation where off-ramp vehicles are traveling side-by-side on a one-lane ramp. The off-ramp vehicles are not signed for Ashley Street (right lane) and Scott Street

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(left lane) until after the diverge with mainline I-275 and consequently the non-commuters do not have adequate time and distance to select their desired travel path. Some of the accidents occurring at this off-ramp also involve mainline I-275 vehicles exiting in the painted gore area, driving across to the right to access the Ashley Street off-ramp and hitting a vehicle that was already traveling in the auxiliary lane and exiting at the Scott Street off-ramp.

In summary, the evaluation of the accident data revealed that an above-average number of accidents have occurred in the I-275/I-4 interchange. These accidents are highly concentrated in short sections of I-275 and I-4. A majority of the high accident segments are also currently experiencing recurring operational problems which illustrates the strong correlation between vehicle turbulence (and the associated frequency of lane changing maneuvers) and accident potential. Although rear-end collisions have been the most frequently occurring accident type over the last five years, many of these collisions have resulted from difficult merge/diverge and weaving situations (caused by specific ramp geometrics and gore locations). In addition, a large proportion of the accidents (especially those occurring in the peak hours) have involved sideswipe collisions, lane-changing maneuvers, and/or angle collisions.

2.5 Shoulder Widths

An evaluation of the existing shoulder widths in the I-275/I-4 interchange study area was also conducted. This evaluation included a review of the as-built construction plans, as

well as an on-site verification of the as-built plans. Tables 5 and 6 summarize the existing shoulder widths. Table 5 provides a summary of the existing shoulder widths for mainline I-275 and I-4 while Table 6 provides a summary of the existing shoulder widths on the ramps connecting I-275 and I-4. The existing shoulder widths are also graphically illustrated on Exhibit 2.6.

Table 5 indicates that with the exception of two locations, all the existing inside and outside shoulder widths on mainline I-275 and I-4 are less than 3.0 meters (10 feet). The two exceptions are the following:

- The outside shoulder on northbound I-275 between Palm Avenue and the south end of the Columbus Drive Bridge; and
- The outside shoulder on northbound I-275 from the north end of the Columbus Drive Bridge to the south end of the Floribaska Avenue Bridge

The outside shoulder width for both of these sections of northbound I-275 is 3.0 meters (10 feet). In addition, Table 5 also indicates that most of the existing bridges within the interchange study area have 0.6-meter (2-foot) inside and outside shoulders. The only bridges with shoulder widths greater than 0.6 meters (2 feet) are at the following locations:

- Floribaska Avenue
- 19th Street (inside shoulder only)

Table 6 indicates that the inside shoulder widths of the I-275/I-4 connecting ramps

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I-275/I-4 Interchange Operational/Safety Improvements

range from 0.6 meters (2 feet) to 2.0 meters (6.5 feet), while the outside shoulder widths range from 0.6 meters (2 feet) to 2.6 meters (8.5 feet). It should be noted that none of the existing shoulder widths meet the current design criteria documented in the 1994 *A Policy on Geometric Design of Highways and Streets*, published by the American Association of State Highway and Transportation Officials (AASHTO).

3.0 PROPOSED OPERATIONAL/SAFETY IMPROVEMENTS

I-275/I-4 Interchange Operational/Safety Improvements

This section documents the operational and safety improvements proposed for the I-275/I-4 interchange. The primary improvements are illustrated schematically on Exhibit 3.1 and are discussed in the numerical order listed on this exhibit.

1. Northbound I-275 and the Ashley

Street On-Ramp - The improvement proposed for the Ashley Street on-ramp to I-275 is the addition of a fourth mainline lane at the on-ramp merge area that continues to eastbound I-4. This add lane will allow the Ashley Street on-ramp vehicles to enter northbound I-275 without having to merge and, hence, will provide the on-ramp vehicles with more time and distance to accelerate to the prevailing mainline vehicle speed. In addition, this improvement provides a second lane that can be used by vehicles destined for eastbound I-4. The provision of a second lane is expected to result in a more even distribution of vehicles prior to the I-275/I-4 diverge.

2. Northbound I-275 and the Orange Street/Scott Street On-Ramp to I-4 -

The fourth lane that is added at the Ashley Street on-ramp is continued along northbound I-275 and eastbound I-4. Consequently, the existing right-side I-4 ramp from Orange Street/Scott Street is modified to merge with the outside eastbound I-4 lane (as opposed to joining I-4 as an add lane). A 409 meter (1,340 foot) parallel acceleration lane is provided for this on-ramp followed by a 183 meter (600 foot) taper. The beginning of the on-

ramp taper is located north and east of the I-275/I-4 diverge to separate these two decision areas and provide additional length for acceleration. In addition, the merging of this on-ramp will preclude vehicles from using this on-ramp as a high-speed bypass lane.

3. Southbound I-275 to Eastbound I-4 Flyover Ramp (I-4 Merge Area) -

The proposed improvement in this area involves the construction of a new flyover ramp from southbound I-275 that joins eastbound I-4 on the right side of the roadway. This flyover ramp is added to I-4 as an auxiliary lane that continues eastward to the 21st Street off-ramp where it is terminated as a one-lane off-ramp. The length of this new auxiliary lane is approximately 878.0 meters (2,880 feet).

This improvement eliminates the left-side/right-side weaving movement from southbound I-275 to 21st Street since these vehicles can accomplish this movement without changing lanes. As a result, it will allow the through vehicles on eastbound I-4 to operate with only minimal interference from the southbound I-275 vehicles.

4. Southbound I-275 to Eastbound I-4 Flyover Ramp (I-275 Diverge Area) -

The exit gore for the southbound I-275 flyover ramp to eastbound I-4 is shifted northward, from its existing location to just south of the Floribraska Avenue bridge. This improvement will reduce the

3.0 PROPOSED OPERATIONAL/SAFETY IMPROVEMENTS

I-275/I-4 Interchange Operational/Safety Improvements

distance between this exit gore and the Floribaska Avenue exit gore from 643 meters (2,110 feet) to 500 meters (1,640 feet); however, this distance still exceeds the AASHTO recommended minimum spacing for successive off-ramps (300 meters). The benefit of this improvement is that it will increase the distance between the eastbound I-4 exit gore and the southbound C/D roadway exit gore from 223 meters (730 feet) to 366 meters (1,200 feet) and will provide additional decision sight distance in this critical area.

5. **Southbound I-275 Off-Ramp to the C/D Roadway** - The proposed improvement in this area provides two lanes for the southbound I-275 off-ramp to the C/D roadway and provides lane balance at this diverge area. Vehicles traveling in the center lane of southbound I-275, south of the flyover ramp to eastbound I-4, can access the C/D roadway from this lane or continue traveling south on the mainline. The provision of a second lane on this off-ramp will also allow this off-ramp to better accommodate the additional traffic that will be accessing the C/D roadway due to the proposed relocation of the Ashley Street off-ramp discussed in the next section.
6. **Southbound I-275 Off-Ramp to Ashley Street** - The improvement proposed in this area involves relocating the Ashley Street off-ramp from the southbound I-275 mainline to the southbound C/D roadway. This relocation will reduce the number of mainline off-ramps by one and

eliminate the need for weaving to occur in this portion of the southbound I-275 mainline. This, in turn, is expected to greatly reduce the turbulence experienced by through vehicles on southbound I-275, especially in the vicinity of Tampa Street at the south end of the viaduct section. This improvement will also reduce the mainline volume on southbound I-275 south of the I-275/I-4 merge.

7. **Southbound I-275 Between the I-275/I-4 Junction and the Hillsborough River** - South of the I-275/I-4 junction, four lanes are provided on southbound I-275 until just north of the Ashley Street/Tampa Street on-ramp. With four full-width travel lanes provided on southbound I-275 for a distance of approximately 1,037 meters (3,400 feet) prior to the beginning of the taper, vehicles traveling in the outside (right) lane will have significantly more time and distance to merge into the adjacent lane. This improvement allows the outside lane taper to occur on a tangent section of southbound I-275 instead of immediately prior to a sharp curve, which should decrease the potential for accidents to occur in the vicinity of the transition area. Since the Ashley Street off-ramp traffic exits the mainline prior to the I-275/I-4 junction, the reduced volume on both I-275 and I-4 will also facilitate an easier merge situation for the vehicles in the transition area.

All of these factors should reduce the tendency for vehicle queues to extend

3.0 PROPOSED OPERATIONAL/SAFETY IMPROVEMENTS

I-275/I-4 Interchange Operational/Safety Improvements

back on westbound I-4 east of the northbound I-275 diverge. This, in turn, should reduce the likelihood of forced merges occurring in the northbound I-275 exit gore area (as discussed in Section 2.3 of this report).

8. **Southbound C/D Roadway** - The relocation of the Ashley Street off-ramp from the southbound I-275 mainline to the C/D roadway required that modifications also be made to the C/D roadway. A new single lane off-ramp from westbound I-4 crosses over the new two-lane off-ramp from southbound I-275 and joins these two lanes on the right-hand side to provide a three-lane C/D roadway. The three-lane C/D roadway continues southbound on the existing bridge over 7th Avenue and Henderson Street. Approximately 342 meters (1,120 feet) south of the location where the I-275 and I-4 ramps join, the three-lane C/D roadway diverges with two lanes on the left continuing south to Orange Street (as currently exists today) and two lanes on the right continuing west on a new structure over Morgan Street, Marion Street, Florida Avenue, Franklin Street and Tampa Street. These two lanes diverge in the vicinity of the existing Tampa Street on-ramp to southbound I-275. The left-lane ties into the existing Ashley Street off-ramp and the right lane continues to Doyle Carlton Drive.

Doyle Carlton Drive is a north/south roadway located immediately to the east of the Hillsborough River that passes

underneath I-275. The connection to Doyle Carlton Drive replaces the existing connection to Kay Street and is required due to geometric constraints imposed by the relocation of the Ashley Street off-ramp from mainline I-275 to the C/D roadway. The new flyover ramp from westbound I-4 that joins the southbound C/D roadway on the right side was provided to minimize the weaving volume on the C/D roadway. Currently, a majority of the vehicles exiting southbound I-275 at the Ashley Street off-ramp are from I-4 while a majority of the vehicles exiting the C/D roadway and traveling south on Orange Street are from I-275. If the westbound I-4 off-ramp to the C/D roadway was added on the left side of the road (as opposed to the right), a significant portion of this ramp traffic (i.e., the traffic destined for Ashley Street) would have to weave across the southbound I-275 to Orange Street traffic to access the Ashley Street off-ramp. With the recommended "braided" ramp configuration (i.e., the westbound I-4 off-ramp over the southbound I-275 off-ramp), a majority of the vehicles entering the C/D roadway will not need to change lanes to access their desired destinations.

In addition to the primary geometric improvements discussed in the preceding paragraphs, there are two other operational improvements proposed for the I-275/I-4 interchange. These include the following:

3.0 PROPOSED OPERATIONAL/SAFETY IMPROVEMENTS

I-275/I-4 Interchange Operational/Safety Improvements

- Provision of lane balance at the northbound I-275/eastbound I-4 diverge area with the addition of a choice lane that continues on eastbound I-4 until just east of the 22nd Street on-ramp.
- Provision of a third lane on westbound I-4 that begins just west of the 21st/22nd Street bridge and is terminated at the off-ramp to the southbound C/D roadway. The 21st Street on-ramp merges into this third lane instead of adding a third (auxiliary) lane. This improvement eliminates the need for westbound I-4 vehicles to weave across one lane to access the off-ramp to northbound I-275.

The recommended mainline and ramp configuration for the interchange study area is graphically illustrated on Exhibit 3.2. The recommended geometric improvements are also provided on Exhibits 3.3 through 3.8.

As stated earlier in Section 2.5 of this report, none of the existing shoulder widths in the interchange study area meet current design criteria. The improvements proposed for the I-275/I-4 interchange include the construction of standard inside and outside shoulder widths on mainline I-275 and I-4, on the ramps connecting I-275 and I-4 and on the C/D roadway where feasible. The proposed shoulder width improvements are illustrated on Exhibits 3.3 through 3.8 and are also listed in Tables 5 and 6. As indicated on Exhibits 3.3 through 3.8, the existing shoulder widths

are proposed to remain in certain locations due to specific constraints such as cross street vertical clearance, constructability/maintenance of traffic and/or right-of-way/relocation costs.

A design exception has been requested for those locations where AASHTO shoulder width criteria is not achieved. The rationale for the design exception request is documented in Appendix C of the Engineering Summary Report (August 1996).

4.0 TRAFFIC OPERATIONS COMPARISON

I-275/I-4 Interchange Operational/Safety Improvements

Using the existing peak hour volumes and the existing geometry, traffic operations analyses were conducted for those portions of I-275 and I-4 that are currently experiencing operational problems. These same locations were then re-analyzed with the proposed improvements to provide an estimate of the operational benefits that could be expected to result from the implementation of these improvements. The locations and peak hours that were analyzed include the following:

- Northbound I-275 between the on-ramp from Ashley Street and the I-275/I-4 diverge (p.m. peak hour);
- Eastbound I-4 between the southbound I-275 on-ramp and the 21st Street off-ramp (a.m. and p.m. peak hour);
- Southbound I-275 between the I-275/I-4 merge and the Ashley Street off-ramp (a.m. and p.m. peak hour); and the
- Southbound C/D roadway between the I-275/I-4 on-ramps and the Orange Street off-ramp (a.m. peak hour)

Table 7 provides a comparison of the average overall p.m. peak hour travel speeds for the four individual movements on northbound I-275 between the Ashley Street on-ramp and the I-275/I-4 diverge. As indicated in Table 7, although the average travel speed for the northbound I-275 through movement is 86.9 kilometers per hour (54.0

miles per hour) with the existing geometry, the average travel speeds for the other three movements are all less than 64.4 kilometers per hour (40.0 miles per hour). These low travel speeds are the result of the large number of p.m. peak hour vehicles traveling in the outside (right) lane of northbound I-275 north of the Ashley Street on-ramp (i.e., 2,576 vehicles). As indicated in Table 7, the volume-to-capacity (v/c) ratio for this outside lane is 1.25.

With the proposed improvements, the average travel speed for the northbound I-275 through movement is estimated to be approximately 69.2 kilometers per hour (43.0 miles per hour) while the estimated average travel speeds for the other three movements range between 65.5 kilometers per hour (40.7 miles per hour) and 69.4 kilometers per hour (43.1 miles per hour). Although the average overall speed of the northbound I-275 through movement is projected to be lower with the proposed improvements than with the existing configuration, the differences in the average travel speeds for the four movements are much smaller with the proposed improvements than with the existing geometry. In addition, the provision of a second travel lane for traffic destined for eastbound I-4 will reduce the v/c ratio for the Ashley Street vehicles and the northbound I-275 to eastbound I-4 vehicles from 1.25 to 0.63. Since many of the accidents that have occurred in this section are the result of large differences in vehicle densities and vehicle speeds across the travel lanes, the proposed improvement is anticipated to reduce the

4.0 TRAFFIC OPERATIONS COMPARISON

I-275/I-4 Interchange Operational/Safety Improvements

accident frequency since it will result in more uniform lane volumes and vehicle speeds.

Table 8 provides a comparison of the weaving volumes, volume ratios and average speeds for the existing and proposed geometry on eastbound I-4 between the southbound I-275 on-ramp and the 21st Street off-ramp. With the existing geometry, the average speed of the weaving and non-weaving vehicles in the a.m. peak hour is 56.4 kilometers per hour (35.0 miles per hour) and 48.3 kilometers per hour (30.0 miles per hour), respectively. In the p.m. peak hour, the average weaving and non-weaving vehicle speeds are 56.4 kilometers per hour (35.0 miles per hour) and 49.9 kilometers per hour (31.0 miles per hour), respectively. The overall average vehicle speeds in the existing weaving area are 52.8 kilometers per hour (32.8 miles per hour) and 53.9 kilometers per hour (33.5 miles per hour).

The low existing peak hour vehicle speeds in this segment of I-4 are due to the large number of weaving vehicles present in the roadway segment. In the a.m. peak hour, the weaving volume is 2,736 vehicles while in the p.m. peak hour, the weaving volume is 2,698 vehicles. These weaving volumes represent approximately 56 percent and 63 percent of the total volume present in this segment in the a.m. and p.m. peak hours, respectively. The high weaving volumes in this area are due to the fact that this is a left-side/right-side Type C weaving area. With this type of weaving area, the through volume is one of the two weaving volumes and usually the highest volume in the weaving area.

With the proposed improvements, the average speed of the weaving and non-weaving vehicles in the a.m. peak hour is 72.5 kilometers per hour (45.0 miles per hour) and 80.5 kilometers per hour (50.0 miles per hour), respectively. In the p.m. peak hour, the average weaving and non-weaving vehicle speeds are 75.7 kilometers per hour (47.0 miles per hour) and 85.3 kilometers per hour (53.0 miles per hour), respectively. The increases in vehicle speeds are the result of a reduction in the weaving volumes brought about by a change in the weaving area configuration. The relocation of the southbound I-275 flyover ramp from the left side to the right side of eastbound I-4 creates a Type A weaving area where all weaving occurs on only one side (the right side) of the roadway. A comparison of the volume ratios associated with the existing geometry and the proposed geometry indicates that the improvements are expected to reduce the percentage of weaving vehicles by approximately 21 percent and 41 percent in the a.m. and p.m. peak hours, respectively. As indicated in Table 8, with the proposed improvements, the weaving volume constitutes only 44 percent and 37 percent of the total volume present in this segment during the a.m. and p.m. peak hours, respectively.

Table 9 provides a comparison of the average overall a.m. and p.m. peak hour travel speeds for the portion of southbound I-275 between the I-275/I-4 merge and the Ashley Street off-ramp. With the existing geometry, the average overall travel speeds are 54.4 kilometers per hour (33.8 miles per

4.0 TRAFFIC OPERATIONS COMPARISON

I-275/I-4 Interchange Operational/Safety Improvements

hour) and 55.7 kilometers per hour (34.6 miles per hour) in the a.m. and p.m. peak hours, respectively. These low vehicle speeds are attributable to the large number of vehicles present in the three southbound I-275 lanes (as reflected in the high per lane volumes) as well as the large number of weaving vehicles present in this section. As indicated in the footnote on Table 9, the average per lane volumes in the peak hours exceed the capacity of the weaving area. The weaving volumes represent approximately 56 percent and 54 percent of the total a.m. and p.m. peak hour volumes in this section.

With the proposed improvements, the average overall travel speed is 83.7 kilometers per hour (52.0 miles per hour) in both the a.m. and p.m. peak hours. This represents a 53.9 percent increase in the a.m. peak hour travel speed and a 50.3 percent increase in the p.m. peak hour travel speed. These higher average vehicle speeds are due to the relocation of the Ashley Street off-ramp from the mainline to the C/D roadway and the provision of the fourth southbound mainline lane that extends for approximately 1,037 meters (3,400 feet). The removal of the Ashley Street off-ramp from the southbound I-275 mainline eliminates the need for vehicles to weave after westbound I-4 joins southbound I-275.

Table 10 provides a comparison of the weaving volumes, volume ratios and average vehicle speeds for the existing and proposed geometry on the southbound C/D roadway. With the existing geometry, the average

speed of the weaving and non-weaving vehicles in the a.m. peak hour is 66.0 kilometers per hour (41.0 miles per hour) and 67.6 kilometers per hour (42.0 miles per hour), respectively. The average overall a.m. peak hour vehicle speed on the C/D roadway is 66.5 kilometers per hour (41.3 miles per hour).

With the proposed improvements, the average speed of the weaving and non-weaving vehicles in the a.m. peak hour is 64.4 kilometers per hour (40 miles per hour) and 62.8 kilometers per hour (39.0 miles per hour), respectively. The average overall vehicle speed on the C/D roadway with the proposed improvements is 63.1 kilometers per hour (39.2 miles per hour). It should be noted that the relocation of the Ashley Street off-ramp from the southbound I-275 mainline to the C/D roadway increases the total a.m. peak hour volume on the C/D roadway by approximately 68 percent. The braided ramp configuration, however, reduces the total number of weaving vehicles by approximately 40 percent and the volume ratio by approximately 65 percent. Consequently, the average weaving, non-weaving and overall vehicle speeds are only slightly lower with the proposed geometry than with the existing geometry. This slight reduction in vehicle speeds on the C/D roadway is compensated for by the significant increase in vehicle speeds on the mainline roadway.

5.0 COMPLIANCE WITH FHWA POLICY

I-275/I-4 Interchange Operational/Safety Improvements

As stated in Volume 55, Number 204 of the Federal Register (FHWA Docket No. 89-23), "It is in the national interest to maintain the Interstate System to provide the highest level of service in terms of safety and mobility." As a result, new or revised access points are only considered for approval if the following six criteria are satisfied.

1. The existing interchanges and/or local roads cannot provide the necessary access and cannot be improved to satisfactorily accommodate the design year traffic demands;
2. All reasonable alternatives for design options, location and transportation system management type improvements have been assessed and provided for if currently justified (or provisions are included for accommodating such facilities if a future need is justified);
3. The proposed access point does not have a significant adverse impact on the safety and operations of the Interstate;
4. The proposed access connects to a public road only and will provide for all traffic movements;
5. The access is consistent with local and regional land use and transportation plans; and
6. The request for a new or revised access generated by new or

expanded development demonstrates appropriate coordination between the development and related/required transportation system improvements.

The improvements documented in this technical memorandum are recommended to improve the operations and safety of the existing interchange -- not to provide additional access that is required due to new or expanded development. Most of the improvements involve upgrading the geometric design of entry and exit areas (e.g., extending the length of an acceleration lane, providing lane balance at a diverge area) and/or providing full width shoulders in high accident locations; therefore, they represent relatively low cost transportation system management type improvements. Because these improvements are limited to one interchange, the addition of HOV lanes would not be feasible. In addition, the implementation of HOV lanes would not do anything to help improve the safety of the existing interchange. It should be noted that the ultimate I-275 and I-4 improvements do include HOV lanes, exclusive bus and carpool access to the HOV lanes (via priority ramps) and park-and-ride lots.

Ramp metering would limit the volume of traffic accessing the Interstate during the peak periods; however, this would also result in significant queues on the local arterials (e.g., Scott Street, Ashley Street). Mitigating the additional congestion on the local streets caused by ramp metering would be difficult due to the City of Tampa's limited financial resources. Many of the current operational

5.0 COMPLIANCE WITH FHWA POLICY

I-275/I-4 Interchange Operational/Safety Improvements

problem areas and high accident areas involve freeway-to-freeway connections or the merging of Interstate mainline lanes. These locations are not appropriate for ramp metering.

The analyses discussed in this report indicate that the proposed improvements will have a significant positive impact on the operations and safety of the interchange. A comparison of the existing traffic operations and the traffic operations anticipated to occur with the proposed improvements indicates that the improvements are expected to result in a more uniform distribution of volume across the travel lanes, higher overall travel speeds, smaller disparities in vehicle speeds across the travel lanes and in adjacent roadway segments and fewer numbers of weaving vehicles. These improvements will also provide drivers with increased time and distance to execute merge, diverge, and weaving maneuvers. Consequently, these improvements are expected to reduce the frequency of accidents and improve driver safety. The proposed improvements are also expected to reduce the turbulence experienced by mainline through vehicles as a result of merging/diverging and weaving vehicles which, in turn, will improve the overall quality of flow through the entire interchange area. Lastly, the construction of standard shoulders, where economically feasible, will provide a safer refuge area for use by disabled vehicles.

All of the access within the interchange is to/from public streets and the interchange is a "full interchange." A majority of the

proposed improvements are to be designed to meet current standards for Federal-aid projects on the Interstate System. Design exceptions or variances have been requested and documented for those locations that cannot be improved to Federal standards.

Lastly, the improvements recommended in this document are consistent with local and regional land use and transportation plans. The development of these improvements has been coordinated with the City of Tampa and the Hillsborough County Metropolitan Planning Organization.

TABLES

I-275/I-4 Interchange Operational/Safety Improvements

Table 1

MAINLINE ACCIDENT SUMMARY (1990 - 1994)
I-275/I-4 Interchange Operational/Safety Improvements
Technical Memorandum

Segment	All Hours			Peak Hours ¹			Non-Peak Hours		
	Total No. of Crashes	Total No. of Vehicles	Total No. of Injuries	Total No. of Crashes	Total No. of Vehicles	Total No. of Injuries	Total No. of Crashes	Total No. of Vehicles	Total No. of Injuries
1N	64	156	66	21	56	16	43	100	50
1S	37	93	28	23	66	21	14	27	7
2N	110	238	69	19	50	11	91	188	58
2S	83	177	51	21	55	14	62	122	37
3N	69	140	48	15	44	20	54	96	28
3S	64	131	60	17	40	14	47	91	46
4E	32	63	10	14	31	3	18	32	7
4W	68	152	46	12	28	16 ²	56	124	30
5E	90	200	55	29	70	15	61	130	40 ²
5W	163	391	137	39	104	40	124	287	97
6E	101	241	95	43	103	34	58	138	61
6W	101	258	78	34	91	25	67	167	53
Total	982	2,240	743	287	738	229	695	1,502	514

¹7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m.

²There was one fatality at this location.

Table 2

MAINLINE ACCIDENT TYPOLOGY
I-275/I-4 Interchange Operational/Safety Improvements
Technical Memorandum

Peak Hours	Non-Peak Hours
NB I-275 South of Ashley/Scott Street Off-Ramp (Segment 1N)	
21 Total Accidents	43 Total Accidents
<ul style="list-style-type: none"> 81% rear-end collisions 	<ul style="list-style-type: none"> 58% rear-end collisions 23% hit guardrail, barrier wall or crash attenuator
<ul style="list-style-type: none"> 57% on straight-level roadway 38% on straight upgrade/downgrade 	<ul style="list-style-type: none"> 63% on straight-level roadway 30% on straight upgrade/downgrade
<ul style="list-style-type: none"> 43% in Lane 3 33% in Lane 1 	<ul style="list-style-type: none"> 44% in Lane 3 26% in Lane 2
NB I-275 Between Ashley Street Off-Ramp and Ashley Street On-Ramp (Segment 2N)	
19 Total Accidents (42% occurred in the vicinity of the on-ramp merge area)	91 Total Accidents (38% occurred in the vicinity of the on-ramp merge area)
<ul style="list-style-type: none"> 74% rear-end collisions 21% angle collisions 	<ul style="list-style-type: none"> 54% rear-end collisions 22% hit pole, guardrail or barrier wall
<ul style="list-style-type: none"> 63% on straight-level roadway 	<ul style="list-style-type: none"> 55% on straight-level roadway
<ul style="list-style-type: none"> 53% in Lane 3 21% at the on-ramp gore area 	<ul style="list-style-type: none"> 29% in Lane 3 29% at the on-ramp gore area 22% in Lane 2
NB I-275 Between Ashley Street On-Ramp and Morgan Street Overpass (Section 3N)	
15 Total Accidents	54 Total Accidents
<ul style="list-style-type: none"> 27% involved improper lane changing 33% rear-end collisions 33% sideswipe collisions 20% hit guardrail or barrier wall 	<ul style="list-style-type: none"> 17% involved improper lane changing 54% rear-end collisions 24% hit guardrail, barrier wall, or other fixed object
<ul style="list-style-type: none"> 73% on straight-level roadway 20% on curved-level roadway 	<ul style="list-style-type: none"> 50% on straight-level roadway 20% on curved-level roadway
<ul style="list-style-type: none"> 46% in Lane 3 27% in Lane 1 	<ul style="list-style-type: none"> 31% in Lane 3 31% in Lane 2

Table 2 (Continued)

**MAINLINE ACCIDENT TYPOLOGY
I-275/I-4 Interchange Operational/Safety Improvements
Technical Memorandum**

Peak Hours	Non-Peak Hours
EB I-4 from the I-4/I-275 Diverge to the SB I-275 Flyover Ramp (Segment 4E)	
14 Total Accidents (36% occurred in the vicinity of the on-ramp gore area)	18 Total Accidents (33% occurred in the vicinity of the on-ramp gore area)
<ul style="list-style-type: none"> • 21% involved improper lane changing • 50% rear-end collisions • 29% sideswipe collisions 	<ul style="list-style-type: none"> • 17% involved improper lane changing • 33% hit guardrail • 22% rear-end collisions
<ul style="list-style-type: none"> • 36% on straight-level roadway • 36% on curved upgrade/downgrade • 28% on straight upgrade/downgrade 	<ul style="list-style-type: none"> • 39% on straight-level roadway • 33% on curve upgrade/downgrade
<ul style="list-style-type: none"> • 43% in Lane 2 • 29% in Lane 1 	<ul style="list-style-type: none"> • 28% at the on-ramp gore area • 22% in Lane 1 • 22% on shoulder
EB I-4 from the SB I-275 Flyover Ramp to the 21st Off-Ramp (Segment 5E)	
29 Total Accidents	61 Total Accidents
<ul style="list-style-type: none"> • 24% involved improper lane changing • 52% rear-end collisions • 21% sideswipe collisions • 17% angle collisions 	<ul style="list-style-type: none"> • 23% involved improper lane changing • 52% rear-end collisions • 18% sideswipe collisions
<ul style="list-style-type: none"> • 79% on straight-level roadway • 17% on straight upgrade/downgrade 	<ul style="list-style-type: none"> • 59% on straight-level roadway • 38% on straight upgrade/downgrade
<ul style="list-style-type: none"> • 48% in Lane 2 • 38% in Lane 1 	<ul style="list-style-type: none"> • 49% in Lane 2 • 18% in Lane 1 • 16% in Lane 3

Table 2 (Continued)

**MAINLINE ACCIDENT TYPOLOGY
I-275/I-4 Interchange Operational/Safety Improvements
Technical Memorandum**

Peak Hours	Non-Peak Hours
EB I-4 from the 21st Street Off-Ramp to the 22nd Street On-Ramp (Segment 6E)	
43 Total Accidents	58 Total Accidents
<ul style="list-style-type: none"> • 72% rear-end collisions • 14% angle collisions 	<ul style="list-style-type: none"> • 55% rear-end collisions • 16% hit guardrail or barrier wall
<ul style="list-style-type: none"> • 70% on straight-level roadway • 30% on straight upgrade/downgrade 	<ul style="list-style-type: none"> • 53% on straight-level roadway • 47% on straight upgrade/downgrade
<ul style="list-style-type: none"> • 67% in Lane 1 • 33% in Lane 2 	<ul style="list-style-type: none"> • 33% in Lane 1 • 52% in Lane 2
WB I-4 Between 22nd Street Off-Ramp and 21st Street On-Ramp (Segment 6W)	
34 Total Accidents	67 Total Accidents
<ul style="list-style-type: none"> • 71% rear-end collisions 	<ul style="list-style-type: none"> • 41% rear-end collisions • 34% hit guardrail, fence, barrier wall, or other fixed object
<ul style="list-style-type: none"> • 53% on straight-level roadway • 47% on straight upgrade/downgrade 	<ul style="list-style-type: none"> • 63% on straight-level roadway • 33% on straight upgrade/downgrade
<ul style="list-style-type: none"> • 71% in Lane 1 • 24% in Lane 2 	<ul style="list-style-type: none"> • 51% in Lane 1 • 33% in Lane 2 • 15% on shoulder
WB I-4 Between 21st Street On-Ramp and NB I-275 Off-Ramp (Segment 5W)	
39 Total Accidents	124 Total Accidents
<ul style="list-style-type: none"> • 18% involved improper lane changing • 64% rear-end collisions 	<ul style="list-style-type: none"> • 13% involved improper lane changing • 55% rear-end collisions • 20% hit pole, guardrail, barrier wall, or crash attenuator
<ul style="list-style-type: none"> • 49% on straight-level roadway • 46% on straight upgrade/downgrade 	<ul style="list-style-type: none"> • 57% on straight-level roadway • 35% on straight upgrade/downgrade
<ul style="list-style-type: none"> • 67% in Lane 1 • 15% in Lane 2 	<ul style="list-style-type: none"> • 50% in Lane 1 • 23% in Lane 2

Table 2 (Continued)

**MAINLINE ACCIDENT TYPOLOGY
I-275/I-4 Interchange Operational/Safety Improvements
Technical Memorandum**

Peak Hours	Non-Peak Hours
WB I-4 Between NB I-275 Off-Ramp and I-4/I-275 Junction (Segment 4W)	
12 Total Accidents	56 Total Accidents
<ul style="list-style-type: none"> • 58% rear-end collisions 	<ul style="list-style-type: none"> • 20% involved improper lane changing • 41% rear-end collisions • 34% hit guardrail, fence, barrier wall, or other fixed object
<ul style="list-style-type: none"> • 42% on curved-level roadway • 25% on curved upgrade/downgrade 	<ul style="list-style-type: none"> • 55% on straight-level section • 23% on curve-level section
<ul style="list-style-type: none"> • 42% in Lane 1 • 25% on shoulder 	<ul style="list-style-type: none"> • 43% in Lane 1 • 23% in Lane 2 • 18% on shoulder
SB I-275 Between Morgan Street Overpass and Ashley Street Off-Ramp (Segment 3S)	
17 Total Accidents	47 Total Accidents
<ul style="list-style-type: none"> • 82% rear-end collisions 	<ul style="list-style-type: none"> • 17% involved improper lane changing • 32% hit guardrail or barrier wall • 23% rear-end collisions • 21% sideswipe collisions
<ul style="list-style-type: none"> • 71% on straight-level section of roadway 	<ul style="list-style-type: none"> • 55% on curved-level roadway • 30% on straight-level roadway
<ul style="list-style-type: none"> • 53% in Lane 1 • 18% in Lane 2 	<ul style="list-style-type: none"> • 36% in Lane 2 • 23% in Lane 3 • 21% in Lane 1 • 19% on shoulder

Table 2 (Continued)

**MAINLINE ACCIDENT TYPOLOGY
I-275/I-4 Interchange Operational/Safety Improvements
Technical Memorandum**

Peak Hours	Non-Peak Hours
SB I-275 Between Ashley Street Off-Ramp and Ashley Street On-Ramp (Segment 2S)	
21 Total Accidents	45 Total Accidents
<ul style="list-style-type: none"> 86% rear-end collisions 	<ul style="list-style-type: none"> 18% involved improper lane changing 31% rear-end collisions 27% sideswipe collisions 24% hit guardrail or barrier wall
<ul style="list-style-type: none"> 62% on straight-level section of roadway 	<ul style="list-style-type: none"> 49% on straight-level roadway 22% on curve upgrade/downgrade
<ul style="list-style-type: none"> 48% in Lane 1 33% in Lane 3 	<ul style="list-style-type: none"> 36% in Lane 1 31% in Lane 2 18% at off-ramp gore area
SB I-275 South of Ashley Street/Tampa Street On-Ramp (Segment 1S)	
23 Total Accidents	14 Total Accidents
<ul style="list-style-type: none"> 87% rear-end collisions 	<ul style="list-style-type: none"> 21% involved improper lane changing 50% hit guardrail, barrier wall, or crash attenuator 21% rear-end collisions
<ul style="list-style-type: none"> 57% on straight-level section of roadway 30% on straight upgrade/downgrade 	<ul style="list-style-type: none"> 43% on straight-level roadway 43% on straight upgrade/downgrade
<ul style="list-style-type: none"> 70% in Lane 1 	<ul style="list-style-type: none"> 29% in Lane 1 29% in Lane 2 21% on shoulder

Table 3

RAMP ACCIDENT SUMMARY (1990 - 1994)
I-275/I-4 Interchange Operational/Safety Improvements
Technical Memorandum

Ramp	All Hours			Non-Peak Hours ¹		
	Total No. of Crashes	Total No. of Vehicles	Total No. of Injuries	Total No. of Crashes	Total No. of Vehicles	Total No. of Injuries
Northbound I-275 On-Ramp from Ashley St.	47	93	37 ²	43	85	35
Northbound I-275 Off-Ramp to Ashley/Scott St.	23	34	11	18	26	8
Westbound I-4 to Northbound I-275 Ramp	16	21	4	15	20	4
Southbound I-275 On-Ramp from Ashley/Tampa St.	14	25	5	11	15	4
Eastbound I-4 Off-Ramp to 21st St.	12	22	3	12	22	3
Southbound I-275 Off-Ramp to Ashley St.	11	17	6	10	15	6
Northbound I-275 On-Ramp from Orange/Scott St.	10	20	5	6	11	5
Southbound I-275 C-D Roadway	8	11	3	5	6	2
Southbound I-275 to Eastbound I-4 Ramp	7	13	3	3	7	0
Eastbound I-4 On-Ramp from 22nd St.	6	15	3	3	8	1
Northbound I-275 Off-Ramp to Dr. Martin Luther King, Jr. Blvd.	4	8	1	4	8	1
Westbound I-4 On-Ramp from 21st St.	3	4	0	2	3	0
Southbound I-275 Off-Ramp to Floribaska Ave.	2	4	1	2	4	1
Southbound I-275 On-Ramp from Dr. Martin Luther King, Jr. Blvd.	1	2	0	1	2	0
TOTAL	164	289	82	135	232	70

¹9:00 a.m. to 4:00 p.m. and 6:00 p.m. to 7:00 a.m.

²There was also one fatality at this location.

Table 4

**RAMP ACCIDENT TYPOLOGY
I-275/I-4 Interchange Operational/Safety Improvements
Technical Memorandum**

NB I-275 On-Ramp from Ashley Street
47 Total Accidents
<ul style="list-style-type: none">• 64% rear-end collisions• 19% hit guardrail, barrier wall, or other fixed object• 13% sideswipe collisions
<ul style="list-style-type: none">• 77% involved careless driving and/or improper lane changing
<ul style="list-style-type: none">• 47% on straight-level sections of the ramp• 38% on curved sections of the ramp
NB I-275 Off-Ramp to Ashley/Scott Street
23 Total Accidents
<ul style="list-style-type: none">• 52% hit pole, guardrail, barrier wall, crash attenuator, or other fixed object• 22% involved an angle or sideswipe collision
<ul style="list-style-type: none">• 35% involved careless driving and/or exceeding safe speed
<ul style="list-style-type: none">• 61% on straight sections of the ramp (either level or on a grade)
<ul style="list-style-type: none">• 39% on curved sections of the ramp

Table 5

**SHOULDER WIDTHS ON MAINLINE I-275 AND I-4
I-275/I-4 Interchange Operational/Safety Improvements
Technical Memorandum**

Roadway	Location	Existing			Proposed with Design Exception		
		No. of Lanes	Inside	Outside	No. of Lanes	Inside	Outside
I-275 NB	Hillsborough River to Tampa Street (Rdwy.)	3	0.6 m (2')	2.6 m (8.5')	3	3.0 m (10')	3.0 m (10')
	Tampa Street to Morgan Street Viaduct	3	0.6 m (2')	0.6 m (2')	4	0.6 m (2')	3.0 m (10')
	Morgan Street to Jefferson Street (Rdwy.)	3	0.6 m (2')	2.6 m (8.5')	4	3.6 m (12')	3.6 m (12')
	Jefferson Street Bridge	3	0.6 m (2')	0.6 m (2')	4	3.6 m (12')	3.0 m (10')
	Jefferson Street to Central Avenue	3	0.6 m (2')	2.4 m (8')	4	3.6 m (12')	3.6 m (12')
	Central Avenue/ Henderson Street Bridge to 7th Avenue Bridge	5	0.6 m (2')	0.6 m (2')	5	0.6 m (2')	1.8 m (6') ¹
	7th Avenue to Palm Avenue	5	2.7 m (9')	2.6 m (8.5')	5	2.7 m (9')	2.4 m (8') ¹
	Palm Avenue Bridge	3	0.6 m (2')	0.6 m (2')	3	0.6 m (2')	0.6 m (2')
	Palm Avenue to Columbus Drive	3	2.7 m (9')	3.0 m (10')	3	2.7 m (9')	3.0 m (10')
	Columbus Drive Bridge	3/4	0.6 m (2')	0.6 m (2')	3	2.7 m (9')	3.0 m (10')
	Columbus Drive to Floribaska Avenue	3	1.8 m (6')	3.0 m (10')	3/4	1.8 m (6')	3.0 m (10')
I-275 SB	Floribaska Avenue Bridge	4	1.8 m (6')	2.7 m (9')	4	1.8 m (6')	1.8 m (6') ¹
	Floribaska Avenue to Columbus Drive	4/3	1.4 m (4.5')	2.6 m (8.5')	4/3	1.4 m (4.5')	3.6 m (12')
	Columbus Drive Bridge	3	0.6 m (2')	0.6 m (2')	3	3.0 m (10')	3.0 m (10')
	Columbus Drive to Palm Avenue	3/2	2.7 m (9')	2.6 m (8.5')	3/2	2.7 m (9')	2.6 m (8.5')
	Palm Avenue Bridge	2	0.6 m (2')	0.6 m (2')	2	0.6 m (2')	0.6 m (2')
	Palm Avenue to 7th Avenue	2/4	1.2 m (4')	2.6 m (8.5')	2/4	1.2 m (4')	2.6 m (8.5')
	7th Street Bridge to Central Avenue/ Henderson Street Bridge	4/3	0.6 m (2')	0.6 m (2')	4	0.6 m (2')	0.6 m (2')
	Central Avenue to Jefferson Street	3	0.6 m (2')	2.6 m (8.5')	4	3.6 m (12')	3.6 m (12')

Table 5 (Continued)

**SHOULDER WIDTHS ON MAINLINE I-275 AND I-4
I-275/I-4 Interchange Operational/Safety Improvements
Technical Memorandum**

Roadway	Location	Existing			Proposed with Design Exception		
		No. of Lanes	Inside	Outside	No. of Lanes	Inside	Outside
	Jefferson Street Bridge	3	0.6 m (2')	0.6 m (2')	4	3.0 m (10')	3.6 m (12')
	Jefferson Street to Morgan Street (Rdwy.)	3	0.6 m (2')	2.6 m (8.5')	4	3.6 m (12')	3.6 m (12')
	Morgan Street to Tampa Street Viaduct	3	0.6 m (2')	0.6 m (2')	4	0.6 m (2')	3.6 m (12')
	Tampa Street to Hillsborough River	3	0.6 m (2')	2.6 m (8.5')	4/3	0.6 m (2')	3.6 m (12')
I-4 EB	12th Street to 17th Street	3	1.2 m (4')	2.6 m (8.5')	4	3.6 m (12')	3.6 m (12')
	17th Street to 19th Street	3	1.2 m (4')	2.6 m (8.5')	4	3.0 m (10')	2.6 m (8.5')
	19th Street Bridge	3/2	1.2 m (4')	0.6 m (2')	4/3	2.5 m (8')	0.6 m (2')
	19th Street to 21st Street	3	1.2 m (4')	2.6 m (8.5')	3	2.8 m (9.5')	2.6 m (8.5')
	21st/22nd Street Bridge	2	0.6 m (2')	0.6 m (2')	3	3.0 m (10')	0.6 m (2')
	22nd Street to 24th Street	2	1.2 m (4')	2.6 m (8.5')	3/2	3.6 m (12')	2.6 m (8.5')
I-4 WB	21st Street to 19th Street (Rdwy.)	2/3	1.2 m (4')	2.6 m (8.5')	2/3	2.8 m (9.5')	2.6 m (8.5')
	19th Street Bridge	3	1.2 m (4')	0.6 m (2')	4	2.5 m (8')	0.6 m (2')
	19th Street to 17th Street (Rdwy.)	3	1.2 m (4')	2.6 m (8.5')	4	2.8 m (9.5')	2.4 m (8') ¹
	17th Street to 16th Street	3	1.2 m (4')	2.6 m (8.5')	4/3	3.6 m (12')	2.4 m (8') ¹
	16th Street to 12th Street	3	1.2 m (4')	2.6 m (8.5')	3	1.2 m (4')	2.6 m (8.5')
	12th Street to Nebraska Avenue	3	1.2 m (4')	2.6 m (8.5')	3	1.2 m (4')	3.6 m (12')

¹A ramp lane is located in this segment.

 These meet FDOT PPM standards; therefore, no design variance or exception is needed.

Table 6

SHOULDER WIDTHS ON CONNECTING FREEWAY RAMPS
I-275/I-4 Interchange Operational/Safety Improvements
Technical Memorandum

Roadway	Location	Existing			Proposed with Design Exception		
		No. of Lanes	Inside	Outside	No. of Lanes	Inside	Outside
I-275 NB to I-4 EB	Palm Avenue Bridge	2	0.6 m (2')	0.6 m (2')	3	1.2 m (4')	2.4 m (8') ¹
	Palm Avenue to Nebraska Avenue	2	1.2 m (4')	2.6 m (8.5')	3	3.6 m (12')	3.6 m (12')
	Nebraska Avenue Bridge	2	0.6 m (2')	0.6 m (2')	3	3.0 m (10')	3.0 m (10')
	Nebraska Avenue to 12th Street	2/3	1.2 m (4')	2.6 m (8.5')	3/4	3.6 m (12')	3.6 m (12')
I-4 WB to I-275 NB	10th Street to Nebraska Avenue	N/A	N/A	N/A	1	1.8 m (6')	1.8 m (6')
	Nebraska Avenue Bridge	1	0.6 m (2')	1.8 m (6')	1	1.8 m (6')	3.6 m (12')
	Nebraska Avenue to Columbus Drive	1	1.2 m (4')	2.0 m (6.5')	1	1.8 m (6')	3.6 m (12')
	Columbus Drive Bridge	N/A	N/A	N/A	1	1.8 m (6')	3.6 m (12')
I-4 WB to I-275 SB	10th Street to Nebraska Avenue	3/2	1.2 m (4')	2.6 m (8.5')	3	1.2 m (4')	3.6 m (12')
	Nebraska Avenue Bridge	2	0.6 m (2')	0.6 m (2')	3	3.6 m (12')	1.8 m (6') ¹
	Nebraska Avenue to I-275	2	2.0 m (6.5')	2.4 m (8')	3	3.6 m (12')	3.6 m (12')
	I-275 Bridge	2	0.6 m (2')	0.6 m (2')	3	3.6 m (12')	3.0 m (10')
	I-275 to Palm Avenue	2	2.0 m (6.5')	2.4 m (8')	3/2	3.6 m (12')	3.6 m (12')
	Palm Avenue Bridge	2	0.6 m (2')	0.6 m (2')	2	3.0 m (10')	3.0 m (10')
	Palm Avenue to I-275 SB	2/4	2.0 m (6.5')	2.4 m (8')	2/4	3.6 m (12')	3.6 m (12')
I-275 SB to I-4 EB	Floribraska Avenue to Columbus Drive	1	0.6 m (2')	2.4 m (8')	1	1.8 m (6')	1.8m (6') ¹
	Columbus Drive Bridge	1	0.6 m (2')	1.8 m (6')	1	0.6 m (2')	1.8 m (6')
	Columbus Drive to Nebraska Avenue	1	0.6 m (2')	1.2 m (4')	1	3.6 m (12')	1.8 m (6')
	Nebraska Avenue to I-4 EB	1	2.0 m (6.5')	1.8 m (6')	1	1.8 m (6') ¹	1.8 m (6')

¹A ramp lane is located in this segment.

 These meet FDOT PPM standards, therefore, no design variance or exception is needed.

Table 7

**P.M. PEAK HOUR OPERATIONS ANALYSIS SUMMARY
NORTHBOUND I-275 BETWEEN THE ASHLEY STREET
ON-RAMP AND THE I-275/I-4 DIVERGE
I-275/I-4 Interchange Operational/Safety Improvements
Technical Memorandum**

Movement	Volume (in vph)	Average Overall Speed km/hr (mi/hr)	
		Existing Geometry	Proposed Geometry
Northbound I-275 Through	3,423	86.9 (54.0)	69.2 (43.0)
Northbound I-275 to Eastbound I-4	1,826	<64.4 (<40.0) ¹	68.1 (42.3) ²
Ashley Street to Eastbound I-4	651	<64.4 (<40.0) ¹	69.4 (43.1) ²
Ashley Street to Northbound I-275	99	<64.4 (<40.0) ¹	65.5 (40.7) ²

¹With the existing geometry, all three of these movements occupy the same travel lane. The v/c ratio associated with this lane is 1.25.

²With the proposed geometry, all three of these movements occupy two travel lanes. The v/c ratio associated with these two lanes is 0.63.

Table 8

**A.M. AND P.M. PEAK HOUR OPERATIONS ANALYSIS SUMMARY
EASTBOUND I-4 BETWEEN THE SOUTHBOUND I-275 ON-RAMP
AND THE 21ST STREET OFF-RAMP
I-275/I-4 Interchange Operational/Safety Improvements
Technical Memorandum**

A.M. PEAK HOUR OPERATIONS

	Total Volume (in vph)	Weaving Volume (in vph)	Volume Ratio ¹	# of Lanes	Average Weaving Speed km/hr (mi/hr)	Average Non- Weaving Speed km/hr (mi/hr)	Average Overall Speed ² km/hr (mi/hr)
Existing Geometry	4,875	2,736	0.56	3	56.4 (35.0)	48.3 (30.0)	52.8 (32.8)
Proposed Geometry	4,875	2,139	0.44	4	72.5 (45.0)	80.5 (50.0)	77.0 (47.8)

P.M. PEAK HOUR OPERATIONS

	Total Volume (in vph)	Weaving Volume (in vph)	Volume Ratio ¹	# of Lanes	Average Weaving Speed km/hr (mi/hr)	Average Non- Weaving Speed km/hr (mi/hr)	Average Overall Speed ² km/hr (mi/hr)
Existing Geometry	4,283	2,698	0.63	3	56.4 (35.0)	49.9 (31.0)	53.9 (33.5)
Proposed Geometry	4,283	1,585	0.37	4	75.7 (47.0)	85.3 (53.0)	81.8 (50.8)

¹Volume Ratio = Weaving Volume/Total Volume.

²Average Overall Speed is the weighted average travel speed and is calculated as follows:

$$\frac{[(\text{Average weaving speed} \times \text{weaving volume}) + (\text{Average non-weaving speed} \times \text{non-weaving volume})]}{(\text{Total Volume})}$$

Table 9

**A.M. AND P.M. PEAK HOUR OPERATIONS ANALYSIS SUMMARY
SOUTHBOUND I-275 BETWEEN THE I-275/I-4 MERGE
AND THE ASHLEY STREET OFF-RAMP
I-275/I-4 Interchange Operational/Safety Improvements
Technical Memorandum**

A.M. PEAK HOUR OPERATIONS

	Total Volume (in vph)	Weaving Volume (in vph)	Number of Lanes	Average Per Lane Volume (pcphpl)	Average Overall Speed km/hr (mi/hr)
Existing Geometry	6,506	3,521	3	2,619 ¹	54.4 (33.8)
Proposed Geometry	5,102	0	4	1,501	83.7 (52.0)

P.M. PEAK HOUR OPERATIONS

	Total Volume (in vph)	Weaving Volume (in vph)	Number of Lanes	Average Per Lane Volume (pcphpl)	Average Overall Speed km/hr (mi/hr)
Existing Geometry	5,504	3,079	3	2,186 ¹	55.7 (34.6)
Proposed Geometry	4,802	0	4	1,400	83.7 (52.0)

¹These per lane volumes exceed the capacity of the weaving area (1,900 pcphpl).

Table 10

**A.M. PEAK HOUR OPERATIONS ANALYSIS SUMMARY
SOUTHBOUND I-275 COLLECTOR/DISTRIBUTOR ROADWAY
I-275/I-4 Interchange Operational/Safety Improvements
Technical Memorandum**

	Total Volume (in vph)	Weaving Volume (in vph)	Volume Ratio ¹	# of Lanes	Average Weaving Speed km/hr (mi/hr)	Average Non- Weaving Speed km/hr (mi/hr)	Average Overall Speed ² km/hr (mi/hr)
Existing Geometry	2,054	1,396	0.68	3	66.0 (41.0)	67.6 (42.0)	66.5 (41.3)
Proposed Geometry	3,458	844	0.24	3	64.4 (40.0)	62.8 (39.0)	63.1 (39.2)

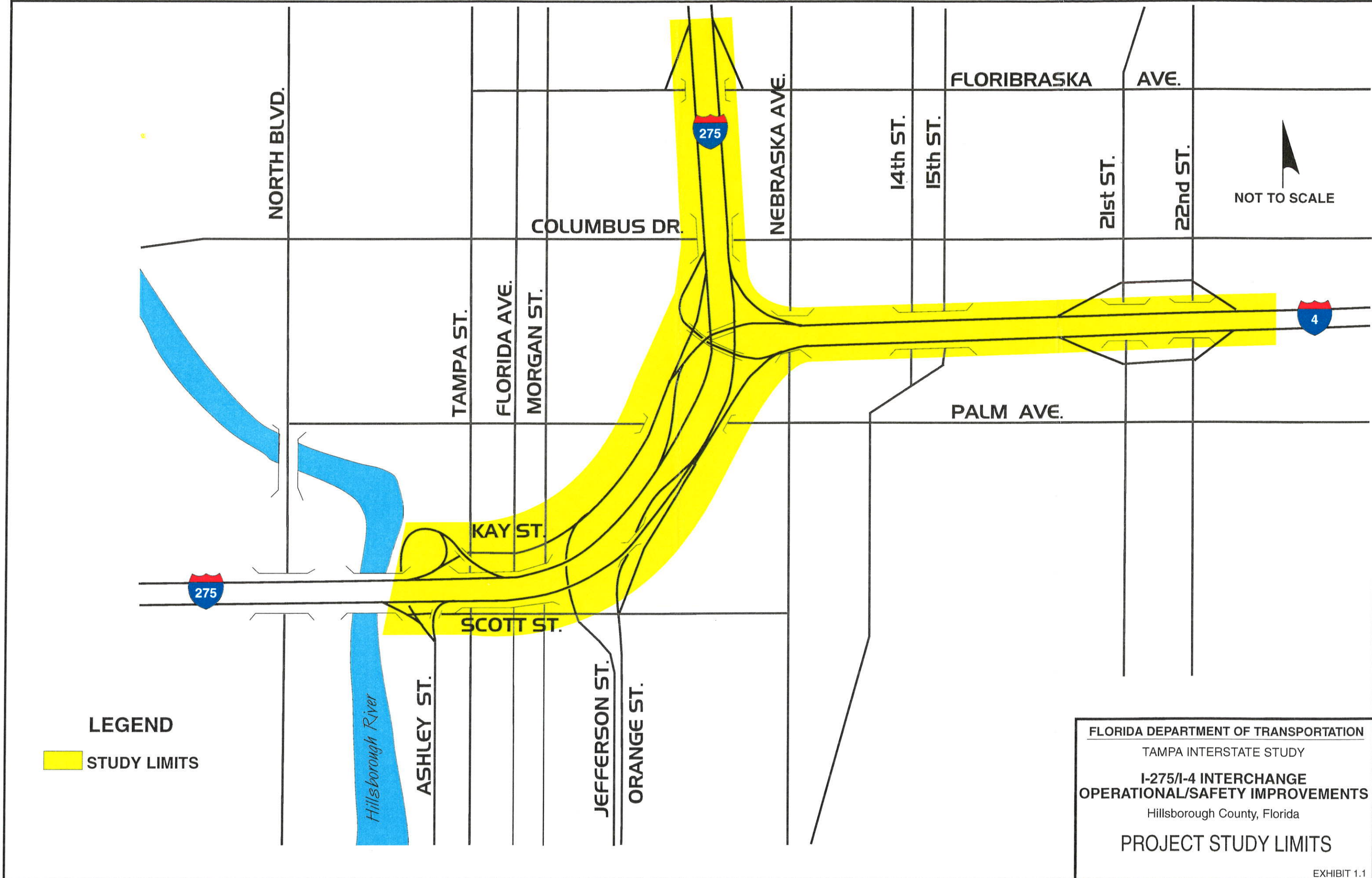
¹Volume Ratio = Weaving Volume/Total Volume.

²Average Overall Speed is the weighted average travel speed and is calculated as follows:

$$\frac{[(\text{Average weaving speed} \times \text{weaving volume}) + (\text{Average non-weaving speed} \times \text{non-weaving volume})]}{(\text{Total Volume})}$$

EXHIBITS

I-275/I-4 Interchange Operational/Safety Improvements



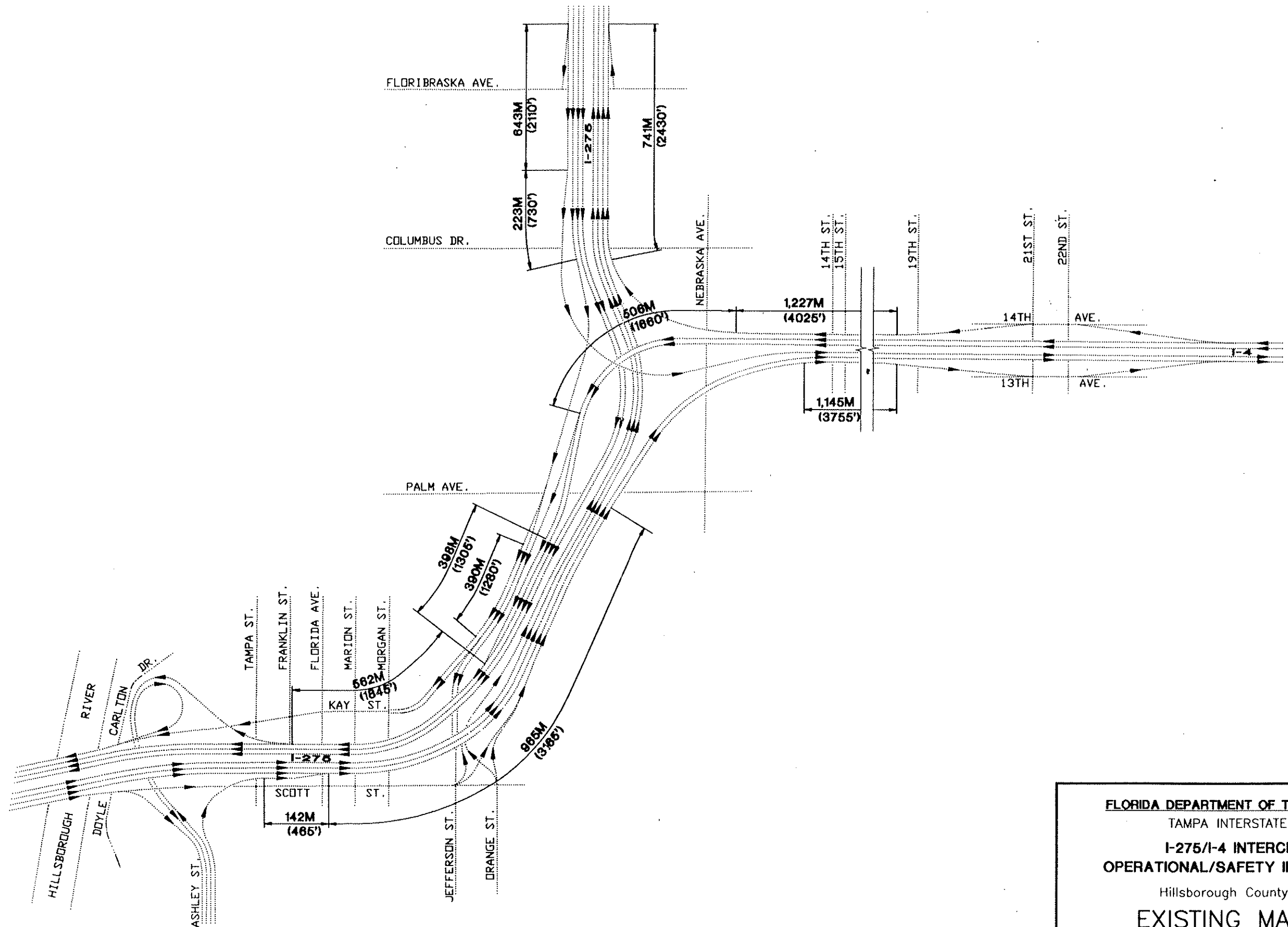
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 **STUDY LIMITS**

FLORIDA DEPARTMENT OF TRANSPORTATION
TAMPA INTERSTATE STUDY
**I-275/I-4 INTERCHANGE
OPERATIONAL/SAFETY IMPROVEMENTS**
Hillsborough County, Florida
PROJECT STUDY LIMITS

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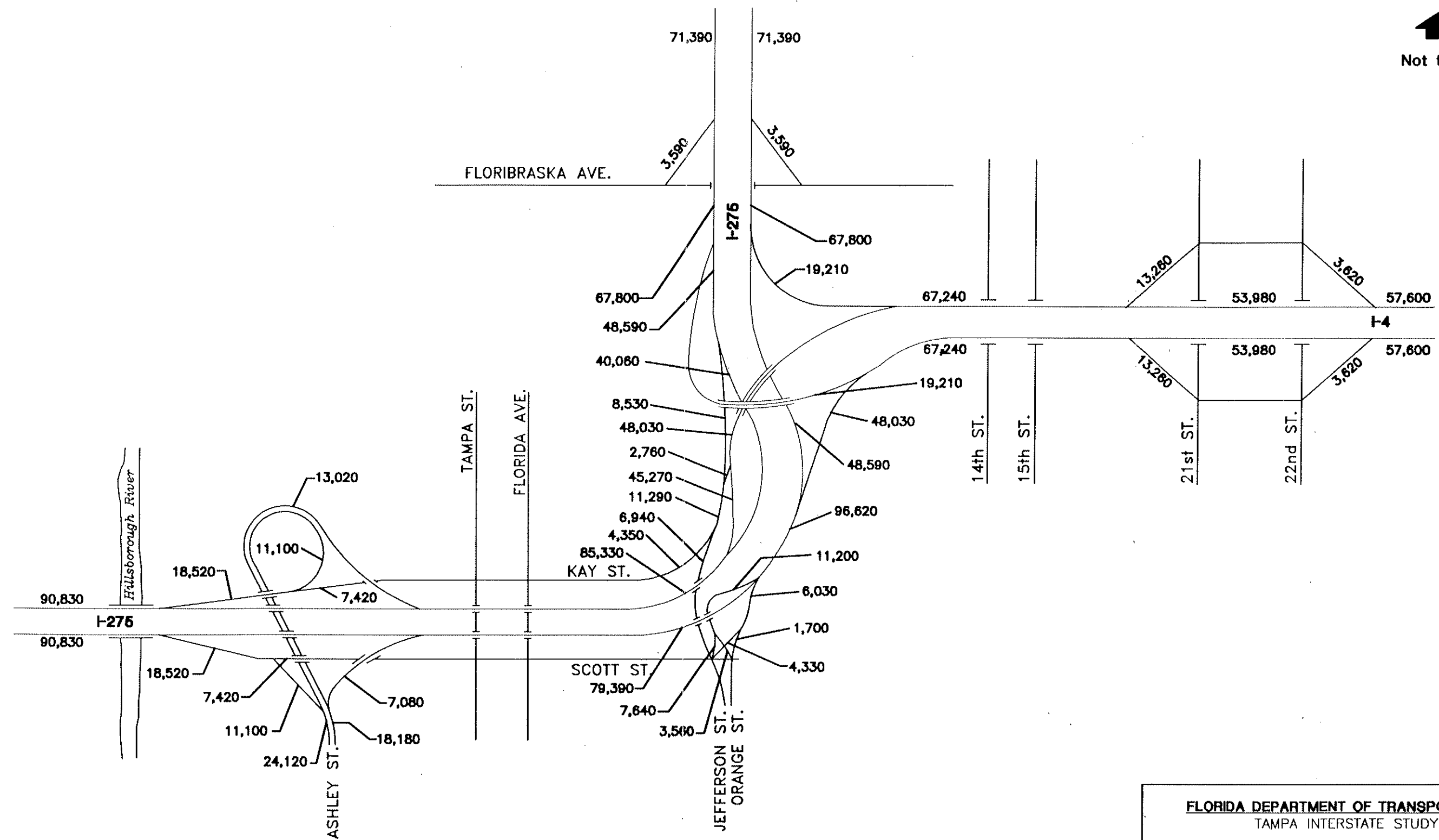
Greiner, Inc.



Not to Scale

FLORIDA DEPARTMENT OF TRANSPORTATION
TAMPA INTERSTATE STUDY
I-275/I-4 INTERCHANGE
OPERATIONAL/SAFETY IMPROVEMENTS
Hillsborough County, Florida
EXISTING MAINLINE
AND RAMP LANEAGE

EXHIBIT 2.1

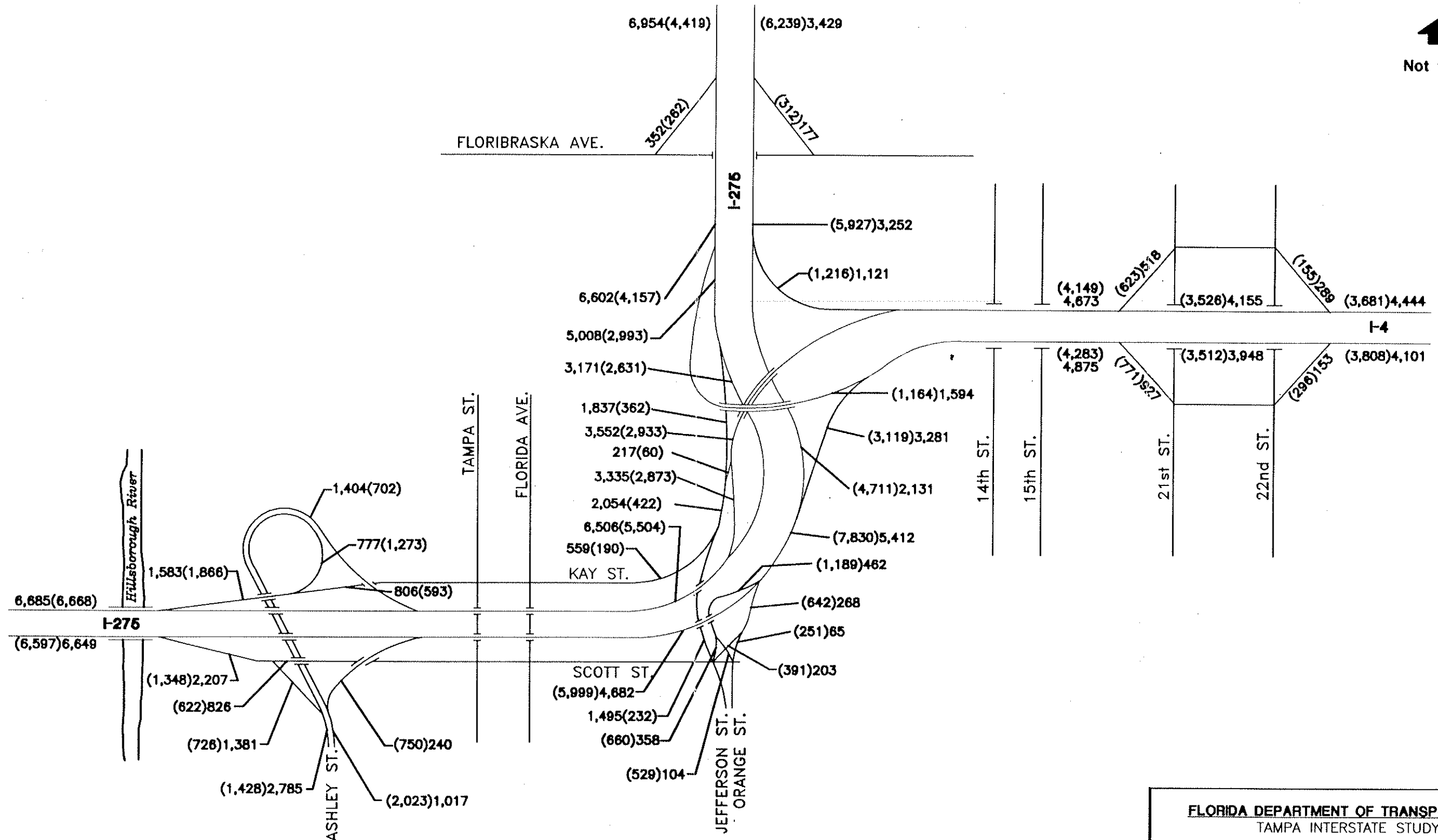


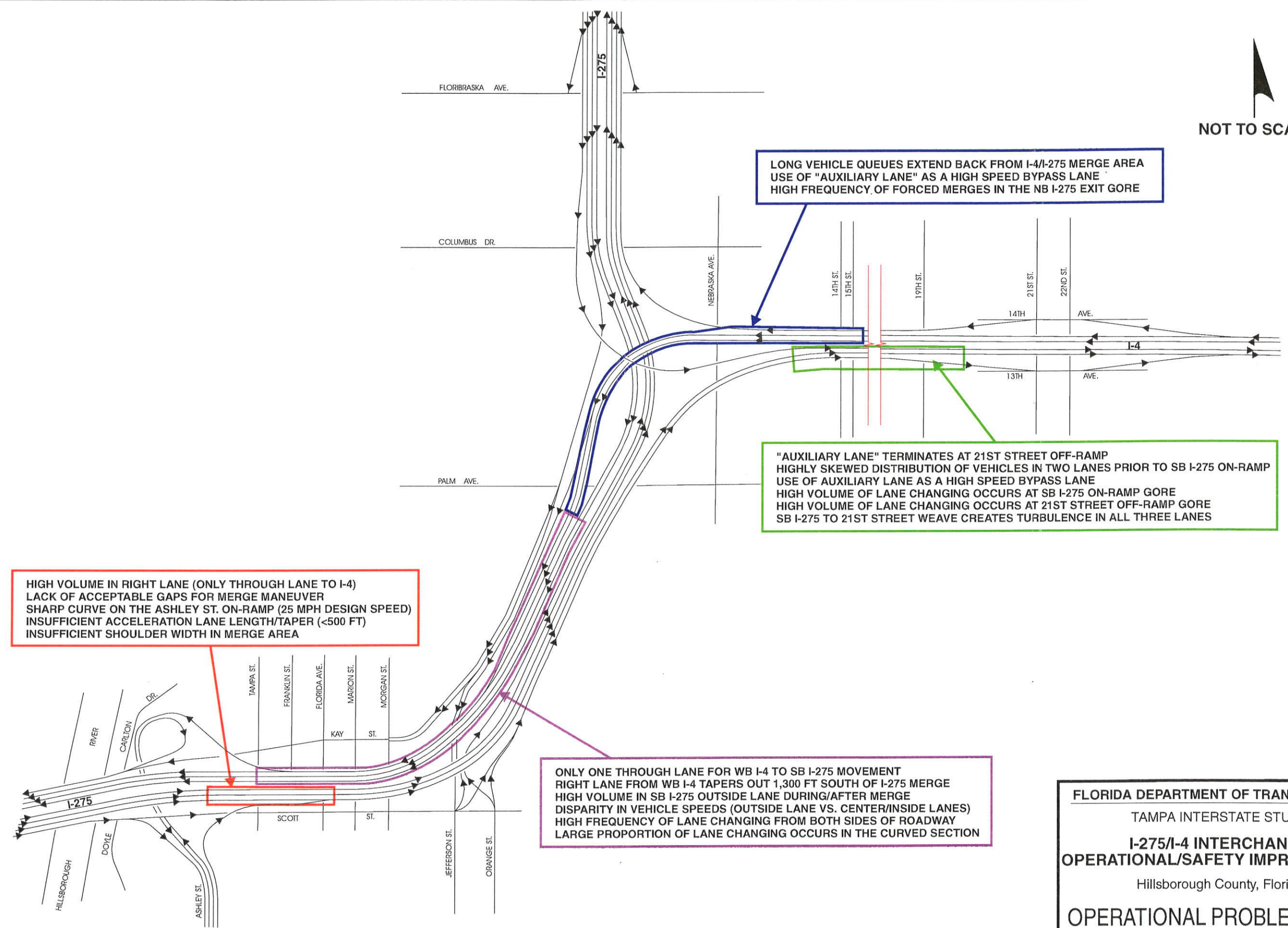
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79,390 Average Daily Traffic Volume

FLORIDA DEPARTMENT OF TRANSPORTATION
TAMPA INTERSTATE STUDY
I-275/I-4 INTERCHANGE
OPERATIONAL/SAFETY IMPROVEMENTS
Hillsborough County, Florida
EXISTING (1995) DAILY
TRAFFIC VOLUMES

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LONG VEHICLE QUEUES EXTEND BACK FROM I-4/I-275 MERGE AREA
USE OF "AUXILIARY LANE" AS A HIGH SPEED BYPASS LANE
HIGH FREQUENCY OF FORCED MERGES IN THE NB I-275 EXIT GORE

"AUXILIARY LANE" TERMINATES AT 21ST STREET OFF-RAMP
HIGHLY SKEWED DISTRIBUTION OF VEHICLES IN TWO LANES PRIOR TO SB I-275 ON-RAMP
USE OF AUXILIARY LANE AS A HIGH SPEED BYPASS LANE
HIGH VOLUME OF LANE CHANGING OCCURS AT SB I-275 ON-RAMP GORE
HIGH VOLUME OF LANE CHANGING OCCURS AT 21ST STREET OFF-RAMP GORE
SB I-275 TO 21ST STREET WEAVE CREATES TURBULENCE IN ALL THREE LANES

HIGH VOLUME IN RIGHT LANE (ONLY THROUGH LANE TO I-4)
LACK OF ACCEPTABLE GAPS FOR MERGE MANEUVER
SHARP CURVE ON THE ASHLEY ST. ON-RAMP (25 MPH DESIGN SPEED)
INSUFFICIENT ACCELERATION LANE LENGTH/TAPER (<500 FT)
INSUFFICIENT SHOULDER WIDTH IN MERGE AREA

ONLY ONE THROUGH LANE FOR WB I-4 TO SB I-275 MOVEMENT
RIGHT LANE FROM WB I-4 TAPERS OUT 1,300 FT SOUTH OF I-275 MERGE
HIGH VOLUME IN SB I-275 OUTSIDE LANE DURING/AFTER MERGE
DISPARITY IN VEHICLE SPEEDS (OUTSIDE LANE VS. CENTER/INSIDE LANES)
HIGH FREQUENCY OF LANE CHANGING FROM BOTH SIDES OF ROADWAY
LARGE PROPORTION OF LANE CHANGING OCCURS IN THE CURVED SECTION

FLORIDA DEPARTMENT OF TRANSPORTATION
TAMPA INTERSTATE STUDY
I-275/I-4 INTERCHANGE
OPERATIONAL/SAFETY IMPROVEMENTS
Hillsborough County, Florida

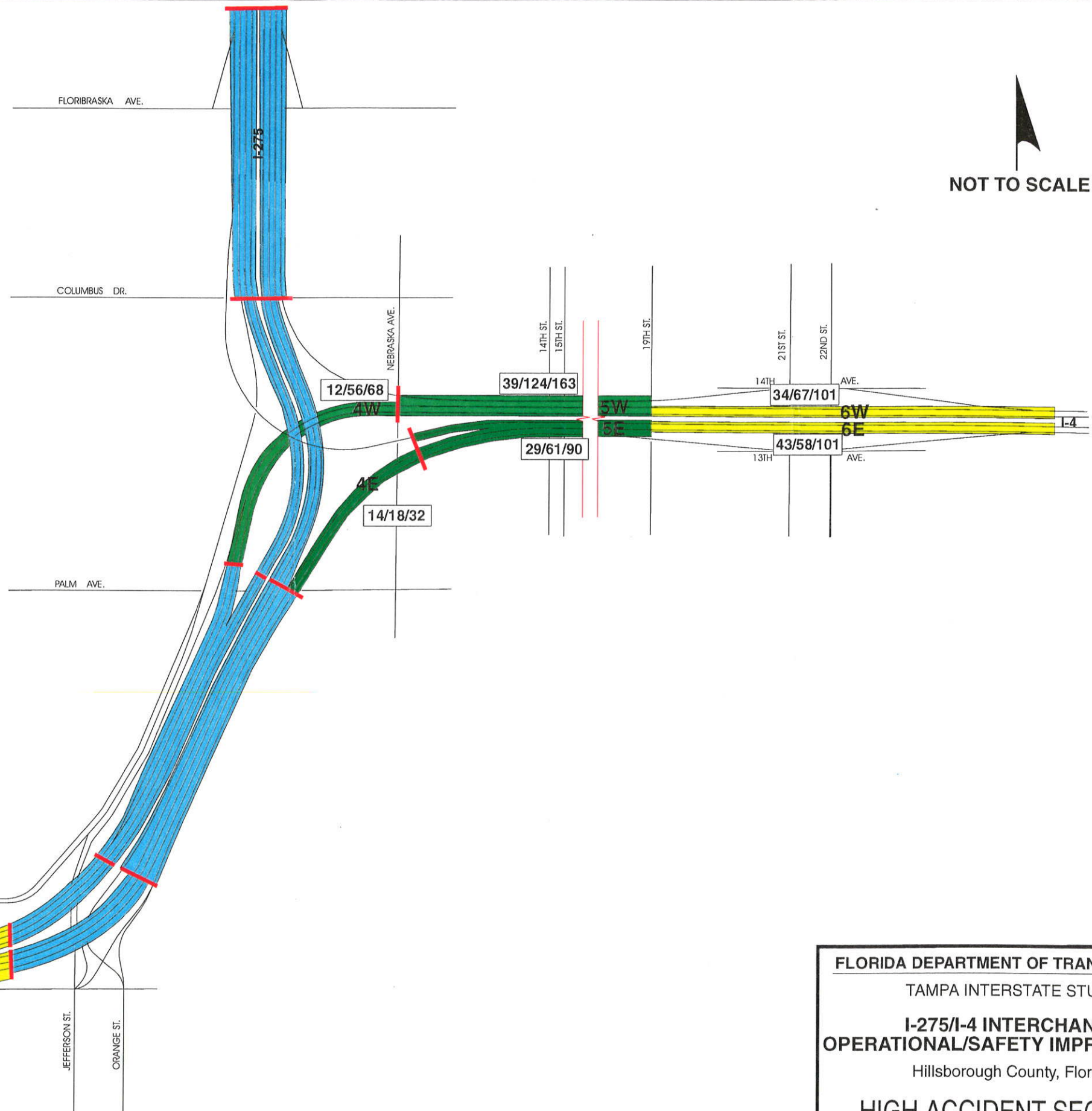
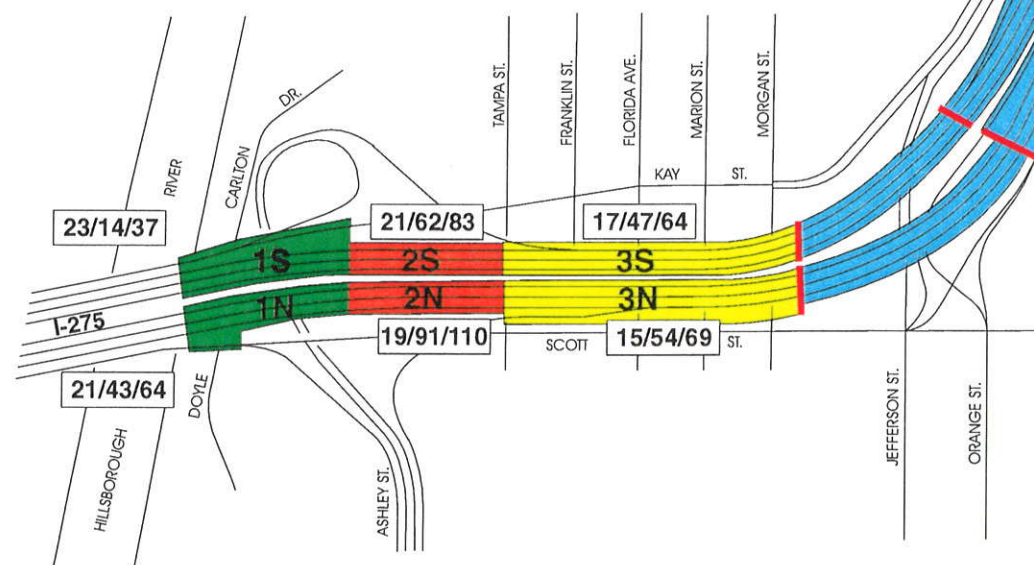
OPERATIONAL PROBLEM AREAS



LEGEND
5 YEAR AVERAGE SAFETY RATIO
(1990-1994)

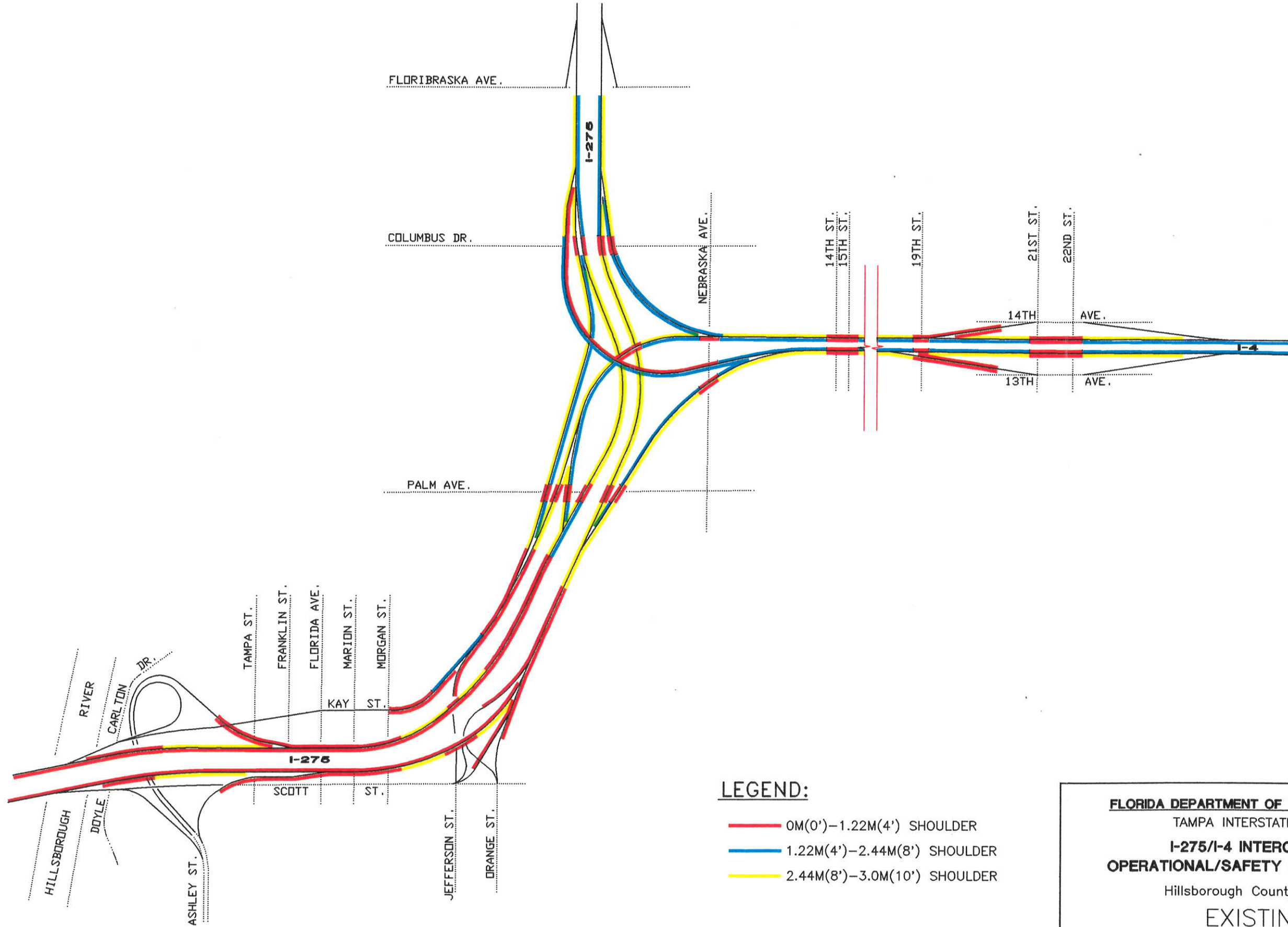


15/54/69
— TOTAL NUMBER OF ACCIDENTS
— NUMBER OF NON-PEAK HOUR ACCIDENTS
— NUMBER OF PEAK HOUR ACCIDENTS (7-9 AM AND 4-6 PM)



FLORIDA DEPARTMENT OF TRANSPORTATION
TAMPA INTERSTATE STUDY
**I-275/I-4 INTERCHANGE
OPERATIONAL/SAFETY IMPROVEMENTS**
Hillsborough County, Florida
HIGH ACCIDENT SEGMENTS

Q:\TIS\ENG_SUM\EXSHOWID.DWG/08.16.96



LEGEND:

- 0M(0')-1.22M(4') SHOULDER
- 1.22M(4')-2.44M(8') SHOULDER
- 2.44M(8')-3.0M(10') SHOULDER

FLORIDA DEPARTMENT OF TRANSPORTATION

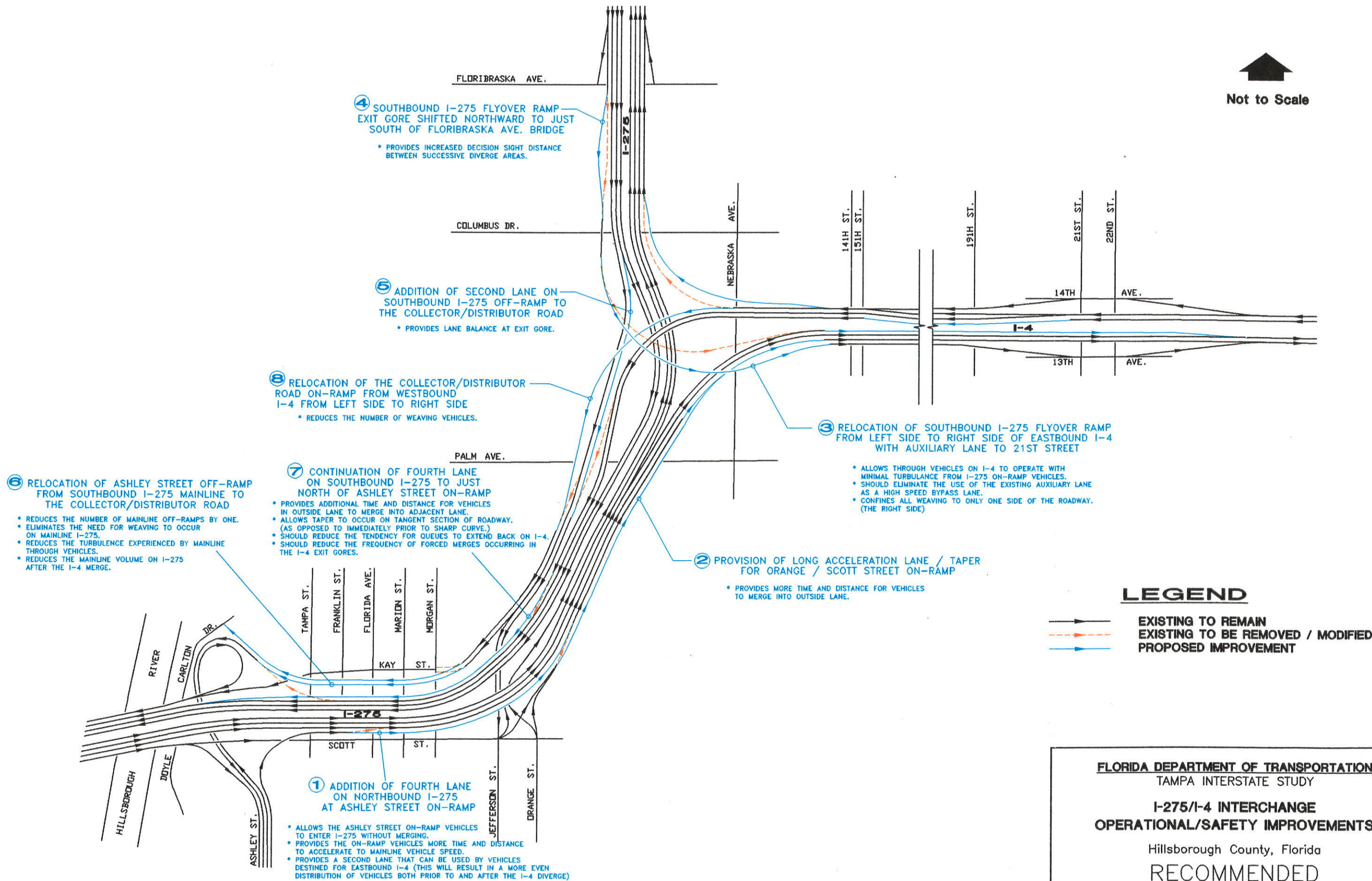
TAMPA INTERSTATE STUDY

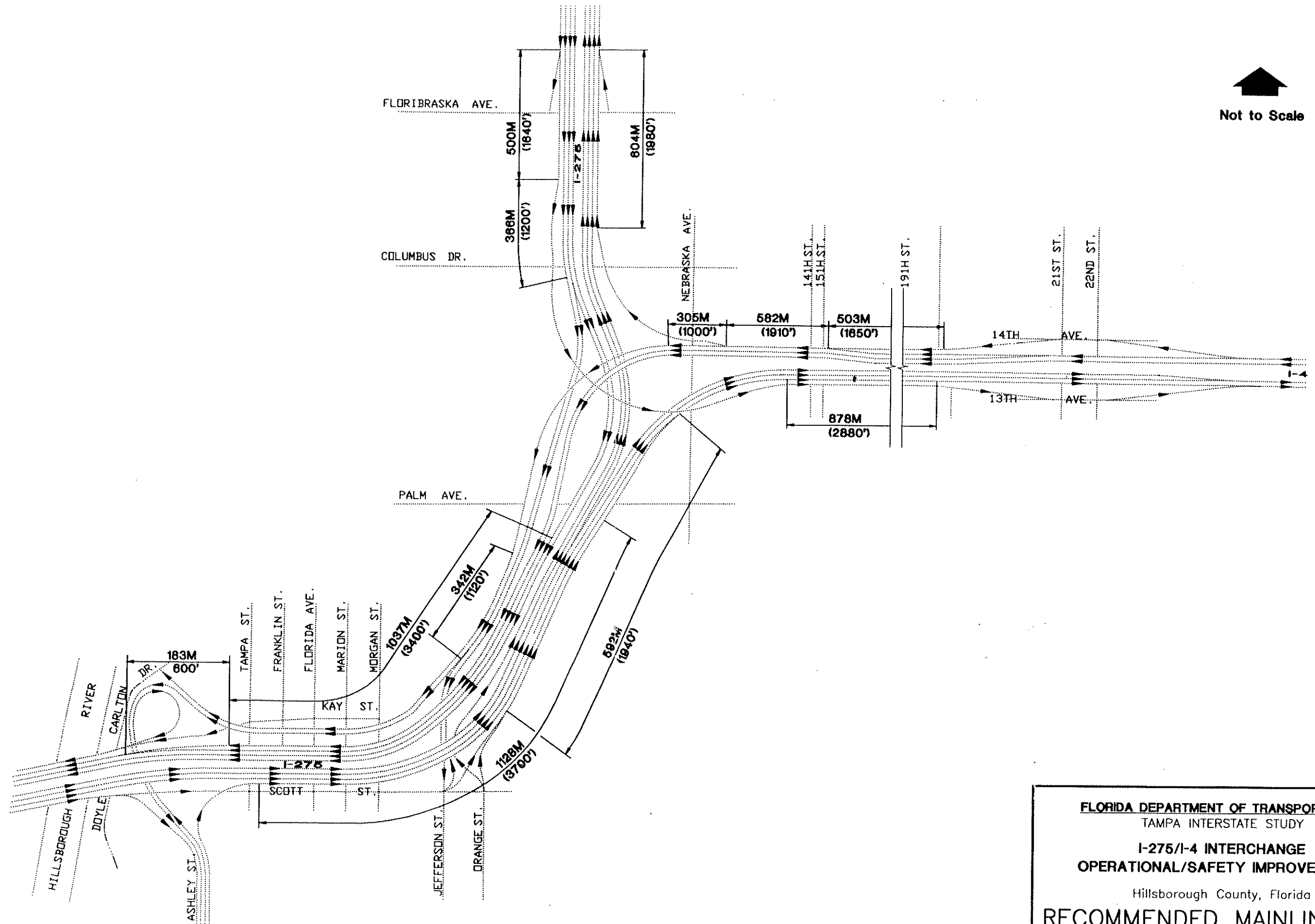
I-275/I-4 INTERCHANGE

OPERATIONAL/SAFETY IMPROVEMENTS

Hillsborough County, Florida

EXISTING
SHOULDER WIDTHS





FLORIDA DEPARTMENT OF TRANSPORTATION
TAMPA INTERSTATE STUDY
I-275/I-4 INTERCHANGE
OPERATIONAL/SAFETY IMPROVEMENTS
Hillsborough County, Florida
**RECOMMENDED MAINLINE AND
RAMP CONFIGURATION**

DATE: 20-Aug-96 14:23

GREINER, INC.

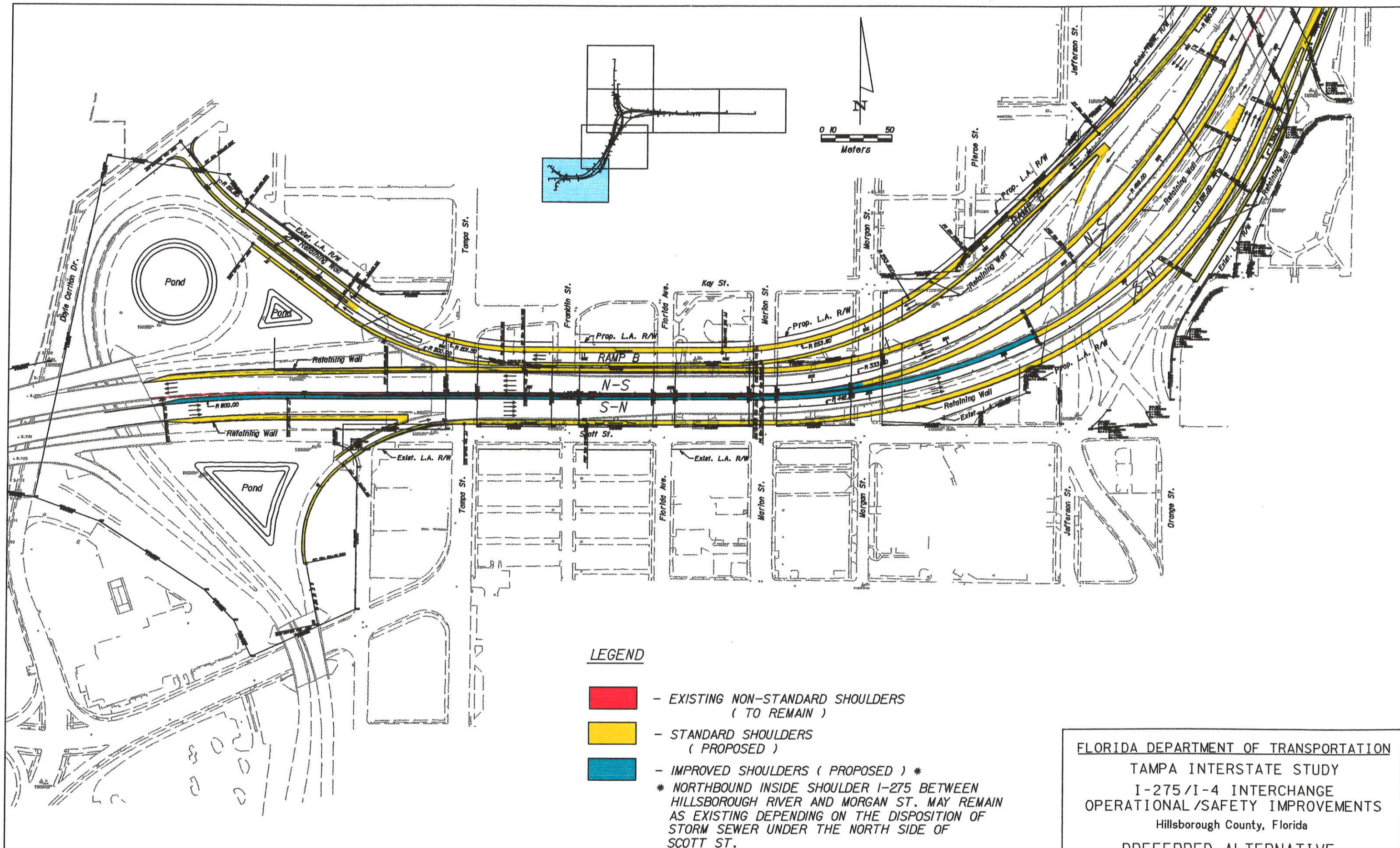
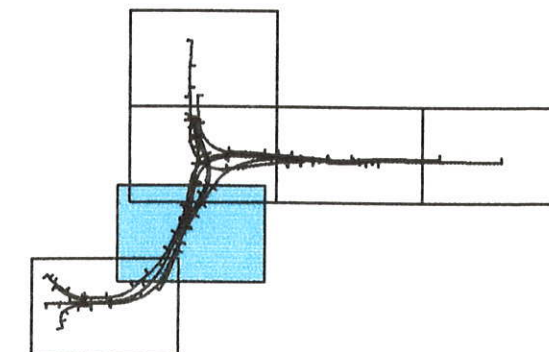
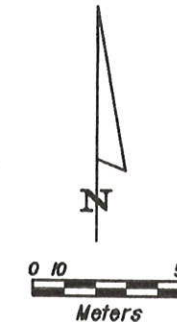
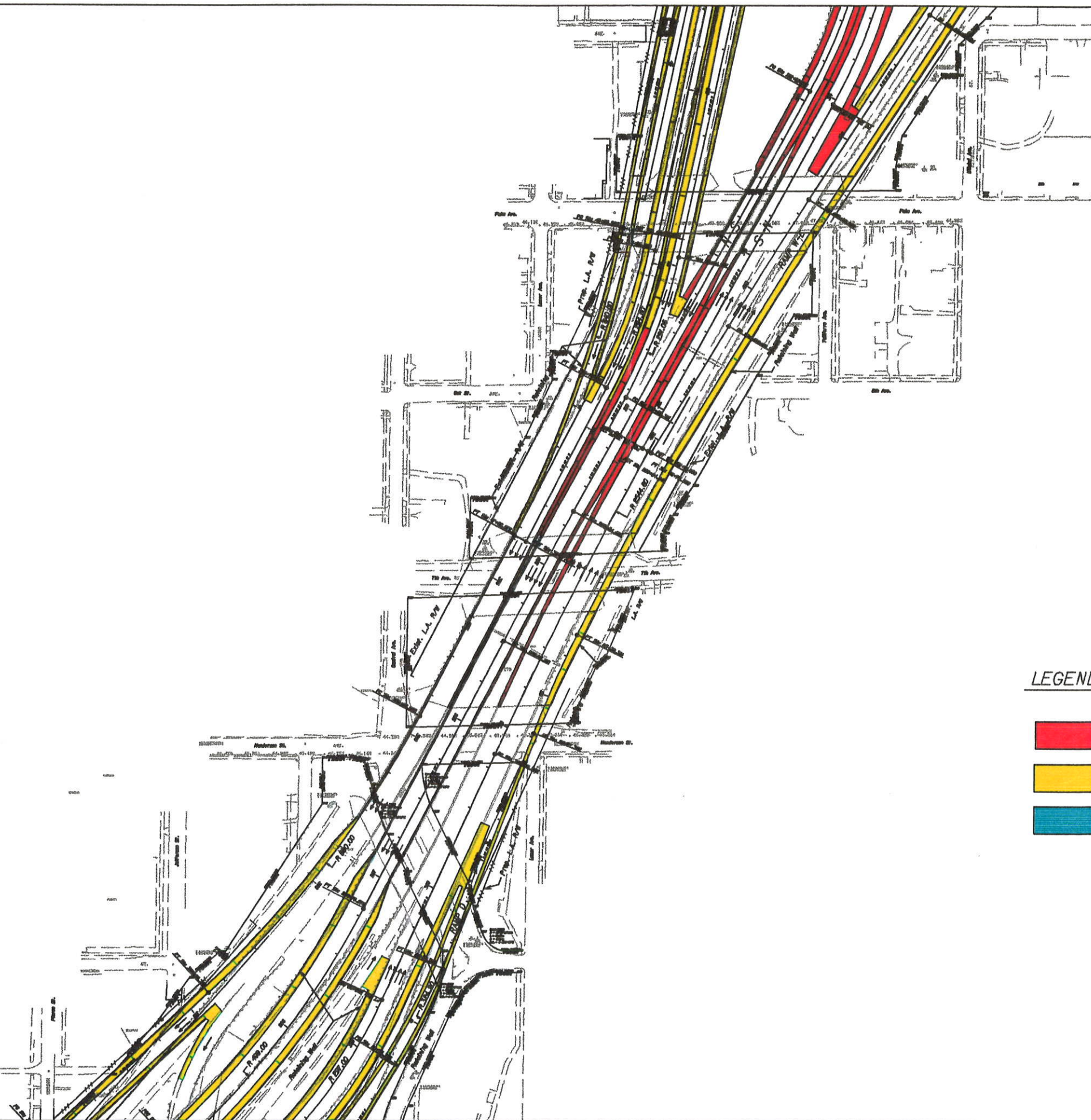





EXHIBIT 3.3

DATE: 20-Aug-96 14:25

GREINER, INC.



LEGEND

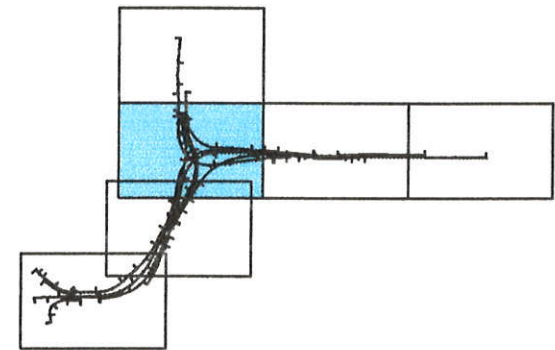
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(TO REMAIN)
-  - STANDARD SHOULDERS
(PROPOSED)
-  - IMPROVED SHOULDERS
(PROPOSED)

FLORIDA DEPARTMENT OF TRANSPORTATION




TAMPA INTERSTATE STUDY
I-275/I-4 INTERCHANGE
OPERATIONAL/SAFETY IMPROVEMENTS
Hillsborough County, Florida

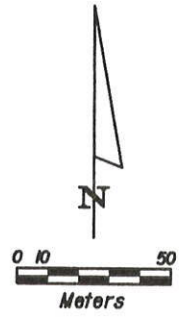
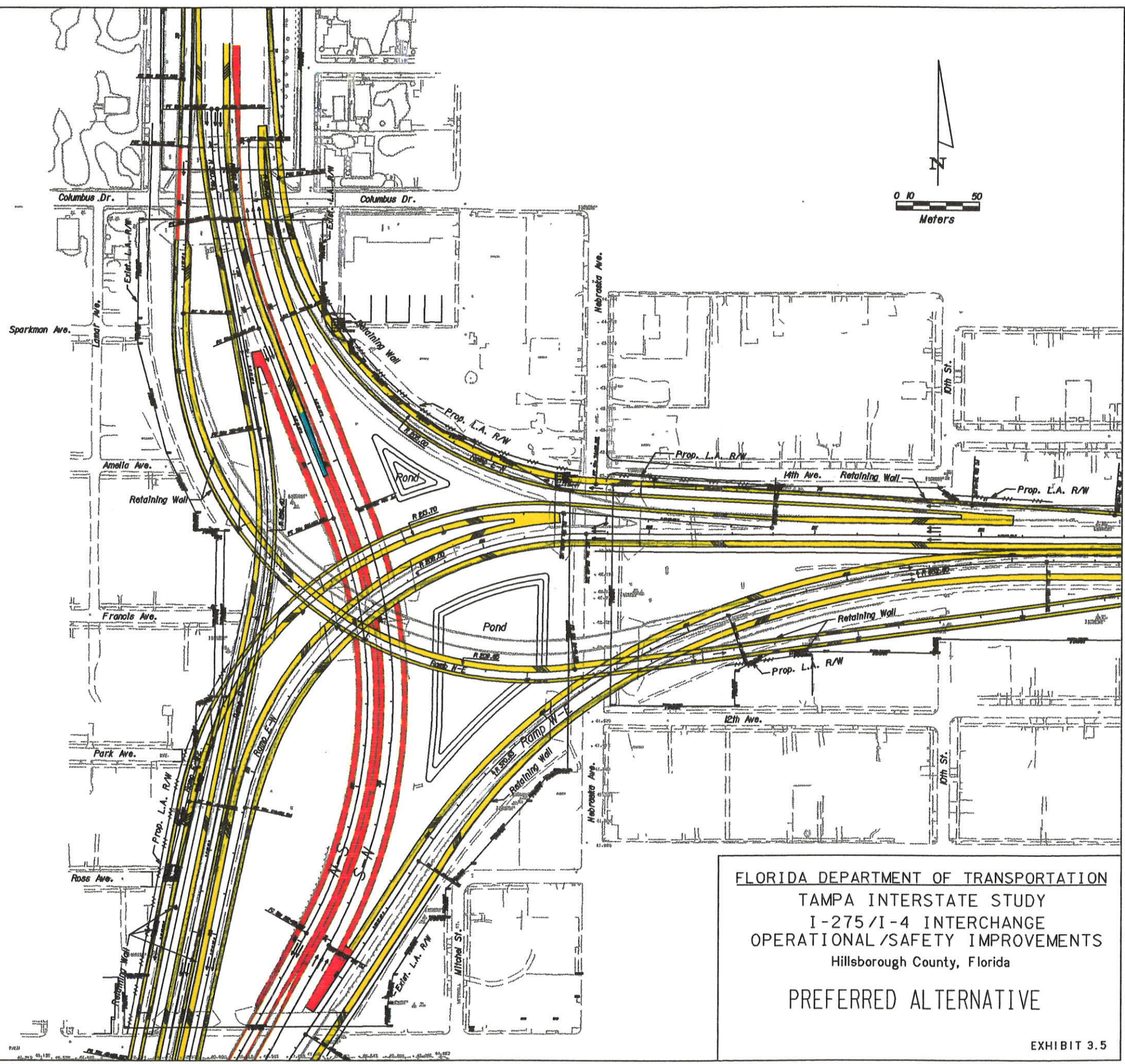
PREFERRED ALTERNATIVE

EXHIBIT 3.4



LEGEND




-  - EXISTING NON-STANDARD SHOULDERS (TO REMAIN)
-  - STANDARD SHOULDERS (PROPOSED)
-  - IMPROVED SHOULDERS (PROPOSED)



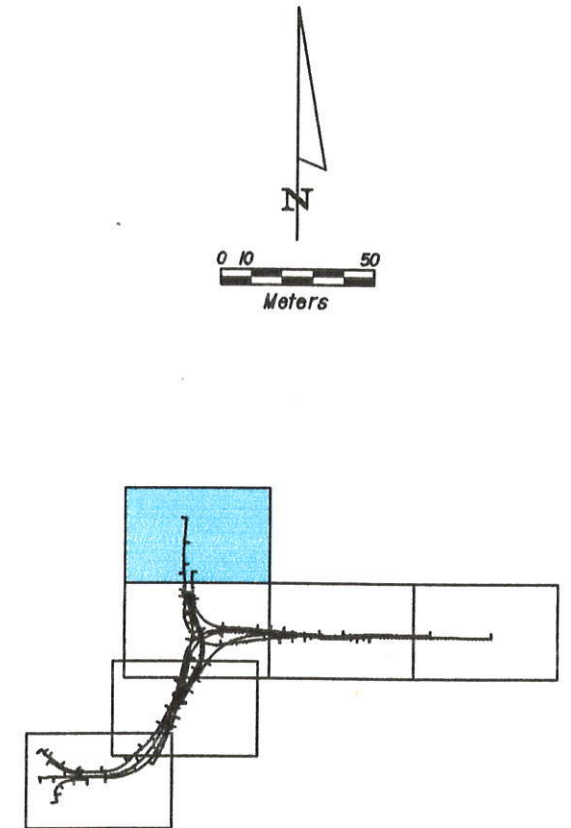
FLORIDA DEPARTMENT OF TRANSPORTATION
TAMPA INTERSTATE STUDY
I-275/I-4 INTERCHANGE
OPERATIONAL/SAFETY IMPROVEMENTS
Hillsborough County, Florida

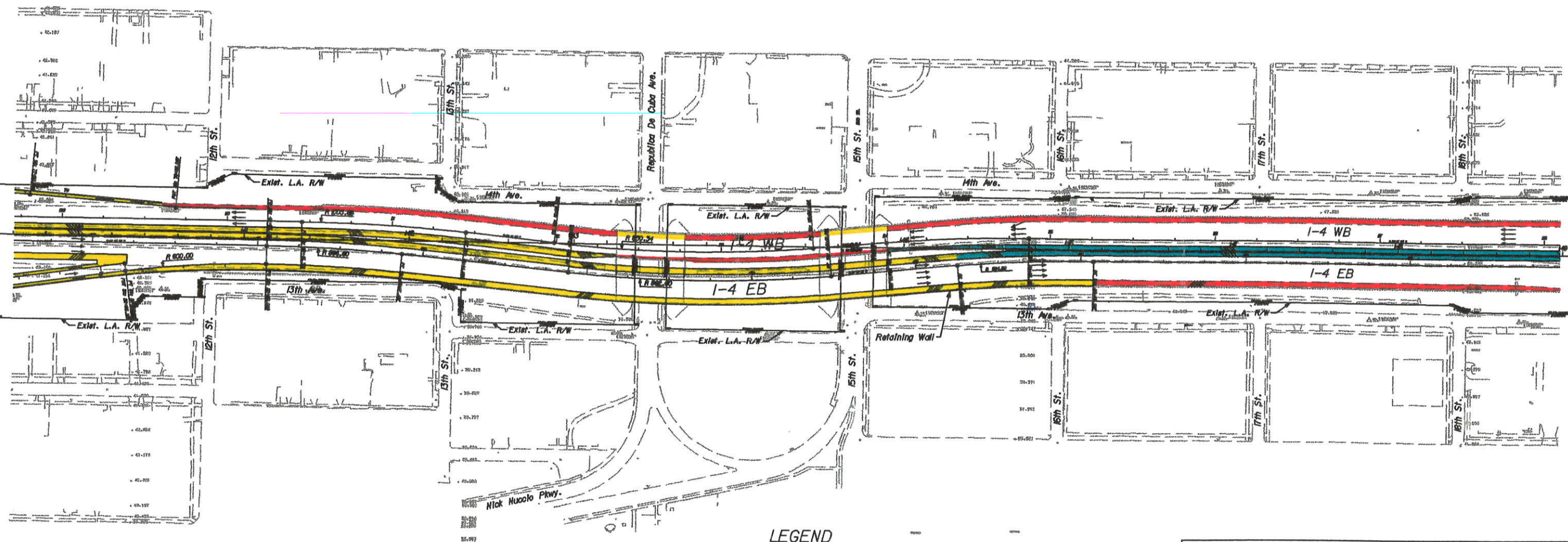
PREFERRED ALTERNATIVE



-  - EXISTING NON-STANDARD SHOULDERS
(TO REMAIN)
-  - STANDARD SHOULDERS
(PROPOSED)
-  - IMPROVED SHOULDERS
(PROPOSED)

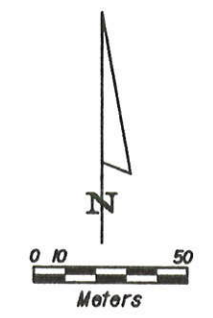
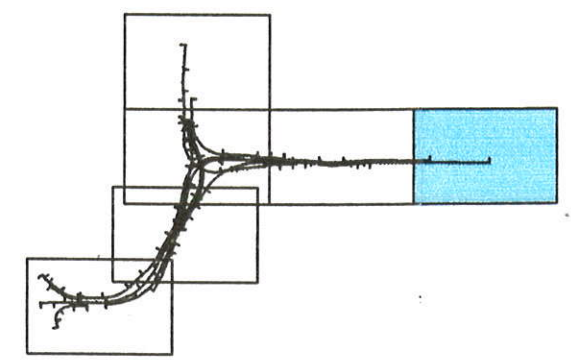
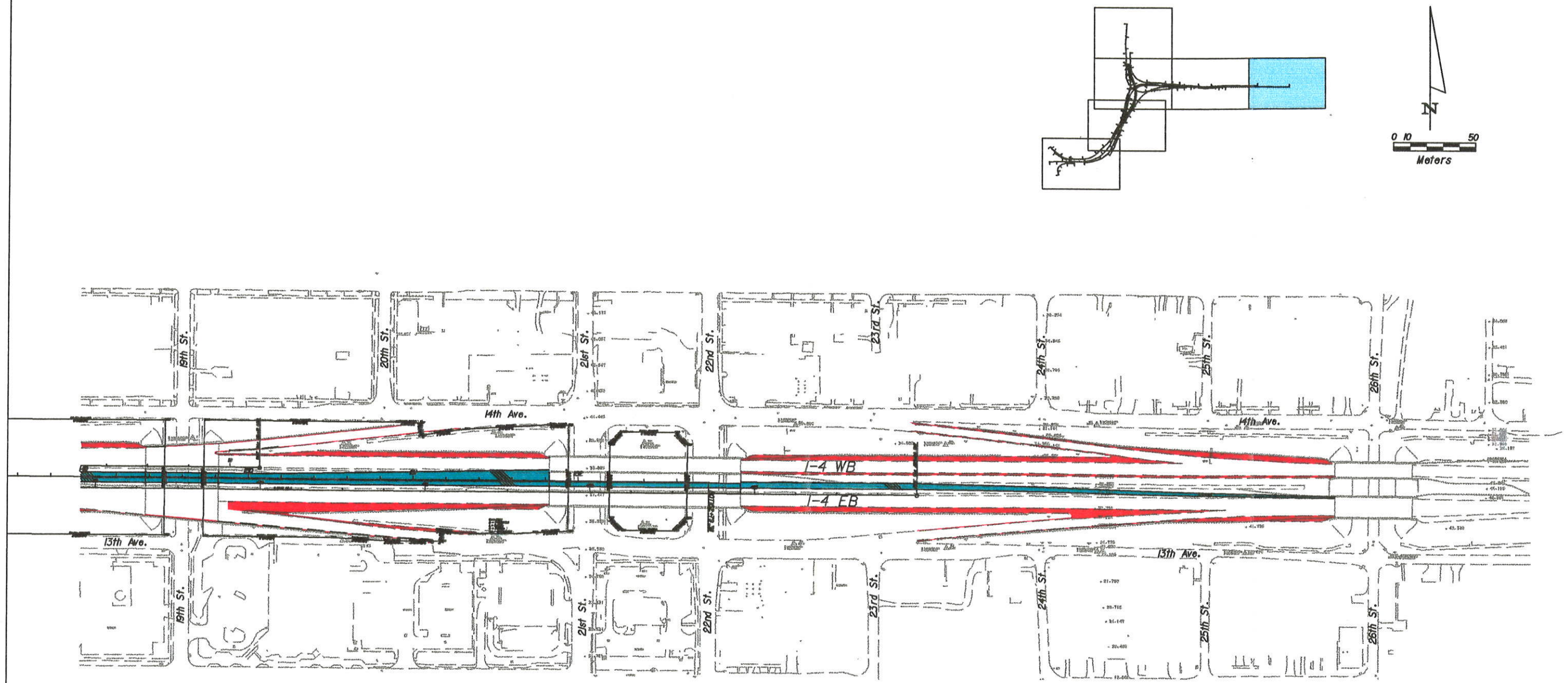
FLORIDA DEPARTMENT OF TRANSPORTATION
TAMPA INTERSTATE STUDY
I-275/I-4 INTERCHANGE
OPERATIONAL /SAFETY IMPROVEMENTS
Hillsborough County, Florida
PREFERRED ALTERNATIVE








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DATE: 20-Aug-96 14:36

GREINER, INC.



LEGEND

-  - EXISTING NON-STANDARD SHOULDERS
(TO REMAIN)
-  - STANDARD SHOULDERS
(PROPOSED)
-  - IMPROVED SHOULDERS
(PROPOSED)

FLORIDA DEPARTMENT OF TRANSPORTATION
TAMPA INTERSTATE STUDY
I-275/I-4 INTERCHANGE
OPERATIONAL/SAFETY IMPROVEMENTS
Hillsborough County, Florida
PREFERRED ALTERNATIVE