Technical Memorandum
For Congestion Management and Crash Mitigation

Estimating Travel Time Reliability and the Impacts of Operations and Safety Improvements on the 2050 Network

FINAL

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Hillsborough TPO

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1.0 Introduction

Purpose

This technical memorandum is prepared as part of the 2050 Long Range Transportation Plan. The Congestion Management and Crash Mitigation Needs Assessment helps to identify the existing transportation deficiencies and future needs of the region and to serve as a guide for the Hillsborough TPO to make investment decisions for transportation projects that will help improve travel time reliability and safety.

This report is the result of a technical analysis conducted using the C-11 Post Processor tool developed by Federal Highway Administration's Second Strategic Highway Research Program 2 (SHRP 2) for transportation investment planning. Efforts have been taken to coordinate with the local agencies to get feedback on the type of improvements that are currently being implemented in the region and the cost estimates based on the functional classification of the roads namely highway, divided and undivided arterials and collectors. The goal of the technical memorandum is to analyze safety and reliability improvements that could be bundled and recommended specific to the corridor type. The results are mainly focused on two categories as follows:

- Identify typical safety treatments that are either currently being deployed or could be deployed in the future to achieve a desirable level of safety performance for the functional class of the roadway and to develop cost estimates for the treatments.
- Identify typical Transportation Systems Management and Operations (TSMO) improvements that could reduce congestion and improve travel time reliability measured in Travel Time Index (TTI) and to develop cost estimates for these improvements.

Background

The following section explains the methodology used to estimate congestion management performance measures for alternative investment plans in the 2050 Long Range Transportation Plan (LRTP) update. The methodology is based on work done for the Strategic Highway Research Program 2 (SHRP 2) under Project C11, *Development of Improved Economic Impact Analysis Tools*.[1] In that project, several modules were developed to estimate the economic impact of transportation investments on factors not usually accounted for in transportation analyses: market access, connectivity, and travel time reliability. It is the reliability module that forms the basis for the current reliability and safety work.

A spreadsheet was developed in the original SHRP 2 Project C11 to estimate the reliability impacts of highway investments, but it is not being used in the current work. Rather, its basic procedures were extended and built into a separate tool that post-processes the loaded network file from the Tampa Bay Regional Planning Model (TBRPM), henceforth known as the "C11 Post-Processor." At the request of the Hillsborough TPO, the ability to estimate safety impacts was added. The C11 Post-Processor was previously used in the 2045 LRTP update.

[1] http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2350

Travel Time Reliability

A key feature of this report is the inclusion of travel time reliability as a key feature of mobility. Simply put, travel time reliability relates to how travel varies of time. That is, travel times can be unpredictable because conditions change from day-to-day due to incidents, inclement weather, and surges in demand. The Federal Highway Administration describes travel time reliability as follows.

> Few people will dispute the fact that traffic congestion is common in many cities in the United States. In these cities, drivers are used to congestion and they expect and plan for some delay, particularly during peak driving times. Many drivers either adjust their schedules or budget extra time to allow for traffic delays. But what happens when traffic delays are much worse than expected? Most travelers are less tolerant of unexpected delays because they cause travelers to be late for work or important meetings, miss appointments, or incur extra childcare fees. Shippers that face unexpected delay may lose money and disrupt just-in-time delivery and manufacturing processes.[2]

2.0 Technical Approach

2.1 Modeling Structure

For input, the scripts read the loaded network file as well as a list of safety improvements. The analysis is conducted at the corridor level, using corridors defined by the TPO and structured into four large groups:

1. Freeways;
2. Divided arterials;
3. Undivided arterials; and
4. Other roadways (collectors and local roads combined).

Corridors range 2-6 miles in length.

2.2 Performance Measures

Reliability

- Planning Time Index (95th percentile travel time/free flow travel time)
- Reliability Index (80th percentile travel time/free flow travel time)

Congestion

- Mean Travel Time Index (mean travel time/free flow travel time)
- Delay (vehicle-hours)
- Average Speed

[2] Federal Highway Administration, https://ops.fhwa.dot.gov/publications/tt_reliability/TTR_Report.htm

Safety

- Crashes by severity: fatal, injury, property damage only
- Crashes for special user types: pedestrian and bicycle

2.3 Methodology

Predicting Travel Time Reliability

The method in the original C11 tool was upgraded to include the following features.

Assign Free Flow Speed (FFS)

= 60 when Highway Type = 'Freeway'
= 45 when Highway Type = 'Divided Arterial'
= 40 when Highway Type = 'Undivided Arterial'
= 35 when Highway Type = 'Collector'
= 30 when Highway Type = 'Other'

Calculate Speed Due to Recurring Conditions Only

The travel time function proposed by Davidson (1966, 1978) for transport planning purposes has been subject to much discussion and efforts of calibration and improvement including some controversy over the meaning of its parameters. A new travel time function was proposed by Akçelik[3] as an alternative to Davidson's function to overcome the conceptual and calibration problems.

In *Development of Speed Models for Improving Travel Forecasting and Highway Performance Evaluation*, Moses et al. presented a piecewise modified Davidson volume-delay function for use in a study of SR-9 and I-95 in Pompano Beach, Florida.[4]

$$S = \begin{cases} \dfrac{S_0}{1 + \dfrac{J_D\left(\frac{V}{C}\right)}{1 - \frac{V}{C}}} & for\ \dfrac{V}{C} \leq \mu \\ \dfrac{S_0}{1 + \dfrac{J_D \times \mu}{1-\mu} + \dfrac{J_D\left(\frac{V}{C} - \mu\right)}{(1-\mu)^2}} & for\ \dfrac{V}{C} > \mu \end{cases}$$

Where:

S = predicted travel speed (mph)

S_o = free-flow speed (mph)

J_D = a delay parameter,

[3] Akcelik, *Travel time functions for transport planning purposes: Davidson's function, its time-dependent form and an alternative travel time function*, December 2000.
[4] Moses, Ren and Enock, Mtoi, *Development of Speed Models for Improving Travel Forecasting and Highway Performance Evaluation*, FDOT Project No. BDK83, December 2013

V = volume (veh/h)

C = capacity (veh/h)

μ = saturation threshold parameter

This piecewise modified Davidson equation is used in the C11 tool. Figure 1 shows how the function behaves over a range of volume-to-capacity ratios, assuming a free speed of 45 mph.

Calculate the Recurring Delay Rate (hours per vehicle-mile)

RecurringDelayRate = (1/Speed) – (1/FFS)

Calculate the Base Incident-Related Delay Rate (hours per vehicle-mile)

The lookup tables from the IDAS User Manual[5] are used to calculate incident delay. This requires the v/c ratio, number of lanes, and length and type of the period being studied, which is set at 3-hours. Equations were fit to these tables as follows:

- Number of lanes <= 2: Du = -0.0111/(1 -1471 * exp(-6.8498 * v/c))
- Number of lanes = 3: Du = -0.0085/(1 -1872 * exp(-7.1381 * v/c))
- Number of lanes >= 4: Du = -0.0068/(1 -1827 * exp(-7.1090 * v/c))

Where: Du = Base incident delay rate

v/c = volume-to-capacity ratio

Calculate Delay (vehicle-hours)

- RecurringDelay = RecurringDelayRate * VMT
- IncidentDelay = Du * VMT
- TotalDelay = RecurringDelay + IncidentDelay

Calculate the Mean Travel Time Index (MTTI)

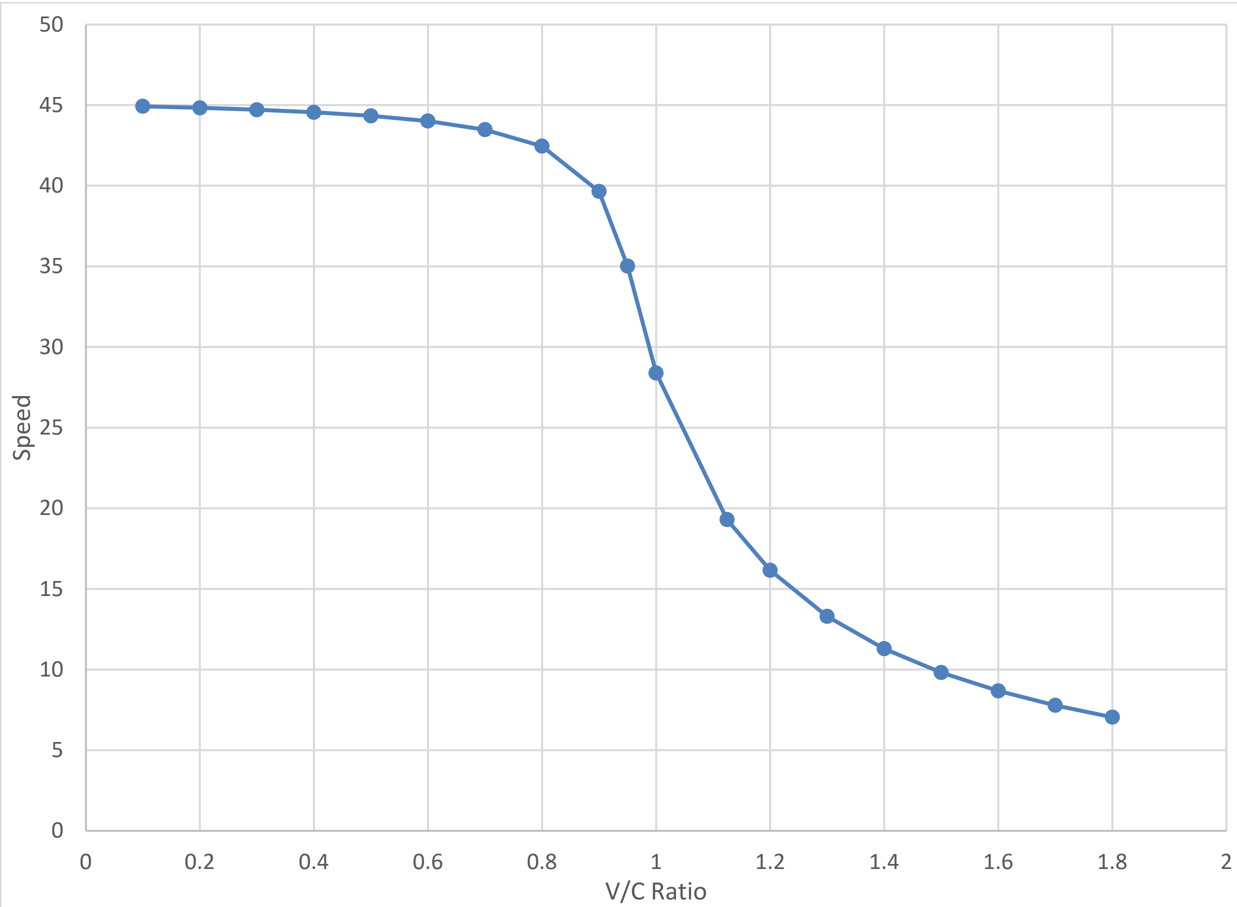
- MTTI = 1 + (FFS * (RecurringDelayRate + Du))

Calculate Reliability Measures

- Apply the equations developed below to derive the reliability measures.

[5] IDAS User's Manual, Appendix B, Tables B.2.14 – B.2.18, http://idas.camsys.com/documentation.htm

Figure 1. Volume-Delay Function in the C11 Tool



Assess the Impacts of Improvements

The above procedures are repeated with the impact factors from Table 4 applied as appropriate.

If incident management programs have been added as a strategy **or** if a strategy lowers the incident rate (frequency of occurrence), then the "after" delay is calculated as follows:

$$D_a = D_u * (1-R_f) * (1-R_d)^2$$

Where:

D_a = Adjusted delay (hours of delay per mile)

D_u = Unadjusted (base)delay (hours of delay per mile)

R_f = Reduction in incident frequency expressed as a fraction (with R_f = 0 meaning no reduction, and R_f = .30 meaning a 30 percent reduction in incident frequency)

R_d = Reduction in incident duration expressed as a fraction (with R_d = 0 meaning no reduction, and R_d = .30 meaning a 30-percent reduction in incident duration).

Because the data on which the reliability metric predictive functions do not include extremely high values of TTI_m, it is recommended that TTI_m be capped at a value of 6.0, which roughly corresponds to an average speed of 10 mph. Even though the data included highway sections that were considered to be severely congested, an overall annual average speed of 10 mph for a peak period was never observed. At TTI_m = 6.0, the reliability prediction equations are still internally consistent.

Develop Custom Equations for Predicting Reliability Metrics

Instead of relying on the C11 tool's equations, developed from data from several cities, it was decided to recalibrate them using data from Florida. The National Performance Management Research Data Set (NPMRDS) for 2014 and 2015 was previously used for the purpose of developing reliability prediction equations for Florida. As specified in the original SHRP 2 C11 project, these relationships predict reliability measures as a function of the mean travel time index (MTTI) for a segment. For this analysis, segments were defined as Traffic Message Channels (TMCs), the basic geographic reporting unit (link) in the NPMRDS data.

The equations that were fit from the data follow. Figures 2 through 7 show the equations superimposed on the original data.

Freeway Relationships

In the following equations: X = Mean Travel Time Index (TTI)
TTI_{50} = 50th percentile TTI
TTI_{80} = 80th percentile TTI
TTI_{95} = 95th percentile TTI

$$TTI_{50} = 10.4910 - 9.5867 \times e^{(-0.0142 \times X^{2.2367})} \quad for\ X > 1.07$$
$$= 0.963X + 0.037 \quad otherwise$$
$$TTI_{80} = 7.3567 - 6.9965 \times e^{(-0.0910 \times X^{2.0185})} \quad for\ X > 1.03$$
$$= 1.0\ otherwise$$

$$TTI_{95} = 11.7933 - 16.2178 \times e^{(-0.3855 \times X^{1.0336})} \quad for\ X > 1.08$$
$$= 1.3737X - 0.3737 \quad otherwise$$

Signalized Arterial Relationships

$$TTI_{50} = \frac{0.9333 \times 101.7049 + 12.887 \times X^{2.403}}{101.7049 + X^{2.403}} \quad for\ X < 1.07$$
$$= X \quad otherwise$$

$$TTI_{80} = \frac{0.7266 \times 26.26 + 9.6702 \times X^{2.5698}}{26.26 + X^{2.5698}}$$

$$TTI_{95} = 21.1669 \times e^{-\frac{2.9506}{X}}$$

Figure 2. Relationship for Determining the Median TTI from the Average (Typical) Condition, Urban Interstates

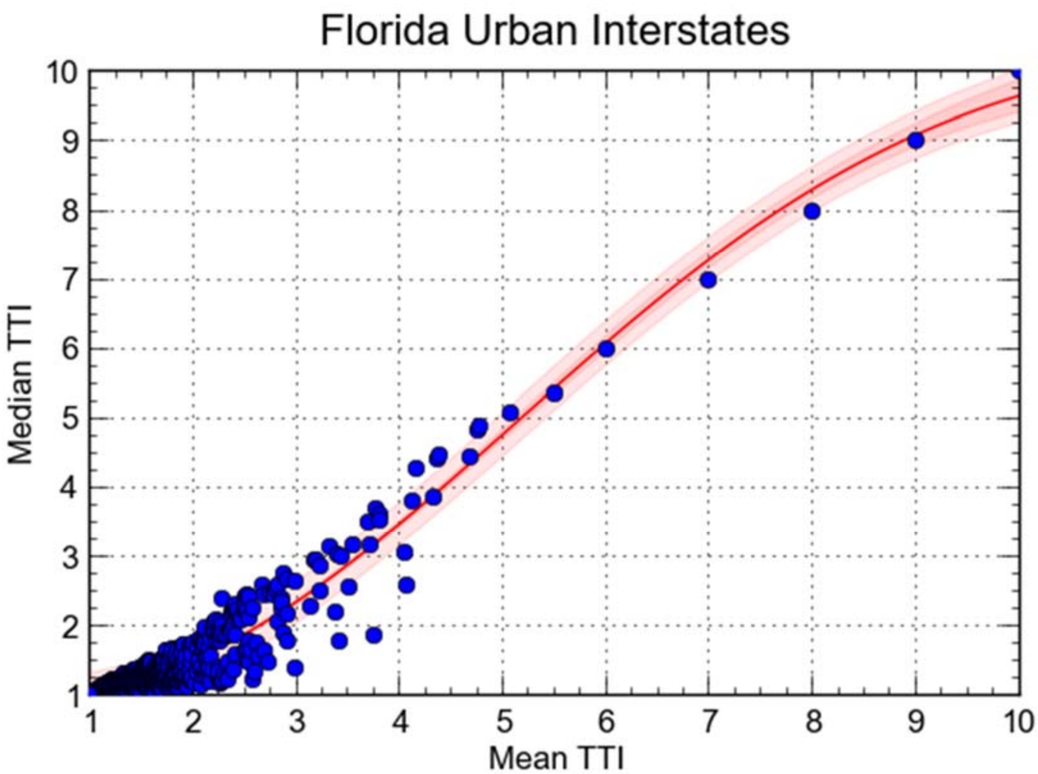


Figure 3. Relationship for Determining the 80th Percentile TTI from the Average (Typical) Condition, Urban Interstates

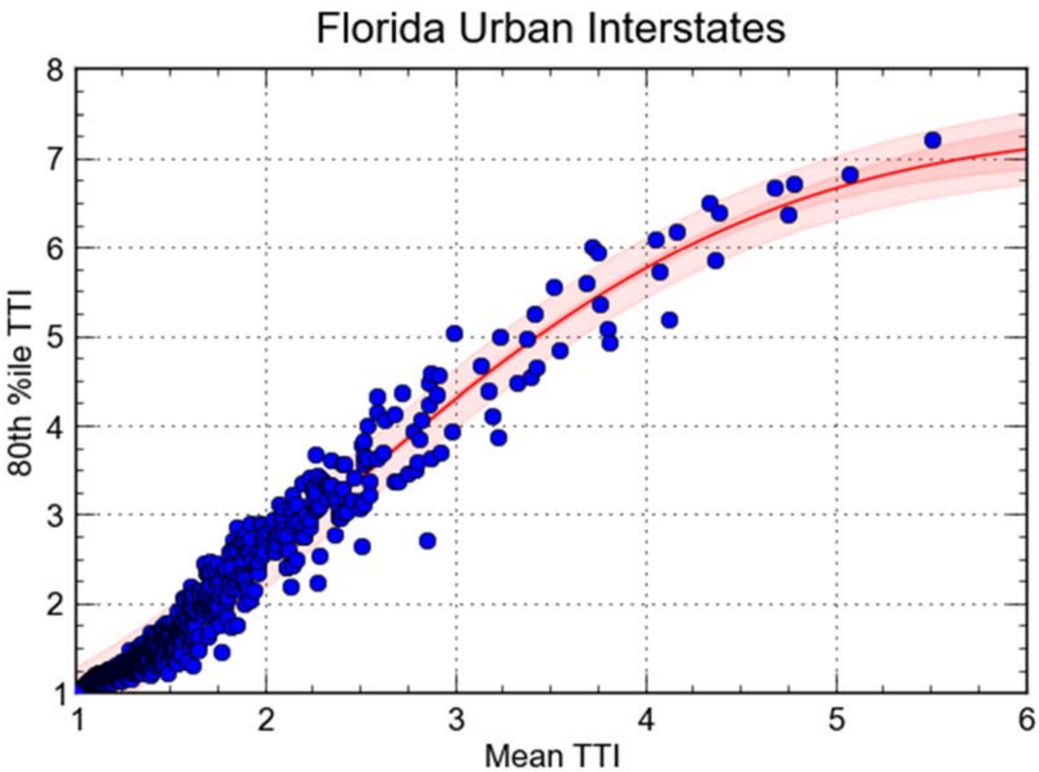


Figure 4. Relationship for Determining the 95th Percentile TTI from the Average (Typical) Condition, Urban Interstates

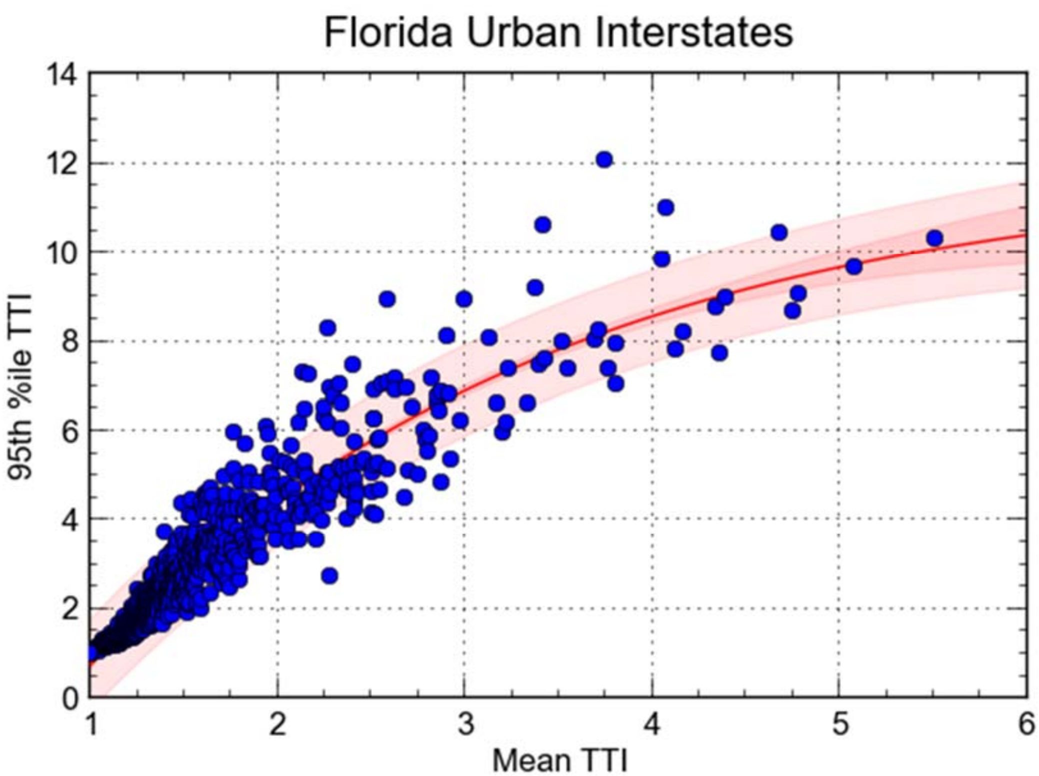


Figure 5. Relationship for Determining the Median TTI from the Average (Typical) Condition, Signalized Arterials

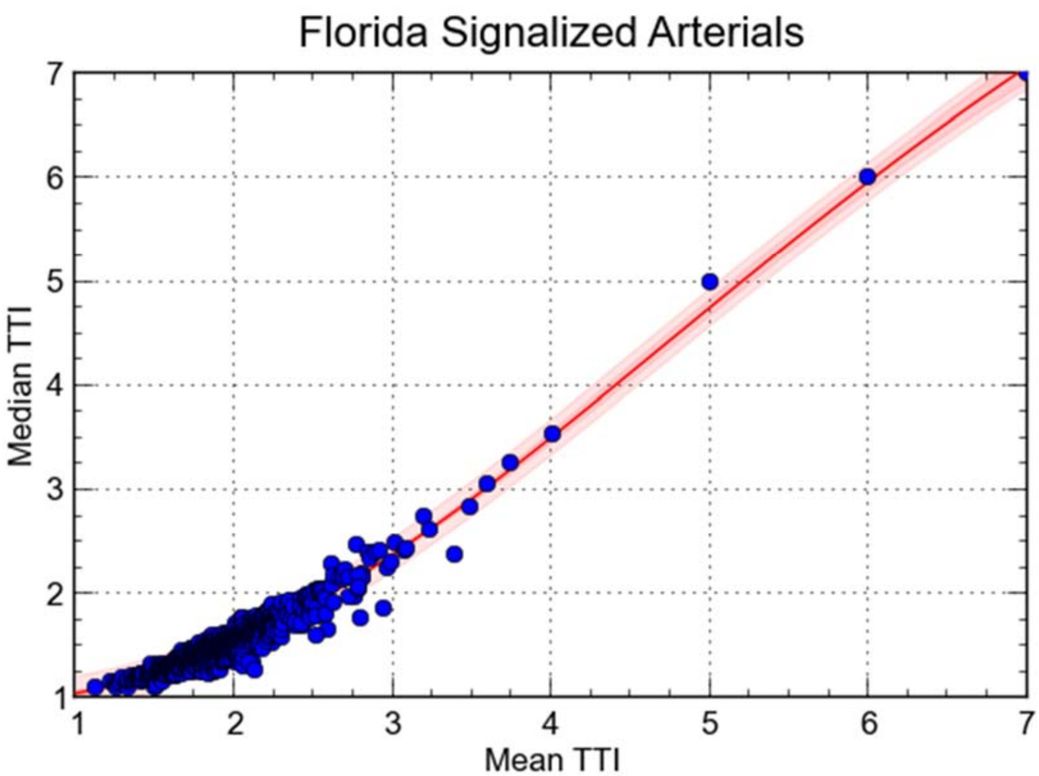


Figure 6. Relationship for Determining the 80th Percentile TTI from the Average (Typical) Condition, Signalized Arterials

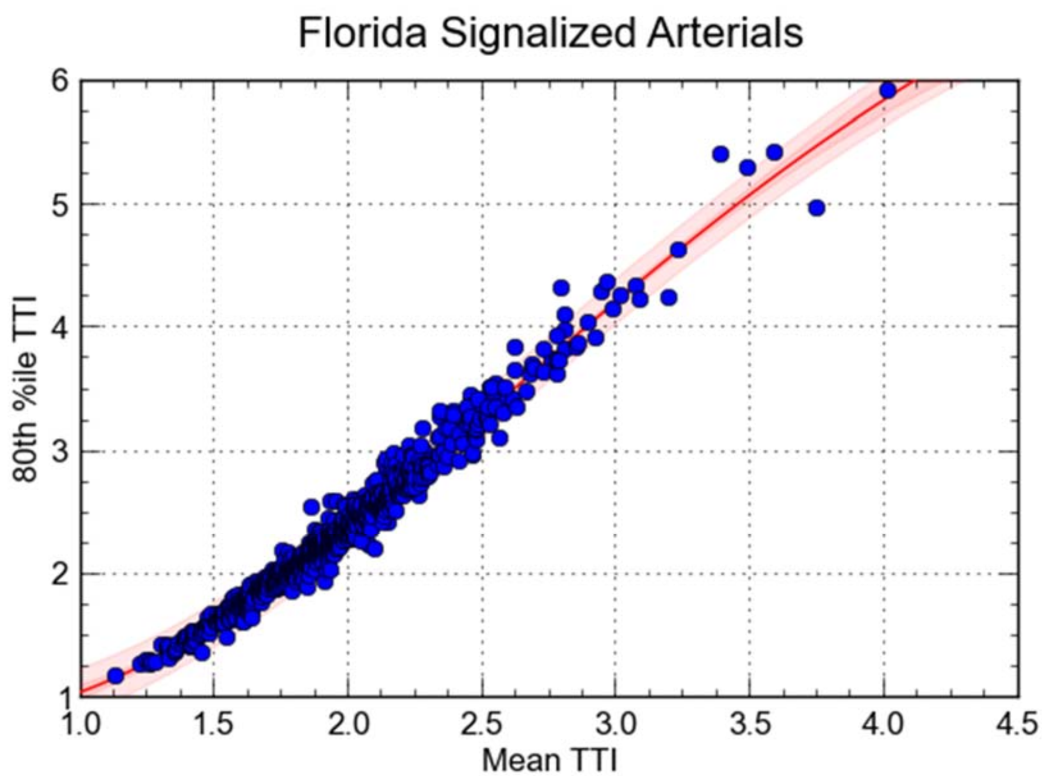
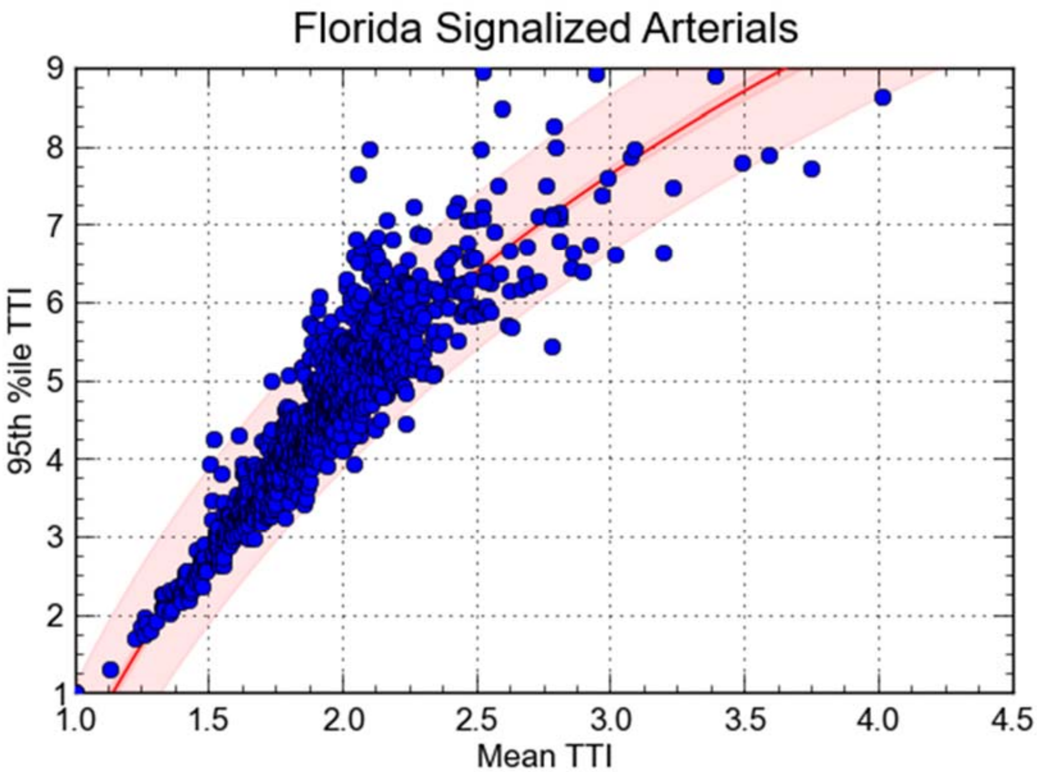


Figure 7. Relationship for Determining the 95th Percentile TTI from the Average (Typical) Condition, Signalized Arterials



Safety Analysis

Safety Performance Functions (SPFs)

The SPFs used in the previous updates to the LRTP were taken directly from the *Highway Safety Manual* (HSM).[6] These SPFs are national defaults and the HSM strongly recommends that local SPFs be developed. Fortunately, FDOT had funded other efforts with University of Central Florida (UCF) to do just that. Previously, UCF produced SPFs based on the major functional classes of roads.[7] They are SPFs for "average" conditions as opposed to "base" (close to ideal) conditions. In the HSM, Base SPFs are used in conjunction with CMFs to predict crashes for a particular highway segment. For example, the Base SPF might be for roadways with 12 foot lanes – CMFs are used to account for a roadway with less than 12 foot lanes. However, for long range planning, data on geometric and highway environment conditions are not available so average SPFs are appropriate.

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[6] American Association of State Highway and Transportation Officials, *Highway Safety Manual*, ISBN: 978-1-56051-477-0, 2010.

[7] Abdel-Aty, Mohamed et al., Two Level Approach to Safety Planning Incorporating the Highway Safety Manual (HSM) Network Screening, FDOT Project Report BDK78 977-13, Florida Department of Transportation, 2014.

UCF recently updated the SPFs and these are the ones used in the updated C11 tool (Tables 1 and 2).[8]

Table 1. Individual SPFs Developed by UCF and Used in the C11 Tool: Highway Segments

Highway Type	SPF Equation (annual segment crashes)
2-lane undivided	exp[-4.2842 + 0.5933 * ln(AADT) + ln(Segment Length)]
Multi-lane undivided	exp[-2.8471 + 0.5292 * ln(AADT) + ln(Segment Length)]
Multi-lane divided	exp[-6.1612 + 0.8374 * ln(AADT) + ln(Segment Length)]
4-lane freeway	exp[-11.9299 + 1.3092 * ln(AADT) + ln(Segment Length)]
6-lane-freeway	exp[-7.9867 + 0.9627 * ln(AADT) + ln(Segment Length)]
8+lane freeway	exp[-9.4829 + 1.1258 * ln(AADT) + ln(Segment Length)]

Table 2. Individual SPFs Developed by UCF and Used in the C11 Tool: Intersections

Intersection Type	SPF Equation (annual intersection crashes)
Signalized	NO_SIGNALS * exp[-10.3764 + 0.8138 * ln(AADT) + 0.2606 * ln(AADT/2)]
Other types	OTHER_INTERSECTION_COUNT * exp[-8.3872 + 0.5690 * ln(AADT) + 0.2189 * ln(AADT/2)]

Improvement Scenarios

Under each scenario below, the improvements listed are deployed as a complete "bundle." That is, if a roadway section is identified as deficient, all the scenario improvements are made. In practice, TSMO strategies are commonly deployed this way. Safety strategies are bundled as well, but the strategies included in the bundle will depend on specific roadway conditions.

Reliability: TSMO/Operations Improvements[9]

- Scenario 1: "TREND" (funding follows existing trend)
  - Revenue Constraint: $472,871,952 over 20 years
  - TSMO Improvement Types
    - Freeways: Ramp Metering (including loop detectors) and Hard Shoulder Running
    - Arterials and Collectors: Real-time traffic adaptive signal control
- Scenario 2" "PERFORMANCE" (funding increased to improve system performance above "TREND")

[8] Abdel-Aty, Mohamed et al., Enhancing and Generalizing the Two-Level Screening Approach incorporating the Highway Safety Manual (HSM) Methods, Phase 2, FDOT Project Report BDV-24-977-06, May 2016.

[9] TSMO is Transportation Systems Management and Operations.

    - Revenue Constraint: $945,743,900 over 20 years
    - TSMO Improvement Types
        - Freeways: Ramp Metering, Hard Shoulder Running, and Traffic Incident Management (TIM)[10]
        - Arterials: Real-Time Traffic Adaptive Signal Control and addition of left turn lanes at intersections that do not already have them.

<u>Safety Improvements</u>

- Scenario 1: "TREND" (funding follows existing trend)
    - Revenue Constraint: $504,014,820 over 20 years
- Scenario 2: "PERFORMANCE" (funding increased to improve system performance above "TREND")
    - Revenue Constraint: $ 1,008,029,640 over 20 years
- Safety Improvement Types for Arterials and Collectors (both scenarios)
    - Bike lanes
    - Intersection lighting and street lights
    - Pedestrian crosswalks and signals at intersections
    - Midblock crosswalks
    - Sidewalks
    - Convert TWLTL to raised median (undivided only)
    - Reduce driveway density (access management)
    - Speed control/enforcement/reduction
    - Traffic calming (Collectors only) – speed humps and plantings.

Impact Factors

<u>Operations Improvements</u>[11]

- Ramp meters – capacity increase of +8%. Ramp meters control smooth traffic flow by spacing out the number of vehicles that have to merge onto a freeway.
- Part-time shoulder use – capacity increase of 1,600 vehicle per hour. This strategy effectively adds another through lane on the freeway.
- Real-time traffic adaptive signal control – capacity increase of 15%. This type of signal control continuously adjusts the phasing and timing of signals to match the traffic volumes that show up at signals.

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[10] Tim includes CCTV cameras and service patrol vehicles

[11] When capacity improvements are modeled, the result is reduced travel time. The amount of reduction depends on what the starting conditions were because of the nonlinear relationship between capacity and travel time.

Safety Improvements

The following crash modification factors (CMFs), obtained from reviewing the studies summarized in the CMF Clearinghouse,[12] were used. The factors were applied multiplicatively. Note that some treatments only affect pedestrian and bicycle crashes.

- Bike lanes – 0.42 (i.e., a 58% reduction in bicycle-related crashes) – these treatments provide either a delineated or physically separated space for bicyclists to use, removing them from traffic lanes. For this study, delineated lanes were assumed. It is likely that physically separated lanes would have a greater safety benefit, but precise impact data was not available.
- Pedestrian crosswalks and signals; raised and midblock crosswalks – 0.21 (pedestrian-related crashes; combined for all treatments) – these treatments provide positive guidance to pedestrians in crossing urban streets, including where to walk and when to proceed. Midblock crosswalks are assumed to have no traffic control such as the High Intensity Activated Crosswalk (HAWK) beacon signal.
- Intersection lighting – 0.88 (night-time signal-related crashes) – lighting improves nighttime visibility at intersections.
- Convert TWLTL to raised median – 0.77 (all crashes) – raised medians provide more separation in traffic and reduces left turn movements, both of which reduce vehicular conflicts.
- Reduce driveways from an average of 20 per mile to 10 per mile – 0.908 (all crashes) – this treatment reduces the number of potential vehicular conflicts along an urban street.
- Traffic calming on Collectors (speed humps) – 0.67 (all crashes) – traffic calming reduces speeds and focus drivers' attention on the roadway environment.
- Speed reduction – 0.68 (all crashes) – this treatment lowers the posted speed limit by 10 mph.
- Street lights (non-intersection) – 0.98 (all crashes).
- Sidewalks – 0.60 (pedestrian crashes only).

Project Costs

All the costs identified in this section (given in 2010 dollars) were increased during the analysis by 20 percent to account for contingencies. For operations (TSMO) treatments, the 2010 costs were converted 2020 dollars using the Consumer Price Index.

Operations Improvements

The current version of TOPS-BC[13] was used to derive costs. For operations, these include costs for both basic infrastructure and incremental costs (Table 3).

Safety Improvements

- Bike lanes – $55,000 per mile (assumed to be the same for all highway types).
- Pedestrian crosswalks and signals – $140,000 per signal.
- Intersection lighting -- $60,000 per signal.

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[12] http://www.cmfclearinghouse.org/

[13] https://ops.fhwa.dot.gov/plan4ops/topsbctool/index.htm

- Convert TWLTL to raised median – $90,000 per mile.
- Traffic calming – $200,000 per mile.
- 10 mph reduction in speed limit – $20,000 per mile.
- Streetlights (non-intersection) – $700,000 per mile
- Sidewalks -- $200,000 per mile

Table 3. Operation Improvement Unit Costs

Improvement	Costs (2010 $)	
	Capital	**Operations and Maintenance**
Ramp Metering	$55,000 per ramp	$6,700 per ramp per year
Loop Detection	$40,000 per ramp	$2,000 per ramp per year
Part-Time Shoulder Use	$300,000 per mile	$10,000 per mile per year
Real-Time Traffic Adaptive Signal Control	$25,000 per signal + $1M areawide deployment	$11,000 per signal per year

3.0 Results of Operations and Safety Improvements

Tables 4 through 8 show the results of applying the C11 tool to the 2050 forecasted network. Priorities for spending funds on operations improvements were based on sorting first by highway type. In priority order they are freeways, arterials, and collectors. Within each highway type, the sections were sorted from highest to lowest based on their mean TTI, and only sections with a mean TTI of 1.5 or greater received an improvement. For safety improvements, sections were also sorted first by highway type, then by the highest to lowest predicted crashes per mile. Divided arterials were improved first followed by undivided arterials, then collectors. Under the Trend Scenario, the budget was expended before collectors could be improved.

The effect of deploying TSMO projects includes measures of travel time reliability: the 80th and 95th percentile travel time indices (TTIs). When compared to mean TTI, they give a sense of the amount of variability in travel times that occur over time. As an example, consider a commuter's route to work. Some days, travel times are adversely affected by disruptions such as incidents, inclement weather, and work zones. Also, traffic volumes can vary from day-to-day. All of these factors interact to produce travel times that change from day-to-day over the course of year.

Table 6 shows the effect of TSMO projects on truck performance. Because truck VMT is much higher on Interstates and freeways, the largest delay savings are there. An additional measure, the Truck Travel Time Reliability (TTTR) Index also shows an improvement in truck reliability performance. This measure is one of the three PM3 performance measures required by the Federal Highway Administration to be reported annually by state Departments of Transportation.[14] The Index is based on examining reliability in five time periods throughout the day for weekdays and weekends. Along with the other PM3

[14] https://www.fhwa.dot.gov/tpm/guidance/hif18040.pdf

measures, empirical travel time data is used to compute it. Since this study is based on modeling results, travel time data for these time periods were replicated by decomposing the model's predicted volumes into hourly bins using continuous count data from Florida for 2019. Then, the federally-prescribed calculation method in Reference 13 was applied. The reporting requirement is for Interstates only, so Table 6 follows this rule.

Table 7 transforms the travel time performance measures into the monetary costs saved by users. The methodology is adapted from Strategic Highway Research Program Project C11.[15] The concept is to break travel time performance into two components: the cost of "typical" delay and the extra costs associated with unreliable travel. The first step is to compute a new TTI value for the segment which represents the combination of these components:

$$TTI_e = TTI_{50} + (TTI_{80} - TTI_{50})$$

Where:

TTI_e is the TTI equivalent that represents the combined effect of typical delay and the unexpected delay caused by unreliable travel.

The next step is to convert the TTI equivalent into delay values:

$$TotalEquivalentAnnualWeekdayDelay_{VT} = ((TTI_e/FreeFlowSpeed - 1/FreeFlowSpeed) * AVMT$$

Where: $TotalEquivalentAnnualWeekdayDelay_{VT}$ is in vehicle-hours, separately for vehicle types (passenger and truck for now)

AVMT = *Annual VMT for the weekday peak period*

The final step is to compute the cost to users for typical and unreliable delay.

$$TotalDelayCost = TotalEquivalentAnnualWeekdayDelay * UnitCost$$

$$AverageDelayCost = TotalDelayCost * (TTI_{50}/TTI_{e)})$$

$$ReliabilityCost = TotalDelayCost - RecurringDelayCost$$

Where *UnitCost* is the value of travel time. This value is set at $17 per hour following recent Federal guidance.[16]

Because of the uncertainty in future funding, the model was applied to different funding constraints to produce cost/performance curves (Figures 8 and 9). The operations cost/performance curve is nonlinear because delay is a nonlinear function of VMT. The safety cost/performance curve is linear because crashes are a linear function of VMT.

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[15] https://www.trb.org/Main/Blurbs/169524.aspx

[16] https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance

Table 4. Results of Making Operations (TSMO) Improvements, Weekday PM Peak Period

SCENARIO												
TREND												
	Mean TTI		80th %ile TTI		95th %ile TTI		Miles	Peak Period Delay		Cost of	Average Speed	
HIGHWAY TYPE	Base	Improved	Base	Improved	Base	Improved	Improved	Base	Improved	Improvements	Base	Improved
COLLECTOR	1.36	1.30	1.55	1.45	2.32	2.16	48.1 (3%)	14,645	12,150	$31,473,786	25.6	26.8
DIVID ARTERIAL	1.18	1.09	1.26	1.14	1.73	1.41	146.8 (13%)	12,435	6,280	$187,356,881	38.3	41.3
UNDIVID ARTERIAL	1.16	1.08	1.24	1.13	1.67	1.40	56.0 (13%)	2,280	1,178	$71,496,574	34.5	36.9
URBAN FREEWAY	1.62	1.22	1.95	1.28	2.86	1.68	49.1 (15%)	26,045	9,311	$182,512,452	37.1	49.2
TOTAL	1.35	1.17	1.54	1.24	2.20	1.64	300.0 (8%)	55,404	28,920	$472,839,694	34.5	39.2
PERFORMANCE												
COLLECTOR	1.36	1.15	1.55	1.22	2.32	1.60	237.7 (12%)	14,645	6,011	$237,512,243	25.6	30.4
DIVID ARTERIAL	1.18	1.09	1.26	1.14	1.73	1.41	146.8 (13%)	12,435	6,280	$187,356,881	38.3	41.3
UNDIVID ARTERIAL	1.16	1.08	1.24	1.13	1.67	1.37	56.0 (13%)	2,280	1,071	$99,679,518	34.5	37.2
URBAN FREEWAY	1.62	1.08	1.95	1.07	2.86	1.18	107.9 (33%)	26,045	3,273	$421,143,437	37.1	55.7
TOTAL	1.35	1.09	1.54	1.13	2.20	1.37	548.3 (14%)	55,404	16,635	$945,692,078	34.5	41.8

Notes: (1) Annual Investment Cost includes one-time capital cost plus the annualized cost of Operations & Maintenance.
(2) "Base" represents the unimproved condition.

Table 5. Percent Improvement in Performance Measures Due to TSMO Improvements

TREND	Mean TTI	80th %ile	95th %ile	Peak Period	Average
HIGHWAY TYPE	**MTTI**	**TTI**	**TTI**	**Delay**	**Speed**
COLLECTOR	-4.4%	-6.5%	-6.8%	-17.0%	4.8%
DIVID ARTERIAL	-7.4%	-9.9%	-18.1%	-49.5%	8.0%
UNDIVID ARTERIAL	-6.7%	-8.9%	-16.7%	-48.3%	7.2%
URBAN FREEWAY	-24.5%	-34.5%	-41.2%	-64.2%	32.4%
TOTAL	-13.5%	-19.5%	-25.8%	-47.8%	13.5%
PERFORMANCE					
COLLECTOR	-15.7%	-21.2%	-30.7%	-59.0%	18.8%
DIVID ARTERIAL	-7.4%	-9.9%	-18.1%	-49.5%	8.0%
UNDIVID ARTERIAL	-7.4%	-9.5%	-18.3%	-53.0%	7.9%
URBAN FREEWAY	-33.3%	-45.1%	-58.8%	-87.4%	50.0%
TOTAL	-19.1%	-26.7%	-38.0%	-70.0%	21.1%

Table 6. Truck Performance and Cost Impacts

TREND			
Highway Type		**Federal Truck Travel Time Reliability Index[17]**	
	Annual Truck Delay Cost Savings	**Base**	**Improved**
Collector	$113,184	N/A	N/A
Divided Arterial	$1,412,436	N/A	N/A
Undivided Arterial	$305,182	N/A	N/A
Interstate/Freeway	$12,208,205	1.84	1.55
TOTAL	$14,039,007	1.84	1.55
PERFORMANCE			
Highway Type		**Federal Truck Travel Time Reliability Index[18]**	
	Annual Truck Delay Cost Savings	**Base**	**Improved**
Collector	$754,770	N/A	N/A
Divided Arterial	$1,412,436	N/A	N/A
Undivided Arterial	$333,000	N/A	N/A
Interstate/Freeway	$16,706,510	1.84	1.21
TOTAL	$19,206,716	1.84	1.21

Table 7. User Cost Savings Include the Effect of Typical (Average) Travel Time As Well As Its Variability (Reliability)

TREND	**Annual User Cost Savings (PM Peak Period)**		
Highway Type	**Due to Average Travel Time**	**Due to Reliability**	**Total User Cost Savings**
Collector	$21,629,269	$5,296,275	$26,925,543
Divided Arterial	$37,383,864	$4,970,999	$42,354,862
Undivided Arterial	$6,706,368	$849,310	$7,555,678
Interstate/Freeway	$88,509,551	$35,123,140	$123,632,691
TOTAL	$154,229,052	$46,239,723	$200,468,775
PERFORMANCE	**Annual User Cost Savings (PM Peak Period)**		
Highway Type	**Due to Average Travel Time**	**Due to Reliability**	**Total User Cost Savings**
Collector	$49,730,879	$12,177,406	$61,908,285
Divided Arterial	$37,383,864	$4,970,999	$42,354,862
Undivided Arterial	$7,066,068	$894,863	$7,960,931
Interstate/Freeway	$111,060,971	$44,072,193	$155,133,165
TOTAL	$205,241,783	$62,115,461	$267,357,244

[17] Computed for Interstates only.

[18] Computed for Interstates only.

Table 8. Results of Making Safety Improvements

TREND	Miles	Total Crashes		Bike Crashes		Pedestrian Crashes		Injury Crashes		Fatal Crashes		
HIGHWAY TYPE	Improved	Base	Improved	Base	Improved	Base	Improved	Base	Improved	Base	Improved	Project Cost
DIVID ARTERIAL	565.2 (51%)	21,508	8,884	401	168	1,893	242	6,259	2,585	129	53	$424,835,372
COLLECTOR	0.0 (0%)	8,766	8,766	257	257	771	771	2,551	2,251	53	53	$0
UNDIVID ARTERIAL	77.3 (18%)	3,926	2,343	108	79	345	181	1,143	682	24	14	$78,779,361
FREEWAY	0.0 (0%)	8,923	8,923	0	0	0	0	2,871	2,871	35	35	$0
TOTAL	642.5 (17%)	43,123	28,916	766	504	3,010	1,194	12,823	8,389	240	155	$503,614,733
CRASH REDUCTION			-32.9%		-34.1%		-60.3%		-34.6%		-35.4%	
PERFORMANCE												
DIVID ARTERIAL	565.2 (51%)	21,508	8,884	401	168	1,893	242	6,259	2,585	129	53	$485,526,139
COLLECTOR	276.6 (14%)	8,766	5,344	257	188	771	411	2,551	1,555	53	32	$213,041,226
UNDIVID ARTERIAL	220.3 (50%)	3,926	1,417	108	45	345	44	1,143	412	24	9	$309,361,624
FREEWAY	0.0 (0%)	8,923	8,923	0	0	0	0	2,871	2,871	35	35	$0
TOTAL	1062.1 (28%)	43,123	24,567	766	401	3,010	697	12,823	7,424	240	129	$1,007,928,989
CRASH REDUCTION			-43.0%		-47.6%		-76.8%		-42.1%		-46.3%	

Note: “Base” represents the unimproved condition.

Figures 8 and 9 show the results of varying budgets from those used in the scenarios to get an idea of how investment at different levels affects congestion and safety performance.

Maps for the improvement in reliability, as measured by the Planning Time Index (PTI), and safety appear in the Appendix.

Figure 8. Cost/Performance Curve for Operations (TSMO) Investments

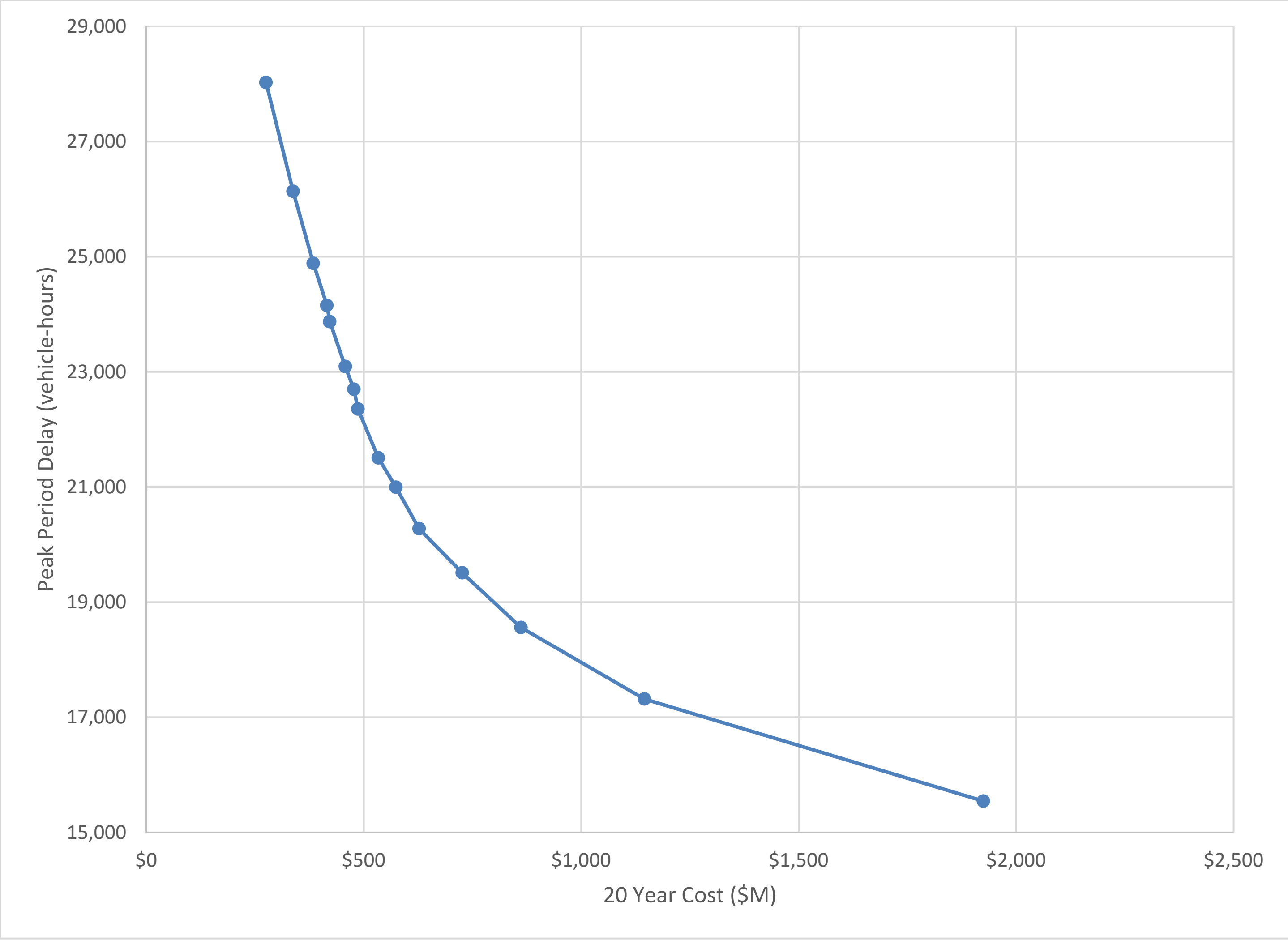
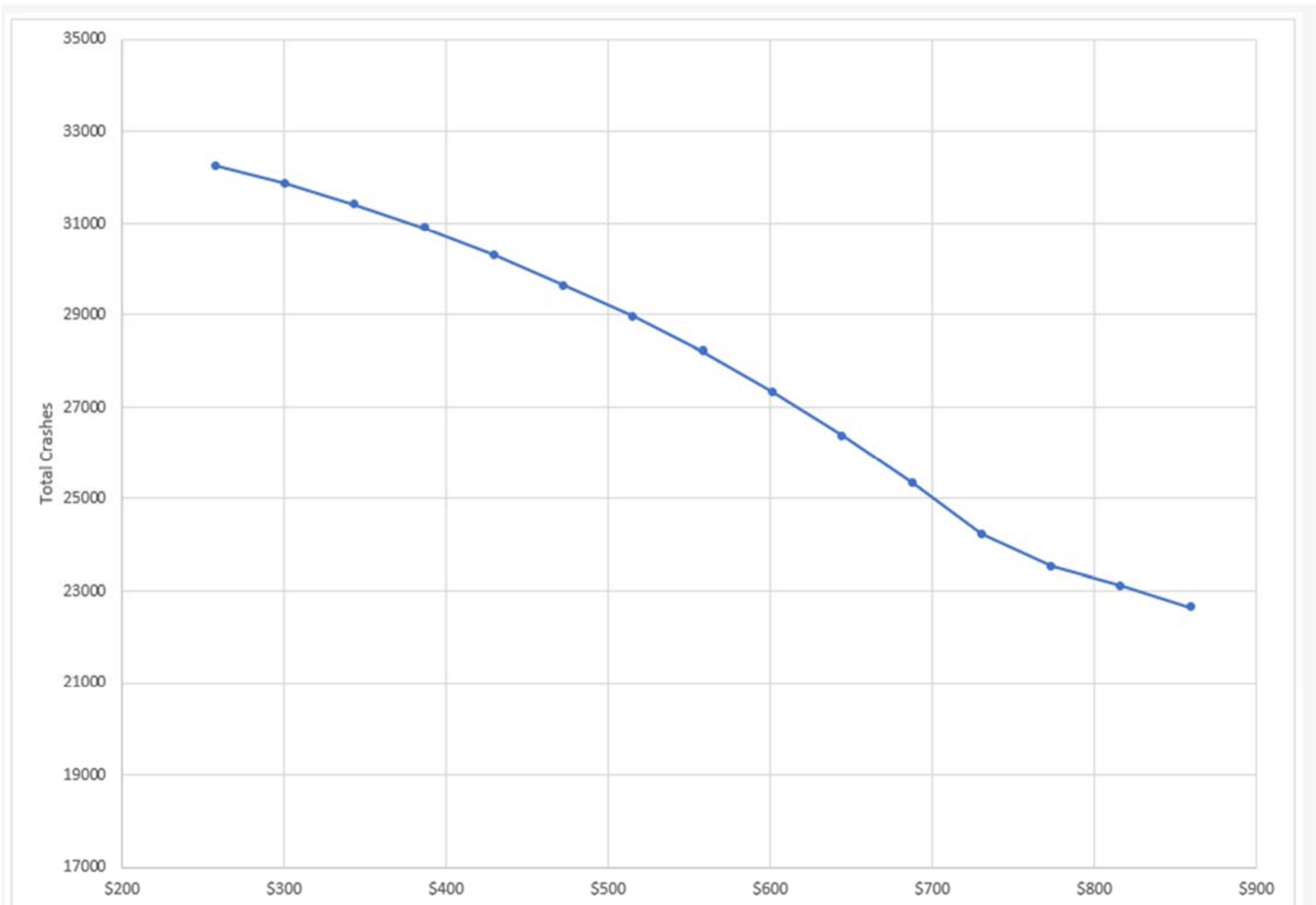


Figure 9. Cost/Performance Curve for Safety Investments



APPENDIX

Results by Individual Roadway

Effect of Operational Improvements on Priority Corridors

		Mean TTI		80th %ile TTI		95th %ile TTI		Peak Period Delay	
Corridor	**Cost**	**Base**	**Improved**	**Base**	**Improved**	**Base**	**Improved**	**Base**	**Improved**
22ND ST	$159,820	1.24	1.10	1.29	1.14	1.97	1.45	0.744	0.319
30TH ST	$164,352	1.53	1.15	1.70	1.19	3.08	1.64	4.401	1.213
30TH ST / BRUCE B DOWN	$195,690	2.30	1.45	2.99	1.59	5.61	2.77	18.961	6.815
39TH ST	$77,038	1.23	1.10	1.27	1.14	1.92	1.45	0.876	0.388
40TH ST	$694,575	1.29	1.06	1.34	1.11	2.14	1.32	4.393	0.774
46TH ST	$376,849	1.98	1.07	2.35	1.11	4.78	1.33	9.209	0.621
50TH ST	$213,306	1.33	1.11	1.41	1.15	2.29	1.49	2.388	0.840
56TH ST	$374,147	1.29	1.12	1.34	1.16	2.16	1.51	4.362	1.683
ALEXANDER ST	$162,437	1.39	1.14	1.47	1.18	2.54	1.59	2.275	0.836
ANDERSON RD	$343,128	1.78	1.20	2.12	1.25	3.91	1.81	10.561	2.774
ARMENIA AVE	$293,429	1.54	1.12	1.68	1.16	3.12	1.53	4.363	0.976
ASHLEY ST	$81,314	1.77	1.18	2.06	1.22	3.95	1.75	2.710	0.633
BAYSHORE BLVD	$185,125	2.36	1.51	3.09	1.71	5.82	2.95	19.568	7.117
BEARSS AVE	$319,321	1.69	1.21	1.96	1.28	3.57	1.86	7.005	1.975
BIG BEND RD	$391,955	1.74	1.21	2.07	1.26	3.73	1.84	17.351	4.752
BIRD ST	$206,881	1.38	1.05	1.46	1.09	2.48	1.26	0.491	0.065
BLOOMINGDALE AVE	$350,660	1.87	1.27	2.23	1.34	4.22	2.06	12.512	3.630
BOY SCOUT BLVD	$55,592	2.95	1.67	4.14	1.84	7.80	3.61	11.409	3.907
BOYETTE RD	$719,382	1.69	1.22	1.94	1.29	3.59	1.89	12.430	3.914
BRUCE B DOWNS BLVD	$511,118	1.91	1.29	2.35	1.38	4.33	2.17	28.614	8.683
BUSCH BLVD	$318,427	1.35	1.12	1.43	1.16	2.39	1.53	4.390	1.568
CHANNELSIDE DR	$78,123	2.25	1.42	2.91	1.53	5.46	2.64	3.655	1.234
COUNTY LINE RD	$486,226	1.49	1.15	1.64	1.20	2.89	1.65	5.774	2.020
CR 39	$1,144,973	1.30	1.11	1.36	1.16	2.21	1.50	12.794	4.910
CYPRESS ST	$249,517	2.23	1.16	2.83	1.21	5.53	1.67	5.391	0.757
DALE MABRY HWY	$529,372	1.55	1.12	1.74	1.17	3.12	1.54	8.606	2.321
EHRLICH RD	$248,283	1.40	1.14	1.48	1.18	2.56	1.59	3.585	1.333
FALKENBURG RD	$415,188	1.67	1.19	1.94	1.23	3.50	1.77	7.714	2.277
FISH HAWK BLVD	$524,075	1.68	1.18	1.85	1.22	3.64	1.74	11.744	3.145
FLETCHER AVE	$369,616	1.52	1.18	1.71	1.23	2.97	1.72	5.075	1.778

		Mean TTI		80th %ile TTI		95th %ile TTI		Peak Period Delay	
Corridor	**Cost**	**Base**	**Improved**	**Base**	**Improved**	**Base**	**Improved**	**Base**	**Improved**
FLORIBRASKA AVE	$263,112	2.17	1.09	2.74	1.14	5.11	1.43	1.853	0.142
FLORIDA AVE	$408,443	1.29	1.04	1.34	1.09	2.16	1.25	2.990	0.442
FORBES RD	$182,542	2.33	1.51	3.04	1.66	5.68	2.99	9.684	3.720
FOWLER AVE	$583,943	1.49	1.18	1.67	1.24	2.86	1.72	9.441	3.303
GANDY BLVD	$3,413,122	1.25	1.02	1.29	1.00	1.80	1.03	30.890	2.092
GEORGE BEAN PKWY	$763,692	2.95	1.08	4.10	1.07	6.48	1.19	32.202	1.331
GUNN HWY	$546,435	1.63	1.13	1.88	1.18	3.36	1.56	4.899	0.992
HILLSBOROUGH AVE	$243,687	1.46	1.16	1.62	1.22	2.73	1.66	4.630	1.511
HOOVER BLVD	$265,601	2.38	1.07	3.06	1.12	6.13	1.35	9.940	0.524
I-275	$3,880,654	2.30	1.13	3.08	1.14	5.05	1.35	169.535	11.569
I-4	$1,929,963	2.00	1.07	2.57	1.06	4.14	1.15	44.716	3.183
I-75	$1,989,452	2.42	1.07	3.31	1.06	5.42	1.13	162.837	7.868
JACKSON ST	$189,800	4.83	2.20	6.86	2.73	11.49	5.54	13.652	4.283
JIM JOHNSON RD	$316,248	1.30	1.04	1.35	1.09	2.21	1.26	2.096	0.306
JOHN MOORE RD	$176,850	1.68	1.17	1.87	1.21	3.66	1.71	7.904	1.991
KENNEDY BLVD / SR 60	$162,437	1.74	1.23	2.06	1.30	3.73	1.94	4.839	1.460
KINGS AVE	$207,626	1.64	1.18	1.82	1.22	3.51	1.73	7.629	2.033
LEE ROY SELMON EXPWY	$611,185	1.25	1.03	1.30	1.00	1.82	1.03	3.995	0.399
LINEBAUGH AVE	$425,910	1.39	1.11	1.47	1.15	2.54	1.47	4.698	1.581
LITHIA PINECREST RD	$605,899	1.72	1.27	2.01	1.39	3.58	2.03	10.992	4.002
LIVINGSTON AVE	$576,624	1.87	1.06	2.22	1.11	4.28	1.32	7.774	0.567
LOIS AVE	$162,182	2.06	1.57	2.63	1.85	4.58	3.12	3.472	1.684
LUMSDEN RD	$248,538	2.55	1.41	3.41	1.50	6.53	2.61	22.750	5.522
LUTZ LAKE FERN RD	$420,932	1.38	1.14	1.44	1.18	2.49	1.57	5.357	1.923
LYNN TURNER	$329,406	1.41	1.13	1.52	1.17	2.60	1.55	2.869	0.986
M L KING BLVD	$422,974	1.67	1.19	1.93	1.24	3.50	1.77	9.217	2.691
M L KING BLVD / SR 574	$334,575	1.21	1.09	1.25	1.13	1.83	1.42	2.161	0.970
MADISON AVE	$178,521	1.47	1.16	1.55	1.20	2.83	1.65	5.328	1.796
MANGO RD	$129,260	2.09	1.50	2.67	1.71	4.83	2.91	10.185	4.849
MCKINLEY DR	$248,602	1.38	1.13	1.49	1.17	2.48	1.55	2.935	1.102
MEMORIAL HWY	$239,092	1.67	1.19	1.85	1.23	3.63	1.77	10.633	2.976
MERIDIAN ST	$19,559	4.00	2.98	5.66	4.19	9.75	7.51	15.468	10.464

		Mean TTI		80th %ile TTI		95th %ile TTI		Peak Period Delay	
Corridor	**Cost**	**Base**	**Improved**	**Base**	**Improved**	**Base**	**Improved**	**Base**	**Improved**
MORRIS BRIDGE RD	$1,317,239	1.62	1.16	1.83	1.20	3.36	1.68	13.094	3.911
N BOULEVARD	$357,255	1.38	1.05	1.48	1.09	2.50	1.27	2.323	0.278
N Florida Ave	$34,539	3.47	2.53	5.03	3.34	9.03	6.58	3.863	2.388
NEBRASKA AVE	$287,812	1.65	1.20	1.91	1.26	3.39	1.80	4.056	1.258
PARK RD	$262,771	1.50	1.15	1.65	1.19	2.96	1.63	7.853	2.293
PARSONS AVE	$250,325	1.39	1.14	1.46	1.18	2.53	1.59	3.096	1.138
PROGRESS BLVD	$260,920	1.69	1.19	1.90	1.23	3.70	1.77	8.032	2.190
PROVIDENCE RD	$292,067	1.62	1.18	1.83	1.23	3.34	1.75	6.394	2.046
RACE TRACK RD	$394,657	1.27	1.04	1.31	1.09	2.07	1.25	1.973	0.320
SHELDON RD	$336,937	1.28	1.11	1.32	1.15	2.10	1.50	5.470	2.255
SR 39 / PAUL BUCHMAN H	$2,019,580	1.51	1.18	1.69	1.25	2.91	1.74	10.983	3.939
SR 60 / ADAMO DR	$325,065	1.38	1.12	1.46	1.16	2.49	1.53	4.492	1.580
SR 60 / BRANDON BLVD	$646,301	1.93	1.31	2.34	1.42	4.40	2.23	14.328	4.814
SR 60 / MEMORIAL HWY	$656,472	2.87	1.04	4.10	1.01	6.64	1.05	25.057	0.518
SR 674	$403,188	1.56	1.19	1.76	1.25	3.12	1.78	6.801	2.435
TEMPLE TERRACE HWY	$625,622	1.37	1.14	1.43	1.18	2.45	1.58	11.256	4.196
THONOTOSASSA RD	$92,675	2.22	1.62	2.82	1.91	5.24	3.31	5.448	2.531
US HWY 301	$810,525	1.57	1.18	1.78	1.23	3.18	1.75	12.750	3.892
US HWY 41	$1,158,249	1.60	1.17	1.82	1.22	3.26	1.72	14.557	4.577
US HWY 92	$517,373	2.11	1.44	2.71	1.57	4.92	2.73	18.907	7.588
VAN DYKE RD	$149,225	2.54	1.85	3.41	2.26	6.25	4.19	7.721	4.381
WATERS AVE	$487,523	1.40	1.10	1.51	1.15	2.57	1.46	4.674	1.135
WESTSHORE BLVD	$348,298	1.67	1.17	1.90	1.21	3.55	1.70	4.830	1.194

Note: Does not include basic infrastructure costs, only deployments on each roadway.

Effect of Safety Improvements on Arterial Roadways

	Total Crashes		Bike Crashes		Pedestrian Crashes		Injury Crashes		Fatal Crashes[19]		Project
Roadway	**Base**	**Improved**	**Base**	**Improved**	**Base**	**Improved**	**Base**	**Improved**	**Base**	**Improved**	**Cost**
20TH ST	29	19	1	0	3	1	8	6	0	0	$203,133
22ND ST	26	17	1	0	2	0	8	5	0	0	$583,810
30TH ST / BRUCE B DOWN	59	39	1	0	5	1	17	11	0	0	$416,788
39TH ST	18	12	0	0	2	0	5	4	0	0	$185,830
40TH ST	101	61	1	1	9	2	29	18	1	0	$1,379,986
46TH ST	18	10	0	0	2	0	5	3	0	0	$230,476
50TH ST	54	37	1	0	5	1	16	11	0	0	$675,654
56TH ST	124	84	2	1	11	2	36	24	1	1	$1,536,867
78TH ST	52	35	1	0	5	1	15	10	0	0	$1,030,714
ALEXANDER ST	87	59	2	1	8	2	25	17	1	0	$1,368,090
ALEXANDER ST EXT	23	15	0	0	2	0	7	4	0	0	$452,065
ANDERSON RD	73	49	2	1	6	1	21	14	0	0	$1,367,240
ARMENIA AVE	95	53	1	1	8	2	28	15	1	0	$1,424,378
ASHLEY ST	12	8	0	0	1	0	3	2	0	0	$249,384
BAYSHORE BLVD	91	60	2	1	8	2	26	18	1	0	$691,752
BEARSS AVE	154	104	3	1	14	3	45	30	1	1	$1,467,419
BIG BEND RD	103	69	2	1	9	2	30	20	1	0	$1,860,684
BIRD ST	8	4	0	0	1	0	2	1	0	0	$137,260

[19] Model-predicted crashes are fractional, which when rounded for fatal crashes, results in 0 crashes displayed in this table. For summaries, these "fractional crashes" are maintained.

	Total Crashes		Bike Crashes		Pedestrian Crashes		Injury Crashes		Fatal Crashes[19]		Project
Roadway	**Base**	**Improved**	**Base**	**Improved**	**Base**	**Improved**	**Base**	**Improved**	**Base**	**Improved**	**Cost**
BLOOMINGDALE AVE	113	76	2	1	10	2	33	22	1	0	$1,427,269
BOY SCOUT BLVD	51	35	1	0	4	1	15	10	0	0	$499,569
BOYETTE RD	81	55	2	1	7	2	24	16	0	0	$1,076,047
BRANDON PARKWAY	21	14	0	0	2	0	6	4	0	0	$382,831
BRUCE B DOWNS BLVD	392	266	4	2	35	7	114	77	2	2	$2,329,052
BUSCH BLVD	206	133	3	1	18	4	60	39	1	1	$2,036,634
CAUSEWAY BLVD	145	98	3	1	13	3	42	29	1	1	$1,494,085
CHANNELSIDE DR	14	8	0	0	1	0	4	2	0	0	$163,335
CITRUS PARK DR	71	48	1	1	6	1	21	14	0	0	$1,040,554
COLUMBUS DR	6	4	0	0	1	0	2	1	0	0	$63,829
COUNTY LINE RD	150	98	3	1	13	3	44	29	1	1	$2,579,247
CR 39	126	74	5	2	11	2	37	21	1	0	$12,501,904
CYPRESS ST	22	14	0	0	2	0	7	4	0	0	$369,115
CYPRESS VILLAGE BLVD	15	10	0	0	1	0	4	3	0	0	$523,239
DALE MABRY HWY	649	431	12	5	57	12	189	125	4	3	$6,576,782
EHRLICH RD	99	67	2	1	9	2	29	19	1	0	$1,137,209
FALKENBURG RD	122	83	2	1	11	2	36	24	1	0	$2,258,601
FISH HAWK BLVD	35	22	1	0	3	1	10	6	0	0	$1,397,375
FLETCHER AVE	169	114	3	1	15	3	49	33	1	1	$1,983,155
FLORIBRASKA AVE	4	2	0	0	0	0	1	1	0	0	$158,172
FLORIDA AVE	176	113	3	1	15	3	51	33	1	1	$2,297,059
FORBES RD	10	6	0	0	1	0	3	2	0	0	$496,737
FOWLER AVE	255	173	5	2	22	5	74	50	2	1	$2,157,034
GANDY BLVD	21	14	0	0	2	0	6	4	0	0	$391,848
GIBSONTON DR	58	39	1	0	5	1	17	11	0	0	$841,348
GUNN HWY	164	103	4	2	14	3	48	30	1	1	$4,071,275
HENDERSON BLVD	19	10	0	0	2	0	5	3	0	0	$287,233
HILLSBOROUGH AVE	463	314	9	4	41	9	135	91	3	2	$4,011,744

	Total Crashes		Bike Crashes		Pedestrian Crashes		Injury Crashes		Fatal Crashes[19]		Project
Roadway	Base	Improved	Base	Improved	Base	Improved	Base	Improved	Base	Improved	Cost
HOOVER BLVD	17	11	0	0	2	0	5	3	0	0	$294,755
INDEPENDENCE PKWY	20	14	0	0	2	0	6	4	0	0	$211,113
JACKSON ST	1	0	0	0	0	0	0	0	0	0	$8,974
JIM JOHNSON RD	11	7	0	0	1	0	3	2	0	0	$206,474
JOHN MOORE RD	9	6	0	0	1	0	3	2	0	0	$331,881
KENNEDY BLVD / SR 60	117	78	2	1	10	2	34	23	1	0	$1,170,150
KINGS AVE	50	34	1	0	4	1	14	10	0	0	$749,558
LAKEWOOD DR	13	9	0	0	1	0	4	3	0	0	$181,965
LINEBAUGH AVE	193	128	4	2	17	4	56	37	1	1	$3,071,555
LITHIA PINECREST RD	198	127	5	2	17	4	58	37	1	1	$7,066,347
LIVINGSTON AVE	40	23	1	1	4	1	12	7	0	0	$2,312,741
LOIS AVE	27	15	0	0	2	1	8	4	0	0	$385,966
LUMSDEN RD	100	67	2	1	9	2	29	20	1	0	$1,279,626
LUTZ LAKE FERN RD	64	42	1	1	6	1	19	12	0	0	$1,802,375
LYNN TURNER	14	8	0	0	1	0	4	2	0	0	$481,837
M L KING BLVD	385	247	7	3	34	7	112	72	2	1	$5,098,829
MADISON AVE	21	14	0	0	2	0	6	4	0	0	$475,115
MANGO RD	23	16	1	0	2	0	7	5	0	0	$213,926
MCKINLEY DR	27	19	1	0	2	1	8	5	0	0	$410,950
MELBURNE BLVD	3	2	0	0	0	0	1	1	0	0	$270,083
MEMORIAL HWY	33	22	1	0	3	1	10	6	0	0	$450,690
MERIDIAN ST	4	3	0	0	0	0	1	1	0	0	$30,174
MORRIS BRIDGE RD	70	42	2	1	6	1	20	12	0	0	$4,109,415
N BOULEVARD	44	23	0	0	4	1	13	7	0	0	$706,241
N Florida Ave	3	2	0	0	0	0	1	1	0	0	$40,528
NEBRASKA AVE	161	102	3	1	14	3	47	30	1	1	$2,628,505
PARK RD	74	50	1	1	6	1	21	15	0	0	$937,954
PARSONS AVE	74	50	2	1	6	1	21	15	0	0	$1,107,912

	Total Crashes		Bike Crashes		Pedestrian Crashes		Injury Crashes		Fatal Crashes[19]		Project
Roadway	**Base**	**Improved**	**Base**	**Improved**	**Base**	**Improved**	**Base**	**Improved**	**Base**	**Improved**	**Cost**
PROGRESS BLVD	27	18	1	0	2	1	8	5	0	0	$353,992
PROVIDENCE RD	49	33	1	0	4	1	14	10	0	0	$705,033
RACE TRACK RD	33	21	1	0	3	1	10	6	0	0	$1,449,571
REYNOLDS ST / SR 574	8	5	0	0	1	0	2	1	0	0	$422,694
SHELDON RD	121	82	2	1	11	2	35	24	1	0	$1,635,475
SR 39	73	50	1	1	6	1	21	14	0	0	$1,047,458
SR 39 / COLLINS ST	21	14	0	0	2	0	6	4	0	0	$497,800
SR 39 / PAUL BUCHMAN H	81	49	3	1	7	2	24	14	0	0	$4,870,172
SR 39 / WHEELER ST	8	4	0	0	1	0	2	1	0	0	$419,801
SR 60 / ADAMO DR	163	108	3	1	14	3	47	32	1	1	$1,963,780
SR 60 / BRANDON BLVD	470	319	9	4	41	9	137	93	3	2	$5,082,288
SR 60 / MEMORIAL HWY	2	1	0	0	0	0	1	0	0	0	$22,715
SR 674	229	147	6	2	20	4	67	43	1	1	$10,946,199
SUNSET LANE	6	4	0	0	1	0	2	1	0	0	$390,861
TARPON SPRINGS RD	28	17	1	0	2	1	8	5	0	0	$1,693,931
TEMPLE TERRACE HWY	77	49	1	1	7	1	23	14	0	0	$802,020
THONOTOSASSA RD	10	7	0	0	1	0	3	2	0	0	$140,894
US HWY 301	795	528	18	7	70	15	231	154	5	3	$15,117,991
US HWY 41	661	448	13	5	58	12	192	130	4	3	$8,579,232
US HWY 92	195	125	5	2	17	4	57	36	1	1	$5,276,240
US HWY 92 / BAKER ST	2	1	0	0	0	0	1	0	0	0	$22,668
VAN DYKE RD	68	45	2	1	6	1	20	13	0	0	$1,368,933
WATERS AVE	186	119	3	1	16	4	54	35	1	1	$2,115,689
WESTSHORE BLVD	69	44	2	1	6	1	20	13	0	0	$1,339,794

Figures A-1 an A-2 show how reliability, as measured by the Planning Time Index (PTI), changes over the analysis period. The data were taken from the Priority Corridor analysis presented above. The PTI is computed from the distribution of travel times taken over the length of each corridor. It is the ratio of the 95th percentile travel time to the free flow (ideal) travel time. As the ratio increases, travel is increasing unreliable.

Figure A-3 shows the impact of safety improvements over the analysis period, as measured by the decrease in crashes. The data were taken from the Priority Corridor analysis presented above.

Figure A-1.

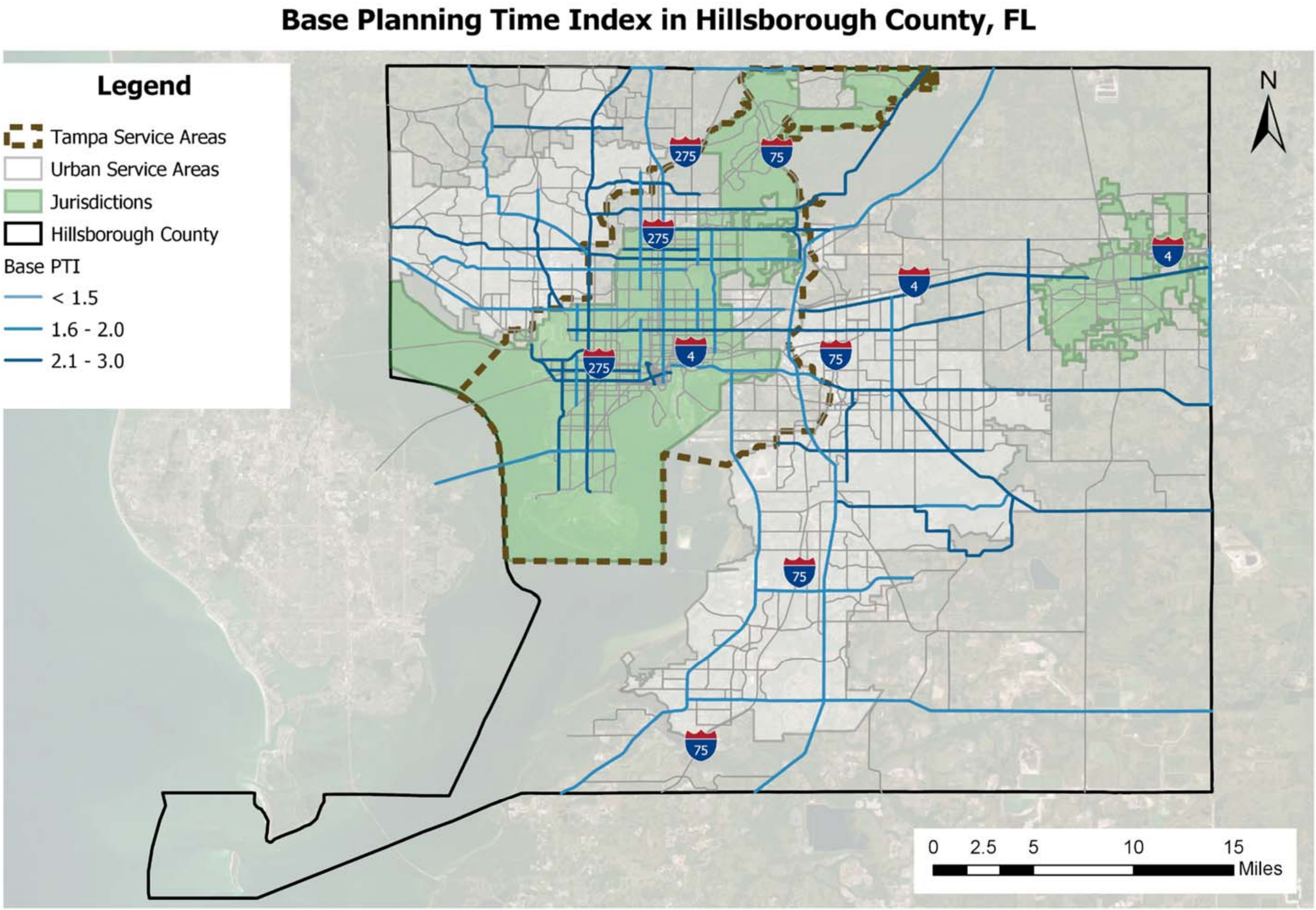

Base Planning Time Index in Hillsborough County, FL
Legend
Tampa Service Areas
Urban Service Areas
Jurisdictions
Hillsborough County
Base PTI
< 1.5
1.6 - 2.0
2.1 - 3.0
275
75
4
N
0 2.5 5 10 15
Miles

Figure A-2.

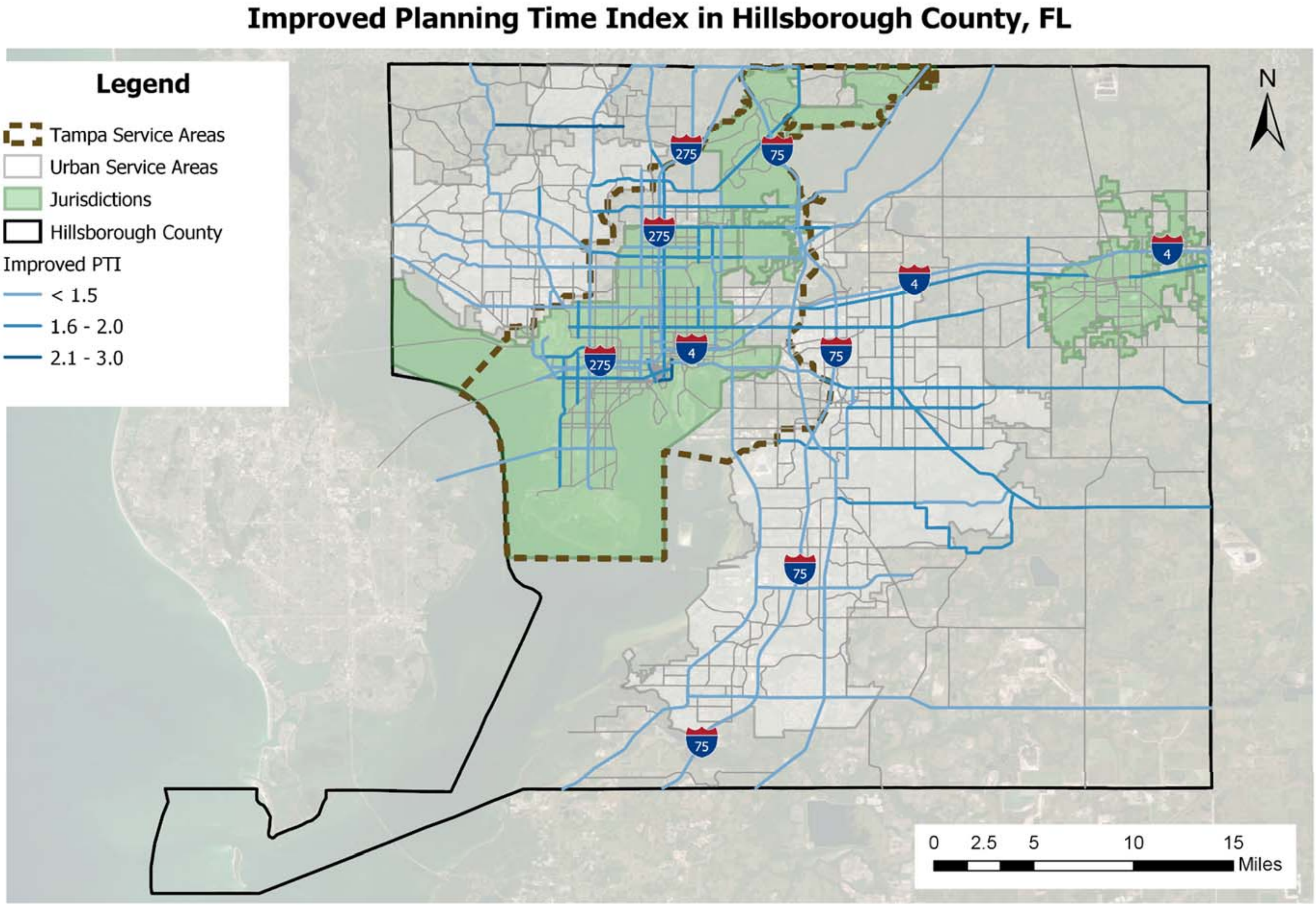
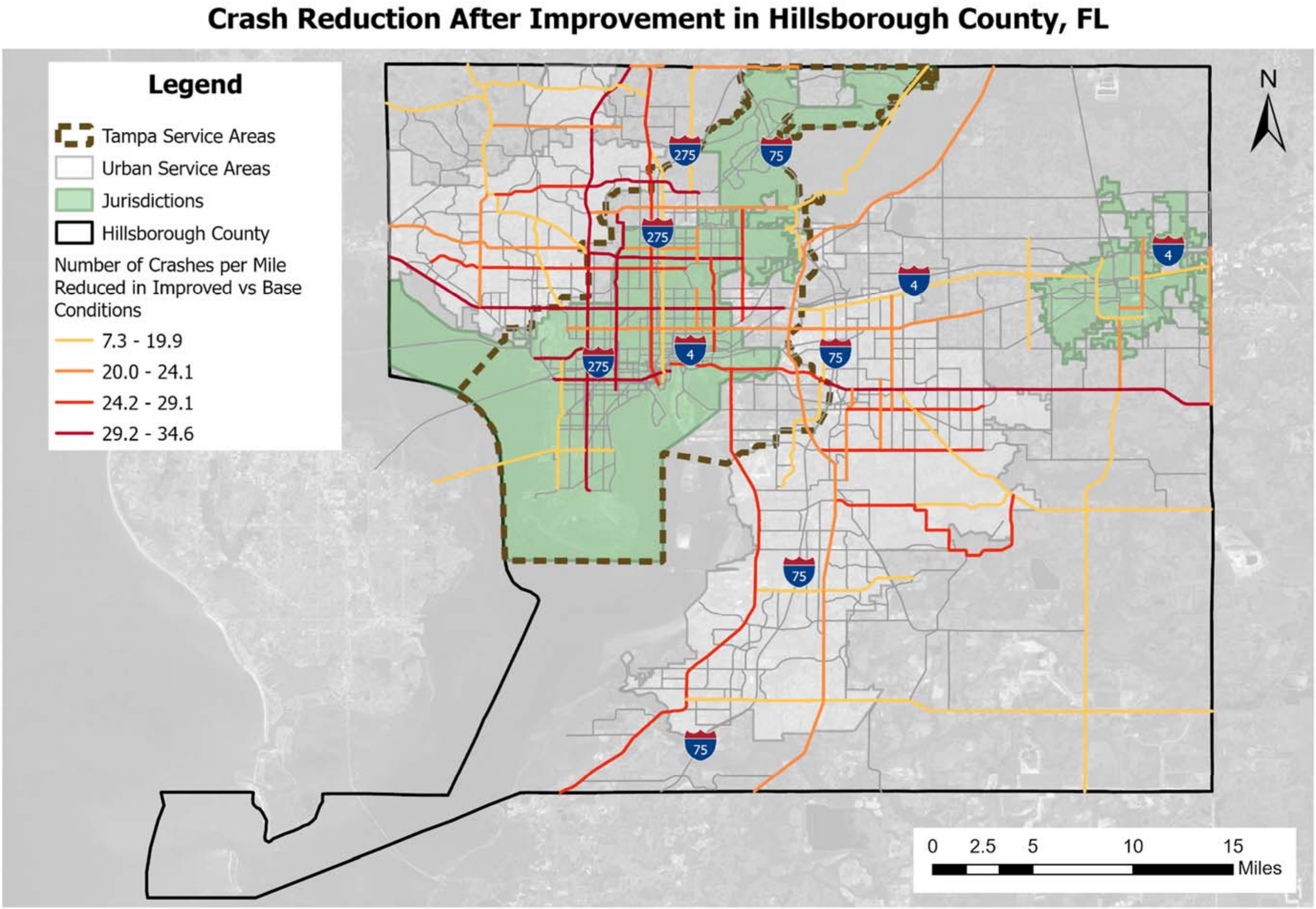

Improved Planning Time Index in Hillsborough County, FL
Legend
Tampa Service Areas
Urban Service Areas
Jurisdictions
Hillsborough County
Improved PTI
< 1.5
1.6 - 2.0
2.1 - 3.0
N
275
75
275
4
4
275
4
75
75
75
0
2.5
5
10
15
Miles

Figure A-3.



Crash Reduction After Improvement in Hillsborough County, FL
Legend
Tampa Service Areas
Urban Service Areas
Jurisdictions
Hillsborough County
Number of Crashes per Mile Reduced in Improved vs Base Conditions
7.3 - 19.9
20.0 - 24.1
24.2 - 29.1
29.2 - 34.6
275
75
4
N
0
2.5
5
10
15
Miles