CITY OF KEY WEST

CARRYING CAPACITY TRAFFIC STUDY :: DECEMBER 2011

VOLUME 1 OF 3
REPORT

CALVIN, GIORDANO & ASSOCIATES, INC.

EXECUTIVE SUMMARY

The purpose of the Carrying Capacity Traffic Study was to assess the capacity of City streets and related transportation infrastructure. The Study was also to address specialized vehicles and their impacts to roadways and adjacent land uses including impacts associated with mobility, noise, and air quality.

Data Collection

In order to accurately evaluate the transportation infrastructure, an extensive amount of data collection was undertaken for this study. Through preliminary meetings with the City staff, 15 roadway corridors and 25 intersections were identified to define the specific study area. The following items were evaluated as part of the data collection process:

- Intersection Traffic Turning Movement Counts
- 24-Hour Bi-Directional Tube Counts
- Traffic Speed Counts
- Vehicle Classification Counts
- Corridor Travel Time Runs
- Multi-Modal Vehicle Attributes
- General Roadway Characteristics
- Existing Speed Limit Inventory
- Existing Parking Inventory
- Cruise Ship Related Data
- Existing Bike Lane Inventory
- Existing Traffic Sound Level Sampling

Existing Conditions Analysis Methodology

VISSIM traffic micro-simulation software was chosen for the project due to the unique characteristics of the City such as the prevalence of multi-modal vehicles and pedestrians. The City transportation network was evaluated using four different methodologies:

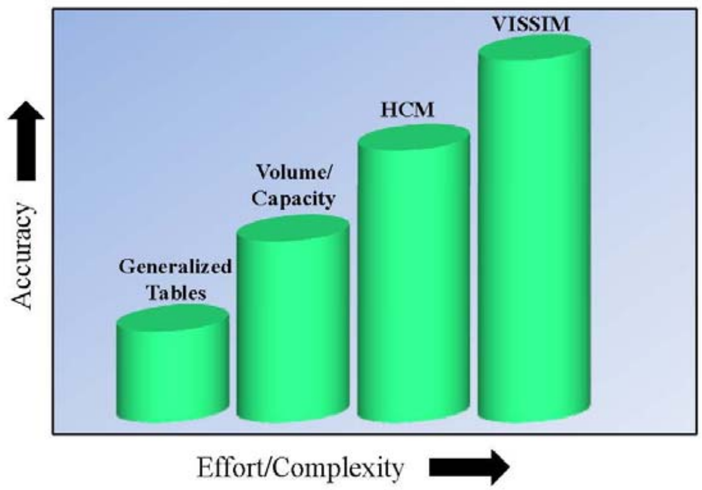
1. **FDOT Generalized Tables**. The first methodology consisted of comparing peak hour traffic volumes to the FDOT Quality/Level of Service tables. This generalized planning analysis is limited and is considered an estimate of capacity.
2. **Volume to Capacity Ratio.** This methodology determined the v/c ratios on each of the study corridors based on the critical intersection. The v/c ratios in this analysis are considered more detailed and accurate than the FDOT v/c ratios.
3. **HCM Average Speed.** The procedure identified in the City Comprehensive Plan and the HCM both require the LOS to be determined based on the average speed methodology. This procedure was completed by actual time travel runs and through a micro-simulation

traffic analysis. The results for this methodology were used for the final determination of LOS as it reflects the most accurate possible evaluation.

4. **VISSIM Micro-simulation**. The final methodology used in this traffic study was to evaluate the traffic operations of the study intersections. The Level of Service thresholds were determined based on delay thresholds identified in the HCM. VISSIM micro-simulation software was utilized to determine the approach and intersection delay.

The hierarchy of complexity and accuracy for each of the four methodologies utilized is illustrated in Figure A below.

Figure A
Hierarchy of Traffic Evaluation Tools



Existing Conditions Analysis Results

The results of the existing conditions analysis demonstrated that there are several roadway corridors and intersections within the City that are over capacity or operating at a Level of Service that is not within defined acceptable standards, as illustrated on Table A below. It can therefore be concluded that the overall transportation network will not support additional traffic unless capacity improvements are implemented. The effects of new trip generators on the overall roadway network will be dependent, in part, on the location of the development/operation, trip distribution/tour route, individual vehicle attributes, and the size of development/operation.

Table A
Existing Conditions Capacity Deficiencies

METHODOLOGY	OVER CAPACITY CORRIDORS
FDOT Generalized LOS Tables	Duval Street
	Eaton Street
	Palm Avenue
	N. Roosevelt Boulevard
	Truman Avenue
Volume/Capacity Ratio	Duval Street
	N. Roosevelt Boulevard
	Truman Avenue
	Whitehead Street
Highway Capacity Manual (HCM)	Duval Street
	Whitehead Street
	Truman Avenue
	N. Roosevelt Boulevard
	Palm Avenue/1st Street/Bertha Street

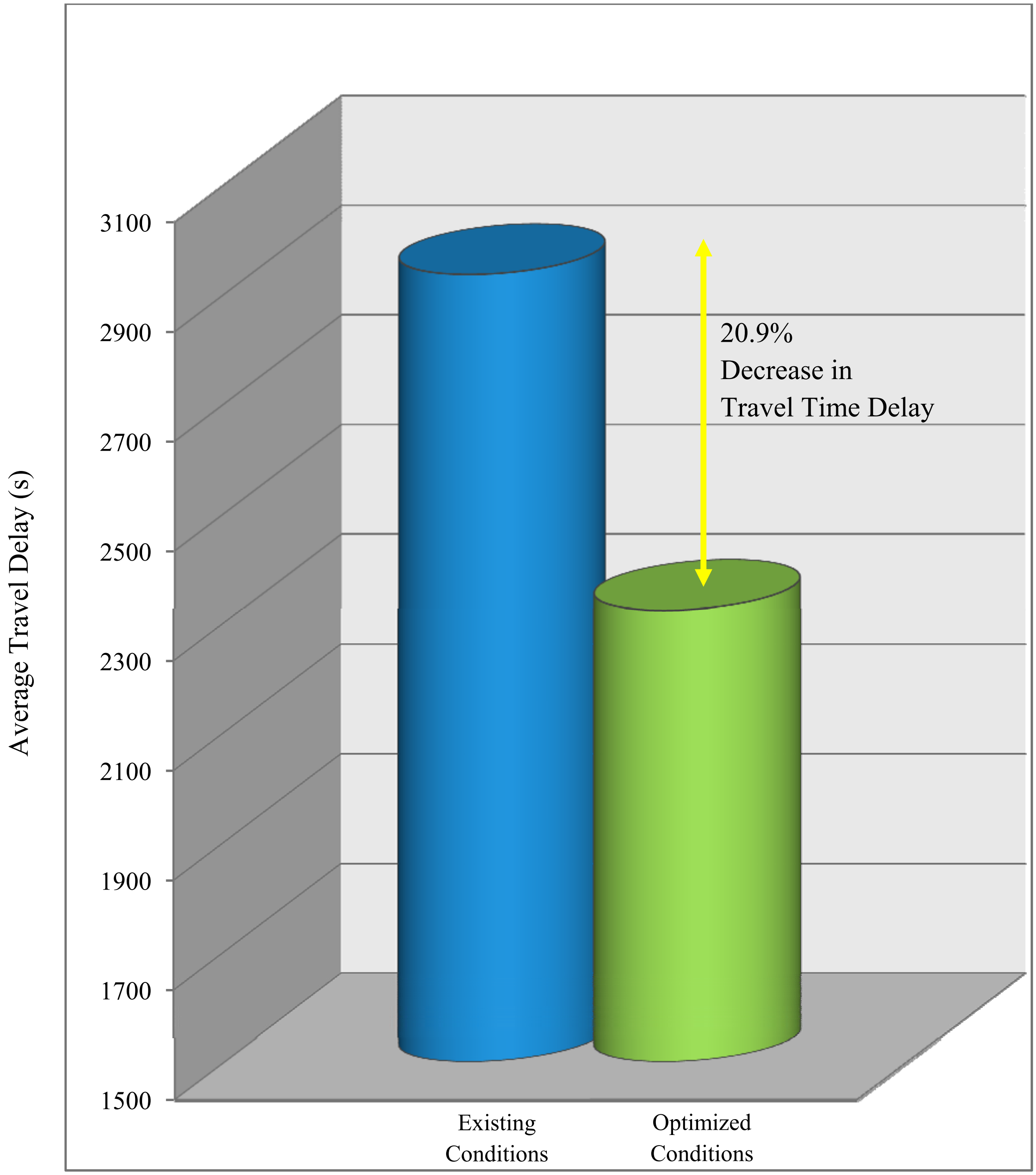
METHODOLOGY	OVER CAPACITY INTERSECTIONS
VISSIM Micro-Simulation	Whitehead Street/Southard Street
	Whitehead Street/Truman Avenue
	Duval Street/Truman Avenue
	Simonton Street/Truman Avenue
	Palm Avenue (1st Street)/N. Roosevelt Boulevard
	N. Roosevelt Boulevard/Overseas Highway

Optimized Conditions Analysis

Since the existing roadway infrastructure within the City is generally not conducive to traditional capacity improvements, such as roadway widening, focus was shifted to operational improvements such as traffic signal modifications. **Improvements to existing traffic signal timing were shown to significantly improve corridor and intersection operations, potentially generating additional roadway capacity, as illustrated in Figure B below.**

In addition to the signal timing improvements, one roadway infrastructure improvement was considered. It would be relatively cost-effective to extend the length of the exclusive left turn lane on Palm Avenue at N. Roosevelt Boulevard by approximately 200 feet. This roadway modification would significantly improve traffic operations at the intersection and throughout the corridor.

Figure B
Average Travel Delay Comparison



Recommendations

1. Plan for and Implement a City-Wide Signal Timing Program to Address Over-Capacity Roadway Congestion.

Several primary roadway corridors and intersections within the City operate below the acceptable Level of Service thresholds established in the City Comprehensive Plan. The results of this study illustrated that improvements to the traffic signal operations can have a significant benefit to traffic operations on the overall City roadway network.

Most of the signalized intersections in Old Town operate on fixed signal timing which means the green time allotted to each particular traffic movement does not vary as the traffic demands change. It is beneficial to operate traffic signals with actuation rather than fixed timing. Actuation simply means that as the traffic demands increase for a given traffic movement (such as northbound left-turns, or east bound through movements, etc.), more green time is allocated to the higher demand movement. This is accomplished through the use of traffic detectors which identify fluctuations in traffic demand. The conversion of a fixed signal timing intersection to an actuated signal timing intersection will require vehicle detection equipment. Common vehicle detectors include in-ground loop detectors, microwave detectors, and video detectors. Actuated signals would minimize wasted green time and improve the efficiency of individual intersections and overall corridors. To realize the most benefit with the least initial cost, it is recommended the City implement the following prioritization for signal timing improvements:

1. Optimize signal timing at intersections already equipped with vehicle detector equipment.
2. Install vehicle detector equipment and optimize signal timing at intersections capable of accommodating the installation of vehicle detector equipment.
3. Modify traffic signal equipment, install vehicle detector equipment and optimize signal timing at intersections currently without detection capabilities.

The signalized intersections phasing plan as well as the existing and optimized signal timing plans are included in **Appendix P**. ***It should be noted that fine-tuning of the proposed signal timing plans will be required in the field. This should be supervised by an experienced professional traffic engineer.

Signal timing progression along the corridors could also increase the efficiency of the roadway network. Progression involves timing traffic signals along a particular corridor in such a way that groups of vehicles can travel through several intersections without stopping. Signal timing progression is commonly implemented by installing underground fiber-optic cables to connect several traffic signals along a corridor. The traffic signals are then able to “communicate” with each other and respond to traffic demand. Implementing signal timing progression would require a substantial infrastructure investment and therefore may not be immediately feasible.

<u>2. Establish and Implement a Transportation Concurrency Management System to Address New Franchise Agreements and Land Development Projects</u>.

This study documented that several roadway corridors and intersections are operating below acceptable LOS thresholds established in the City's Comprehensive Plan. It is therefore reasonable to conclude that the addition of any new traffic generators without substantial capacity improvements would only exacerbate traffic congestion. The signal timing improvements proposed in this study were shown to likely result in improved traffic operations and additional roadway capacity. In the event additional roadway capacity is generated, it is recommended the City monitor the availability of the excess capacity through a Transportation Concurrency Management System.

Concurrency Management Systems stem from Florida Statues relating to growth management which require that facilities needed to support new development, such as roadways, are in place "concurrent" with the new development. In this instance, new trip generators, such as franchise agreements or land development projects, would need to demonstrate that roadway capacity is available to support the proposed franchise agreement or project.

Applicants for new franchise agreements or land development projects can utilize the VISSIM traffic model provided in this study to demonstrate the effects of their respective projects on the overall roadway network. It is recommended that these traffic impacts be considered on a case-specific basis for several reasons:

- Franchise vehicle characteristics that effect roadway capacity can vary greatly. Individual applicants can provide the City with specific vehicle attributes at the time of application.
- Proposed tour routes or areas of utilization can vary greatly. Individual applicants can provide the City specific information as to their proposed routes.

The City should require all applicants for franchise agreements or land development projects submit a traffic study demonstrating the effects of the proposed application on the overall roadway network. Applicants who are able to demonstrate that their particular traffic application will not exceed available roadway network capacity could then be considered for approval. For applicants that are unable to demonstrate an ability to work within available roadway capacity limits, the City may elect to request that the applicant contribute to a predetermined congestion management project, at the discretion of the City. This type of concurrency management requirement is commonplace throughout the State of Florida.

<u>3. Utilize VISSIM Software for Future Traffic Analysis</u>.

VISSIM micro-simulation traffic software was chosen for this study in order to accurately analyze the wide variety of multi-modal vehicles in the City. Many popular traffic software packages such as Synchro and HCS are limited with regard to the types of vehicles that can be evaluated. As part of this study, a highly calibrated VISSIM model was constructed and will be provided to City Staff for use at their discretion. The existing conditions VISSIM model encompasses over 50 intersections and 15 corridors.

As improvements are made to the signal timing, the VISSIM model can be quickly updated to account for the future modifications. The VISSIM model can be updated for infinite future traffic conditions and scenarios such as:

- Proposed franchise vehicle operations.
- Proposed land development projects.
- Proposed modifications to intersection and roadway operations such as one-way streets.
- Future construction projects and associated detours.
- New bicycle/pedestrian facilities.
- New bus routes.
- Signal timing changes.

CGA will provide City Staff with a day of training on how to use the software. It is, however, recommended that a professional traffic engineer be consulted for any major modifications or analysis.

4. Monitor Traffic Counts on an Annual Basis.

It is not expected that the traffic patterns will greatly change in the short term but traffic patterns are not stagnant over time. The FDOT has 23 count stations in the City that are updated on an annual basis. These counts should be reviewed as they are a good indicator of any increase or decrease of traffic volumes over a several year time frame. In addition to the bi-directional roadway counts collected by the FDOT, turning movement counts should also be periodically updated. Travel patterns can change for a number of reasons, the most common being new development and infrastructure improvements. Whenever traffic patterns change, it will be beneficial to modify and optimize signal timing.

5. Lengthen the Existing Southeast Bound Left Turn on Palm Avenue at N. Roosevelt Boulevard.

The southeast bound approach at the intersection of Palm Avenue and N. Roosevelt Boulevard (left-turn movement from Palm Avenue onto N. Roosevelt Blvd) is operating at LOS E during the Mid Day and PM peak hours. The analysis demonstrated that excessive vehicle queuing occurs at this approach due to the high volume of left-turning traffic (590 vehicles during the PM peak hour). This excessive queuing not only causes delay for the left-turn movement, but exacerbates the overall delay at the intersection. The existing left turn lane length of approximately 170 feet should be extended by at least 200 feet to accommodate the vehicle queue. This will greatly improve the overall operation of the intersection. A cursory review of the lane geometry indicated that adequate right-of-way is likely available to accommodate the proposed lane extension.

6. Plan for and Implement a Sign Inventory and Improvement Program.

The data collected as part of this study indicate that over the past five years, more than 25% of the parking violations occurred from unauthorized parking in a designated parking space or in a no parking zone. Since the City is host to a high volume of tourists who may be unfamiliar with local regulations, it may be beneficial to work to improve signage associated with local parking restrictions and regulations.

Other deficiencies in the City's traffic signage were also observed such as signage that is non-compliant with the Manual of Uniform Traffic Control Devices (MUTCD). Ensuring that all roadway signage within the City is compliant with current MUTCD standards will likely improve driving conditions for motorists and ultimately improve roadway capacity.

7. Plan for and Construct Additional Off-Street Parking Facilities.

Key West residents who participated in surveys associated with this study were strongly in favor of adding more off-street parking facilities. On-street parking facilities can contribute to roadway congestion as drivers search for and maneuver within available parking spaces. The addition of off-street parking facilities may reduce some roadway congestion by providing an alternative to on-street parking facilities.

8. Consider Installing Shared Lane Markings for Bicycles in Accordance with Newly Adopted MUTCD Standards.

Bicycles accounted for approximately 8.3% of the overall traffic volumes collected as part of this study and it is evident that bicycles are a popular mode of transportation for both residents and tourists. Although there are few opportunities for new dedicated bike lanes within the City due to existing right-of-way limitations, alternative traffic signage and pavement markings could greatly improve the bicycling experience throughout the City. The 2009 Manual of Uniform Traffic Control Devices (MUTCD) allows for a shared lane marking to be used to:

1. Assist bicyclists with lateral positioning in a shared lane with on-street parallel parking in order to reduce the chance of a bicyclist's impacting the open door of a parked vehicle,
2. Assist bicyclists with lateral positioning in lanes that are too narrow for a motor vehicle and a bicycle to travel side by side within the same traffic lane,
3. Alert road users of the lateral location bicyclists are likely to occupy within the traveled way,
4. Encourage safe passing of bicyclists by motorists, and
5. Reduce the incidence of wrong-way bicycling.

If new bicycle routes are established on roadways without dedicated bike lanes, shared lane markings along with the applicable traffic signage (R4-11: "May Use Full Lane" and W16-1P:

“Share the Road”) should be considered. Related excerpts from the 2009 MUTCD identifying the proposed shared lane markings are included in **Appendix Q**.

9. Complete All-Way Stop Warrant Analysis Prior to the Conversion of Two-Way Stop Control (TWSC) Intersections to All-Way Stop Control (AWSC).

The City receives numerous requests for additional stop control at intersections for various reasons. The State of Florida has adopted standards set forth in the 2009 Manual on Uniform Traffic Control Devices (MUTCD) to address traffic control modifications, including conversions of stop-controlled intersections. It is important that standards set forth in the MUTCD are followed when considering traffic operational changes.

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1.0 INTRODUCTION

The City of Key West is a city of historic significance located at the southern tip of the Florida Keys and is the southernmost city in the continental United States. The Florida Bureau of Economic Business Research (BEBR) estimated the 2009 population of Key West at 23,178 residents; however the number of people in the City at any given time can vary greatly due to the seasonal nature of the tourism industry. The primary industry in the City is tourism which brings in people from all over the world to see the historic City.

Many of the streets within the City are narrow two-lane roadways with very limited opportunities for roadway widening due to physical constraints. The historical significance and unique nature of the City brings in thousands of tourists annually. Tourists arrive and depart the City via motorized vehicles, air travel, ferry boats and cruise ships.

The unique qualities and characteristics of Key West have led to the proliferation of a wide variety of non-traditional modes of transportation. This is most evident in the part of the City known as Old Town. In addition to standard passenger cars, delivery trucks, and buses, other common vehicle types include tour trains, tour trolleys, electric cars, scooters, bikes, and pedicabs. These multi-modal transportation alternatives along with high pedestrian activity and the existing roadway infrastructure limitations present a unique challenge in assessing the existing and future roadway capacity. For this reason, careful consideration was given to several carrying capacity methodologies, which are outlined in detail within this following report.

This study will assess the carrying capacity of the existing roadway network and provide recommendations for improvements, when possible. The study will address specialized vehicles and their impacts to roadways and adjacent land uses including impacts associated with mobility, noise, and air quality.

2.0 DATA COLLECTION

An extensive amount of data collection was undertaken for this study in order to develop an overview of the existing transportation facilities within the City. The data collection process was an integral component in determining existing capacity, and provided a baseline to estimate potential future capacity and feasible transportation related improvements. The following items were evaluated as part of the data collection process:

- Intersection Traffic Turning Movement Counts
- 24-Hour Bi-Directional Tube Counts
- Traffic Speed Counts
- Vehicle Classification Counts
- Corridor Travel Time Runs
- Multi-Modal Vehicle Attributes
- General Roadway Characteristics
- Existing Speed Limit Inventory
- Existing Parking Inventory
- Cruise Ship Related Data
- Existing Bike Lane Inventory
- Existing Traffic Sound Level Sampling

2.1 Determination of Peak Season

For many reasons, such as fluctuations in demand from the tourism industry and seasonal variations in the weather, the population of the City of Key West can vary greatly throughout a typical year. In addition to the transient population attributable to tourism, Key West is home to many "seasonal" residents who only reside in the area during the winter months. In order to determine the peak seasonal periods, available monthly data was evaluated for traffic counts, cruise ship passengers, and ferry vessel departures.

The Florida Department of Transportation (FDOT) collects traffic data at numerous locations throughout the City for various time durations. However, the FDOT has only one continuous count station within the area that collects traffic volumes on a daily basis. This count station is located on US-1 approximately 1,200 feet east of Cow Key Bridge on Stock Island. The monthly breakdown of traffic counts from 2004 through 2010 is presented on **Table 1**. The data indicates that the highest traffic volumes are present from January to April at this location.

Table 1
US-1 Monthly Traffic Volumes

Month	2004	2005	2006	2007	2008	2009	2010	**Average**
January	38,800	39,600	38,250	36,900	36,700	35,800	36,700	**37,500**
February	41,000	41,300	41,500	38,800	39,300	38,200	38,900	**39,900**
March	43,200	43,000	41,300	40,500	39,900	38,900	40,300	**41,000**
April	40,500	39,200	38,700	38,300	36,700	37,200	38,400	**38,400**
May	38,400	38,300	37,100	36,500	35,100	34,600	36,600	**36,700**
June	37,900	36,900	36,000	35,500	34,300	34,000	35,400	**35,700**
July	38,000	33,900	35,600	35,100	33,300	34,200	34,400	**34,900**
August	34,800	33,500	33,400	34,700	32,200	N/A	34,000	**33,800**
September	30,200	33,700	32,900	32,900	28,800	32,800	32,800	**32,000**
October	37,000	32,000	35,100	34,700	32,600	34,300	35,000	**34,400**
November	37,300	40,300	34,400	33,900	32,200	34,100	34,600	**35,300**
December	36,600	36,000	35,400	35,200	34,000	36,200	35,200	**35,500**

Source: FDOT Count Station 90-0165 located on US-1 1,200 feet east of Cow Key Bridge on Stock Island
Yellow highlight indicates highest four months

Cruise ships are a very prevalent component of the tourism industry in Key West. At the time of this study, there were three docking facilities available to large cruise ships: Mallory Square Dock, Pier B, and the Navy Mole. The monthly breakdown of actual cruise ship passenger and vessel disembarkments between fiscal years 2001-2002 and 2010-2011 are shown on **Table 2**. The data indicates that the highest number of passengers and port calls historically has been between the months of December and March.

The final item used to determine the peak season was monthly ferry vessel embarkments. At the time of this study, there were three ferry vessels servicing the City: the Key West Express, the Big Cat, and the Whale Watcher. The monthly breakdown of ferry vessel embarkments between fiscal years 2006-2007 and 2009-2010 is shown on **Table 3**. The results indicate that the highest number of ferry departures historically has occurred between the months of January and April.

The combined data of the FDOT traffic counts, cruise ship data, and the ferry vessel data demonstrates that the peak season is generally between the months of December and April. Additionally, City staff had indicated the months of January through March as peak season for Key West. Therefore, the majority of the peak season data collection was performed from late January to early March. Travel time runs and daily traffic volumes for the study corridors were collected during late January while intersection turning movement counts for the study intersections were collected during early March.

Table 2

Monthly Cruise Ship Passengers and Vessel Disembarkments

Passenger Data											
Month	FY 01-02	FY 02-03	FY 03-04	FY 04-05	FY 05-06	FY 06-07	FY 07-08	FY 08-09	FY 09-10	FY 10-11	**AVERAGE**
October	49,306	80,551	64,237	64,920	38,120	60,080	68,205	50,362	64,745	77,422	**61,795**
November	80,891	102,590	73,942	78,704	64,312	77,532	60,764	64,957	63,456	80,471	**74,762**
December	91,242	126,166	116,153	114,988	103,652	97,576	92,184	92,359	75,119	90,852	**100,029**
January	86,393	109,501	95,356	104,759	96,322	75,714	86,253	71,819	69,747	95,777	**89,164**
February	81,250	109,767	91,782	97,204	85,508	73,057	81,686	77,595	60,465	82,113	**84,043**
March	88,441	109,757	108,987	112,234	100,221	93,470	82,145	78,309	79,734	88,926	**94,222**
April	82,478	103,891	88,213	89,646	89,444	81,119	78,328	72,938	72,484	77,691	**83,623**
May	71,832	76,109	75,110	67,704	64,016	46,026	44,222	91,120	60,829	49,793	**64,676**
June	72,245	76,122	69,907	64,204	62,702	47,437	35,910	79,830	69,457	46,502	**62,432**
July	83,902	78,078	46,355	63,989	62,566	52,627	45,266	64,231	64,665	54,129	**61,581**
August	79,527	84,158	62,023	68,728	50,600	69,083	33,517	58,605	71,077	N/A	**64,146**
September	75,129	65,507	37,725	49,681	41,626	57,233	45,927	61,642	53,067	N/A	**54,171**
Port Calls											
Month	FY 01-02	FY 02-03	FY 03-04	FY 04-05	FY 05-06	FY 06-07	FY 07-08	FY 08-09	FY 09-10	FY 10-11	**AVERAGE**
October	27	44	32	34	18	29	35	22	28	35	**30**
November	51	57	43	46	35	40	31	31	28	36	**40**
December	57	79	60	63	55	51	49	46	34	39	**53**
January	50	66	51	52	50	41	46	37	37	45	**48**
February	47	63	46	48	44	38	40	39	29	37	**43**
March	51	56	54	57	48	48	39	34	35	40	**46**
April	44	56	42	51	41	39	37	34	31	34	**41**
May	35	38	36	33	29	21	18	37	24	18	**29**
June	32	39	31	28	26	20	14	29	26	16	**26**
July	35	34	20	28	26	22	18	23	23	18	**25**
August	33	40	28	31	21	28	13	21	26	N/A	**27**
September	35	31	19	24	20	26	20	25	21	N/A	**25**

Source: City of Key West, 2011

Table 3
Monthly Ferry Vessel Embarkments

Month	FY 06-07				FY 07-08				FY 08-09				FY 09-10				AVERAGE TOTAL
	Vessel			Total	Vessel			Total	Vessel			Total	Vessel			Total	
	Key West Ex	Big Cat	Whale Watcher		Key West Ex	Big Cat	Whale Watcher		Key West Ex	Big Cat	Whale Watcher		Key West Ex	Big Cat	Whale Watcher		
October	21	3	0	24	22	13	0	35	10	15	0	25	17	8	0	25	**27**
November	21	0	2	23	21	9	0	30	9	11	0	20	15	8	0	23	**24**
December	11	12	7	30	22	12	7	41	9	12	6	27	11	9	6	26	**31**
January	15	15	10	40	27	6	9	42	18	11	10	39	17	12	8	37	**40**
February	23	9	12	44	27	9	19	55	23	5	17	45	30	1	14	45	**47**
March	31	21	28	80	29	7	27	63	28	3	27	58	N/A	N/A	N/A	N/A	**67**
April	27	14	15	56	29	0	9	38	22	6	14	42	N/A	N/A	N/A	N/A	**45**
May	31	14	0	45	6	25	0	31	13	18	0	31	N/A	N/A	N/A	N/A	**36**
June	29	9	0	38	12	18	0	30	11	19	0	30	N/A	N/A	N/A	N/A	**33**
July	31	13	0	44	13	18	0	31	16	15	0	31	N/A	N/A	N/A	N/A	**35**
August	26	10	0	36	12	11	0	23	8	17	0	25	N/A	N/A	N/A	N/A	**28**
September	22	10	0	32	9	8	0	17	6	14	0	20	N/A	N/A	N/A	N/A	**23**

2.2 Turning Movement Counts

Traffic turning movement counts were collected for 25 key intersections within the City. The 25 intersections chosen for counts were agreed upon during scoping discussions with City staff. The 25 study intersections are shown below:

- Whitehead St at Greene St
- Whitehead St at Fleming St
- Whitehead St at Southard St
- Duval St at Front St
- Duval St at Eaton St
- Duval St at Southard St
- Duval St at Angela St
- Duval St at Truman Ave
- Duval St at South St
- Simonton St at Caroline St
- Simonton St at Fleming St
- Simonton St at United St
- Grinnell St at Fleming St
- White St at Eaton St
- White St at Southard St
- White St at Truman Ave
- White St at Catherine St
- White St at Flagler Ave
- Palm Ave/1st St at Truman Ave
- 1st St at Flagler Ave
- Roosevelt Blvd at Kennedy Dr
- Roosevelt Blvd at Overseas Hwy
- Roosevelt Blvd at Flagler Ave
- Olivia St at Frances St
- Thomas St at Petronia St

The turning movement counts were collected from March 5, 2011 to March 16, 2011 from 7-9 AM, 12-1 PM, and 4-6 PM. Additionally, the following vehicle classifications were collected during all of the turning movement counts:

1. Cars/Trucks
2. Bicycles
3. Scooters
4. Delivery Trucks/Buses
5. Electric Cars
6. Tour Trains
7. Pedicabs/3-Wheeled Bicycles
8. Tour Vehicles
9. Pedestrians

Standard traffic engineering procedures generally call for vehicle classifications counts for only cars/trucks, heavy vehicles (which incorporates delivery trucks, buses, etc.), and pedestrians. However, due to the unique nature of the City of Key West and to provide a more detailed analysis of roadway functionality, additional multi-modal vehicles were identified. Delivery trucks were grouped with buses since their vehicle characteristics such as size, acceleration, deceleration, and desired speed, are very similar for transportation modeling purposes. This is consistent with nationally accepted Highway Capacity Manual procedures.

The multimodal vehicles are primarily found in the "Old Town" area of the City. For purposes of the study, the Old Town area will consist of the entire lengths of Whitehead Street, Duval Street, and Simonton Street. **Table 4** identifies the vehicle classifications for the Old Town area and the non-Old Town area. The vehicle classification percentages were determined from the 25 study intersections and broken down by the AM, Mid-Day (MD), and PM peak hours. The raw data sheets for the turning movement counts are included in **Appendix A**.

Table 4
Old Town and Non-Old Town Vehicle Classification Percentages

Vehicle Classification	Old Town			Non-Old Town		
	AM	MD	PM	AM	MD	PM
Cars/Trucks	71.3%	63.6%	63.7%	89.5%	89.3%	90.0%
Bicycles	16.6%	17.0%	18.7%	3.8%	3.6%	3.8%
Scooters	7.7%	11.0%	11.4%	4.3%	5.0%	5.0%
Delivery Trucks/Buses	1.3%	1.0%	0.5%	1.9%	1.2%	0.6%
Electric Cars	0.8%	3.5%	1.9%	0.2%	0.4%	0.2%
Tour Trains	0.7%	1.3%	0.8%	0.1%	0.1%	0.1%
Pedicabs	0.4%	1.4%	2.0%	0.1%	0.1%	0.1%
Tour Vehicles	1.0%	1.4%	0.9%	0.2%	0.2%	0.2%

2.3 24-Hour Bi-Directional Tube Counts

24-Hour Bi-Directional Tube Counts were collected during the months of January, April, and July of 2011. The 24-hour counts were performed at various months in order to establish peak and off peak seasonal adjustments. The locations and results of the 24-hour tube counts are shown on **Table 5** for each month. The raw 24-hour tube counts are included in **Appendix B**.

Table 5
2011 24-Hour Tube Counts

Roadway	Location	January		April		July	
		Count Date	Daily Volume	Count Date	Daily Volume	Count Date	Daily Volume
1st St	50' W. of Flagler Ave	1/20/2011	6,366	4/28/2011	6,541	7/21/2011	5,598
Duval St	210' E. of Fleming Ave	1/22/2011	6,714	5/1/2011	6,371	7/24/2011	4,590
Eaton St	240' N. of Elizabeth St	1/20/2011	8,538	4/28/2011	9,031	7/21/2011	8,488
Flagler Ave	220' N. of 1st St	1/21/2011	10,908	4/29/2011	13,756	7/22/2011	13,456
Fleming St	50' S. of Elizabeth St	1/20/2011	2,995	4/28/2011	2,987	7/21/2011	2,745
Simonton St	235' E. of Front St	1/22/2011	3,946	4/30/2011	4,854	7/23/2011	4,308
South St	180' N. of Simonton St	1/22/2011	5,841	4/30/2011	6,797	7/23/2011	6,800
Southard St	135' S. of Simonton St	1/20/2011	2,811	4/28/2011	3,219	7/21/2011	2,857
Truman Ave	140' N. of Duval St	1/21/2011	8,459	4/29/2011	9,417	7/22/2011	7,345
United St	250' S. of Williams St	1/21/2011	6,180	4/29/2011	7,027	7/22/2011	6,029
N. Roosevelt Blvd	230' N. of 1st St	1/20/2011 - 1/22/2011	18,652	4/28/11 - 4/30/11	19,874	7/21/2011 - 7/23/2011	12,430
White St	150' E. of Truman Ave	1/21/2011	9,231	4/29/2011	8,912	7/22/2011	9,076
Whitehead St	220' E. of Greene St	1/22/2011	4,861	4/30/2011	5,106	7/24/2011	5,228
TOTAL			**95,502**		**103,892**		**88,950**

2.4 Speed Counts

Traffic speed counts were collected at the same time and location as the 24-hour bi-directional tube counts. The speed data collection produced 50th percentile and 85th percentile speed volumes for the study corridors. Standard traffic engineering principles call for the 85th percentile speed volume to be considered the free flow speed (FFS). However, due to the nature of the City, some of the collected speed data may have been heavily influenced by prevalent vehicle stops and slow downs. Therefore, the 85th percentile speed may not necessarily reflect the true FFS. The results of the speed data collection are shown on **Table 6**. The raw speed counts are included in **Appendix C**.

Table 6
Speed Count Data

Roadway	Location	NB/EB		SB/WB	
		Average (mph)	85th Percentile (mph)	Average (mph)	85th Percentile (mph)
1st St	50' W. of Flagler Ave	19	25	13	20
Duval St	210' E. of Fleming Ave	10	16	10	17
Eaton St	240' N. of Elizabeth St	21	27	18	24
Flagler Ave	220' N. of 1st St	21	28	16	26
Fleming St	50' S. of Elizabeth St	16	23	N/A	N/A
Simonton St	235' E. of Front St	12	21	13	22
South St	180' N. of Simonton St	20	27	17	24
Southard St	135' S. of Simonton St	N/A	N/A	8	13
Truman Ave	140' N. of Duval St	15	22	13	20
United St	250' S. of Williams St	23	29	21	28
N. Roosevelt Blvd	230' N. of 1st St	27	35	18	29
White St	150' E. of Truman Ave	16	24	11	18
Whitehead St	220' E. of Greene St	15	22	15	23

2.5 Travel Time Runs

Travel time runs were completed for the study corridors between January 20 and January 22, 2011 as well as April 28 and April 29, 2011. The travel time runs were performed from 7-9 AM, 11 AM–1 PM, and 4-6 PM for each of the study corridors. Several key corridors were selected for the travel time runs based on scoping meetings with the City staff. The selected key corridors for the travel time runs were:

- Whitehead St
- Duval St
- Simonton St
- White St
- Eaton St
- Fleming St
- Southard St
- Truman Avenue
- United St
- South St
- Flagler Ave
- Palm Ave
- 1st St
- Bertha St
- N. Roosevelt Blvd

The study corridors and intersections are shown on **Exhibit 1**. The travel time runs were computed utilizing GeoStats travel recording technology. The small GPS travel recorders were placed in vehicles that were then driven by Traffic Engineers to travel the aforementioned roadways during the dates and times listed above. The GPS recorders collected numerous data statistics including GPS coordinates, speed, and distance traveled. Once the travel runs were completed, the data was uploaded to the GeoStats TravTime software.

The TravTime software was then utilized to produce several measures of effectiveness such as average speed over a distance, delay, greenhouse gas emissions, and total travel time. This data helped to identify and quantify existing roadway conditions and to calibrate the microscopic simulation model. The average speed, congestion, and travel time results for each of the study corridors are summarized on **Table 7**.

The average speeds for each of the corridors were further broken down by direction and into small roadway segments. The small traffic segments were chosen using engineering judgment based on distinguishable roadway segmentation along the corridor. The average combined two-way speed for each of the study corridors during the PM peak hour is depicted on **Exhibit 2**.

The average speed by roadway segment results demonstrates that most of the congestion occurs in the Old Town area. The roadways of Whitehead Street, Duval Street, Simonton Street, and the east-west roadway segments between these roads have the lowest average speeds. Additionally, westbound Truman Avenue maintains a low average speed during the PM peak hour.

The raw statistics, measure of effectiveness including the estimated greenhouse gas emissions, and graphs for the travel time runs are included in **Appendix D**.

Exhibit 1 • Study Corridors & Intersections

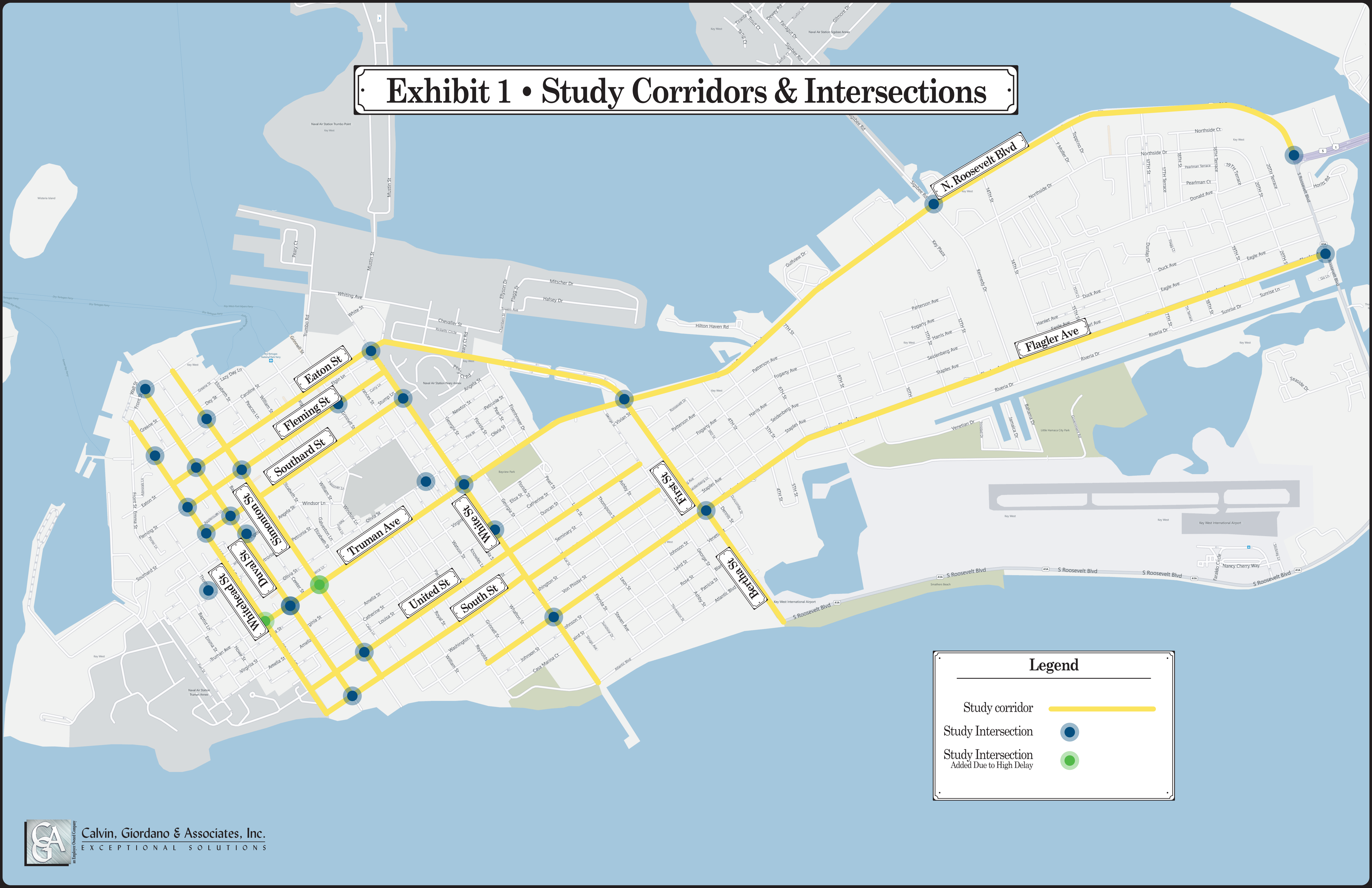


Table 7
TravTime Results – Existing Conditions

Corridor	AM						Mid Day						PM					
	NB/ EB			SB/ WB			NB/ EB			SB/ WB			NB/ EB			SB/ WB		
	Avg Cong. Time (s)	Avg Speed (mph)	Avg Time (s)	Avg Cong. Time (s)	Avg Speed (mph)	Avg Time (s)	Avg Cong. Time (s)	Avg Speed (mph)	Avg Time (s)	Avg Cong. Time (s)	Avg Speed (mph)	Avg Time (s)	Avg Cong. Time (s)	Avg Speed (mph)	Avg Time (s)	Avg Cong. Time (s)	Avg Speed (mph)	Avg Time (s)
Fleming St	68.4	15.03	172.2	N/A	N/A	N/A	166.2	10.37	253.2	N/A	N/A	N/A	147.0	10.65	240.0	N/A	N/A	N/A
Southard St	N/A	N/A	N/A	129.6	11.02	235.2	N/A	N/A	N/A	120.0	11.86	218.4	N/A	N/A	N/A	106.8	11.88	215.4
Duval St	134.4	13.36	285.6	147.0	12.94	294.6	409.8	7.72	494.4	512.4	6.97	547.2	543.6	6.63	581.4	578.4	6.25	610.8
Whitehead St	97.2	14.94	241.2	75.6	16.25	221.4	238.2	10.33	348.6	277.8	9.78	368.4	238.8	10.34	348.0	299.4	9.06	405.6
Simonton St	93.0	14.69	257.4	100.2	14.31	261.6	214.2	10.62	355.8	155.4	12.12	309.0	238.8	10.17	371.4	256.2	9.86	387.0
South St	75.6	15.93	235.2	65.4	16.54	222.0	111.6	14.13	265.2	138.0	12.97	286.2	108.0	13.03	287.4	120.6	13.41	274.2
United St	56.4	18.39	219.0	75.0	16.86	239.4	74.4	17.23	234.0	81.6	16.38	246.0	83.4	16.24	248.4	79.2	16.32	247.2
White St	79.8	17.2	240.6	89.4	16.05	251.4	107.4	15.04	270.6	124.2	14.49	280.8	99.6	15.43	265.8	126.6	14.08	286.2
Palm Ave/1st St	115.2	17.6	315.0	81.0	20.01	273.6	142.8	16.09	344.4	98.4	18.63	294.0	172.8	14.18	388.2	272.4	11.8	463.8
Eaton St	69.6	14.76	168.0	49.8	16.44	147.0	110.4	12.19	198.0	144.6	10.68	225.6	89.4	13.14	183.6	115.8	11.26	211.2
Flagler Ave	51.6	24.21	400.2	82.2	22.12	439.2	105.6	21.69	444.6	81.6	22.33	435.0	84.0	22.49	427.2	76.8	22.47	432.6
Truman	80.4	14.56	222.6	74.4	14.83	216.0	118.2	13.19	243.0	123.6	12.99	249.6	115.2	12.56	255.0	403.8	6.46	513.0
US-1	112.2	22.53	431.4	143.4	21.63	452.4	166.2	19.88	489.0	250.2	16.98	576.6	208.8	17.68	550.2	237.0	17.89	547.2

Notes:
Congestion time for purposes of TravTime refers to total time spent under 15mph.
Palm Ave, 1st St, and Bertha St combined into one study segment
NB/SB roadways include: Duval St, Whitehead St, Simonton St, White St, and Palm Ave/1st St/Bertha St.
EB/WB roadways include: Fleming St, Southard St, South St, United St, Eaton St, Flagler Ave, Truman Ave, and US-1.

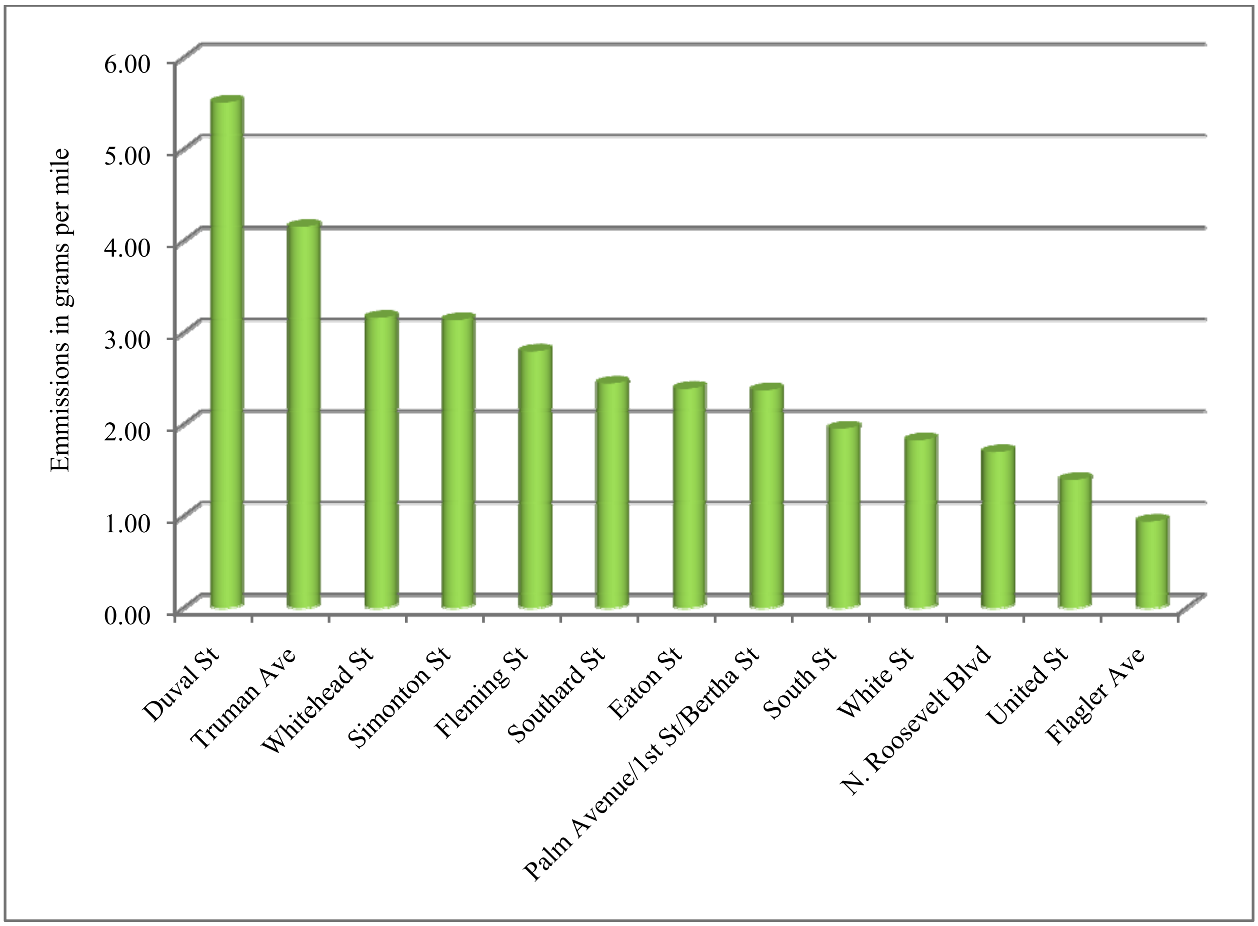
Exhibit 2 • PM Peak Hour Existing Conditions Average Speed

Greenhouse Gas Emissions

Greenhouse gas emissions were calculated for each of the study corridors utilizing the TravTime software. The data output included emissions for Volatile Organic Compound (VOC), Carbon Monoxide (CO), and Oxides of Nitrogen (NOx). The results for the study corridors are shown on **Figure 1**. The data shown on **Figure 1** includes the average emissions per mile of a standard passenger vehicle during the PM peak hour.

The roadways in the Old Town area produced greater emissions per mile per vehicle due to the heavier congestion and associated longer travel times per mile. Duval Street produced the highest amount of emissions while Flagler Avenue produced the lowest amount of emissions.

Figure 1
Greenhouse Gas Emissions



*Greenhouse gas emissions shown include the combined total of Carbon Monoxide (CO), Volatile Organic Compound (VOC), and Oxides of Nitrogen (NOx).

2.6 Multi-Modal Vehicle Attributes

Travel time runs using the GeoStats GPS recorder were also completed for several of the multi-modal vehicles in the City of Key West. Vehicle attributes such as size, speed, and acceleration for cars, trucks, delivery trucks, buses, and bicycles are well documented in many nationally recognized microscopic traffic simulation programs. These simulation programs do not, however, contain specific standards for many of the unique vehicles that traverse the City of Key West. Field data was therefore collected for tour trains, tour trolleys, pedicabs, scooters, and electric cars. The attributes collected for the multi-modal vehicles were utilized in developing the existing conditions traffic simulation model and determining the existing conditions for the study intersections and corridors.

Conch Train

The Conch Train first departs at 9:00 AM and the last departure occurs at 4:30 PM. Train tours depart generally at least every 30 minutes, with increased frequency when demand calls for it. Each tour lasts approximately 90 minutes and therefore, there are usually three tour trains on the roadway network at any given time during operational hours.

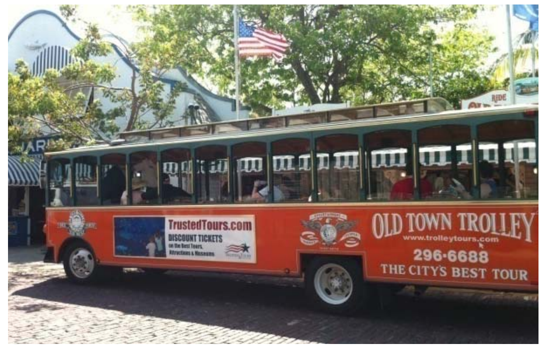
The Conch Train is currently the only touring vehicle that could be considered a “tour train”. The Conch Train tour starts and ends on Front Street between Duval Street and Whitehead Street and travels mostly in the Old Town area. In general, the Conch Train is not on any particular roadway segment for a long period of time and makes numerous turns throughout the tour. Given the large size of the vehicle (approximately 62 feet in length as compared to a standard passenger car length of 15 feet), large gaps in traffic are necessary for the Conch Train to make left turns. This can cause additional delay for vehicles in the queue behind the Conch Train. Additionally, the Conch Train generally travels the roadways at a slower speed than regular vehicles since it is a sightseeing tour. This was measured using the GeoStats GPS recorder.

Tour Trolleys

At the time of this study, two tour trolley companies were operational during daytime hours in Key West: Old Town Trolley and Cityview Trolley. Additionally, there were two “ghost tour” trolleys that were operational exclusively during the evening hours.

Old Town Trolley

Generally, the first daily departure for Old Town Trolley occurs at 9:00 AM and the last daily departure occurs at 4:30 PM. The Old Town Trolley has a departure frequency of at least every 30 minutes with each tour lasting approximately 90 minutes. Therefore, there are usually three Old Town Tour Trolleys on the roadway network at any given time during operational hours.



Generally, the Old Town Trolley has twelve stops throughout the City. The primary stop is in proximity to the Conch Tour Train stop in Mallory Square. The Old Town Trolley travels mostly throughout Old Town but also circulates around the entire city using N. Roosevelt Boulevard and S. Roosevelt Boulevard. Riders are able to freely board and depart any of the Old Town Trolleys at designated stops as frequently as they want during the same day after they purchase a boarding pass. Similarly to the Conch Train, the Old Town Trolley is generally not on a particular roadway segment for a long period of time and makes numerous turns throughout the tour. The Old Town Trolley generally travels the roadways in Old Town at a slower speed than the regular vehicles and also must wait for larger gaps than standard passenger cars when making left turns due to the large size of the vehicle. This was measured using the GeoStats GPS recorder.

Cityview Trolley

Generally, the first daily departure for Cityview Trolley occurs at 9:30 AM and the last departure occurs at 4:30 PM. The Cityview Trolley has a departure frequency of every 30 minutes with each tour lasting approximately 60 minutes. Therefore, at any given time there are two Cityview Trolleys on the roadway network during operational hours.

Generally, the Cityview Trolley has eight stops throughout the City. The primary stop is at Clinton Square on Whitehead Street just south of Front Street. The Cityview Trolley travels throughout Old Town and generally does not travel northeast of White Street. Riders are able to freely board and depart any of the Cityview Trolleys at designated stops as frequently as they desire during the same day after they purchase a boarding pass. Similarly to the Conch Train and Old Town Trolley, the Cityview Trolley generally makes numerous turns throughout the tour and is not on a particular roadway segment for a long period of time. The Cityview Trolley generally travels the roadways at a slower speed than regular vehicles and also must wait for larger gaps than standard passenger cars when making left turns due to the large size of the vehicle. This was measured using the GeoStats GPS recorder.

The Old Town Trolley and Cityview Trolley generally have similar vehicle characteristics in terms of length, width, speed, and acceleration.

Pedicabs

Pedicabs are three-wheeled bicycles that serve in a similar manner as taxis. At the time of this study, the amount charged per pedicab ride was based on the amount of time on the bicycle as opposed to distance traveled. The City currently allows licenses for 12 pedicabs in the City. Most of the pedicabs can be found in the Old Town area particularly Duval Street. However, occasionally pedicabs or other three-wheeled bicycles can be found in other areas of the city. Most of the pedicabs operate in the afternoon and evening hours to coincide with tourist activity.

Pedicabs travel the roadway generally on the right side of the roadway similar to bicycles which allow faster moving vehicles to pass on the left side. However, pedicabs are much wider than a bicycle making it a more difficult task for the passing vehicles. The City instructs pedicab operators that drivers must pull off the road at intersections to allow traffic to pass. However, compliance with this directive was observed to be sporadic. While the traveling speed of a pedicab varies, they were observed in the field traveling significantly slower than passenger cars. This was measured using the GeoStats GPS recorder.

Electric Cars

For the purposes of this study, electric cars refer to small vehicles, similar to golf carts that run entirely on electric power as opposed to gasoline. This classification does not include traditional passenger cars that are electric or hybrid powered. The majority of electric cars in Key West are rental vehicles and not owned and used for personal uses by the local residents. They are popular tourist vehicles for both cruise ship passengers and overnight tourists. They can be rented for a set number of hours or overnight. The City currently allows licenses for 17 electric car businesses and 208 electric cars. Most of the electric cars can be found in the Old Town area particularly Duval Street. However, it is common to see electric cars in other areas of the City as well. Electric cars are more prevalent in the afternoon and evening hours when tourist activity is at its highest.

Electric cars usually accommodate two, four, or six passengers and they generally travel slower than passenger cars. This was measured using the GeoStats GPS recorder. The maximum speed of electric cars varies by model, size, and occupancy. However, most electric cars have two types of drive modes which enable different maximum speeds. Generally, the slower drive mode has a maximum speed of around 15mph and the faster drive mode has a maximum speed of 25mph. Since most drivers of electric cars are tourists, there can be additional delay due to driver behavior and unfamiliarity with the local roadway system.

Scooters

Electric scooters or mopeds are popular vehicles in the City of Key West. The data collection demonstrated that scooters comprise approximately 6.7% of the existing traffic within the City. Scooters are commonly used by the local residents as well as by tourists. Scooters could be considered well suited for Key West because of low speed limits, short travel distances, smaller roadways, limited parking and year-round warm weather. Scooters can be rented for a set number of hours or overnight. The City currently allows licenses for 22 scooter businesses and 985 scooters within the City. Additionally, there are currently licenses for five scooter delivery businesses from outside the city limits. There are a higher percentage of scooters in the Old Town area but since scooters are used frequently by residents, they are commonly found throughout the City.

Electric scooters generally are capable of traveling the speed limit on most of the roadways in Key West. However, some of the smaller engine scooters may not reach the 35 mph posted speed limit on segments of N. Roosevelt Boulevard. The maximum speed and acceleration of scooters varies by model, size, and occupancy.

Bicycles

Bicycles are also a popular mode of transportation in the City of Key West. The data collection demonstrated that bicycles comprise approximately 8.3% of the existing traffic within the City. Bicycles are commonly used by local residents as well as tourists. Bicycles could be considered well-suited for Key West because of short travel distances, smaller roadways, limited parking and year-round warm weather Bicycles can be rented for a set number of hours or overnight. The City currently allows licenses for 35 bicycle rental businesses.

Dedicated bicycle lanes or shared use paths are present on the segments of the following study roadways: Southard Street, Fleming Street, Palm Avenue, White Street, N. Roosevelt Boulevard, and Flagler Avenue.

2.7 Roadway Characteristics

A variety of roadway characteristics were collected and inventoried for each of the study corridors. Data collected included but was not limited to speed limits, on-street parking facilities, bike lanes, roadway widths and lengths, geometry constraints, auxiliary turn lanes, and frequency of driveways and roadway access points. Much of this information was incorporated into the microscopic traffic simulation model.

2.8 Speed Limit Inventory

An inventory of posted speed limits was collected for the study corridors. The results are shown on **Table 8**. There are several corridors without posted speed limits. Pursuant to §316.183, F.S. and §316.189, F.S., the maximum speed within any municipality is 30 mph for business and residence districts. A municipality may set a new maximum speed limit after an investigation determines that such a speed limit is reasonable. Therefore, it is assumed that all roadways that do not have a posted speed limit have a maximum speed limit of 30 mph.

Table 8
Posted Speed Limits

25 mph	30 mph	35 mph	Not Posted
Truman Ave/ US-1 west of Eisenhower Dr	Roosevelt Blvd/ US-1 from Eisenhower Dr to Parrot Key Hotel	Roosevelt Blvd/ US-1 from Parrot Key Hotel to Overseas Hwy	White St
Flagler Ave west of 1st St	Roosevelt Blvd from 1st St to Overseas Hwy		United St
South St	Flagler Ave from 1st St to Roosevelt Blvd		Southard St
Fleming St	Palm Ave		Front St
Whitehead St	1st St/Bertha St		Duval St
	Eaton St		Simonton St

2.9 Parking Inventory

The availability and convenience of vehicle parking is of vital importance in a city like Key West. Many houses in Key West are historic, built without parking garages or driveways. This is particularly the case with the houses located in Old Town. Therefore, many of the local residents rely on on-street parking to access their homes.

Land use is also a prominent constraint on the availability of the parking throughout the city. Key West is a small island and thus there are land limitations for roadway infrastructure.

The tourism industry is a key component of the parking demands in the city particularly in the Old Town area. Many historical and tourism sites are found in the Old Town area such as Duval Street, Mallory Square, the Southernmost Point, Sloppy Joe's, and the Truman House. Additionally, the point of departure for many of the touring vehicles is near Mallory Square. In order to accommodate the high parking demand in the Old Town area, several public pay parking facilities are available. The larger parking facilities in the Old Town area are described below.

Park N Ride (Old Town Garage)

The Park N Ride parking garage contains approximately 300 spaces. This facility is located on Grinnell Street and Caroline Street. The parking garage is open 24 hours a day and has a fee of $2 per hour or $13 per day.

Park N Ride (Old Town Garage)

Mallory Square Parking Lot

The Mallory Square parking lot contains 100 parking spaces and is located just west of Wall Street. The cost of parking is $4 per hour with an eight hour maximum.

City Hall Parking Lot

The City Hall parking lot contains 84 parking spaces and is located west of Simonton Street between Southard Street and Angela Street. The cost of parking is $1.50 per hour with an eight hour maximum.

Key West Bight Parking Lot

The Key West Bight parking lot contains 120 parking spaces and is located north of Caroline Street between William Street and Margaret Street. The cost of parking is $2.50 per hour or $16.25 per day.

Available data from parking garage pay stations (“Cale” pay stations) were reviewed and analyzed to determine trends and occupancy rates. Several new Cale pay stations have been added over the last few years replacing the old metered style equipment. Therefore, several time frames corresponding to the opening of the new Cale pay stations were evaluated.

The utilization rate was determined by taking the summation of the average paid parking times during peak hours for the parking lot/garage. This number was then divided by the total available parking time during those hours. This methodology provided an approximation of the parking utilization for Key West Bight, Mallory Square, and the Old Town Garage. The analysis showed that the Key West Bight and Mallory Square parking lots are utilized at a much higher rate than the Old Town Garage. The parking utilization for these three areas is shown on **Table 9**.

Table 9
Parking Utilization

Location: Key West Bight		Location: Old Town Garage		Location: Mallory Square	
Dates: 6/1/2010 – 9/30/2011		Dates: 7/1/2011 – 9/30/2011		Dates: 6/1/2010/ - 9/30/2011	
Times: 7:00AM – 7:00PM		Times: 7:00AM – 7:00PM		Times: 11:00AM – 7:00PM	
Number of spaces: 120		Number of spaces: 300		Number of spaces: 100	
Average Daily Parking Time Per Hour		Average Daily Parking Time Per Hour		Average Daily Parking Time Per Hour	
Time	**Total (min)**	**Time**	**Total (min)**	**Time**	**Total (min)**
7:00AM	10,306.39	7:00AM	10,066.31		
8:00AM	4,668.79	8:00AM	3,346.96		
9:00AM	8,950.14	9:00AM	4,741.95		
10:00AM	4,447.43	10:00AM	6,874.56		
11:00AM	5,940.07	11:00AM	6,786.52	11:00AM	4,750.16
12:00PM	7,692.43	12:00PM	5,566.96	12:00PM	5,076.37
1:00PM	5,969.65	1:00PM	6,858.91	1:00PM	4,687.02
2:00PM	4,098.24	2:00PM	4,871.73	2:00PM	3,696.52
3:00PM	3,461.30	3:00PM	4,726.30	3:00PM	3,244.91
4:00PM	3,823.31	4:00PM	3,386.74	4:00PM	3,364.24
5:00PM	4,522.68	5:00PM	4,810.43	5:00PM	3,692.43
6:00PM	4,009.55	6:00PM	3,403.04	6:00PM	3,551.86
TOTAL	**67,889.98**	**TOTAL**	**65440.41**	**TOTAL**	**32,063.51**
Total available time*	86,400	Total available time*	216,000	Total available time*	48,000
Average utilization	**78.58%**	Average utilization	**30.30%**	Average utilization	**66.80%**
*Total available time = parking spaces x number of hours x 60 minutes					

The data show that the Mallory Square and the Key West Bight parking lots have historically been the highest revenue terminals. Between January 1, 2011 and September 30, 2011, the Mallory Square and Key West Bight parking lots produced 31.5% and 18.9% of the total Cale pay station revenues, respectively. Historical data from the Cale pay stations is included in **Appendix E**.

In addition to the parking lots and garage, the City has on-street pay parking spaces available throughout the downtown area. These parking spaces are located at various locations on Whitehead Street, Duval Street, Simonton Street, Ann Street, Front Street, Greene Street, Caroline Street, Eaton Street, Fleming Street, Southard Street, Virginia Street, United Street, and South Street. Fees for on-street parking spaces are collected at parking pay stations or traditional individual pay meters. There are currently 42 pay stations and over 300 traditional parking meters in the City. The City intends to phase out the traditional parking meters and replace them with pay stations. A map depicting the on-street pay for parking locations and pay station locations in the Old Town area is illustrated on **Exhibit 3**.

Exhibit 3 • Downtown Parking Inventory

On-street parking was also inventoried for each of the study corridors since the availability of on-street parking affects street classification and roadway capacity. A description of the approximate locations of parking for the study corridors is provided below:

Flagler Avenue

On-street parking is available on both sides of the Flagler Avenue for the majority of the roadway. The on-street parking facilities generally serve the residents and homes adjacent to Flagler Avenue.

Truman Avenue

On-street parking is available on Truman Avenue in the northeast direction from Simonton Street to Eisenhower Drive. The parking facilities generally serve the businesses and public facilities adjacent to Truman Avenue.

US-1/N. Roosevelt Boulevard

There are no on-street parking facilities on US-1/N. Roosevelt Boulevard from Eisenhower Drive to Overseas Highway.

S. Roosevelt Boulevard

On-street parking is available on S. Roosevelt Boulevard from Bertha Street to just before Flagler Avenue in the eastbound direction only. The parking facilities on S. Roosevelt Boulevard serve the beach area and shared use path along the Atlantic Ocean.

White Street

On-street parking is available on White Street primarily from Atlantic Boulevard to Truman Avenue on both sides of the roadway. Additional on-street parking is available from Truman Avenue to Eaton Street but primarily in the southbound direction with only a limited number of northbound parking spaces. The parking facilities along White Street serve both residents and businesses.

United Street

On-street parking is available on United Street on both sides of the roadway from Whitehead Street to Simonton Street. The on-street parking facilities east of Simonton Street are primarily in the westbound direction with only some eastbound parking. The parking facilities on United Street primarily serve residents as well as some businesses.

South Street

On-street parking is generally available for the entire length of the corridor on both sides of the roadway. Parking east of Simonton Street serves the homes adjacent to the roadway. Parking from Simonton Street to Duval Street is paid parking and serves the various tourist attractions such as the Southernmost Point.

Fleming Street

On-street parking is available on both sides of Fleming Street for the entire length of the corridor. The parking facilities from Whitehead Street to Simonton Street serve businesses while the parking from Simonton Street to White Street serves residential homes.

Southard Street

On-street parking is available on both sides of Southard Street from White Street to Whitehead Street. The parking facilities from White Street to Simonton Street serve homes while the parking facilities from Simonton Street to Whitehead Street serve businesses.

Whitehead Street

On-street parking is available on Whitehead Street from Greene Street to Fleming Street in the southbound direction. These southbound parking spaces are paid parking and serve the Old Town businesses. Additionally, parking in the northbound direction on Whitehead Street is present at various locations from South Street to Truman Avenue.

Front Street

On Street parking is available at various locations on Front Street. The parking on Front Street serves the Old Town businesses.

Duval Street

On-street parking is available at various locations throughout the limits of Duval Street. Parking is available in the southbound direction from Caroline Street to Fleming Street and from Petronia Street to south of South Street. On-street parking is also available in the northbound directions from South Street to Truman Avenue. The parking on Duval Street serves the many popular nearby businesses and tourist attractions on Duval Street and in the Old Town area. Additionally, designated delivery and loading zones are present in the southbound direction from Greene Street to Caroline Street and from Fleming Street to Petronia Street.

Simonton Street

On-street parking is available throughout Simonton Street in the southbound direction. A small segment of parking in the northbound direction is available from South Street to United Street. The majority of on-street parking on Simonton Street is paid parking serving the various businesses in the Old Town area.

Eaton Street

On-street parking is available on Eaton Street from Simonton Street to Whitehead Street in both directions and from White Street to Simonton Street in the westbound direction only. The parking spaces on Eaton Street generally serve the Old Town area.

Palm Avenue

There are no on-street parking facilities on Palm Avenue from White Street to US-1/Truman Avenue.

1st Street/Bertha Street

On-street parking facilities on 1st Street are available at various locations on both sides of the roadway from Truman Avenue to Flagler Avenue. Additional parking is available in the southbound direction only from Flagler Avenue to Atlantic Boulevard. The on-street parking facilities on 1st Street primarily serve the homes adjacent to the roadway.

2.10 Loading Zones

In general, the Old Town area of the City does not have back-lot alleys for commercial deliveries. Therefore, many delivery truck drivers utilize on-street parking spaces for delivery loading and unloading. The City provides standard red bag commercial delivery zones as well as standard loading zones in the commercial core business district. The red bag zones are established daily at select, metered parking spaces at 6AM. City Ordinance (Chapter 7, Division 2, Section 70-372 and 70-373) restricts commercial deliveries to the hours of 6AM to 12PM on Duval Street and 6AM to 2PM on Whitehead Street, Simonton Street, Front Street, and Caroline Street. The red bag parking spaces are only in effect during these hours.

The standard loading zones in the commercial core are non-metered spaces marked with a yellow curb. Non-commercial vehicles are allowed to load and unload for 15 minutes from 6AM to 6PM on Monday through Saturday. These loading zones become free parking after 6PM and are sometimes marked as taxi-stands or motorcycle parking after hours.

Additional loading zones are available for the hospitality industry and small businesses. They allow for 30 minutes of loading at any given time with no time of day restrictions. Church parking and loading zones are also regulated.

The loading zones for tour trains and trolleys are regulated. The time limit for designated secondary stops for loading and unloading is 15 minutes. The tour trains and trolleys are permitted to park at their respective primary depots for any length of time between 8AM and 5PM from Monday through Sunday.

2.11 Parking Violations

Enforcement of parking and loading zones is critical in a city such as Key West which experiences a large daily influx of tourists. Parking violations from fiscal years 2006 to 2010 were provided by the City staff and are presented in **Table 10**. Analysis of parking violations over the past five years illustrates the highest number of violations due to time-limit expirations followed by parking in a no parking zone or inapplicable designated parking space.

Table 10

Parking Violations Fiscal Years 2006-2010

Violation	Description	FY 06	FY 07	FY 08	FY 09	FY 10	% Over 5 Year Period
BLK	Blocking Driveways and Line of Sight	82	70	52	54	43	0.14%
DES	Parking in Designated Parking Spaces (used mainly for non residents parking in residential marked spaces)	7,199	4,790	4,047	4,396	3,934	11.35%
FIR	Blocking Fire Hydrant	128	129	134	129	219	0.34%
FLN	Blocking Fire Lane	109	219	303	36	43	0.33%
HAN	Parking in Handicap Space (without placard or plate)	90	33	26	15	20	0.09%
NPZ	No Parking Zone (used mainly for parking in loading zones, yellow curb, Trolley Stops, Commercial Bus space, etc.)	7,148	8,048	8,525	5,167	4,313	15.47%
OTH	Other Violations (parking against traffic, parked for more than 72 hours without moving, trailer or commercial vehicle in residential neighborhood, non emergency repair in right of way (oil change), etc.)	2,392	2,725	3,940	3,009	2,967	7.00%
OTP	Overtime Parking (parking at expired meter or no valid pay station receipt displayed)	24,249	24,339	29,871	33,152	24,816	63.56%
RV	Parking RV in City Right of Way or Oversized (20 feet or greater)	143	135	109	245	332	0.45%
SID	Parking on Sidewalk	81	18	45	20	24	0.09%
STR	Parking in Street	481	361	685	677	336	1.18%
Total Violations		**42,102**	**40,867**	**47,737**	**46,900**	**37,047**	**214,653**

Source: City of Key West Parking Enforcement

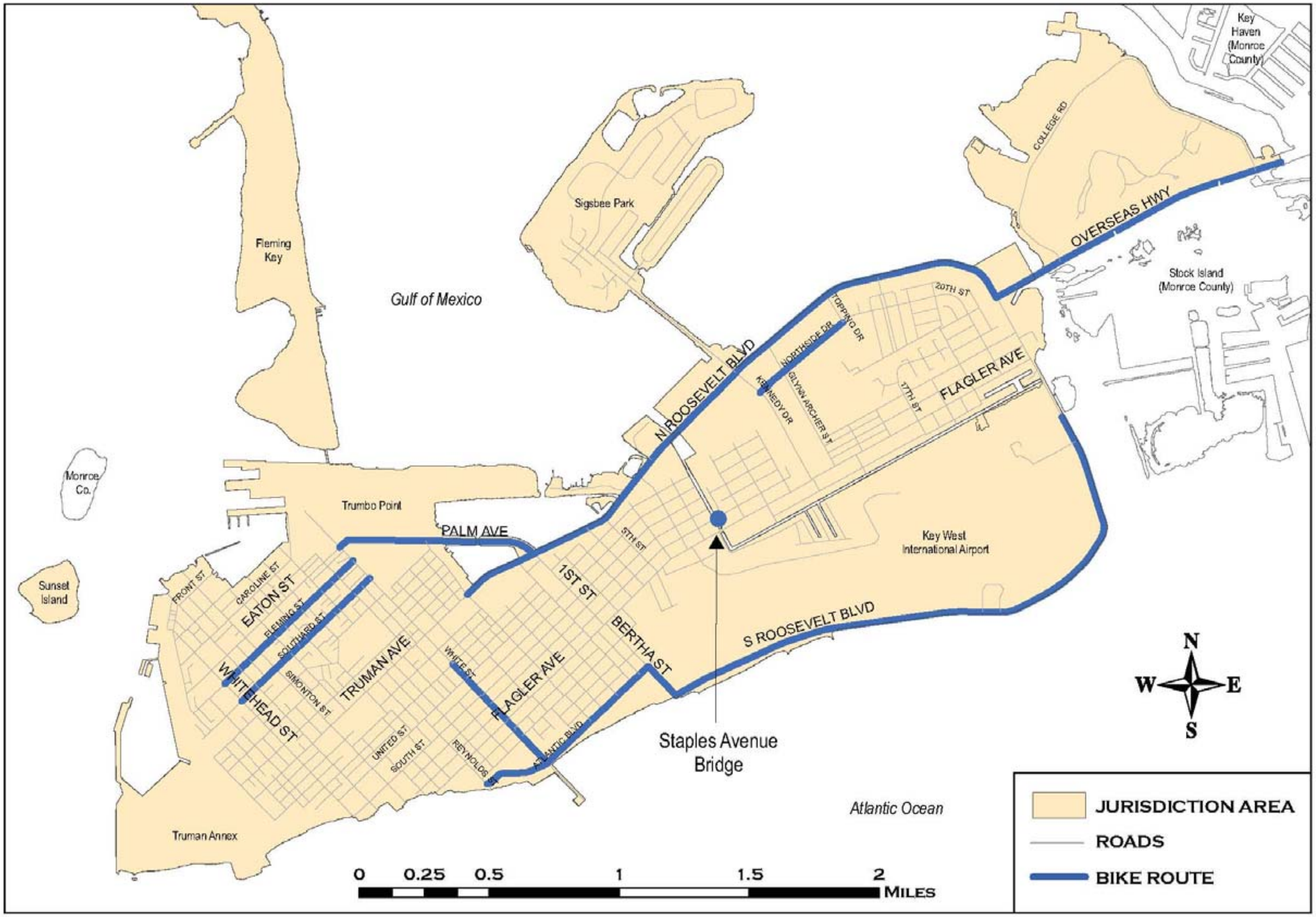
2.12 Bike Lane Inventory

In the City of Key West, bicycles are a popular transportation choice for local residents as well as tourists. Bicycles accounted for over 8% of the total vehicles counted at the 25 study intersections. With the high number of bicyclists utilizing the City streets, it's critical that the roadway infrastructure be sufficient to accommodate bicyclists in a safe and efficient manner.

An inventory of existing bike lines was conducted for each of the study corridors. Bike lanes were found to be present on Fleming Street, Southard Street, White Street from Truman Avenue to Atlantic Boulevard, and Flagler Avenue from Roosevelt Boulevard to Kennedy Drive. In addition to the designated bike lanes, shared use paths were also present on US-1 from Eisenhower Drive to Overseas Highway, Palm Avenue, and S. Roosevelt Boulevard.

Exhibit 4 depicts the Bike Routes map from the 2005 City of Key West Transportation Element that was not approved by the City.

Exhibit 4
Bicycle Routes



Source: Map taken from 2005 City of Key West Transportation Element (not approved)

2.13 Sound Level Measurements

Sound decibel (dB) level measurements were recorded at several locations in the City on Saturday, August 20, 2011. Four locations with relatively low traffic volumes were chosen for the recordings to minimize background noise interference. The four low traffic volume locations included the following:

1. Grinnell Street between Eaton Street and Fleming Street
2. Southard Street between Grinnell Street & Francis Street
3. Reynolds Street between Casa Marina Court and Johnson Street
4. Northeast corner of Fleming Street and Grinnell Street

For reference, sound levels for typical noise sources are shown on **Table 11**.

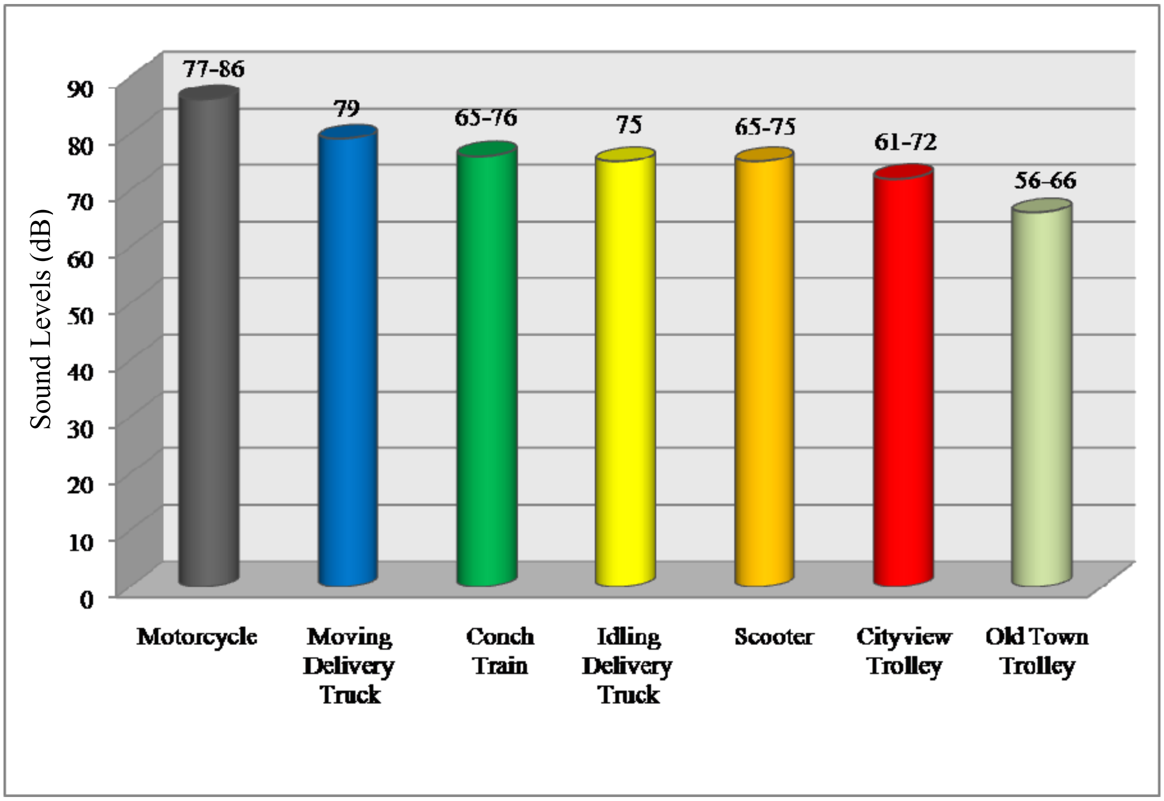
Table 11
Typical Sound Levels

Noise Source or Activity	Sound Level (dBA)	Subject Impression	Relative Loudness (human judgment of different sound levels)
Jet aircraft takeoff from carrier (50 ft)	140	Threshold of pain	64 times as loud
Loud rock concert near stage, Jet takeoff (50 ft)	120	Uncomfortable loud	16 times as loud
Jet takeoff (2,000 ft)	100	Very loud	4 times as loud
Heavy truck or motorcycle (25 ft)	90		2 times as loud
Garbage disposal, food blend (2 ft), Pneumatic drill (50 ft)	80	Moderately loud	Reference loudness
Passenger car at 65 mph (25 ft)	70		1/2 as loud
Large store air-conditioning unit (20 ft)	60		1/4 as loud
Light auto traffic (100 ft)	50	Quiet	1/8 as loud
Bedroom or quiet living room , Bird calls	40		1/16 as loud
Quiet library, soft whisper (15 ft)	30	Very quiet	1/32 as loud

Source: Beranek (1988) and EPA (1971)

The maximum observed decibel levels for vehicles maxed out at the following sound levels as shown on **Figure 2**:

Figure 2
Observed Sound Levels

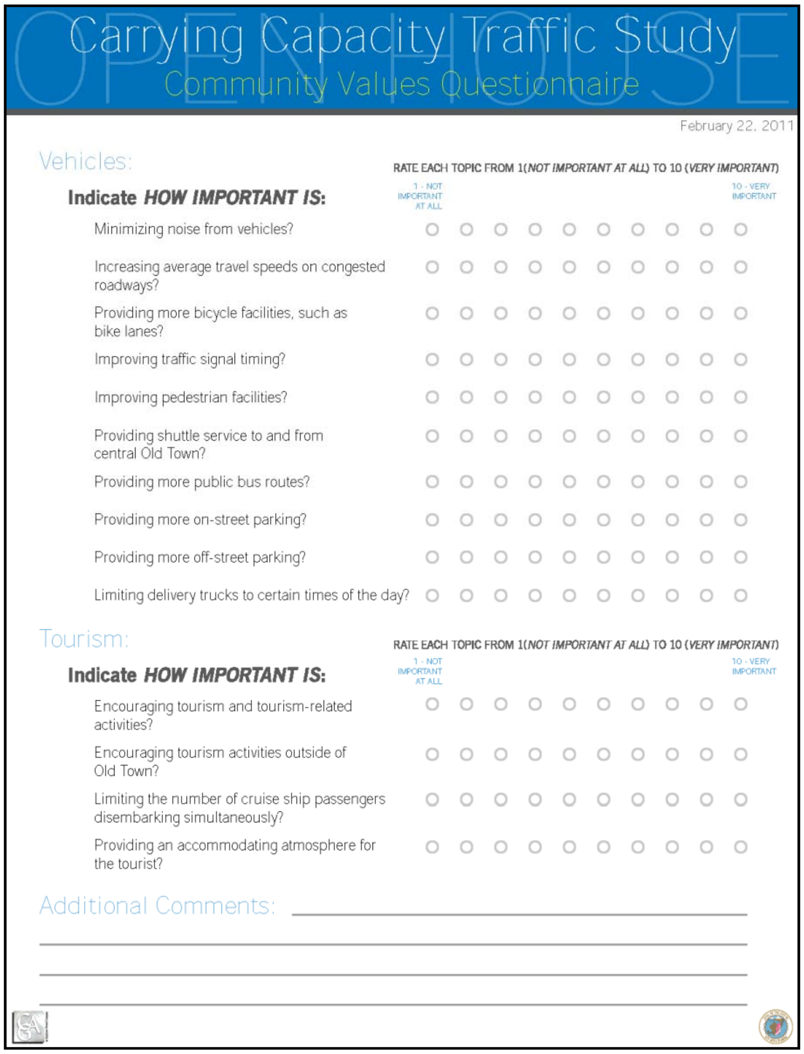


The sound level measurement results demonstrated that the tour trains, tour trolleys, and scooters generally do not produce greater decibel (dB) levels than standard passenger vehicles. Motorcycles produced the highest dB level of any of the observed vehicles.

In addition to the isolated low traffic areas, recordings were also completed at three different locations on Duval Street. All sound recordings were made with the recording device at the back of sidewalk. The sound level recording charts are included in **Appendix F.**

3.0 PUBLIC OUTREACH

An open house was held from 7AM to 7PM on February 22, 2011 at City Hall. Residents were able to meet with the project manager for this study and learn about the Carrying Capacity Traffic Study methodology. A Questionnaire was given to those in attendance to allow the public to voice their opinions on several transportation issues. The results of the Questionnaire showed that residents felt most strongly about the importance of improving bicycle and pedestrian facilities.



OPEN HOUSE

Carrying Capacity Traffic Study

Community Values Questionnaire

February 22, 2011

Vehicles:

RATE EACH TOPIC FROM 1(*NOT IMPORTANT AT ALL*) TO 10 (*VERY IMPORTANT*)

Indicate *HOW IMPORTANT IS*: (1 - NOT IMPORTANT AT ALL ... 10 - VERY IMPORTANT)

- Minimizing noise from vehicles?
- Increasing average travel speeds on congested roadways?
- Providing more bicycle facilities, such as bike lanes?
- Improving traffic signal timing?
- Improving pedestrian facilities?
- Providing shuttle service to and from central Old Town?
- Providing more public bus routes?
- Providing more on-street parking?
- Providing more off-street parking?
- Limiting delivery trucks to certain times of the day?

Tourism:

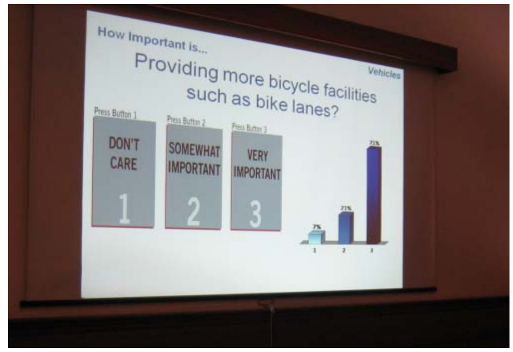
RATE EACH TOPIC FROM 1(*NOT IMPORTANT AT ALL*) TO 10 (*VERY IMPORTANT*)

Indicate *HOW IMPORTANT IS*: (1 - NOT IMPORTANT AT ALL ... 10 - VERY IMPORTANT)

- Encouraging tourism and tourism-related activities?
- Encouraging tourism activities outside of Old Town?
- Limiting the number of cruise ship passengers disembarking simultaneously?
- Providing an accommodating atmosphere for the tourist?

Additional Comments: ____________________

A Community Values Meeting was held on May 25, 2011. Residents were given an opportunity to give feedback on the importance of a variety of transportation issues. The survey was also made available through the City website so that residents not in attendance could still have their opinions heard. The results of the Community Values survey and the Open House Questionnaire are provided in **Appendix G**.



Nearly 200 people responded to the aforementioned surveys. The respondents felt most strongly about the following topics:

- Minimizing noise from vehicles in residential neighborhoods.
- Providing more bicycle facilities such as bike lanes and bike racks.
- Improving pedestrian facilities such as sidewalks, crosswalks, and signalized intersections.
- Providing more off-street parking such as public parking garages and parking lots.
- Providing an accommodating atmosphere for the tourist.
- Respondents indicated they were not willing to experience greater delay on roadways in order to encourage tourism, cruise ship traffic or on-street parking.

It is recognized that the number of respondents is only a small portion of the residents in the City and may not accurately reflect the opinion of the majority of the residents.

4.0 EXISTING CONDITIONS ANALYSIS

4.1 Street Classifications

Chapter 15 of the 2000 Highway Capacity Manual (HCM) defines the methodology in determining Level of Service (LOS) for Urban Streets. The methodology consists of measuring or calculating the average speed along a corridor and comparing it to thresholds of the roadway classification. The 2000 HCM identifies four levels of urban street classifications. The urban street classifications are class I, II, III, or IV roadways.

Each roadway's street classification can be determined by free flow speed or the street's functional and design categories. Free-flow speed is the term used to describe the average speed that a motorist would travel if there were no congestion or other adverse conditions (such as bad weather). Thoroughfare roadways are categorized into functional classification groups according to the character of traffic and the degree of land access that they will provide. The four functional classification groups for urban areas are principle arterials, minor arterials, collectors, and local roads. The primary function of arterial roadways is to provide mobility, while the primary function of local roads is to provide access. The functional classifications of major thoroughfares are further described below:

- **Principal Arterials.** The principal arterial system serves the major centers of activity of a metropolitan area and the highest volume traffic corridors. Principal arterials carry the most trips entering and leaving an urban area. Characteristics of principal arterials also include long average trip lengths, high operating speeds and less access than the other roadway classifications.

- **Minor Arterials.** The minor arterial system provides support for principal arterials. It provides service for trips of moderate length and at a lower mobility than principal arterials. Minor arterials generally interconnect with principal arterials and collector roads.

- **Collectors.** Collectors provide a lower degree of mobility and a higher degree of access than arterial roadways. They are designed for lower operating speeds and shorter trip distances. Collectors provide access and distribute vehicular trips from arterials to residential neighborhoods and commercial areas.

- **Local Streets.** Local streets consist of all roadways that are not an arterial or collector roadway. They provide access to abutting land uses and connect to the higher order systems. Local streets typically have the lowest level of mobility, shortest trip lengths, and lowest operating speeds.

The functional classification definitions described above are typical of an urban roadway network. However, not all roadways fit perfectly into any one classification. The City of Key West is a unique urbanized area located on an island and the majority of the roadway system and land uses were constructed long ago. For this reason as well as infrastructure limitations, many of the arterial roadways provide a greater amount of access, have shorter trip lengths, and lower operating speeds than found on a typical arterial roadway.

The functional classifications for each of the study corridors were determined from the 2009 Florida Department of Transportation (FDOT) Traffic Information and Highway Data CD and are shown below:

<u>Principal Arterials</u>
US-1/N. Roosevelt Boulevard
Truman Avenue
Whitehead Street from Fleming Street to Truman Avenue

<u>Minor Arterials</u>
Flagler Avenue between 1st Street and S. Roosevelt Boulevard
Bertha Street
1st Street
Palm Avenue
Eaton Street
Duval Street between Eaton Street and Truman Avenue

<u>Collectors</u>
Whitehead Street north of Fleming Street
Whitehead Street south of Truman Avenue
Duval Street north of Eaton Street
Duval Street south of Truman Avenue
Simonton Street
White Street
United Street
Flagler Avenue between White Street and 1st Street
Front Street

<u>Local Roads</u>
Flagler Avenue west of White Street
South Street
Fleming Street
Southard Street

HCM design categories are also useful in determining the street classification for the study corridors. Each design category is based on a number of parameters including signal spacing, free flow speed, access density, on-street parking, pedestrian activity, and roadside development. Exhibits 10-3 and 10-4 from the 2000 HCM as shown on **Tables 12 and 13**, respectively, further describe the functional and design categories. Generally, most of the study corridors consist of a high number of driveway and street accesses, on-street parking, low speed limits, high pedestrian activity, and a high amount of roadside density. Based on these parameters, most of the study corridors align with the Intermediate and Urban design categories.

Table 12
Urban Street Class Based On Functional and Design Categories

Design Category	Functional Category	
	Principal Arterial	Minor Arterial
High-Speed	I	N/A
Suburban	II	II
Intermediate	II	III or IV
Urban	III or IV	IV

Source: Exhibit 10-3 from 2000 HCM

Table 13
Roadway Functional and Design Categories

Criterion	Functional Category			
	Principal Arterial		Minor Arterial	
Mobility Function	Very important		Important	
Access Function	Very minor		Substantial	
Points Connected	Freeways, important activity centers, major traffic generators		Principal arterials	
Predominant Trips Served	Relatively long trips between major points and through-trips entering, leaving, and passing through the city		Trips of moderate length within relatively small geographical areas	
Design Category				
Criterion	High Speed	Suburban	Intermediate	Urban
Driveway/access density	Very low density	Low density	Moderate density	High density
Arterial type	Multilane divided; undivided or two-lane with shoulders	Multilane divided; undivided or two-lane with shoulders	Multilane divided or undivided; one-way, two lane	Undivided one-way, two-way, two or more lanes
Parking	No	No	Some	Significant
Separate left turn lanes	Yes	Yes	Usually	Some
Signals/mi	0.5-2	1-5	4-10	6-12
Speed limit	45-55 mph	40-45 mph	30-40 mph	25-35 mph
Pedestrian activity	Very little	Little	Some	Usually
Roadside development	Low density	Low to medium density	Medium to moderate density	High density

Source: Exhibit 10-4 from 2000 HCM

A street classification was assigned to each of the study corridors based on the roadway's functional and design categories and free flow speed determined from speed data counts and travel time runs completed during low volume periods. The assigned street classifications are shown below:

Street Classification II
N. Roosevelt Boulevard east of Eisenhower Drive

Street Classification III
Palm Avenue/1st Street/Bertha Street
Flagler Avenue

Street Classification IV
Fleming Street
Southard Street
Duval Street
Whitehead Street
Simonton Street
South Street
United Street
White Street
Eaton Street
Truman Avenue west of Eisenhower Drive

4.2 Roadway Level of Service

Level of Service (LOS) standards are used to determine the serviceability of roadways. LOS is defined in the 2000 HCM as "*A qualitative measure describing operational conditions within a traffic stream, based on service measures such as speed and travel time, freedom to maneuver, traffic interruptions, comfort, and convenience.*"

There are six different LOS classifications that represent a range of operation conditions and the driver's perception of those conditions.

Level of Service A. This LOS generally describes free-flow traffic operations where motorists are completely unimpeded in their ability to maneuver within the traffic stream. Drivers are able to travel at their desired speed, and delays at intersections are minimal.

Level of Service B. This LOS also describes free-flow traffic conditions, although the presence of other vehicles within the traffic stream is noticeable. The ability to maneuver within the traffic stream is only slightly restricted and stopped delays are not significant.

Level of Service C. For this LOS condition, traffic flow is generally stable, although the driver's choice of speeds and ability to maneuver are increasingly restricted. Longer queues at signalized intersections characterize this level of service.

Level of Service D. Traffic flow is generally unstable where minor increases in flow result in substantial delay. Driving speeds are tolerable for short periods, but are subject to sudden variance. The ability to maneuver and select a travel speed is severely restricted.

Level of Service E. Large traffic volumes and significant delay typify this LOS. Traffic flow is unstable and is generally maintained by a low speed. Driver comfort is low due to limited space between vehicles and rapidly changing speeds, and extensive delays are typically experienced at critical intersections.

Level of Service F. Traffic flow is characterized by extremely low speeds. Driving comfort is low and motorists incur significant delays. Substantial queuing also occurs at critical intersections.

LOS standards are primarily the measure of effectiveness that jurisdictions use to evaluate their roadways. Each jurisdiction establishes the minimum LOS a roadway must meet to be deemed acceptable. Generally, LOS E or LOS F is considered to be a failing roadway.

The established LOS standards as set forth in the City of Key West Comprehensive Plan are shown on **Table 14**.

Table 14
LOS Standards

Roadway Facilities	Segment	Min LOS Standard Peak Hour
State Urban Principal Arterials		C (1)
US 1	N. Roosevelt Blvd	C (1)
	Truman Ave	Physically Constrained (1)
	Whitehead St	Physically Constrained (1)
County Urban Minor Arterials		D
County Urban Collectors		D
City Urban Collectors		D

(1) Due to physical constraints that would make US 1 improvements cost prohibitive, the segments from Eisenhower Drive to Whitehead Street and from Truman Avenue to Fleming Street, are designated as constrained. These segments have an existing operating condition below the LOS C standard. Constrained facilities level of service shall be C plus 5 (five) percent.

The City Comprehensive Plan states that the LOS determination of thresholds shall be calculated using a speed based methodology. Therefore, for purposes of this study, the LOS speed thresholds will be based on Chapter 15 of the 2000 Highway Capacity Manual (HCM). The average speed threshold for each LOS designation is further broken down by the Urban Street Classification as shown on **Table 15.**

Table 15
Urban Street Level of Service by Classification

Urban Street Class	I	II	III	IV
Range of free-flow speeds (FFS)	50 to 45 mph	45 to 35 mph	35 to 30 mph	35 to 25mph
Typical FFS	50 mph	40 mph	35 mph	30 mph
LOS	Average Travel Speed (mph)			
A	> 42	> 35	> 30	> 25
B	> 34-42	> 28-35	> 24-30	> 19-25
C	> 27-34	> 22-28	> 18-24	> 13-19
D	> 21-27	> 17-22	> 14-18	> 9-13
E	> 16-21	> 13-17	> 10-14	> 7-9
F	≤ 16	≤ 13	≤ 10	≤ 7

Source: Exhibit 15-2 from 2000 HCM.

4.3 Travel Time Run Existing Conditions

The travel time run results completed for each study roadway were compared to the thresholds on **Table 15** to establish the existing LOS for each of the corridors. The travel time runs were broken down by peak hour and direction. When evaluating roadways, it is somewhat advantageous to analyze larger roadway segments rather than shorter segments. However, due to the nature of the City, many of the study corridors are short in length. Palm Avenue, 1st Street, and Bertha Street were combined into one segment for analysis purposes for this reason. The existing conditions average speed and LOS for each of the study corridors as determined by the travel time runs are shown on **Table 16**. Additional statistics and graphs from travel time are included in **Appendix D**.

Table 16
TravTime Results – Existing LOS

Corridor	From	To	Approx Dist. (miles)	Street Class	AM				Mid Day				PM			
					NB/ EB		SB/ WB		NB/ EB		SB/ WB		NB/ EB		SB/ WB	
					Avg Speed (mph)	LOS	Avg Speed (mph)	LOS	Avg Speed (mph)	LOS	Avg Speed (mph)	LOS	Avg Speed (mph)	LOS	Avg Speed (mph)	LOS
Fleming St	Whitehead St	White St	0.72	IV	15.03	C	N/A	N/A	10.37	D	N/A	N/A	10.65	D	N/A	N/A
Southard St	White St	Whitehead St	0.73	IV	N/A	N/A	11.02	D	N/A	N/A	11.86	D	N/A	N/A	11.88	D
Duval St	South St	Front St	1.07	IV	13.36	C	12.94	D	7.72	E	6.97	F	6.63	F	6.25	F
Whitehead St	South St	White St	1.00	IV	14.94	C	16.25	C	10.33	D	9.78	D	10.34	D	9.06	D
Simonton St	South St	Front St	1.06	IV	14.69	C	14.31	C	10.62	D	12.12	D	10.17	D	9.86	D
South St	Whitehead St	Ashby St	1.06	IV	15.93	C	16.53	C	14.13	C	13.22	C	13.03	C	15.37	C
United St	Whitehead St	George St	1.14	IV	18.39	C	16.86	C	17.23	C	16.38	C	16.24	C	16.32	C
White St	Atlantic Blvd	Eaton St	1.16	IV	17.2	C	16.05	C	15.04	C	14.49	C	15.43	C	14.08	C
Palm Ave/ 1st St	Roosevelt Blvd	White St	1.56	III	17.6	D	20.01	C	16.09	D	18.63	C	14.18	D	11.8	E
Eaton St	Whitehead St	White St	0.69	IV	14.76	C	16.44	C	12.19	D	10.68	D	13.14	C	11.26	D
Flagler Ave	Reynolds St	Roosevelt Blvd	2.71	III	24.21	B	22.12	C	21.69	C	22.33	C	22.49	C	22.47	C
Truman Ave	Whitehead St	Eisenhower Dr	0.91	IV	14.56	C	14.83	C	13.19	C	12.99	D	12.56	D	6.46	F
US-1	Eisenhower Dr	Overseas Blvd	2.65	II	22.53	C	21.63	D	19.88	D	16.98	E	17.68	D	17.89	D

Notes:
Street Class and LOS based on 2000 HCM Chapter 15.
NB/SB roadways include: Duval St, Whitehead St, Simonton St, White St, Palm Ave/ 1st St.
EB/WB roadways include: Fleming St, Southard St, South St, United St, Eaton St, Flagler Ave, Truman Ave, and US-1.

The travel time results demonstrate that **the following roadways are operating below minimum LOS standards** established in the City Comprehensive Plan:

Duval Street

Duval Street is operating at LOS E and LOS F during the mid day peak hour for the northbound and southbound directions, respectively. Duval Street is also failing in both directions during the PM peak hour.

Palm Avenue/1St Street/Bertha Street

This segment is operating at LOS E during the PM peak hour in the southbound direction.

Truman Avenue

Truman Avenue is operating at LOS D during the mid day peak hour in the westbound direction. Truman Avenue is also operating at LOS D and LOS F during the PM peak hour for the eastbound and westbound directions, respectively.

N. Roosevelt Boulevard

N. Roosevelt Boulevard is operating at LOS D during the AM peak hour in the westbound direction and during the PM peak hour in both directions. US-1 is also operating at LOS E in the westbound direction during the mid day peak hour.

In addition to the failing roadways identified above, the average speed on Whitehead Street and Simonton Street is only one mph higher than that of a failing roadway segment.

4.4 FDOT LOS Tables

There are several methodologies that are commonly used to evaluate and determine capacity for roadways. The most basic level of analysis that is used by the FDOT is a generalized planning analysis. The generalized planning analysis compares hourly or daily roadway volumes to LOS volume thresholds identified in the FDOT Quality/Level of Service tables. The volume thresholds are broken down by area type, roadway classification, and number of lanes among other variables. The FDOT LOS tables are extensively researched throughout the nation and the State of Florida. The generalized planning analysis is limited and is most appropriate when "ballpark" determination of capacity or LOS is needed.

The volumes for the study corridors were compared to volume thresholds provided in the FDOT generalized planning tables. The two-way peak hour and directional volumes used in the analysis were taken from the various turning movement counts collected for the study. The highest volumes were taken for each roadway. In actuality, the volume to capacity (v/c) ratios can vary throughout the entire length of each roadway, but since each of the study corridors are short in length, only the highest v/c ratio was calculated. The two-way peak hour and directional peak hour v/c ratios are shown in **Tables 17 and 18**, respectively. Additionally, the v/c ratios for the two-way PM peak hour are shown on **Exhibit 5**.

The results of the planning analysis show that the following roadways exceed capacity at a minimum of one location on the corridor:

- Duval Street
- Eaton Street
- Palm Avenue
- N. Roosevelt Boulevard
- Truman Avenue

There are numerous assumptions taken into account to develop the FDOT Level of Service threshold including signal timing, lane width, heavy vehicle percentage, free flow speed, among many others. The latest FDOT Quality/Level of Service tables are included in **Appendix H**. Since so many assumptions are made, other methodologies are recommended to provide a more accurate analysis of the roadway network that takes into account the characteristics of the City.

Table 17
Two-Way Peak Hour V/C Ratios

Roadway(1)	From	To	Class(2)	LOS Standard	Standard Capacity(3)	Non State Rd Adjust.	Exclusive Turn Lane Adjust.	Adjust. Capacity	AM Peak Hour		MD Peak Hour		PM Peak Hour	
									2-Way Volume	V/C Ratio	2-Way Volume	V/C Ratio	2-Way Volume	V/C Ratio
1st St/ Bertha	N. Roosevelt Blvd	S. Roosevelt Blvd	II	D	1,480	-10%	No	1,332	460	0.35	530	0.40	530	0.40
Duval St	Front St	South St	III/IV	D	1,150	-10%	-20%	805	294	0.37	764	0.95	762	0.95
Eaton St	Whitehead St	White St	III/IV	D	1,150	-10%	-20%	805	1,052	1.31	1,276	1.59	1,422	1.77
Flagler Ave	1st St	S. Roosevelt Blvd	II	D	3,220	-10%	No	2,898	1,040	0.36	1,189	0.41	1,360	0.47
Flagler Ave	Reynolds St	1st St	II	D	1,480	-10%	No	1,332	825	0.62	977	0.73	1,070	0.80
Fleming St	Whitehead St	White St	III/IV	D	690	-10%	-20%	483	160	0.33	319	0.66	366	0.76
Palm Ave	White St	S. Roosevelt Blvd	II	D	1,480	-10%	No	1,332	1,192	0.89	1,475	1.11	1,499	1.13
Roosevelt Blvd	Eisenhower Dr	Overseas Blvd	II	C	2,420	No	No	2,420	1,897	0.78	2,851	1.18	2,919	1.21
Simonton St	Front St	South St	III/IV	D	1,150	-10%	-20%	805	341	0.42	590	0.73	585	0.73
South St	Whitehead St	Ashby St	III/IV	D	1,150	-10%	-20%	805	313	0.39	509	0.63	485	0.60
Southard St	Whitehead St	White St	III/IV	D	690	-10%	-20%	483	148	0.31	306	0.63	258	0.53
Truman Ave(4)	Whitehead St	Eisenhower Dr	III/IV	C	1,150	No	-20%	920	907	0.99	1,357	1.48	1,307	1.42
United St	Whitehead St	George St	III/IV	D	1,150	-10%	-20%	805	200	0.25	389	0.48	449	0.56
White St	Eaton St	Atlantic Blvd	III/IV	D	1,150	-10%	-20%	805	539	0.67	721	0.90	765	0.95
Whitehead St	Front St	South St	III/IV	C	1,150	No	-20%	920	361	0.39	616	0.67	700	0.76

Notes:

(1) Volumes determined from highest two-way peak hour volumes collected for the turning movement counts.

(2) Roadway Classification based on signals per mile and not the same as Roadway Classification per Average Speed Methodology.

(3) Roadway Capacity taken from 2009 FDOT Quality/Level of Service Handbook.

(4) LOS Standard for US-1 is LOS C pursuant to City Comprehensive Plan and FDOT. However, the Truman Avenue and Whitehead Street standard capacity is based on LOS D for the planning analysis due to the low capacity standards for LOS C on a two-lane undivided Class III/IV roadway.

Table 18

Directional Peak Hour V/C Ratios

Roadway(1)	From	To	Direction	Class(2)	LOS Standard	Standard Capacity(3)	Non State Rd Adjust.	Exclusive Turn Lane Adjust.	Adjust. Capacity	AM Peak Hour		MD Peak Hour		PM Peak Hour	
										1-Way Volume	V/C Ratio	1-Way Volume	V/C Ratio	1-Way Volume	V/C Ratio
1st St/ Bertha St	N. Roosevelt Blvd	S. Roosevelt Blvd	NWB	II	D	810	-10%	No	729	258	0.35	327	0.45	277	0.38
			SEB							249	0.34	250	0.34	283	0.39
Duval St	Front St	South St	NWB	III/IV	D	630	-10%	-20%	441	185	0.42	469	1.06	386	0.88
			SEB							109	0.25	295	0.67	372	0.84
Eaton St	Whitehead St	White St	NEB	III/IV	D	630	-10%	-20%	441	275	0.62	533	1.21	674	1.53
			SWB							748	1.70	743	1.68	748	1.70
Flagler Ave	1st St	S. Roosevelt Blvd	NEB	II	D	1,770	-10%	No	1,593	510	0.32	581	0.36	721	0.45
			SWB							626	0.39	608	0.38	639	0.40
Flagler Ave	Reynolds St	1st St	NEB	II	D	810	-10%	No	729	342	0.47	402	0.55	529	0.73
			SWB							483	0.66	575	0.79	541	0.74
Palm Ave	White St	S. Roosevelt Blvd	NWB	II	D	810	-10%	No	729	825	1.13	758	1.04	756	1.04
			SEB							384	0.53	717	0.98	804	1.10
Roosevelt Blvd	Eisenhower Dr	Overseas Blvd	NEB	II	C	1,330	No	No	1,330	661	0.50	1,383	1.04	1,463	1.10
			SWB							1,236	0.93	1,573	1.18	1,488	1.12
Simonton St	Front St	South St	NWB	III/IV	D	630	-10%	-20%	441	213	0.48	280	0.63	256	0.58
			SEB							128	0.29	310	0.70	348	0.79
South St	Whitehead St	Ashby St	NEB	III/IV	D	630	-10%	-20%	441	125	0.28	239	0.54	248	0.56
			SWB							188	0.43	270	0.61	237	0.54
Truman Ave(4)	Whitehead St	Eisenhower Dr	NEB	III/IV	C	630	No	-20%	504	463	0.92	785	1.56	747	1.48
			SWB							444	0.88	572	1.13	560	1.11
United St	Whitehead St	George St	NEB	III/IV	D	630	-10%	-20%	441	76	0.17	200	0.45	231	0.52
			SWB							124	0.28	189	0.43	218	0.49
White St	Eaton St	Atlantic Blvd	NWB	III/IV	D	630	-10%	-20%	441	335	0.76	418	0.95	390	0.88
			SEB							205	0.46	308	0.70	323	0.73
Whitehead St	Front St	South St	NWB	III/IV	C	630	No	-20%	504	210	0.42	370	0.73	345	0.68
			SEB							170	0.34	265	0.53	459	0.91

Notes:

(1) Volumes determined from highest directional peak hour volumes collected for the turning movement counts. Southard St and Fleming St v/c ratios shown on previous table.

(2) Roadway Classification based on signals per mile and not the same as Roadway Classification per Average Speed Methodology.

(3) Roadway Capacity taken from 2009 FDOT Quality/Level of Service Handbook.

(4) LOS Standard for US-1 is LOS C pursuant to City Comprehensive Plan and FDOT. However, the Truman Avenue and Whitehead Street standard capacity is based on LOS D for the planning analysis due to the low capacity standards for LOS C on a two-lane undivided Class III/IV roadway.

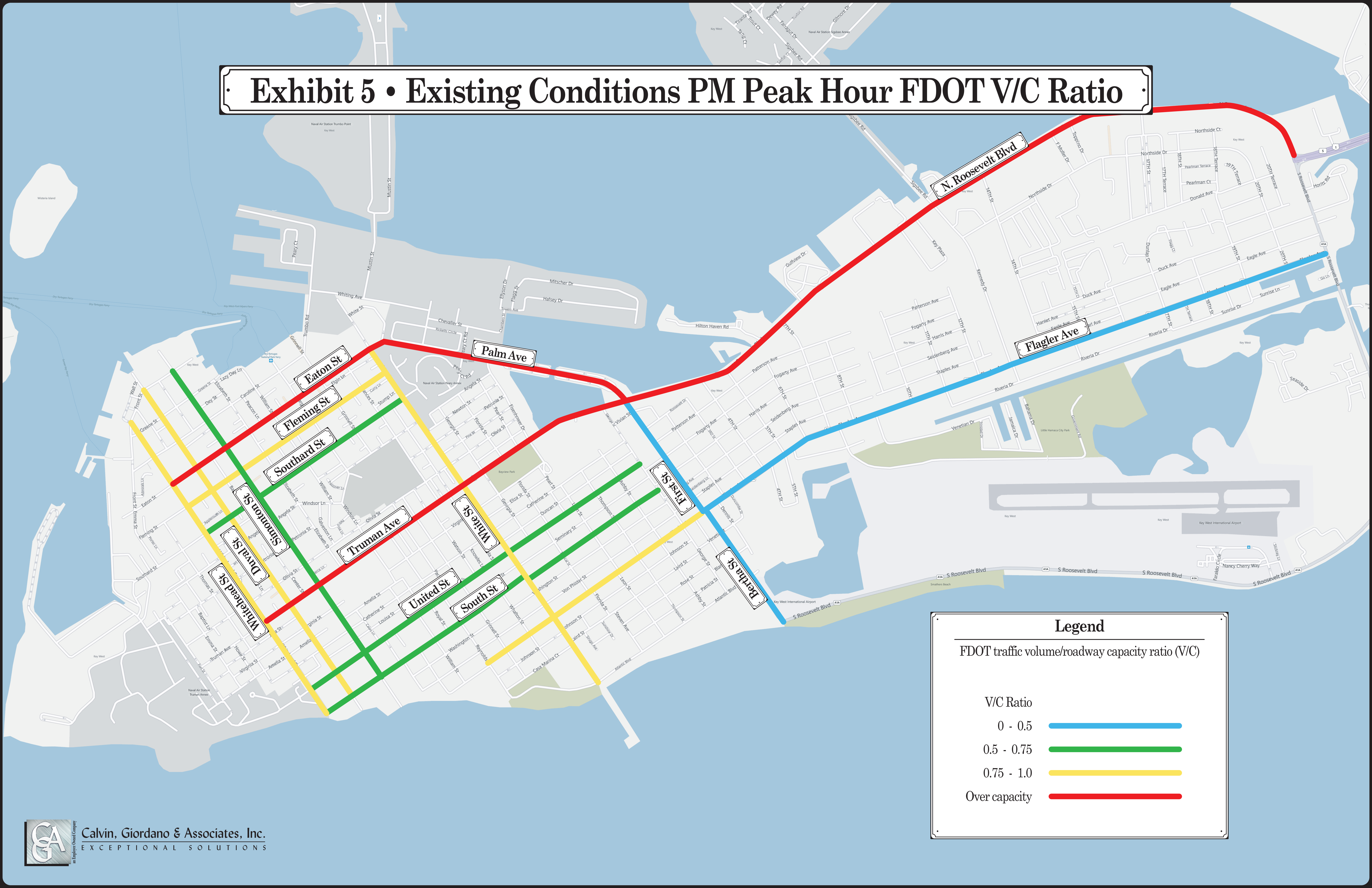


Exhibit 5 • Existing Conditions PM Peak Hour FDOT V/C Ratio
N. Roosevelt Blvd
Palm Ave
Eaton St
Fleming St
Southard St
Simonton St
Duval St
Whitehead St
Truman Ave
White St
United St
South St
First St
Bertha St
Flagler Ave
Legend
FDOT traffic volume/roadway capacity ratio (V/C)
V/C Ratio
0 - 0.5
0.5 - 0.75
0.75 - 1.0
Over capacity
Calvin, Giordano & Associates, Inc.
EXCEPTIONAL SOLUTIONS

4.5 Highway Capacity Manual V/C Ratios

After the generalized planning analysis, the next evaluation methodology available in a higher degree of accuracy and complexity level is the FDOT developed software ARTPLAN. ARTPLAN evaluates roadway conditions based on average speed and is primarily used in the planning phase of a transportation project. ARTPLAN includes multi-modal elements and some traffic signal parameters. However, ARTPLAN is still far too limited to accurately provide analysis of the roadways in Key West.

The next commonly used methodology in the State of Florida is an operational analysis using the analytical methods found in the HCM and the Highway Capacity Software (HCS). The HCS allows for detailed analysis of intersections using actual traffic signal timing data. The HCM states that the capacity of an Urban Street is based on the critical point in the roadway which is usually at a signalized intersection. The v/c ratio utilizing the HCM methodology is based on a number of parameters including:

- Number of lanes
- Lane width
- Heavy vehicles
- Roadway grade
- Parking activity
- Bus blockages
- Area type
- Lane utilization
- Left turns
- Right turns
- Pedestrian and bicycle conflicts
- Signal timing

The v/c ratio for each of the study corridors was evaluated at the critical intersections utilizing the HCM methodology as shown on **Table 19**. The results demonstrated that Duval Street, N. Roosevelt Boulevard, Truman Avenue, and Whitehead Street are overcapacity. The HCS reports for the critical intersections are included in **Appendix I**.

The main limitations of the HCM are that it does not account for non-traditional multi-modal vehicles or inadequately sized exclusive turn lanes.

Table 19
HCM Critical V/C Ratios

Roadway	Critical Intersection	Direction	Peak Hour	Critical V/C Ratio
1st St	Flagler Ave	SEB	PM	0.79
Bertha St	Flagler Ave	NWB	MD	0.71
Duval St	Truman Ave	SEB	PM	1.15
Eaton St	White St	NEB	PM	0.70
Flagler Ave	S. Roosevelt Blvd	NEB	PM	0.92
Fleming St	Simonton St	NEB	PM	0.90
Palm Ave	N. Roosevelt Blvd	SEB	PM	0.88
N. Roosevelt Blvd	Kennedy Dr	NEB	PM	1.01
Simonton St	United St	SEB	PM	0.45
South St	Simonton St(1)	SWB	PM	0.51
Southard St	Whitehead St(2)	SWB	PM	0.59
Truman Ave	Simonton St(1)	SWB	PM	1.06
United St	Simonton St	NEB	PM	0.32
White St	Eaton St	NWB	MD	0.98
Whitehead St	Truman Ave(1)	SEB	PM	1.14

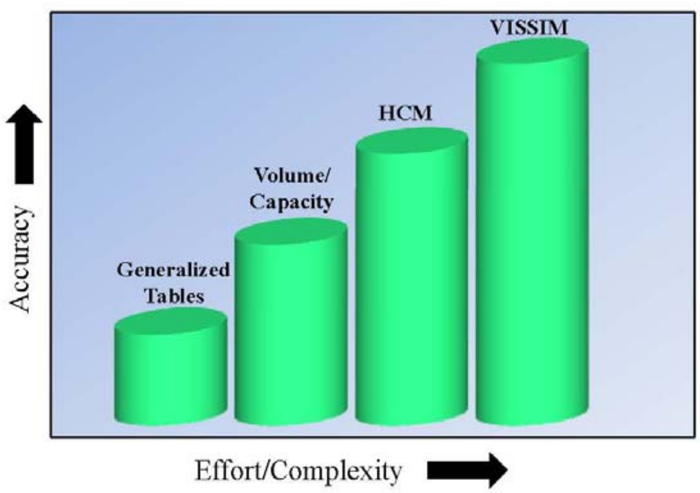
Notes:
(1) Turning movements estimated
(2) NEB direction has a higher v/c ratio but is not included in the one-way segment analysis

4.6 Microscopic Traffic Simulation

The HCM v/c ratios generally provide a relatively accurate portrayal of the existing conditions. However, a more detailed analysis is required to truly reflect the unique characteristics of the City of Key West. The most complex methodology for traffic analysis is microscopic simulation. Popular microscopic simulation tools include SIMTRAFFIC, CORSIM, PARAMICS, and VISSIM. The most popular micro simulation software used in Florida is CORSIM. CORSIM is one of the easier to use and simpler micro-simulation software packages. However, CORSIM is limited in the modeling of pedestrians and multi-modal vehicles. After careful evaluation of the each of the micro simulation software packages, VISSIM was chosen for this study. VISSIM is one of the most sophisticated micro simulation programs available and allows for detailed customization of Key West specific vehicles, pedestrians, and bicycles. Additional advantages of VISSIM include the ability to accurately model on-street parking, loading zones, specific tour routes, geometrical constraints, and driver behavior. A 3D interface is also built into the program which allows for realistic visual presentations.

The hierarchy of traffic evaluation tools is shown on **Figure 3** below:

Figure 3
Hierarchy of Traffic Evaluation Tools



4.7 VISSIM Network

The VISSIM network model was built utilizing the extensive amount of data collection performed for this study. An aerial of the entire city was imported into the model and scaled appropriately. The 15 study corridors and 25 study intersections were then added to the model. Additional intermediate roadways and intersections were added to the model as necessary including each intersection that contained a traffic signal or stop control along the study corridors. A sample of the model input parameters include the following:

- Roadway width
- Free-flow speed
- Speed limit
- Exclusive turn lanes
- Existing signal timing
- Peak hour traffic volumes
- On-street parking/loading zones
- Bike lanes
- Tour vehicle routes
- Right turn and left turn speeds by vehicle type
- Vehicle types including Key West specific vehicles
- Acceleration/deceleration profiles by vehicle type
- Overall percent of volume by vehicle type
- Driving behavior

Free flow speed is defined as the ideal travel speed one would travel on a roadway without impediments such as traffic signals, stop signs, or other vehicles. VISSIM utilizes a speed distribution for each roadway that is based on the free flow speed and speed limit. A speed distribution allows for a more realistic modeling scenario since vehicles do not always travel at the same speed. It was determined based on field review, speed counts, and travel time runs that the free flow speed in the Old Town area changes based on time of day. It should be noted that the free flow speed does not necessarily correlate with average speed, which is affected by traffic volume and vehicle following conditions.

One explanation for variations in free flow speeds is driver familiarity and the presence of pedestrians. During the morning hours, most of the vehicles using the Old Town streets such as Whitehead Street, Duval Street, and Simonton Street are familiar with the area and will naturally drive faster. However, during the afternoon and PM peak hour, a higher percentage of drivers are tourists and may likely be less familiar with the local streets and area. This may cause a decrease in vehicle speeds. Additionally, fewer pedestrians are present in Old Town in the AM peak hour. The presence of such a large amount of pedestrians later in the day in proximity may cause a slower driving speed. Therefore, the speed distributions were adjusted by time of day for the Old Town streets.

Once the entire VISSIM network was built, simulations were run to compare the model to the conditions observed in the field and documented in the travel time runs. An extensive calibration effort was undertaken to fine tune the model to more closely resemble the field conditions. Various adjustments were made to speed distributions, acceleration profiles, driving behavior and aggressiveness, and vehicle specific parameters. Due to the nature of the modeling process, the model results will never exactly replicate field conditions. However, through extensive fine tuning, the existing conditions model was calibrated to closely resemble measured field conditions with only minor discrepancies. A comparison of the average speed and travel time for the VISSIM final existing conditions and the Time Travel runs is shown on **Table 20 and 21**, respectively. **Exhibit 6** depicts the PM peak hour directional LOS for each of the study corridors. Variations in LOS conditions between TravTime runs and VISSIM results are shown on Exhibit 6.

The combined average speed of the study corridors resulted in a variation of 3.9%, 2.9%, and 1.0% for the AM, MD, and PM peak hours, respectively, between the VISSIM model and TravTime field runs. The total travel time of the study corridors resulted in a difference of 3.8%, 2.9%, and 0.1% for the AM, MD, and PM peak hours, respectively between the VISSIM model and TravTime field runs. **These results indicate that the simulation model is very well calibrated to existing field conditions measured during the data collection phase of this study**.

Unlike other less sophisticated traffic analysis programs, the results for each VISSIM simulation run will vary. A random seed generator is built into the VISSIM software that seeds the network at different time intervals using different combinations and properties of vehicles. This creates variation in each roadway and the entire network from one random seed to another. For purposes of this study, five different random seed VISSIM simulations were run for the existing conditions and each subsequent scenario. The lowest and highest value for each Measure of Effectiveness (MOE) was then removed and the middle three values were averaged. The results shown in this report are the averages of the simulation runs and are not broken down by each random seed. However, the data and results for each random seed run for all scenarios are included in the Appendix. The VISSIM existing conditions results are included in **Appendix J**.

Table 20

Existing Conditions Average Speed Comparison

Roadway	Road way Class	AM Peak Hour					MD Peak Hour					PM Peak Hour				
		VISSIM (mph)	Trav Time (mph)	%	VISSIM LOS	Trav Time LOS	VISSIM (mph)	Trav Time (mph)	%	VISSIM LOS	Trav Time LOS	VISSIM (mph)	Trav Time (mph)	%	VISSIM LOS	Trav Time LOS
Duval St EB/SB	IV	14.00	12.94	8.2%	C	D	8.20	6.97	17.6%	E	F	6.53	6.25	4.5%	F	F
Duval St WB/NB	IV	13.50	13.36	1.0%	C	C	7.07	7.72	-8.5%	E	E	6.60	6.63	-0.5%	F	F
Eaton St EB/NB	IV	16.30	14.76	10.4%	C	C	13.27	12.19	8.8%	C	D	11.63	13.14	-11.5%	D	C
Eaton St WB/SB	IV	15.07	16.44	-8.4%	C	C	13.00	10.68	21.7%	D	D	11.47	11.26	1.8%	D	D
Flagler Ave NB/EB	III	22.70	24.21	-6.2%	C	B	22.67	21.69	4.5%	C	C	21.23	22.49	-5.6%	C	C
Flagler Ave WB/SB	III	22.37	22.12	1.1%	C	C	22.23	22.33	-0.4%	C	C	21.73	22.47	-3.3%	C	C
Fleming St EB/NB	IV	13.47	15.03	-10.4%	C	C	10.20	10.37	-1.6%	D	D	10.03	10.65	-5.8%	D	D
Palm Ave/1st St EB/SB	III	17.50	20.01	-12.5%	D	C	14.43	18.63	-22.5%	D	C	11.53	11.80	-2.3%	E	E
Palm Ave/1st St NB/WB	III	16.43	17.60	-6.6%	D	D	15.90	16.09	-1.2%	D	D	16.10	14.18	13.5%	D	D
Simonton St EB/SB	IV	13.77	14.31	-3.8%	C	C	11.33	12.12	-6.5%	D	D	10.80	9.86	9.5%	D	D
Simonton St NB/WB	IV	13.50	14.69	-8.1%	C	C	10.10	10.62	-4.9%	D	D	9.93	10.17	-2.3%	D	D
South St NB/EB	IV	16.03	15.93	0.6%	C	C	13.43	14.13	-4.9%	C	C	13.93	13.03	6.9%	C	C
South St SB/WB	IV	14.93	16.54	-9.7%	C	C	13.83	12.97	6.7%	C	D	14.00	13.41	4.4%	C	C
Southard St WB/SB	IV	11.87	11.02	7.7%	D	D	11.03	11.86	-7.0%	D	D	11.23	11.88	-5.4%	D	D
Truman Ave NB/EB	IV	14.63	14.56	0.5%	C	C	10.77	13.19	-18.4%	D	C	10.53	12.56	-16.1%	D	D
Truman Ave SB/WB	IV	13.60	14.83	-8.3%	C	C	10.23	12.99	-21.2%	D	D	7.60	6.46	17.6%	E	F
United St EB/NB	IV	16.23	18.39	-11.7%	C	C	14.53	17.23	-15.7%	C	C	15.17	16.24	-6.6%	C	C
United St SB/WB	IV	16.83	16.86	-0.2%	C	C	16.57	16.38	1.1%	C	C	15.40	16.32	-5.6%	C	C
US-1 NB/EB	II	24.03	22.53	6.7%	C	C	21.67	19.88	9.0%	D	D	17.57	17.68	-0.6%	D	D
US-1 SB/WB	II	20.90	21.63	-3.4%	D	D	18.00	16.98	6.0%	D	E	18.57	17.89	3.8%	D	D
White St NB/WB	IV	15.03	17.20	-12.6%	C	C	14.30	15.04	-4.9%	C	C	14.63	15.43	-5.2%	C	C
White St SB/EB	IV	15.70	16.50	-4.8%	C	C	13.37	14.49	-7.8%	C	C	15.00	14.08	6.5%	C	C
Whitehead St SB/EB	IV	14.43	16.25	-11.2%	C	C	9.47	9.78	-3.2%	D	D	8.37	9.06	-7.7%	E	D
Whitehead St NB/WB	IV	13.93	14.94	-6.7%	C	C	9.43	10.33	-8.7%	D	D	10.67	10.34	3.2%	D	D
AVERAGE		16.12	16.78	-3.9%			13.54	13.94	-2.9%			12.93	13.05	-1.0%		

Table 21

Existing Conditions Travel Time Comparison

Roadway	AM Peak Hour			MD Peak Hour			PM Peak Hour		
	VISSIM (s)	Trav Time (s)	%	VISSIM (s)	Trav Time (s)	%	VISSIM (s)	Trav Time (s)	%
Duval St EB/SB	271.3	294.6	-7.9%	462.1	547.2	-15.6%	581.0	610.8	-4.9%
Duval St WB/NB	282.4	285.6	-1.1%	538.0	494.4	8.8%	579.8	581.4	-0.3%
Eaton St EB/NB	148.5	168.0	-11.6%	182.3	198.0	-7.9%	207.8	183.6	13.2%
Eaton St WB/SB	163.2	147.0	11.0%	189.9	225.6	-15.8%	213.9	211.2	1.3%
Flagler Ave NB/EB	423.7	400.2	5.9%	424.4	444.6	-4.5%	452.7	427.2	6.0%
Flagler Ave WB/SB	420.6	439.2	-4.2%	422.8	435.0	-2.8%	433.0	432.6	0.1%
Fleming St EB/NB	191.7	172.2	11.3%	254.0	253.2	0.3%	257.4	240.0	7.2%
Palm Ave/1st St EB/SB	320.7	273.6	17.2%	389.4	294.0	32.4%	486.9	463.8	5.0%
Palm Ave/1st St NB/WB	337.8	315.0	7.2%	349.4	344.4	1.4%	343.8	388.2	-11.4%
Simonton St EB/SB	277.4	261.6	6.1%	337.0	309.0	9.1%	354.2	387.0	-8.5%
Simonton St NB/WB	281.6	257.4	9.4%	377.8	355.8	6.2%	382.6	371.4	3.0%
South St NB/EB	238.1	235.2	1.2%	284.5	265.2	7.3%	274.1	287.4	-4.6%
South St SB/WB	258.4	222.0	16.4%	278.4	286.2	-2.7%	275.8	274.2	0.6%
Southard St WB/SB	221.7	235.2	-5.7%	239.0	218.4	9.4%	233.8	215.4	8.5%
Truman Ave NB/EB	218.5	226.2	-3.4%	296.3	243.0	21.9%	305.2	255.0	19.7%
Truman Ave SB/WB	241.2	216.0	11.7%	322.3	249.6	29.1%	431.3	513.0	-15.9%
United St EB/NB	254.1	219.0	16.0%	283.4	234.0	21.1%	272.1	248.4	9.6%
United St SB/WB	229.5	239.4	-4.1%	232.8	246.0	-5.4%	250.7	247.2	1.4%
US-1 NB/EB	404.4	431.4	-6.3%	448.0	489.0	-8.4%	557.9	550.2	1.4%
US-1 SB/WB	467.2	452.4	3.3%	541.1	576.6	-6.2%	525.5	547.2	-4.0%
White St NB/WB	270.3	240.1	12.6%	284.3	270.6	5.1%	277.8	265.8	4.5%
White St SB/EB	258.7	251.4	2.9%	302.9	280.8	7.9%	271.0	286.2	-5.3%
Whitehead St SB/EB	251.0	221.4	13.4%	381.9	368.4	3.7%	436.2	405.6	7.6%
Whitehead St NB/WB	259.4	241.2	7.5%	384.6	348.6	10.3%	341.1	348.0	-2.0%
TOTAL	6691.4	6445.3	3.8%	8206.5	7977.6	2.9%	8745.7	8740.8	0.1%

Exhibit 6 • Existing Conditions PM Peak Hour Peak Direction LOS

4.8 Intersection Level of Service

Distinct Levels of Service for intersections are similar to those of roadways with six LOS designations (LOS A – LOS F). LOS A represents the most ideal situation with minimal if any delay while LOS F represents the worst conditions with high vehicular delay. The 2000 HCM determines intersection LOS by control delay rather than average speed. The 2000 HCM contains a methodology that is standard in traffic analysis practices that calculates intersection delay and LOS based on a variety of parameters including number of lanes, signal timing, progression, traffic volumes, heavy vehicle percentage, and approach speed, among others. The HCM methodology is limited, however, in incorporating the unique vehicles present in the City of Key West and in analyzing oversaturated conditions and incorporating geometrical limitations such as short turn lanes.

Micro-simulation analysis accommodates more complex input parameters resulting in a higher degree of accuracy than the standard HCM analysis. It is used less frequently due to the amount of time and effort necessary to construct the network. Due to many of the reasons already stated and to keep consistency with the roadway analysis, VISSIM was used to analyze the study intersections. The MOE used to determine the LOS for the intersections is delay similarly to the HCM. The delay criterion for the LOS designation also remains the same as identified in the 2000 HCM for both signalized intersections and stop control intersections. Stop control intersections have a different threshold for delay and LOS because of driver perception. A driver is more willing to tolerate a higher amount of delay at a signalized intersection since they know that the light will eventually turn green and they will have an opportunity to get through the intersection. This does not occur at stop controlled intersections and thus drivers are less willing to tolerate delay.

The LOS designations for signalized intersections and stop controlled intersections are shown on **Tables 22 and 23**, respectively.

Table 22
LOS Criteria for Signalized Intersections

LOS	Control Delay per Vehicle (seconds/veh)
A	≤ 10
B	> 10-20
C	>20-35
D	>35-55
E	>55-80
F	>80

Source: 2000 HCM Exhibit 16-2

Table 23
LOS Criteria for Stop Controlled Intersections

LOS	Control Delay per Vehicle (seconds/veh)
A	0-10
B	> 10-15
C	>15-25
D	>25-35
E	>35-50
F	>50

Source: 2000 HCM Exhibit 17-2 and 17-22

In addition to the previously identified 25 study intersections, the intersections of Truman Avenue at Whitehead Street and Simonton Street were analyzed. The intersections of Truman Avenue at Whitehead Street and Simonton Street were included due to high peak hour delays identified during the data collection phase. Results of the intersection operational analyses for existing conditions are presented in **Table 24**. The existing signal timings for all signalized intersections on the study corridors are included in **Appendix K**.

Table 24
Intersections Existing Conditions

Intersection	Intersection Control	Approach	AM Peak Hour		MD Peak Hour		PM Peak Hour	
			Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Duval St at Eaton St	Signal	NEB	15.4	B	18.1	B	25.3	C
		SEB	9.7	A	21.0	C	36.4	D
		SWB	17.4	B	28.4	C	25.4	C
		NWB	9.7	A	28.2	C	27.8	C
		Total	12.9	B	25.1	C	30.8	C
Duval St at Front St	Signal	NB	14.9	B	18.6	B	20.7	C
		SEB	10.9	B	11.7	B	14.0	B
		SWB	13.8	B	19.4	B	22.8	C
		NWB	12.2	B	25.0	C	32.1	C
		Total	13.4	B	21.2	C	25.7	C
Duval St at Southard St	Signal	SEB	10.0	B	20.7	C	30.6	C
		SWB	16.1	B	23.3	C	21.2	C
		NWB	8.8	A	37.5	D	45.3	D
		Total	11.4	B	27.9	C	33.3	C
Duval St at Angela St	Signal	NEB	12.7	B	14.9	B	15.0	B
		SEB	11.4	B	21.7	C	38.5	D
		SWB	10.6	B	14.9	B	12.9	B
		NWB	9.4	A	29.2	C	30.3	C
		Total	10.6	B	24.2	C	31.0	C
Duval St at Truman Ave	Signal	NEB	10.4	B	20.5	C	27.7	C
		SEB	13.1	B	42.3	D	75.7	E
		SWB	9.6	A	16.5	B	14.3	B
		NWB	11.9	B	39.8	D	50.8	D
		Total	11.2	B	29.6	C	46.3	D
Duval St at South St	Four-Way Stop	NEB	7.9	A	15.3	C	12.8	B
		SEB	7.3	A	16.6	C	13.8	B
		SWB	12.3	B	24.3	C	17.1	C
		NWB	6.3	A	8.5	A	8.9	A
		Total	9.8	A	18.6	C	14.0	B
White St at Eaton St	Signal	NEB	6.3	A	11.0	B	13.9	B
		SEB	17.6	B	22.1	C	24.2	C
		SWB	10.1	B	10.1	B	10.4	B
		NWB	22.3	C	34.7	C	40.6	D
		Total	11.4	B	15.5	B	17.1	B
Whitehead St at Fleming St	Signal	NEB	13.5	B	15.4	B	17.4	B
		SEB	9.7	A	16.0	B	20.6	C
		NWB	13.4	B	24.9	C	18.7	B
		Total	12.5	B	19.0	B	19.0	B

Table 24 Continued
Intersections Existing Conditions

Intersection	Intersection Control	Approach	AM Peak Hour		MD Peak Hour		PM Peak Hour	
			Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Simonton St at Fleming St	Signal	NEB	11.9	B	19.8	B	18.1	B
		SEB	7.6	A	10.2	B	12.3	B
		NWB	9.5	A	16.1	B	11.8	B
		Total	10.0	B	17.0	B	14.6	B
Grinnell St at Fleming St	Signal	NEB	8.5	A	12.9	B	13.7	B
		SEB	14.4	B	14.9	B	14.8	B
		NWB	8.1	A	10.2	B	11.3	B
		Total	9.2	A	13.1	B	13.5	B
White St at Southard St	Signal	SEB	1.4	A	2.2	A	2.4	A
		SWB	5.6	A	5.6	A	5.1	A
		NWB	3.5	A	4.6	A	3.5	A
		Total	2.6	A	3.3	A	3.0	A
Whithead St at Southard St	Signal	NEB	31.7	C	38.7	D	65.5	E
		SEB	22.2	C	31.2	C	49.8	D
		SWB	39.4	D	46.0	D	43.4	D
		NWB	20.3	C	33.7	C	24.4	C
		Total	27.7	C	37.4	D	46.0	D
Whitehead St at Greene St	Four-Way Stop	NEB	6.1	A	8.3	A	8.4	A
		SEB	8.4	A	13.7	B	13.3	B
		SWB	6.0	A	8.3	A	8.6	A
		NWB	7.2	A	15.1	C	20.7	C
		Total	7.3	A	12.9	B	14.7	B
Whitehead St at Truman Ave(1)	Signal	SEB	10.0	A	22.0	C	60.2	E
		SWB	10.4	B	12.7	B	14.8	B
		NWB	10.8	B	26.6	C	19.4	B
		Total	10.6	B	22.2	C	40.2	D
Simonton St at Caroline St	Signal	NEB	10.8	B	14.3	B	12.6	B
		SEB	8.9	A	10.0	A	11.2	B
		SWB	11.8	B	17.2	B	16.9	B
		NWB	9.2	A	12.8	B	10.8	B
		Total	10.0	A	13.9	B	13.1	B
Simonton St at Truman Ave(1)	Signal	NEB	15.7	B	37.4	D	66.5	E
		SEB	10.2	B	15.0	B	18.3	B
		SWB	20.7	C	34.5	C	111.7	F
		NWB	16.9	B	23.7	C	23.0	C
		Total	17.0	B	30.6	C	61.6	E

Table 24 Continued
Intersections Existing Conditions

Intersection	Intersection Control	Approach	AM Peak Hour		MD Peak Hour		PM Peak Hour	
			Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Simonton St at United St	Signal	NEB	8.6	A	11.6	B	11.6	B
		SEB	14.5	B	17.5	B	19.0	B
		SWB	12.4	B	14.1	B	12.5	B
		NWB	11.9	B	15.3	B	14.9	B
		Total	12.4	B	14.5	B	14.5	B
Thomas St at Petronia St	Signal	SEB	7.5	A	8.0	A	8.0	A
		SWB	6.8	A	8.6	A	8.3	A
		NWB	8.0	A	8.8	A	9.2	A
		Total	7.5	A	8.6	A	8.4	A
Olivia St at Frances St	One-Way Stop	NEB	6.2	A	7.5	A	7.5	A
		SEB	0.0		0.1		0.2	
		NWB	0.1		0.2		0.1	
		Total	3.2		4.5		4.3	
Truman Ave at White St	Signal	NEB	15.3	B	36.8	D	23.7	C
		SEB	29.0	C	43.9	D	35.2	D
		SWB	20.7	C	38.4	D	31.1	C
		NWB	36.3	D	41.9	D	37.6	D
		Total	24.3	C	39.3	D	31.3	C
White St at Catherine St	Two-Way Stop	NEB	8.3	A	9.0	A	9.7	A
		SEB	1.0		1.6		3.5	
		SWB	7.4	A	7.9	A	7.8	A
		NWB	1.5		1.2		1.3	
		Total	2.1		2.6		3.0	
White St at Flagler Ave	Signal	NEB	14.4	B	11.0	B	13.6	B
		SEB	15.7	B	16.0	B	25.0	C
		SWB	18.0	B	15.5	B	20.3	C
		NWB	12.5	B	11.8	B	14.1	B
		Total	16.1	B	14.5	B	20.0	B
Truman Ave at 1st St	Signal	EB	17.1	B	24.9	C	25.3	C
		SEB	21.4	C	69.3	E	73.5	E
		WB	24.3	C	31.7	C	22.6	C
		NWB	27.9	C	31.0	C	29.2	C
		Total	23.4	C	37.8	D	36.9	D
Flagler Ave at 1st St	Signal	NEB	24.0	C	24.9	C	29.9	C
		SEB	35.2	D	39.3	D	49.6	D
		SWB	23.9	C	24.3	C	25.3	C
		NWB	29.3	C	47.0	D	31.6	C
		Total	26.6	C	31.7	C	31.4	C

Table 24 Continued
Intersections Existing Conditions

Intersection	Intersection Control	Approach	AM Peak Hour		MD Peak Hour		PM Peak Hour	
			Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Roosevelt Blvd at Kennedy Dr	Signal	NEB	23.5	C	35.7	D	39.9	D
		SEB	20.6	C	23.4	C	25.7	C
		SWB	31.0	C	52.3	D	44.1	D
		NWB	20.6	C	24.8	C	28.2	C
		Total	26.5	C	39.7	D	38.2	D
US-1 at Overseas Hwy	Signal	NB	8.0	A	18.0	B	27.3	C
		SEB	16.3	B	28.1	C	67.4	E
		WB	10.9	B	16.4	B	19.4	B
		Total	11.6	B	21.1	C	39.4	D
US-1 at Flagler Ave	Signal	NB	11.4	B	13.0	B	14.6	B
		EB	19.2	B	17.3	B	25.6	C
		SB	16.5	B	12.9	B	13.5	B
		Total	15.9	B	13.9	B	18.0	B
NETWORK TOTAL			16.4		25.3		29.9	

Notes:

(1) Included in analysis due to high delay but not a study intersection.

NEB – Northeast Bound

SEB – Southeast Bound

SWB – Southwest Bound

NWB – Northwest Bound

EB – Eastbound

WB – Westbound

NB – Northbound

SB - Southbound

4.9 Analysis of Failing Roadways and Intersections

The results of the existing conditions analysis show that the following roadways and intersections are operating below the minimum LOS standards, as previously defined in this study:

Roadways

AM Peak

US-1 westbound from Overseas Highway to Eisenhower Drive

MD Peak

Duval Street southbound

Duval Street northbound

Truman Avenue eastbound

Truman Avenue westbound

US-1 eastbound from Eisenhower Drive to Overseas Highway

US-1 westbound from Overseas Highway to Eisenhower Drive

PM Peak

Duval Street southbound

Duval Street northbound

Truman Avenue eastbound

Truman Avenue westbound

Palm Avenue/1st Street eastbound/southbound

US-1 eastbound from Eisenhower Drive to Overseas Highway

US-1 westbound from Overseas Highway to Eisenhower Drive

Whitehead Street southbound

Intersections

MD Peak

N. Roosevelt Boulevard at 1st Street – Southeast approach

PM Peak

Duval Street at Truman Avenue – Southeast approach

Whitehead Street at Southard Street – Northeast approach

Whitehead Street at Truman Avenue – Southeast approach

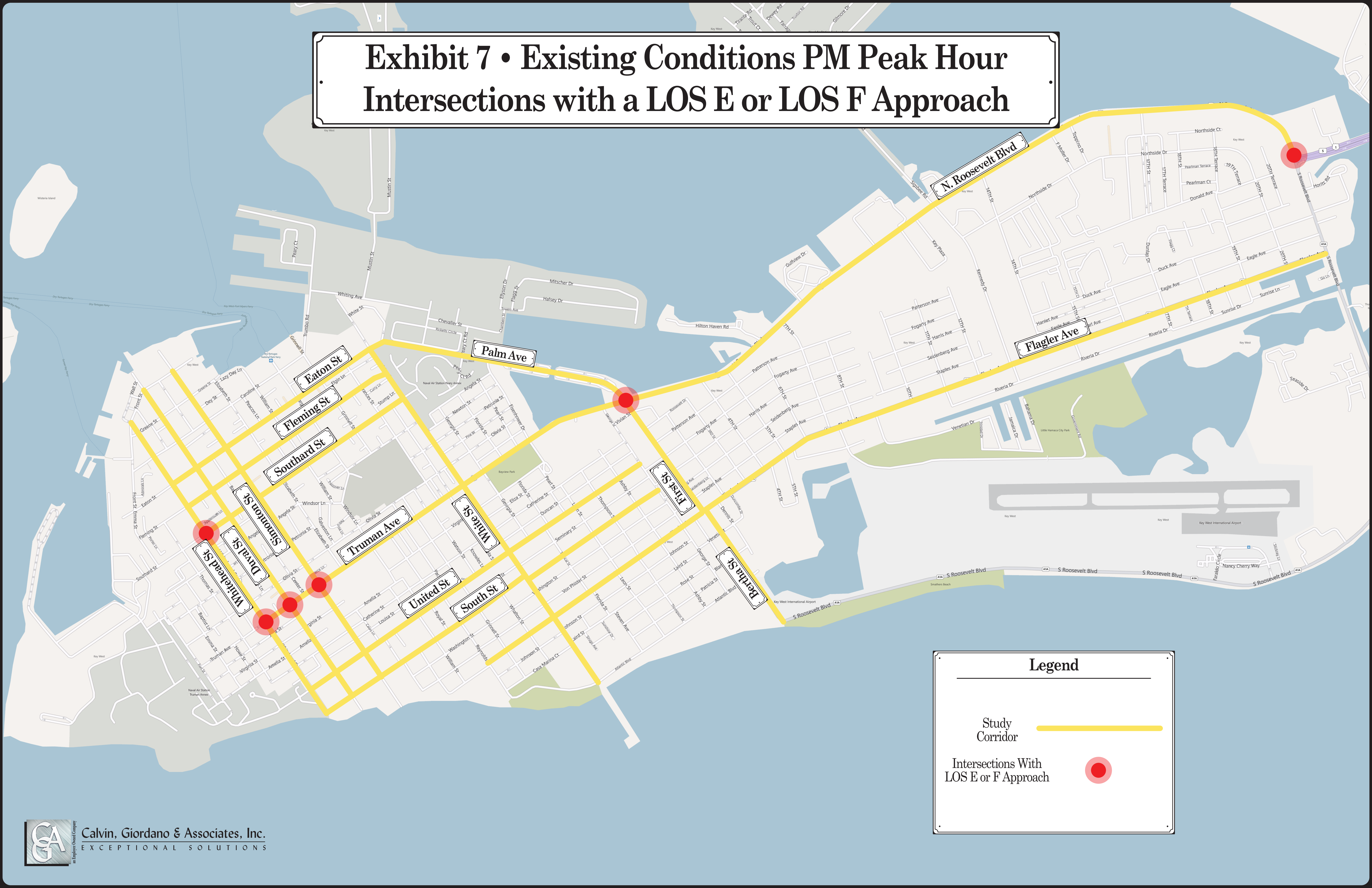
Simonton Street at Truman Avenue – Northeast and Southwest approaches, overall intersection

N. Roosevelt Boulevard at 1st Street – Southeast approach

US-1 at Overseas Highway – Southeast approach

Exhibit 7 depicts each of the intersections that currently contain at least one approach operating at LOS E or F.

Exhibit 7 • Existing Conditions PM Peak Hour Intersections with a LOS E or LOS F Approach



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EXCEPTIONAL SOLUTIONS

Duval Street Capacity Issues

Duval Street is arguably the most famous street in the City and a widely popular tourist attraction. Retail shops, restaurants, and bars are prevalent along the entire Duval Street corridor, attracting significant pedestrian activity. In addition to link failures, the southeast approach on Duval Street at Truman Avenue was found to be failing during the PM peak hour. This can be attributed primarily to the high volume of left-turning vehicles from Duval Street onto Truman Avenue. Like all intersections on Duval Street, there is no left- or right-turn deceleration lane available to reduce intersection delay.

In general, congestion along the Duval Street corridor can be attributed to a number of factors including the following:

- Heavy Pedestrian Activity. Since Duval Street is a primary tourist destination, it attracts a high volume of pedestrians. This can make traffic turning movements more difficult as drivers yield to pedestrians and can cause traffic delays as drivers tend to be more cautious when pedestrians are present.
- Intersection Spacing. There are eight signalized intersections and two stop-controlled intersections in just over a one mile portion of the Duval Street corridor. This frequency of intersections can contribute to traffic delays. In addition, the signalized intersections operate with fixed timing rather than a coordinated progression timing plan that is responsive to demand.
- Non-traditional Vehicles. Numerous modes of transportation can be found on Duval Street at any given time of day, such as pedicabs, tour vehicles, bicycles, scooters and such. Some non-traditional vehicles were found to generally travel slower than a typical passenger car, causing additional traffic delay.
- On Street Parking. Parking maneuvers and limited roadway width can contribute to increased travel delay on the corridor.

Truman Avenue Capacity Issues

Truman Avenue from Whitehead Street to Eisenhower Drive in the eastbound direction was found to be operating at LOS D during the mid day and PM peak hours. Truman Avenue from Eisenhower Drive to Whitehead Street in the westbound direction was found to be operating at LOS D and LOS F during the mid day and PM peak hours, respectively. LOS D is considered acceptable for all other roadways in the City except the US-1 corridor. There are seven signalized intersections on Truman Avenue from Whitehead Street to Eisenhower Drive, a distance of just under one mile. This high frequency of traffic signals along with the other characteristics such as driver unfamiliarity, high volume of non-traditional vehicles, lack of auxiliary turn lanes, high pedestrian volumes, and poor signal progression arguably contribute to the slow travel times on Truman Avenue.

The very slow average speed on Truman Avenue in the westbound direction during the PM peak hour can be most attributed to delays at the intersection of Truman Avenue at Simonton Street. Computer analysis and field data collection demonstrated that there is significant delay on the southwest bound approach on Truman Avenue at Simonton Street. The main cause of this is the high traffic volume approaching the intersection with inadequate signal timing. The green time to cycle length (g/C) ratio for this approach during the PM peak hour is 0.36 which is insufficient for an approach with this high of traffic volumes. The signal timing is currently configured at this intersection to assist vehicles making a left turn from the southeast bound approach on Simonton Street to eastbound Truman Avenue. The southeast bound approach is given exclusive green time before the start of the northwest bound approach on Simonton Street to help clear the queue. By doing this, the cycle length time is extended and this results in a smaller percentage of green time for Truman Avenue.

The aerial image shown below and provided by Google Earth illustrates the long vehicular queue that can occur on the southwest approach at the intersection of Truman Avenue at Simonton Street.

Southwest bound approach on Truman Avenue at Simonton Street.
Source: Google Earth

US-1/N. Roosevelt Boulevard Capacity Issues

N. Roosevelt Boulevard from Eisenhower Drive to Overseas Highway in the eastbound direction is operating at LOS D during the mid day and PM peak hours. US-1 from Overseas Highway to Eisenhower Drive in the westbound direction is operating at LOS D during the AM, mid day, and PM peak hours. Some contributing factors to the slower average speeds are the high traffic volumes, frequency of signalized intersections, and poor signal timing progression. Conditions on US-1 are congested but there are no single points of significantly high delay. Unlike many other roadways in the City, N. Roosevelt Boulevard contains exclusive left turn lanes at various locations and a two-way center left turn lane throughout a majority of the roadway. The south side of N. Roosevelt Boulevard is mostly filled with commercial development which contributes to the congestion because of the frequent access driveways. While some non-traditional vehicles use N. Roosevelt Boulevard, the volume as a percentage of overall traffic is much lower than the roads in the Old Town area.

The southeast bound approach on N. Roosevelt Boulevard at Overseas Highway is currently operating at LOS E during the PM peak hour. The high delay for this approach is primarily caused by the high number of left turns at this approach. N. Roosevelt Boulevard and S. Roosevelt Boulevard serve as the only connection to Overseas Highway which is the only vehicular ingress and egress into Key West. Therefore, the southeast bound left turn movement during the PM peak hour consists of a large number of workday commuters.

Palm Avenue/1st Street/Bertha Street Capacity Issues

For analysis purposes, Palm Avenue, 1st Street, and Bertha Street were combined into one study segment since all three roadway segments are contiguous and share common characteristics. The Palm Avenue corridor in the eastbound/southbound direction is operating at LOS E during the PM peak hour, which is primarily attributable to delay at the Palm Avenue/1st Street at N. Roosevelt Boulevard intersection.

The southeast bound approach at the intersection of Palm Avenue and N. Roosevelt Boulevard is operating at LOS E during the MD and PM peak hours. This is primarily attributable to the high volume of left-turning vehicles in the southeast bound left-turn lane. Although a left-turn deceleration lane is provided, the lane is only 170 feet in length, which was shown to be significantly insufficient to accommodate the demand during the PM peak hour.

Southeast bound approach at Palm Avenue at US-1
Source: Google Earth

The image shown to the right from Google Earth illustrates the deficiency at this approach.

Whitehead Street Capacity Issues

The existing conditions TravTime results showed that the average speed on Whitehead Street in the southbound direction during the PM peak hour is 9.06 mph, which corresponds to an LOS D. However, this average speed should be considered borderline LOS D/LOS E since the threshold for LOS E is 9.0 mph. Furthermore, the existing conditions VISSIM results show that Whitehead Street in the southbound direction during the PM peak hour is operating at LOS E with an average speed of 8.37 mph. The Whitehead Street segment from Fleming Street to Truman Avenue is considered US-1.

Whitehead Street is home to many popular tourist attractions such as the beginning and end of US-1, the Southernmost Point, and the Hemmingway House. The on-street parking present on Whitehead Street is attractive to tourists as well because of the proximity to Duval Street, Front Street, and Mallory Square.

There are three traffic signals and three stop controlled intersection on the approximately one-mile stretch of roadway. The reasons for the slow average speed is similar to that of Duval Street in that there is a high percent of driver unfamiliarity, high number of pedestrians, high number of non-traditional vehicles, and the constant vehicle interactions of the on-street parking. The most congested portion of Whitehead Street is the southbound segment approaching Truman Avenue.

The only failing approach on Whitehead Street is the southeast bound approach at Truman Avenue. This approach processes the highest traffic volume on Whitehead Street and is commonly used as a gateway to other parts of the City. Similar to the other intersections on Whitehead Street, an exclusive left turn lane is not provided at this intersection.

Southard Street at Whitehead Street Capacity Issues

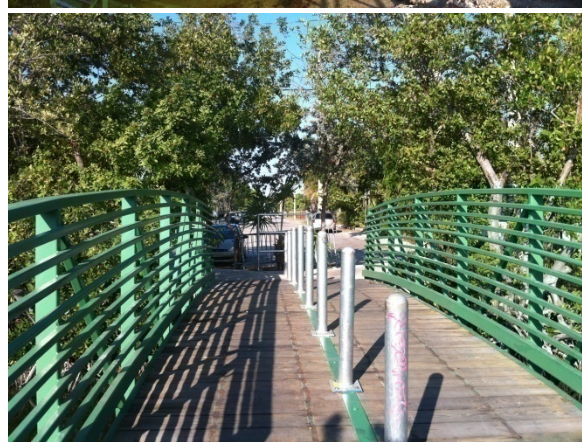
The northeast approach on Southard Street at Whitehead Street is operating at LOS E during the PM peak hour. The traffic signal at this intersection operates under split phasing, which can be less efficient, and has one of the longest signal timing cycle lengths in the City.

Flagler Avenue at 1st Street/Bertha Street Capacity Issues

The traffic signal at Flagler Avenue and 1st Street/Bertha Street currently operates under split phasing. Although split phasing can be less efficient, it is necessary at this intersection due to physical constraints.

4.10 Staples Avenue Bridge

Bicycle and pedestrian counts were collected during the PM peak hour on April 27, 2011 on the Staples Avenue Bridge between 8th Street and 10th Street. There were several pedestrians who crossed the bridge but the majority of crossings were bicyclists. The peak hour from 4:30PM to 5:30 PM consisted of 115 bicycles and 15 pedestrians crossing the bridge.



The Staples Avenue Bridge is popular among residents who commute between their homes southwest of the bridge and the many commercial areas on Kennedy Drive and northeast of the bridge. It is also used frequently by students of the Poinciana Elementary School which is located approximately ½ mile northeast of the bridge.

The only roadway that crosses the canal between N. Roosevelt Boulevard and S. Roosevelt Boulevard is Flagler Avenue. Flagler Avenue contains a bike lane but only for the segment from Kennedy Drive to S. Roosevelt Boulevard. Therefore, the Staples Avenue Bridge is an attractive alternative.

5.0 FUTURE CONDITIONS ANALYSIS

5.1 Background Growth

It is a common engineering practice when evaluating future traffic scenarios to first consider future growth resulting from undeveloped land and identified through historical trends. Most counties and Metropolitan Planning Organizations (MPO) throughout the state of Florida use a traffic modeling tool known as Florida State Urban Transportation Modeling Structure (FSUTMS). The FSUTMS is calibrated to existing conditions by using parameters such as the existing land use data, roadway network, traffic data, and many data inputs. After calibration of the existing roadway network, the future planning year parameters such as future land uses and the future transportation network are input into the model. Additionally, employment and population data are input into the FSUTMS for the existing year and the future planning year. The existing and future population data is generally developed in the County's Long Range Transportation Plan and based on data provided by the University of Florida Bureau of Economic and Business Research (BEBR). Once all the future planning year data is inserted into the model, the FSUTMS will project the future traffic conditions onto the roadway network taking all data into account. The future year FSUTMS projections are considered more reliable for a region as a whole and less reliable for individual roadway segments.

However, an MPO has not been established for Monroe County and the County does not maintain a FSUTMS. Therefore, it was necessary to develop an alternative approach in order to account for background growth. It was determined that the most feasible alternative would be to evaluate historical traffic counts in the City of Key West and to evaluate future Monroe County population projections from BEBR. Future population projections for Key West were not available so County information was considered.

There are 23 FDOT count stations within the City of Key West. 22 of the 23 FDOT count stations have yearly data dating back to at least 1995. Therefore, 22 FDOT count stations were evaluated for a 15-year span from 1995 to 2009. A regression analysis of the historical Average Annual Daily Traffic (AADT) volumes was completed using the FDOT "Traffic Trends" spreadsheet. A linear trend line was fit to the data, and the trend analysis printouts for each traffic monitoring site are provided in **Appendix L**. A summary of the historical FDOT traffic counts are shown on **Table 25** and included in **Appendix M**.

The results show that there has been inconsistent growth for most of the individual roadways in the City. Additionally, the summation of all the count stations demonstrate that while fluctuations have occurred during various time spans, the overall traffic volumes are very similar in 1995 and 2009.

Table 25
FDOT Historical Traffic Volumes

FDOT Station #	LOCATION	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	15 Year LGR	R^2
90-004	Atlantic Blvd E. of White St	4,600	4,400	4,400	4,300	4,000	5,100	4,700	5,600	5,900	5,200	6,700	4,400	4,800	5,600	4,900	1.11%	20.7%
90-0020	Eaton St W. of Duval St	5,900	5,800	6,600	6,300	5,900	6,100	5,600	3,900	4,500	4,200	5,500	3,700	4,800	5,300	4,700	-2.19%	42.7%
90-0023	Duval St N. of Truman Ave	11,000	7,200	11,000	10,500	5,100	8,000	10,500	8,900	10,500	9,400	8,900	7,500	6,600	6,600	7,000	-2.18%	39.8%
90-0025	White St N. of Truman Ave	7,300	9,200	6,800	6,600	7,200	7,400	5,900	7,600	6,700	7,400	7,100	5,300	4,700	5,600	5,000	-1.90%	44.9%
90-0026	White St S. of Truman Ave	9,800	10,000	8,800	10,500	9,200	12,000	9,500	8,400	11,500	8,900	9,900	8,500	7,600	7,800	8,500	-1.37%	23.7%
90-0028	Kennedy Blvd S. of US-1	8,400	8,600	9,000	11,000	10,500	8,500	9,400	9,900	10,500	9,700	9,900	9,900	8,800	7,500	9,300	-0.15%	0.5%
90-0029	Byrd Rd N. of Roosevelt Blvd	6,800	5,900	6,100	7,400	6,400	5,600	5,800	6,500	6,600	5,800	5,800	5,100	4,400	6,200	4,600	-1.71%	40.5%
90-0049	Roosevelt Blvd S. of US-1	17,500	18,000	19,000	21,000	19,000	18,100	20,500	20,000	22,000	21,500	21,500	23,500	18,900	17,900	19,400	0.72%	11.9%
90-0073	1st St S. of US-1	6,500	7,000	9,200	7,800	6,500	7,300	7,100	7,400	7,700	8,000	8,000	7,000	6,000	7,800	6,700	-0.29%	1.7%
90-0103	Palm Ave N. of US-1	18,500	17,500	18,000	21,000	19,900	15,500	18,000	18,300	22,500	19,700	19,500	18,200	17,800	16,200	18,300	-0.15%	0.8%
90-0105	US-1 W. of SR A1A	29,500	28,000	30,500	40,500	34,500	31,500	34,500	34,500	36,500	34,500	31,000	32,500	32,000	29,000	33,500	0.46%	6.7%
90-5004	Truman Ave W. of 1st St	17,500	15,000	20,000	22,500	22,500	20,500	21,500	22,500	22,500	21,000	18,600	13,700	18,100	18,500	19,600	0.00%	0.0%
90-5008	Truman Ave W. of White St	13,000	13,500	17,000	17,400	16,000	25,100	17,000	14,500	14,000	14,300	14,000	14,800	16,800	15,200	16,800	0.28%	1.7%
90-5011	Truman Ave E. of Duval St	13,500	5,300	11,000	12,000	9,300	9,200	12,000	8,800	9,000	10,400	8,200	7,600	8,600	8,600	9,300	-2.48%	59.2%
90-5013	Whitehead St S. of Olivia St	6,700	6,100	9,800	7,400	9,100	10,100	9,600	8,100	8,800	8,300	6,700	5,900	5,300	6,400	6,700	-1.58%	15.5%
90-5017	Flagler Ave W. of Roosevelt Blvd	8,400	9,300	9,200	10,700	10,400	10,800	11,000	10,600	11,100	10,500	9,900	12,500	11,200	9,300	11,900	2.00%	63.3%
90-5025	Flagler Ave E. of White St	9,300	9,800	10,000	11,000	11,000	10,400	10,000	10,200	11,500	10,200	10,100	10,200	10,300	8,600	10,500	0.28%	6.8%
90-5026	1st St S. of Seidenberg Ave	5,600	4,000	6,000	7,400	6,200	5,600	7,000	6,200	6,800	6,700	6,100	6,400	5,400	5,800	5,800	0.36%	1.9%
90-5027	Roosevelt Blvd S. of Flagler Ave	12,000	11,500	11,500	12,000	12,500	9,600	11,000	13,000	13,500	13,100	12,700	10,000	9,500	10,100	11,200	-0.65%	7.8%
90-5028	Roosevelt Blvd E. of Bertha St	10,500	10,000	10,500	10,000	8,700	11,800	11,000	10,100	11,500	11,200	10,700	6,900	6,400	8,900	7,200	-1.80%	28.7%
90-5034	Roosevelt Blvd W. of Byrd Rd	31,500	30,000	36,500	42,500	42,500	34,500	32,500	37,000	37,500	37,500	34,000	33,000	34,500	30,000	34,500	-0.39%	3.0%
90-5035	United St E. of Royal St	7,300	8,200	6,400	6,300	6,400	6,900	8,000	6,800	8,100	6,100	6,700	6,300	5,400	6,000	5,700	-1.43%	31.1%
90-7071	Eaton St W. of Grinnell St															10,700	N/A	N/A
Total (excluding FDOT Station # 90-7071)		261.1	244.3	277.3	306.1	282.8	279.6	282.1	278.8	299.2	283.6	271.5	252.9	247.9	242.9	261.1	-0.48%	9.8%

Notes:
Sum of all roadway volumes shown in thousands.
Orange highlight indicates not a study corridor.
Red highlight indicates removed from trend analysis for consistency.

The analysis for population projections was taken from *Projections of Florida Population by County, 2008-2035* produced by BEBR in March 2009. **Table 26** documents the findings for Monroe County:

Table 26
Monroe County Population Projections

Monroe County	2008	2010	2015	2020	2025	2030	2035
Estimate	76,081						
Low		72,400	69,000	65,800	62,600	59,600	56,600
Medium		74,600	73,500	72,300	71,200	70,200	69,200
High		76,900	77,800	78,800	79,700	80,600	81,500

Source: University of Florida BEBR
All projections for April 1.

The BEBR projections show that a slight negative growth is expected between 2008 and 2035. In addition to the roadway volume analysis and the BEBR projections, the future land use and the City's Comprehensive Plan were reviewed. The City Comprehensive Plan shows that there are few vacant parcels available in the City. However, there are additional parcels that are underdeveloped and could be redeveloped at a higher density at some point in the future.

After taking into account the historical traffic trends, the BEBR projections, and the future land use, it was determined that future background traffic growth could be considered minimal and therefore no adjustments were made to the existing traffic volumes. The data showed that while fluctuations may occur over short periods of time, population and traffic demand projections do not vary significantly through Year 2035.

5.2 Optimized Conditions

Most of the traffic signals throughout the City and particularly in Old Town operate on fixed timing plans. In fixed signal timing plans, each signal phase will give the allotted green time each cycle regardless of vehicle demand. Fixed signal timing plans can sometimes increase delay since stopped vehicles may have to wait while green time is given to the roadway where no vehicles are present.

For the optimized conditions simulation runs, each signalized intersection in the model was set up to operate in a fully actuated or semi-actuated signal timing plan. This means the signals will respond to traffic demand and adjust green times accordingly. In order for traffic signals to operate under these conditions, vehicle detectors must be present at each signalized intersection. Several corridors were also coordinated to increase progression along the roadways. Coordinated patterns were developed for particular segments of Duval Street, N. Roosevelt Boulevard, Truman Avenue, Eaton Street/Palm Avenue, and Flagler Avenue. Additional signal timing adjustments were made throughout the roadway network as well, focusing on the existing deficiencies.

The addition of vehicle detectors, actuated traffic signals, and signal timing optimization proved to be the most beneficial in improving travel times and delay. Signal timing progression can be difficult for many of the corridors in the City due to lack of sufficient turn lanes at intersections and the inconsistent speeds of vehicles.

Only one roadway lane geometry improvement was included for the optimized conditions scenario. The auxiliary left-turn lane for the southeast bound approach on Palm Avenue at N. Roosevelt Boulevard was extended approximately 200 feet. It appears that this improvement can be constructed with only a minor impact to the existing infrastructure. Some landscape areas would be reduced and the existing shared use paths would need to be relocated. However, it appears this improvement could be accommodated within the existing right-of-way.

Signal timing adjustments were incorporated into the traffic simulation model for each signalized intersection on the study corridors, rather than just the 25 study intersections. For each of the non-study signalized intersections, the turning movement volumes were estimated based on engineering judgment and volume balancing the network. Therefore, the optimized signal timing documented in this report for these non study intersections may need to be adjusted once actual traffic counts are collected.

Table 27 shows signalized intersections modeled in this report that currently have vehicle detection or pedestrian signals. Many of the signalized intersections particularly in Old Town that do have vehicle detection are currently not operating in an actuated mode.

Table 27
Signalized Intersection Operations

Intersection		Vehicle Detection		Pedestrian Signal	
Street 1	**Street 2**	**Yes**	**No**	**Yes**	**No**
Duval Street	Caroline Street		X		X
Duval Street	Front Street		X		X
Duval Street	Eaton Street		X		X
Duval Street	Fleming Street		X		X
Duval Street	Southard Street		X		X
Duval Street	Angela Street		X		X
Duval Street	Greene Street		X		X
Eaton Street	Grinnell Street		X		X
Flagler Avenue	White Street		X		X
Flagler Avenue	1st Street		X		X
Flagler Avenue	5th Street		X		X
Flagler Avenue	Kennedy Drive	X			X
Fleming Street	Grinnell Street		X		X
N. Roosevelt Boulevard	Palm Avenue	X		X	
N. Roosevelt Boulevard	5th Street	X		X	
N. Roosevelt Boulevard	Kennedy Drive	X		X	
N. Roosevelt Boulevard	Overseas Market	X		X	
Palm Avenue	Ely Street		X		X
S. Roosevelt Boulevard	Flagler Avenue	X		X	
Simonton Street	Eaton Street		X		X
Simonton Street	Fleming Street		X		X
Simonton Street	Southard Street		X		X
Simonton Street	United Street		X		X
Simonton Street	South Street		X		X
Simonton Street	Caroline Street		X		X
Thomas Street	Petronia Street		X		X
Truman Avenue	Duval Street	X		X	
Truman Avenue	Simonton Street	X		X	
Truman Avenue	White Street	X		X	
Truman Avenue	Windsor Lane	X		X	
Truman Avenue	Whitehead Street	X		X	
Truman Avenue	Florida Street	X		X	
Truman Avenue	Eisenhower Drive	X		X	
US-1	N. Roosevelt Boulevard	X		X	
White Street	Southard Street	X			X
White Street	Eaton Street		X		X
White Street	Virginia Street	X			X
Whitehead Street	Fleming Street	X		X	
Whitehead Street	Southard Street	X		X	

The results of the optimized conditions analysis demonstrate that the proposed traffic signal timing improvements resulted in a significant increase in average speed and decrease in travel times throughout the study area. Additionally, all roadways considered under this scenario were shown to operate at LOS D or better with the exception of Duval Street. The average speed results for the study roadways are shown on **Table 28**. Additional measures of effectiveness including travel time, corridor delay, and intersection delay for the optimized conditions are included in **Appendix N**. **Exhibit 8** depicts the PM peak hour directional LOS for each of the study corridors. The modified signal timing used in the Optimized Conditions Analysis is included in **Appendix O**.

Table 28
Optimized Conditions Average Speed

Roadway	Road way class	AM Peak					MD Peak					PM Peak				
		Existing Conditions		Optimized Conditions			Existing Conditions		Optimized Conditions			Existing Conditions		Optimized Conditions		
		Avg Time (mph)	LOS	Avg Time (mph)	LOS	%	Avg Time (mph)	LOS	Avg Time (mph)	LOS	%	Avg Time (mph)	LOS	Avg Time (mph)	LOS	%
Duval St EB/SB	IV	14.00	C	15.70	C	12.1%	8.20	E	9.17	D	11.8%	6.53	F	7.87	E	20.4%
Duval St WB/NB	IV	13.50	C	15.17	C	12.3%	7.07	E	8.13	E	15.1%	6.60	F	7.97	E	20.7%
Eaton St EB/NB	IV	16.30	C	18.63	C	14.3%	13.27	C	14.13	C	6.5%	11.63	D	11.30	D	-2.9%
Eaton St WB/SB	IV	15.07	C	15.33	C	1.8%	13.00	D	13.30	C	2.3%	11.47	D	12.57	D	9.6%
Flagler Ave NB/EB	III	22.70	C	23.60	C	4.0%	22.67	C	22.60	C	-0.3%	21.23	C	21.73	C	2.4%
Flagler Ave WB/SB	III	22.37	C	22.83	C	2.1%	22.23	C	22.30	C	0.3%	21.73	C	22.30	C	2.6%
Fleming St EB/NB	IV	13.47	C	13.87	C	3.0%	10.20	D	10.80	D	5.9%	10.03	D	10.53	D	5.0%
Palm Ave/1st St EB/SB	III	17.50	D	18.73	C	7.0%	14.43	D	17.60	D	21.9%	11.53	E	16.97	D	47.1%
Palm Ave/1st St NB/WB	III	16.43	D	16.27	D	-1.0%	15.90	D	15.50	D	-2.5%	16.10	D	15.80	D	-1.9%
Simonton St EB/SB	IV	13.77	C	14.90	C	8.2%	11.33	D	11.57	D	2.1%	10.80	D	10.90	D	0.9%
Simonton St NB/WB	IV	13.50	C	15.33	C	13.6%	10.10	D	10.20	D	1.0%	9.93	D	10.50	D	5.7%
South St NB/EB	IV	16.03	C	16.37	C	2.1%	13.43	C	14.17	C	5.5%	13.93	C	14.83	C	6.5%
South St SB/WB	IV	14.93	C	15.77	C	5.6%	13.83	C	14.43	C	4.3%	14.00	C	14.20	C	1.4%
Southard St WB/SB	IV	11.87	D	14.10	C	18.8%	11.03	D	12.20	D	10.6%	11.23	D	12.53	D	11.6%
Truman Ave NB/EB	IV	14.63	C	16.60	C	13.4%	10.77	D	12.07	D	12.1%	10.53	D	13.53	C	28.5%
Truman Ave SB/WB	IV	13.60	C	15.17	C	11.5%	10.23	D	12.17	D	18.9%	7.60	E	12.23	D	61.0%
United St EB/NB	IV	16.23	C	16.47	C	1.4%	14.53	C	14.90	C	2.5%	15.17	C	14.87	C	-2.0%
United St SB/WB	IV	16.83	C	17.13	C	1.8%	16.57	C	16.13	C	-2.6%	15.40	C	16.00	C	3.9%
US-1 NB/EB	II	24.03	C	25.07	C	4.3%	21.67	D	22.43	C	3.5%	17.57	D	20.13	D	14.6%
US-1 SB/WB	II	20.90	D	22.27	C	6.5%	18.00	D	19.33	D	7.4%	18.57	D	18.63	D	0.4%
White St NB/WB	IV	15.03	C	16.73	C	11.3%	14.30	C	15.87	C	11.0%	14.63	C	15.43	C	5.5%
White St SB/EB	IV	15.70	C	17.30	C	10.2%	13.37	C	15.07	C	12.7%	15.00	C	15.10	C	0.7%
Whitehead St SB/EB	IV	14.43	C	15.80	C	9.5%	9.47	D	10.07	D	6.3%	8.37	E	9.93	D	18.7%
Whitehead St NB/WB	IV	13.93	C	14.97	C	7.4%	9.43	D	10.00	D	6.0%	10.67	D	10.27	D	-3.7%
AVERAGE		**16.12**		**17.25**		**7.1%**	**13.54**		**14.34**		**5.9%**	**12.93**		**14.01**		**8.3%**

Exhibit 8 • Optimized Conditions PM Peak Direction LOS

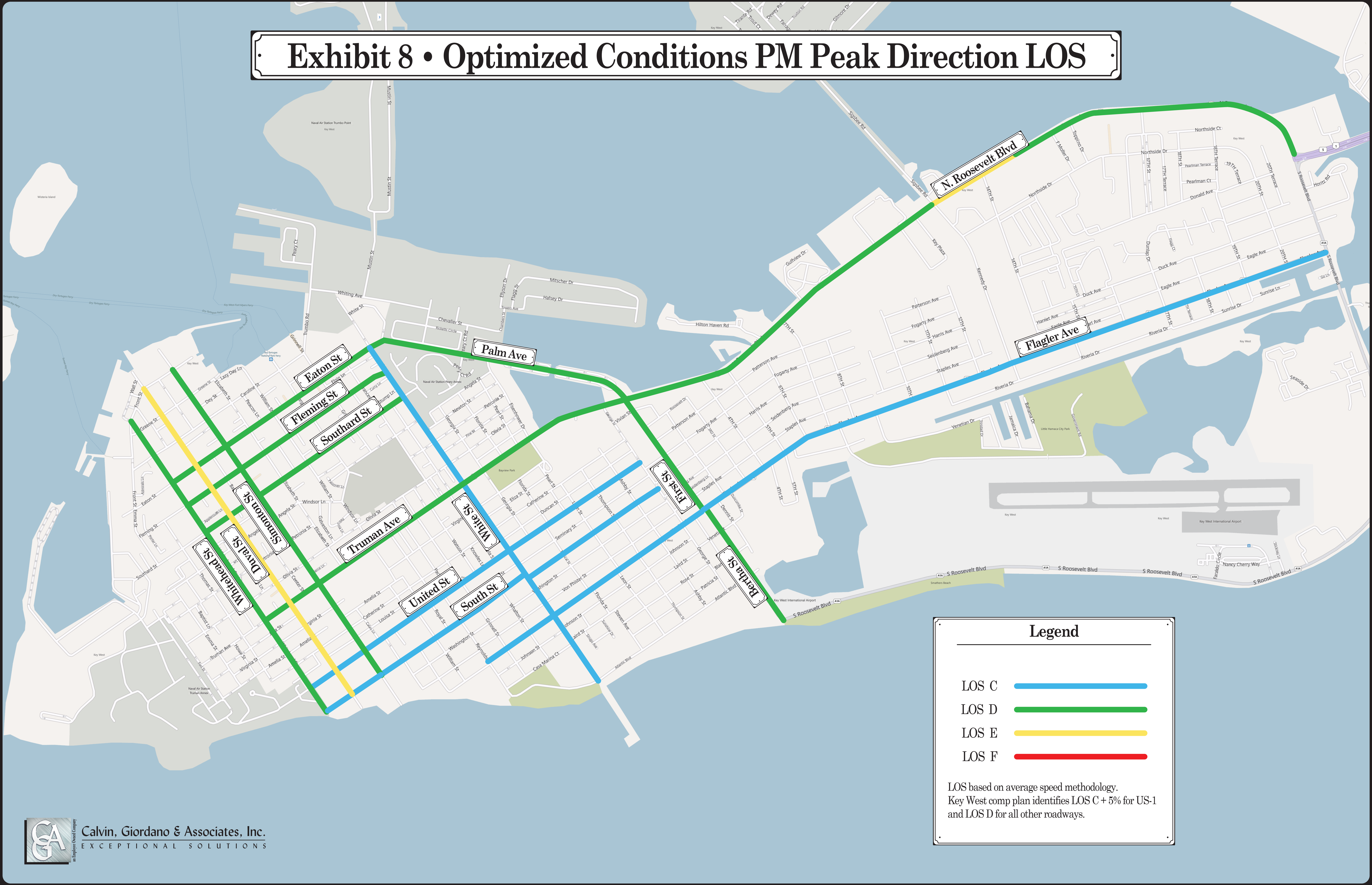


Table 29 illustrates that that optimized conditions provide a significant decrease in travel time and decrease in corridor delay.

Table 29
Optimized Conditions Travel Times

Measure of Effectiveness (MOE)	Peak Hour	Existing Conditions (s)	Optimized Conditions	
			Time (s)	% Increase
Total Travel Time	AM	6691.4	6255.6	-6.5%
	MD	8206.5	7689.9	-6.3%
	PM	8745.7	7899.4	-9.7%
Travel Time Delay	AM	1967.7	1509.2	-23.3%
	MD	3155.2	2606.4	-17.4%
	PM	3681.7	2850.8	-22.6%

Exhibit 9 illustrates a comparison of travel times between the existing conditions and optimized conditions for each of the study corridors during the PM peak hour. Similarly, **Exhibit 10** shows a comparison of travel time delay between the existing conditions and optimized conditions for each of the study corridors during the PM peak hour. **Figures 4, 5, and 6** depict a comparison of the existing conditions and optimized conditions for average speed, travel time, and travel time delay, respectively, for the average of the three peak hours.

In addition to the improved corridor travel times, the optimized conditions improve each of the existing failing signalized intersections identified below to an LOS D or better.

<u>MD Peak</u>
Truman Avenue at 1st Street – Southeast approach

<u>PM Peak</u>
Duval Street at Truman Avenue – Southeast approach
Whitehead Street at Southard Street – Northeast approach
Whitehead Street at Truman Avenue – Southeast approach
Simonton Street at Truman Avenue – Northeast and Southwest approaches, overall intersection
Truman Avenue at 1st Street – Southeast approach
US-1 at Overseas Highway – Southeast approach

Exhibit 9 • Peak Hour Average Travel Time

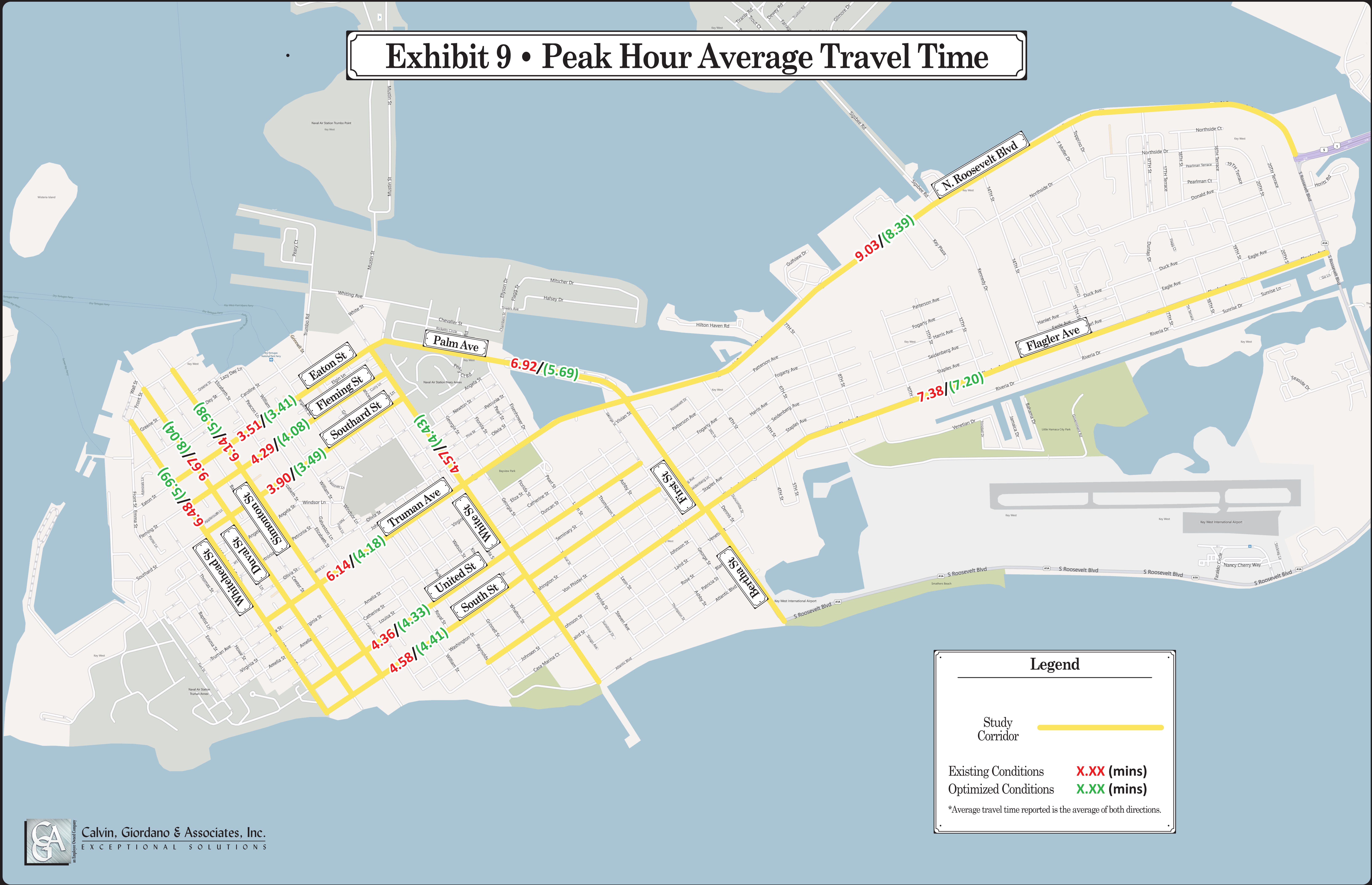


Exhibit 10 • Peak Hour Average Delay

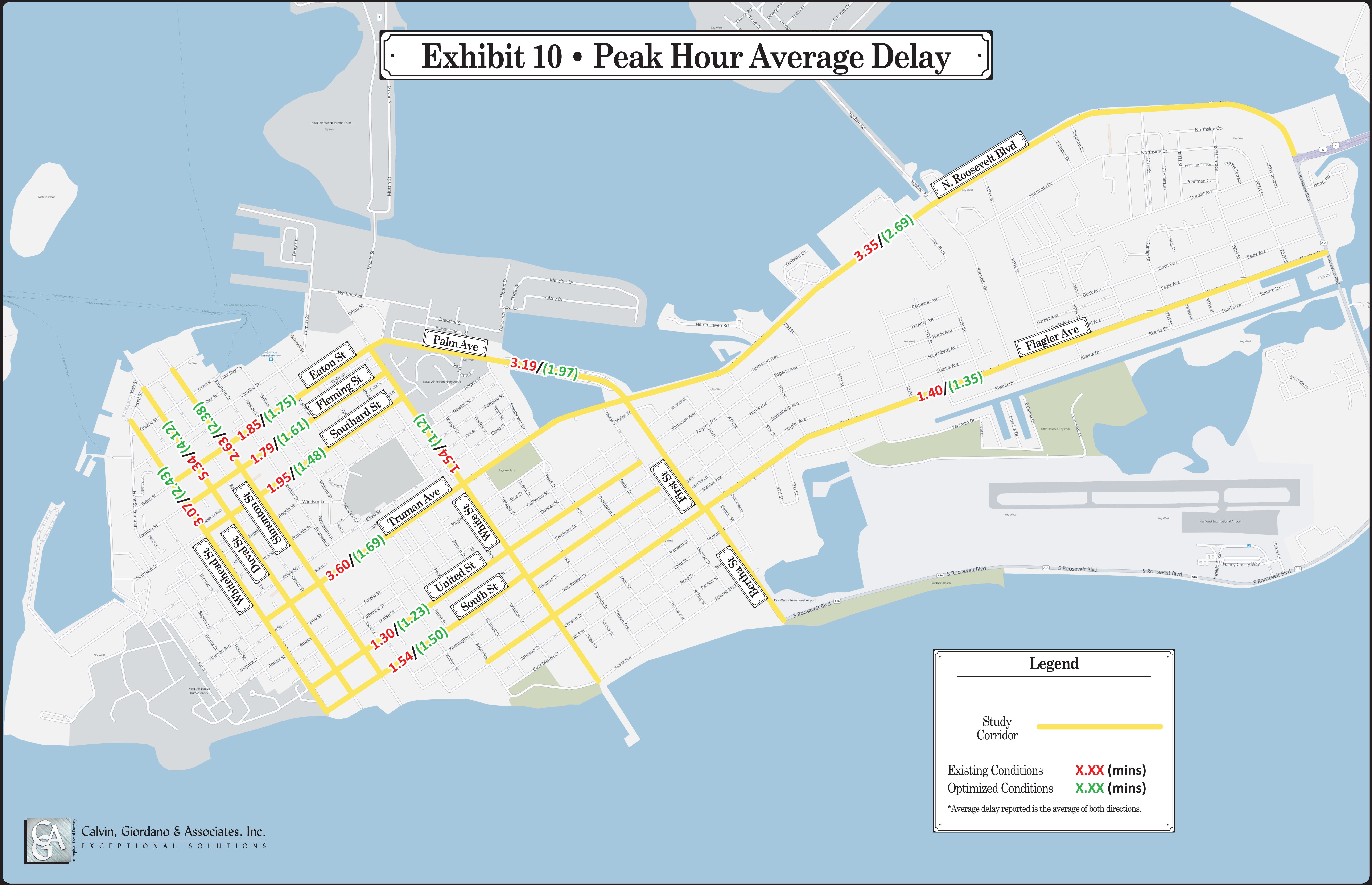


Figure 4
Average Speed Comparison

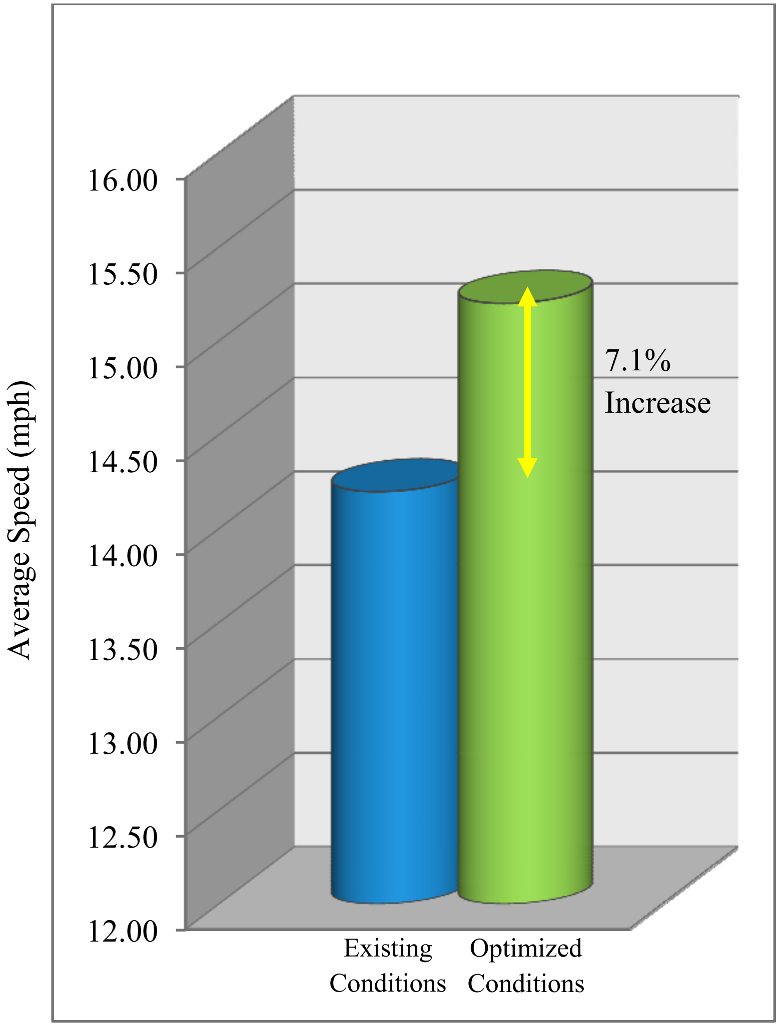


Figure 5
Average Travel Time Comparison

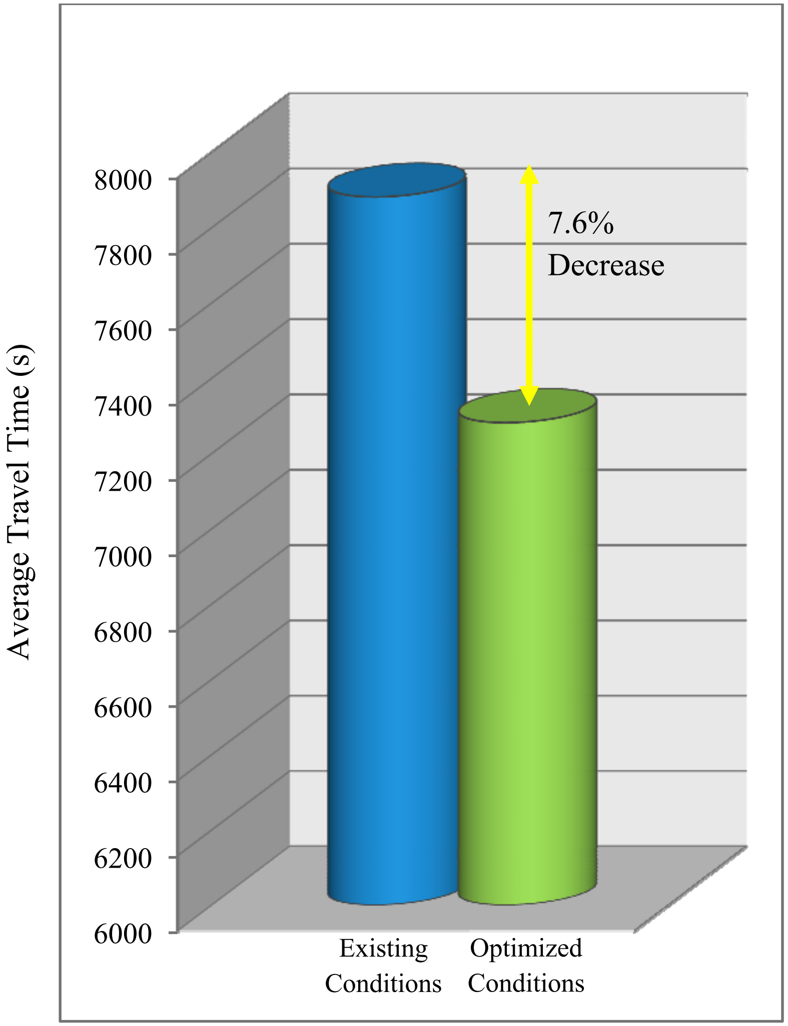
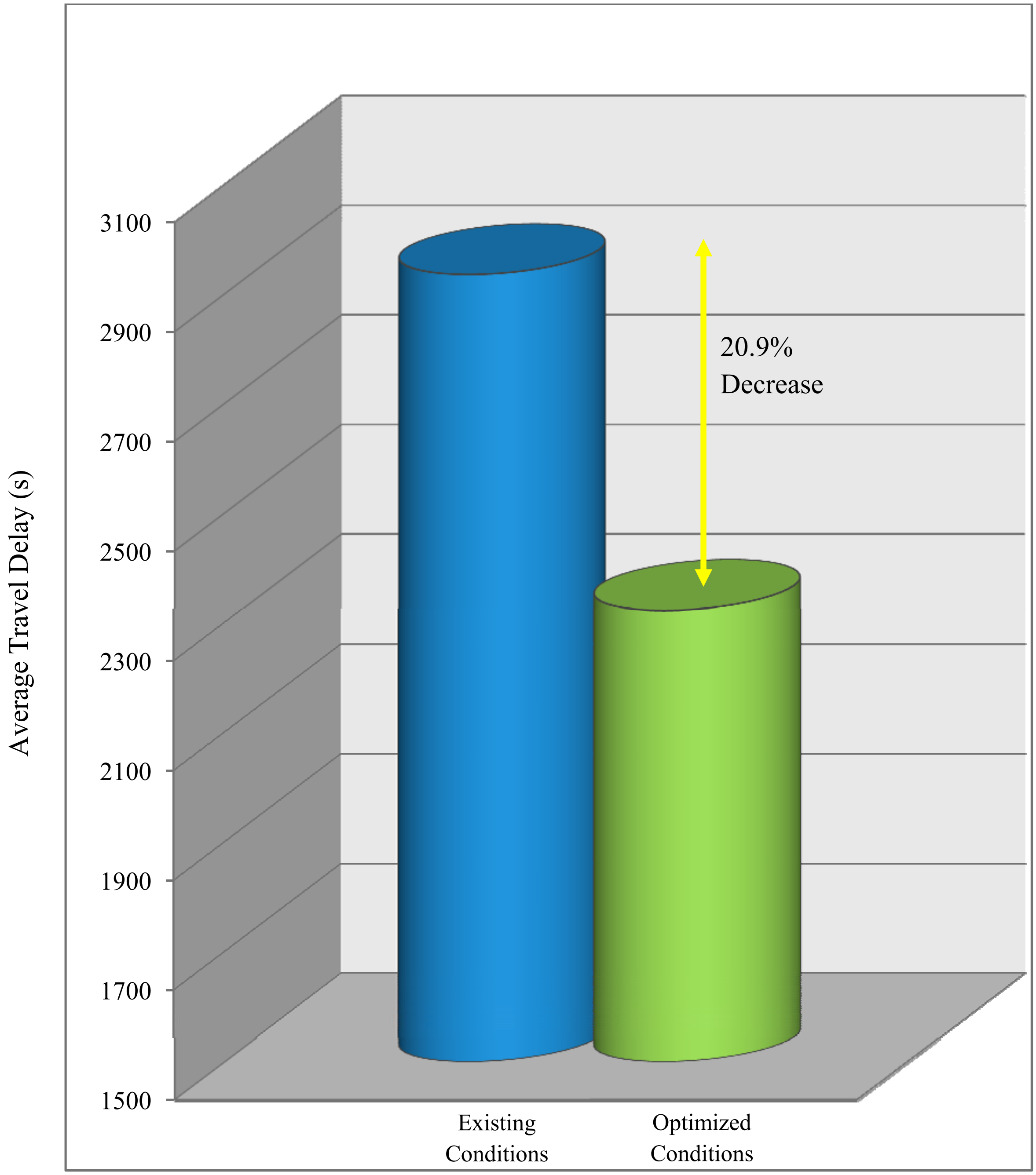


Figure 6
AVERAGE TRAVEL DELAY COMPARISON



5.3 Duval Street Scenarios

At the request of the City, additional alternate scenarios were considered for Duval Street to determine the operational effects. The following scenarios were considered and modeled in the VISSIM traffic simulation network:

1. No parking on Duval Street.
2. Closure of Duval Street to vehicular traffic during the afternoon and evening hours.
3. Closure of only a portion of Duval Street to vehicular traffic during evening hours.
4. Reconfiguring Duval Street and Whitehead Street into one-way only roadways..

<u>No Parking on Duval Street</u>

The existing conditions roadway network was evaluated with the removal of parking on Duval Street to determine the operational effects. The results of the analysis showed that eliminating parking on Duval Street would only result in minor improvements for the roadway and would not improve the LOS.

While it is likely that on-street parking on Duval Street does have a negative impact on the corridor, it is not the primary reason for the heavy congestion. The two primary factors contributing to the congestion are the number of fixed timing signalized intersections and the high number of pedestrians. Additional contributing factors include the variety of multi-modal vehicles, unfamiliar drivers, and the high volume of vehicular traffic. The combination of these factors results in the slow travel time along Duval Street.

<u>Duval Street Closure</u>

The existing conditions roadway network was modified so that only pedestrians could utilize Duval Street. The current vehicle traffic on Duval Street was re-distributed to Simonton Street and Whitehead Street to determine the operational effects.

The results of the analysis demonstrated that a significant degradation to traffic operations would occur on Simonton Street and Whitehead Street with the removal of vehicular traffic on Duval Street. The additional vehicles re-routed to Simonton Street and Whitehead Street would create an unstable traffic flow that would increase travel times and delay significantly.

<u>Partial Duval Street Closure</u>

The existing conditions roadway network was modified to replicate a partial closure of Duval Street between the 500-600 block during the PM peak hour. As part of this study, turning movement counts were collected during the AM, MD, and PM peak hours. The PM peak hour for Duval Street fell between 4-5PM. The partial closure of Duval Street caused a significant amount of congestion in the immediate surrounding areas on Simonton Street and Whitehead Street. However, no turning movement counts were collected as part of this study after 6PM. Therefore, at later evening hours, it is possible that traffic volumes would have decreased enough that the partial road closure would have a less significant impact on the surrounding roadway network.

<u>Reconfiguring Duval Street and Whitehead Street from two-way roadways to one-way only roadways</u>

The existing conditions roadway network was modified so that Duval Street would only allow for northbound one-way traffic while Whitehead Street would only allow for southbound one-way traffic. The typical section of Duval Street and Whitehead Street was also modified so that the roadway would be 11 feet wide with a 5' foot bike lane. No additional roadway modifications were made.

The results of the analysis demonstrated that conditions on Whitehead Street and Duval Street would deteriorate resulting in an increase in travel times.

6.0 CONCLUSIONS

The purpose of the Carrying Capacity Traffic Study was to assess the capacity of City streets and related transportation infrastructure. The Study was also to address specialized vehicles and their impacts to roadways and adjacent land uses including impacts associated with mobility, noise, and air quality.

In order to accurately evaluate the transportation infrastructure, an extensive amount of data collection was undertaken for this study. The following items were evaluated as part of the data collection process:

- Turning Movement Counts
- 24 Hour Bi-Directional Tube Counts
- Speed Counts
- Vehicle Classification Counts
- Travel Time Runs
- Multi-Modal Vehicle Attributes
- Roadway Characteristics
- Speed Limit Inventory
- Parking Inventory
- Cruise Ship Data
- Bike Lane Inventory
- Sound Level Inventory

Existing Conditions Analysis Methodology

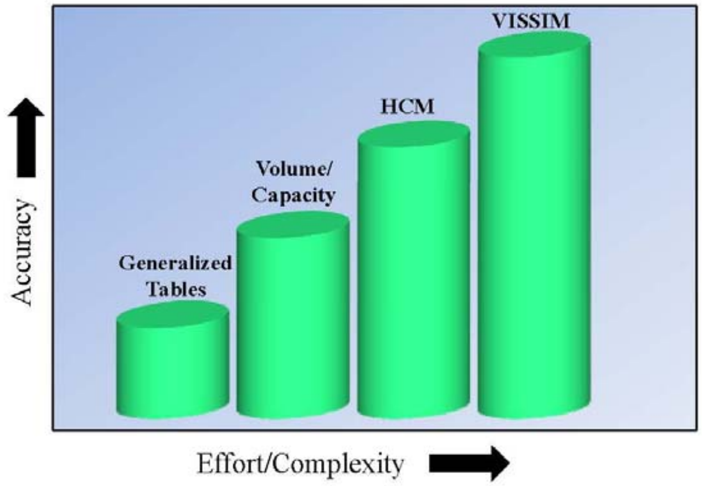
VISSIM traffic micro-simulation software was chosen for the project due to the unique characteristics of the City such as the prevalence of multi-modal vehicles and pedestrians. The City transportation network was evaluated using four different methodologies:

1. **FDOT Generalized Tables**. The first methodology consisted of comparing peak hour traffic volumes to the FDOT Quality/Level of Service tables. This generalized planning analysis is limited and is considered an estimate of capacity.
2. **Volume to Capacity Ratio.** This methodology determined the v/c ratios on each of the study corridors based on the critical intersection. The v/c ratios in this analysis are considered more detailed and accurate than the FDOT v/c ratios.
3. **HCM Average Speed.** The procedure identified in the City Comprehensive Plan and the HCM both require the LOS to be determined based on the average speed methodology. This procedure was completed by actual time travel runs and through a micro-simulation traffic analysis. The results for this methodology were used for the final determination of LOS as it reflects the most accurate possible evaluation.

4. **VISSIM Micro-simulation**. The final methodology used in this traffic study was to evaluate the traffic operations of the study intersections. The Level of Service thresholds were determined based on delay thresholds identified in the HCM. VISSIM micro-simulation software was utilized to determine the approach and intersection delay.

The hierarchy of complexity and accuracy for each of the four methodologies utilized is illustrated in Figure A below.

Figure A
Hierarchy of Traffic Evaluation Tools



Existing Conditions Analysis Results

The results of the existing conditions analysis demonstrated that there are several roadway corridors and intersections within the City that are over capacity or operating at a Level of Service that is not within defined acceptable standards, as illustrated on Table A below. It can therefore be concluded that the overall transportation network will not support additional traffic unless capacity improvements are implemented. The effects of new trip generators on the overall roadway network will be dependent, in part, on the location of the development/operation, trip distribution/tour route, individual vehicle attributes, and the size of development/operation.

Table A
Existing Conditions Deficiencies

METHODOLOGY	OVER CAPACITY CORRIDORS
FDOT Generalized LOS Tables	Duval Street
	Eaton Street
	Palm Avenue
	N. Roosevelt Boulevard
	Truman Avenue
Volume/Capacity Ratio	Duval Street
	N. Roosevelt Boulevard
	Truman Avenue
	Whitehead Street
Highway Capacity Manual (HCM)	Duval Street
	Whitehead Street
	Truman Avenue
	N. Roosevelt Boulevard
	Palm Avenue/1st Street/Bertha Street
METHODOLOGY	**OVER CAPACITY INTERSECTIONS**
VISSIM Micro-Simulation	Whitehead Street/Southard Street
	Whitehead Street/Truman Avenue
	Duval Street/Truman Avenue
	Simonton Street/Truman Avenue
	Palm Avenue (1st Street)/N. Roosevelt Boulevard

Optimized Conditions Analysis

Since the existing roadway infrastructure within the City is generally not conducive to traditional capacity improvements, such as roadway widening, focus was shifted to operational improvements such as traffic signal modifications. **Improvements to existing traffic signal timing were shown to significantly improve corridor and intersection operations, potentially generating additional roadway capacity.**

In addition to the signal timing improvements, one roadway infrastructure improvement was considered. It would be relatively cost-effective to extend the length of the exclusive left turn lane on Palm Avenue at N. Roosevelt Boulevard by approximately 200 feet. This roadway modification would significantly improve traffic operations at the intersection and throughout the corridor.

The optimized conditions scenario (signal timing improvements, one infrastructure improvement) resulted in a significant improvement in the overall roadway network operations. Each of the study corridors where shown to experience shorter vehicular travel times and delays. Truman Avenue, Whitehead Street, and Palm Avenue/1st Street were improved from Level of Service E to Level of Service D during the PM peak hour. Duval Street improved from LOS F to

LOS E during the PM peak hour. Each of the study intersections that had an LOS E or LOS F approach improved to LOS D or better in the optimized conditions scenario.

The improvements identified in this study will likely provide additional capacity on the overall roadway network within the study area. However, Duval Street and US-1 will likely continue to operate below the established LOS identified in the City Comprehensive Plan, even with proposed operational improvements.

Should the City elect to implement the proposed improvements, it is likely traffic operations on the overall roadway network within the study area will improve, resulting in additional roadway capacity. If additional roadway capacity is generated, it is recommended that the City monitor the availability of the excess capacity through a Concurrency Management System. This system is simply a means for the City to "keep track" of the available roadway capacity as new traffic generators, such as additional franchise agreements or new land development projects, are approved. It is recommended that the City follow similar concurrency management system practices throughout Florida and require new applicants provide a comprehensive traffic study detailing the ramifications of their respective proposals. Applicants can either demonstrate that their proposed development or operation will not result in traffic volumes that exceed the available capacity, or if proposed franchise agreements or land development projects will result in traffic volumes that exceed available capacity, the City can then require the applicant mitigate the resulting traffic congestions through appropriate infrastructure or operational improvements.

7.0 RECOMMENDATIONS

1. Plan for and Implement a City-Wide Signal Timing Program to Address Over-Capacity Roadway Congestion.

Several primary roadway corridors and intersections within the City operate below the acceptable Level of Service thresholds established in the City Comprehensive Plan. The results of this study illustrated that improvements to the traffic signal operations can have a significant benefit to traffic operations on the overall City roadway network.

Most of the signalized intersections in Old Town operate on fixed signal timing which means the green time allotted to each particular traffic movement does not vary as the traffic demands change. It is beneficial to operate traffic signals with actuation rather than fixed timing. Actuation simply means that as the traffic demands increase for a given traffic movement (such as northbound left-turns, or east bound through movements, etc.), more green time is allocated to the higher demand movement. This is accomplished through the use of traffic detectors which identify fluctuations in traffic demand. The conversion of a fixed signal timing intersection to an actuated signal timing intersection will require vehicle detection equipment. Common vehicle detectors include in-ground loop detectors, microwave detectors, and video detectors. Actuated signals would minimize wasted green time and improve the efficiency of individual intersections and overall corridors. To realize the most benefit with the least initial cost, it is recommended the City implement the following prioritization for signal timing improvements:

4. Optimize signal timing at intersections already equipped with vehicle detector equipment.
5. Install vehicle detector equipment and optimize signal timing at intersections capable of accommodating the installation of vehicle detector equipment.
6. Modify traffic signal equipment, install vehicle detector equipment and optimize signal timing at intersections currently without detection capabilities.

The signalized intersections phasing plan as well as the existing and optimized signal timing plans are included in **Appendix P**. ***It should be noted that fine-tuning of the proposed signal timing plans will be required in the field. This should be supervised by an experienced professional traffic engineer.

Signal timing progression along the corridors could also increase the efficiency of the roadway network. Progression involves timing traffic signals along a particular corridor in such a way that groups of vehicles can travel through several intersections without stopping. Signal timing progression is commonly implemented by installing underground fiber-optic cables to connect several traffic signals along a corridor. The traffic signals are then able to “communicate” with each other and respond to traffic demand. Implementing signal timing progression would require a substantial infrastructure investment and therefore may not be immediately feasible.

2. Establish and Implement a Transportation Concurrency Management System to Address New Franchise Agreements and Land Development Projects.

This study documented that several roadway corridors and intersections are operating below acceptable LOS thresholds established in the City's Comprehensive Plan. It is therefore reasonable to conclude that the addition of any new traffic generators without substantial capacity improvements would only exacerbate traffic congestion. The signal timing improvements proposed in this study were shown to likely result in improved traffic operations and additional roadway capacity. In the event additional roadway capacity is generated, it is recommended the City monitor the availability of the excess capacity through a Transportation Concurrency Management System.

Concurrency Management Systems stem from Florida Statues relating to growth management which require that facilities needed to support new development, such as roadways, are in place "concurrent" with the new development. In this instance, new trip generators, such as franchise agreements or land development projects, would need to demonstrate that roadway capacity is available to support the proposed franchise agreement or project.

Applicants for new franchise agreements or land development projects can utilize the VISSIM traffic model provided in this study to demonstrate the effects of their respective projects on the overall roadway network. It is recommended that these traffic impacts be considered on a case-specific basis for several reasons:

- Franchise vehicle characteristics that effect roadway capacity can vary greatly. Individual applicants can provide the City with specific vehicle attributes at the time of application.
- Proposed tour routes or areas of utilization can vary greatly. Individual applicants can provide the City specific information as to their proposed routes.

The City should require all applicants for franchise agreements or land development projects submit a traffic study demonstrating the effects of the proposed application on the overall roadway network. Applicants who are able to demonstrate that their particular traffic application will not exceed available roadway network capacity could then be considered for approval. For applicants that are unable to demonstrate an ability to work within available roadway capacity limits, the City may elect to request that the applicant contribute to a predetermined congestion management project, at the discretion of the City. This type of concurrency management requirement is commonplace throughout the State of Florida.

3. Utilize VISSIM Software for Future Traffic Analysis.

VISSIM micro-simulation traffic software was chosen for this study in order to accurately analyze the wide variety of multi-modal vehicles in the City. Many popular traffic software packages such as Synchro and HCS are limited with regard to the types of vehicles that can be evaluated. As part of this study, a highly calibrated VISSIM model was constructed and will be provided to City Staff for use at their discretion. The existing conditions VISSIM model encompasses over 50 intersections and 15 corridors.

As improvements are made to the signal timing, the VISSIM model can be quickly updated to account for future modifications. The VISSIM model can be updated for infinite future traffic conditions and scenarios such as:

- Proposed franchise vehicle operations.
- Proposed land development projects.
- Proposed modifications to intersection and roadway operations such as one-way streets.
- Future construction projects and associated detours.
- New bicycle/pedestrian facilities.
- New bus routes.
- Signal timing changes.

CGA will provide City Staff with a day of training on how to use the software. It is, however, recommended that a professional traffic engineer be consulted for any major modifications or analysis.

4. Monitor Traffic Counts on an Annual Basis.

It is not expected that the traffic patterns will greatly change in the short term but traffic patterns are not stagnant over time. The FDOT has 23 count stations in the City that are updated on an annual basis. These counts should be reviewed as they are a good indicator of any increase or decrease of traffic volumes over a several year time frame. In addition to the bi-directional roadway counts collected by the FDOT, turning movement counts should also be periodically updated. Travel patterns can change for a number of reasons, the most common being new development and infrastructure improvements. Whenever traffic patterns change, it will be beneficial to modify and optimize signal timing.

5. Lengthen the Existing Southeast Bound Left Turn on Palm Avenue at N. Roosevelt Boulevard.

The southeast bound approach at the intersection of Palm Avenue and N. Roosevelt Boulevard (left-turn movement from Palm Avenue onto N. Roosevelt Blvd) is operating at LOS E during the Mid Day and PM peak hours. The analysis demonstrated that excessive vehicle queuing occurs at this approach due to the high volume of left-turning traffic (590 vehicles during the PM peak hour). This excessive queuing not only causes delay for the left-turn movement, but exacerbates the overall delay at the intersection. The existing left turn lane length of approximately 170 feet should be extended by at least 200 feet to accommodate the vehicle queue. This will greatly improve the overall operation of the intersection. A cursory review of the lane geometry indicated that adequate right-of-way is likely available to accommodate the proposed lane extension.

6. Plan and Implement a Sign Inventory and Improvement Program.

The data collected as part of this study indicate that over the past five years, more than 25% of the parking violations occurred from unauthorized parking in a designated parking space or in a no parking zone. Since the City is host to a high volume of tourists who may be unfamiliar with local regulations, it may be beneficial to work to improve signage associated with local parking restrictions and regulations.

Other deficiencies in the City's traffic signage were also observed such as signage that is non-compliant with the Manual of Uniform Traffic Control Devices (MUTCD). Ensuring that all roadway signage within the City is compliant with current MUTCD standards will likely improve driving conditions for motorists and ultimately improve roadway capacity.

7. Plan for and Construct Additional Off-Street Parking Facilities.

Key West residents who participated in surveys associated with this study were strongly in favor of adding more off-street parking facilities. On-street parking facilities can contribute to roadway congestion as drivers search for and maneuver within available parking spaces. The addition of off-street parking facilities may reduce some roadway congestion by providing an alternative to on-street parking facilities.

8. Consider Installing Shared Lane Markings for Bicycles in Accordance with Newly Adopted MUTCD Standards.

Bicycles accounted for approximately 8.3% of the overall traffic volumes collected as part of this study and it is evident that bicycles are a popular mode of transportation for both residents and tourists. Although there are few opportunities for new dedicated bike lanes within the City due to existing right-of-way limitations, alternative traffic signage and pavement markings could greatly improve the bicycling experience throughout the City. The 2009 Manual of Uniform Traffic Control Devices (MUTCD) allows for a shared lane marking to be used to:

6. Assist bicyclists with lateral positioning in a shared lane with on-street parallel parking in order to reduce the chance of a bicyclist's impacting the open door of a parked vehicle,
7. Assist bicyclists with lateral positioning in lanes that are too narrow for a motor vehicle and a bicycle to travel side by side within the same traffic lane,
8. Alert road users of the lateral location bicyclists are likely to occupy within the traveled way,
9. Encourage safe passing of bicyclists by motorists, and
10. Reduce the incidence of wrong-way bicycling.

If new bicycle routes are established on roadways without dedicated bike lanes, shared lane markings along with the applicable traffic signage (R4-11: "May Use Full Lane" and W16-1P:

"Share the Road") should be considered. Related excerpts from the 2009 MUTCD identifying the proposed shared lane markings are included in **Appendix Q**.

9. Complete All-Way Stop Warrant Analysis Prior to the Conversion of Two-Way Stop Control (TWSC) Intersections to All-Way Stop Control (AWSC).

The City receives numerous requests for additional stop control at intersections for various reasons. The State of Florida has adopted standards set forth in the 2009 Manual on Uniform Traffic Control Devices (MUTCD) to address traffic control modifications, including conversions of stop-controlled intersections. It is important that standards set forth in the MUTCD are followed when considering traffic operational changes.