

JOINT FLORIDA  
Model Task Force & Transportation  
Data and Analytics Workshop



# TCRPM5 External Trips Estimation

Using License Plate Survey & Streetlight OD Data





# Importance of External Traffic

48% of the regional VMT has one or both ends of the trip outside the three counties. Model outputs indicate:

**Total VMT: 17,237,828**

- EE VMT: 2,850,060 – 16.5% (avg. distance: 70.8 miles)
- EI VMT: 5,469,643 – 31.7% (avg. distance: 27.2 miles)
- Internal-internal VMT: 8,918,125 – 51.7% (avg. distance: 6.2 miles)

**Total Trips: 1,690,272**

- EE Trips: 40,255 – 2.4%
- EI Trips: 200,731 – 11.9%
- Internal-internal Trips: 1,449,286 – 85.7%



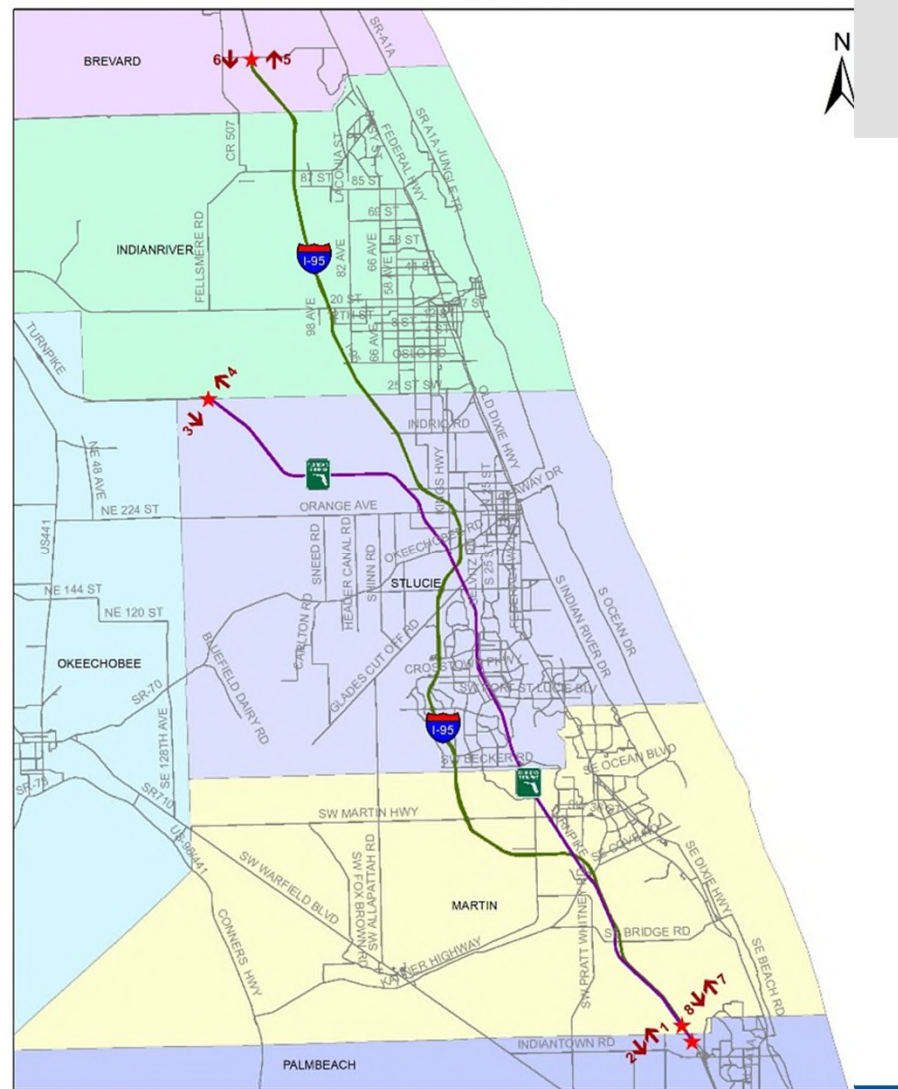


# FDOT's New External Travel Survey

- Survey goal: "... identify vehicles traversing the study area on I-95 by recording their license plates at selected locations along the study boundaries, and to differentiate whether each of the vehicles is making an external- external (EE), external-internal (E/I) or internal-external (IE) trip."
- Conducted with simultaneous License Plate Reader (LPR) cameras, May 24, 30, and 31, 2018.
  - Video recordings were digitally transcribed to computer files.
  - 8 cameras on I-95 and the Turnpike, both directions. No data were collected for any other roadways.
  - Cameras operated at the northern and southern study area boundaries 7 AM - 8 PM.
  - 75% of the plates entering and leaving the 3-county region were readable and recorded.
  - Controlled by tube counts at each camera location.
- Plate numbers of vehicles entering and exiting the region were digitally matched to determine EE trip movements. It was required that the entry time was earlier than the exit time. No geocoding was required for the through trip analysis.
- License plate numbers were geocoded to the Florida DMV database to determine the home location of each vehicle, so limited to vehicles registered in Florida.
  - Vehicles registered inside the 3 Treasure Coast counties could be used to characterize IE travel, both inbound and outbound, because both the registration location, and external station location were known.
  - Vehicles registered in Florida outside the 3 counties and recorded at external stations might be E/I trips, but the trip end locations inside the three counties were not known, so these records were not useful for estimating the model.



## Camera Locations



# EXTERNAL SURVEY CAMERA LOCATIONS

Note: Camera 1,2,3,4 are on the turpike, and Camera 5,6,7,8 are on the I-95.







# Summary of Observations & DMV Geocode Matches for EI/IE trips

Sta/Camera	24-May	# Geocoded		TC	30-May	# Geocoded		TC	31-May	# Geocoded		TC
	Records	all Florida	TC Counties	sample	Records	all Florida	TC Counties	sample	Records	all Florida	TC Counties	sample
S TPK NB (1)	13,069	800	157	1.20%	12,231	1,915	460	3.76%	13,524	2,625	669	4.95%
S TPK SB (2)	12,053	1,362	220	1.83%	12,699	1,333	281	2.21%	12,077	2,119	649	5.37%
N TPK SB (3)	8,246	1,111	113	1.37%	8,080	655	44	0.54%	8,054	1,031	200	2.48%
N TPK NB (4)	8,985	1,487	187	2.08%	8,714	867	116	1.33%	8,062	1,212	240	2.98%
N I-95 NB (5)	13,794	1,352	364	2.64%	11,239	873	231	2.06%	11,731	1,997	751	6.40%
N I-95 SB (6)	12,551	2,333	742	5.91%	10,495	652	131	1.25%	10,966	1,644	541	4.93%
S I-95 NB (7)	27,531	8,217	3,171	11.52%	23,719	6,011	2,678	11.29%	25,248	4,985	2,415	9.57%
S I-95 NB (8)	24,692	6,755	2,835	11.48%	24,400	6,787	3,242	13.29%	23,761	2,398	2,386	10.04%
	(match summary.xlsx)											

% Geocoded = 17.5% to a Florida address

% Geocoded = 6.6% to a TCRPM address





# EE Trip Tabulation

## Trip Interchanges between Surveyed Locations

Date	TPK Martin			TPK Indian River			I-95 Indian River			I-95 Martin		
	Destination	Paired OD	%	Destination	Paired OD	%	Destination	Paired OD	%	Destination	Paired OD	%
5/24/2018	TPK Indian River	2,773	74%	TPK Martin	3,437	93%	TPK Martin	878	22%	TPK Indian River	366	14%
	I-95 Indian River	995	26%	I-95 Martin	257	7%	I-95 Martin	3,179	78%	I-95 Indian River	2,166	86%
	<b>Total</b>	<b>3,768</b>		<b>Total</b>	<b>3,694</b>		<b>Total</b>	<b>4,057</b>		<b>Total</b>	<b>2,532</b>	
5/30/2018	TPK Indian River	2,316	75%	TPK Martin	3,689	96%	TPK Martin	1,171	28%	TPK Indian River	157	9%
	I-95 Indian River	760	25%	I-95 Martin	145	4%	I-95 Martin	3,077	72%	I-95 Indian River	1,663	91%
	<b>Total</b>	<b>3,076</b>		<b>Total</b>	<b>3,834</b>		<b>Total</b>	<b>4,248</b>		<b>Total</b>	<b>1,820</b>	
5/31/2018	TPK Indian River	3,263	79%	TPK Martin	3,231	93%	TPK Martin	709	20%	TPK Indian River	204	11%
	I-95 Indian River	881	21%	I-95 Martin	236	7%	I-95 Martin	2,775	80%	I-95 Indian River	1,630	89%
	<b>Total</b>	<b>4,144</b>		<b>Total</b>	<b>3,467</b>		<b>Total</b>	<b>3,484</b>		<b>Total</b>	<b>1,834</b>	

## Sample External to External Trip Matrix

Shaded cells are unlikely to be through trips

O/D	I-95 Martin	I-95 Indian River	Turnpike Martin	Turnpike Indian River	Total
I-95 Martin	1,271	1,820	115	242	3,448
I-95 Indian River	3,010	760	919	54	4,744
Turnpike Martin	292	879	470	2,784	4,425
Turnpike Indian River	213	76	3,452	222	3,963
Total	4,786	3,535	4,957	3,302	16,579





# Estimates of EI & IE Trips

## Internal to External Trip Matrix

Exit To	I-95 Martin County	I-95 Indian River County	Turnpike Martin County	Turnpike Indian River County
Total traffic count	32,726	16,295	16,062	10,863
I-E Trip Percentage	43%	40%	30%	19%
I-E Trip	14,072	6,518	4,819	2,064
E-E trip (Control Total)	18,654	9,777	11,243	8,799

## External to Internal Trip Matrix

Enter From	Total Traffic Count	E-I Trip Percentage	E-I Trip	E-E trip (Control Total)
I-95 Martin County	34,556	47%	16,241	18,315
I-95 Indian River County	15,868	32%	5,078	10,790
Turnpike Martin County	17,287	25%	4,322	12,966
Turnpike Indian River County	10,365	19%	1,969	8,396

(Actually I-E trips in the inbound direction)

These percentages were not used because they were based only on the number of vehicles that could be geocoded to Treasure Coast County locations, versus all other observed data.





# Review of License Plate Survey Results

- Some EE movements in the survey table are illogical and should not be counted as EE trips. The matches may be due to errors in reading some licenses plates (0 vs O vs Q, 1 vs L, 8 vs B, etc.), duplicate license numbers from multiple states, trips recorded as EE which should have been an EI + IE, or other condition.
- License plate detection at the various stations appears to have been relatively consistent, and the cameras operated for the specified time periods.
- It is likely that the split between EE and EI/IE trips reported from the license plate survey greatly underestimates the percentage of EI & IE trips because it is based only on trips which could be geocoded to a Florida address (only 6.6% of recorded plates to Treasure Coast counties, and 17.5 % to any Florida address). That limits the observations only to Florida plates that could be found in the 2015 DMV file. A better estimate was made by comparing the “paired” EE plates, factored by the detection rates, and compared to the tube count. EE matches do not depend on geocoding plates to the Florida DMV file, and can find a match for plates registered in any state. This calculation was used.
- The model uses the geocoded license plate observations to estimate the trip length frequency distribution and average trip length for EI & IE trips. Note that these data represent ONLY vehicles registered in the 3 counties, and exclude vehicles registered elsewhere traveling to the Treasure Coast counties, but this is the only data available. Without another data source EI travel must be assumed to be very similar to Treasure Coast-based IE travel.
- The license plate survey provided data only for I-95 and the Turnpike, only 63 percent of the traffic counts at the external stations. Note, for example, that US-1 accounts for 14% of the traffic volume at external stations. More data are needed.





# Revised EE vs EI/IE Split

The table below is based on tube counts, capture rates (CTS Tables 5, 6 & 7) , and paired license plates

Corrected for likelihood of observing plates at both stations (see capture rate sheet) --> IPF

O/D	I-95 Martin (8)	I-95 Indian River (5)	Turnpike Martin (2)	Turnpike Indian River (4)	Counts Total	tube count	EE fraction	EI fraction	CTS EI fraction
I-95 Martin (7)		3,283		413	3,696	34,556	0.1070	0.8930	0.4700
I-95 Indian River (6)	5,665		1,679		7,343	15,868	0.4628	0.5372	0.3200
Turnpike Martin (1)		1,567		4,684	6,251	17,287	0.3616	0.6384	0.2500
Turnpike Indian River (3)	365		5,747		6,112	10,365	0.5897	0.4103	0.1900
Total	6,030	4,849	7,426	5,097	23,402				
tube count	32,726	16,295	16,062	10,863					
<b>EE fraction</b>	<b>0.1843</b>	<b>0.2976</b>	<b>0.4623</b>	<b>0.4692</b>					
<b>EI fraction</b>	<b>0.8157</b>	<b>0.7024</b>	<b>0.5377</b>	<b>0.5308</b>					
CTS - EI fraction	0.4300	0.4000	0.3000	0.1900					

Average EE	0.145604	0.380171	0.41195	0.529481
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Data confirm that the EI/IE percentages at the Turnpike and I-95 south stations are much larger than at north stations.

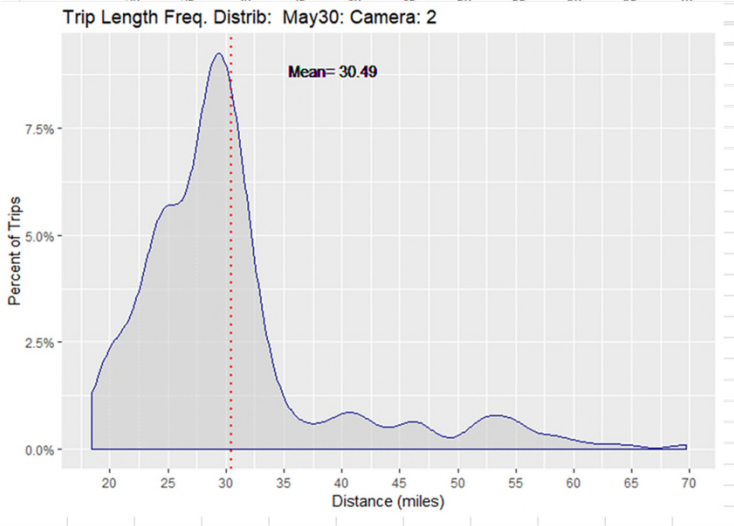
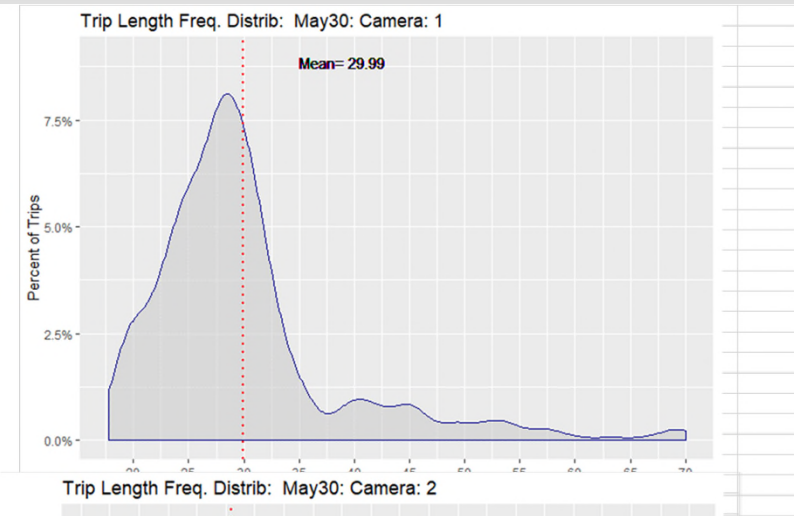
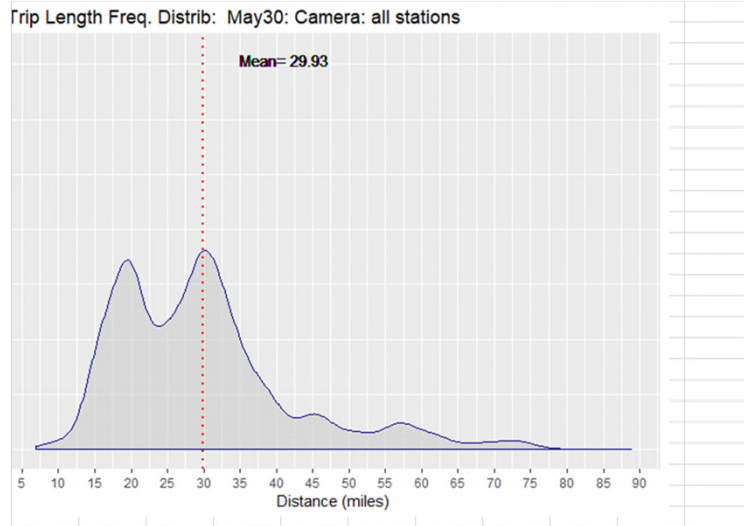


(revised EEvsEI).xlsx





# EI/IE Trip Length Frequency Distribution



TLFD.xlsx  
Presents all stations for all three dates.





# Summary of the Summary

We have better EXTERNAL data than we had in earlier versions of TCRPM.

**BUT**, the data are limited to I-95 and the Turnpike.

**AND**, EI/IE data are limited only to vehicles registered in the three Treasure Coast counties.

Other data were sought to supplement this survey.





# TCRPM5 External Model Calibration Using Streetlight OD Data

## Streetlight OD Data: Zones

- 50 Streetlight zones
- 24 Internal zones
- 26 External/ Pass-through zones
- AADT were coded on External/ Pass-through zones for Streetlight calibration.

Project: TCRPM5 External OD Data | Type: O-D Analysis

General Information

Info

Name: TCRPM5 External OD Data  
Country: US  
Folder: Unassigned  
Type: O-D Analysis  
Data Source (Travel Type): Location-Based Services with Pass-through (Personal - All Modes)  
Calibration Type: Single Factor with User-provided Counts  
Premium Add-On Metrics: None

Zones

Origin Zones Destination Zones Calibration Zones

Search

Zone Name	Pass-through	Direction	Bi-directional
TCRPM5_Origin - Polygon Set with 25 Zones.			
A1A External - Brevard	Yes		No
Baseline Hwy External - Okeechobee	Yes		No
Baseline Hwy External Palm Beach	Yes		No

Options

Standard

Data Period(s)  
Jan'16, Feb'16, Apr'16, May'16, Sep'16, Oct'16

Specific Date(s)

All Days

Day Types

Average Day: M-Su  
Average Weekday: Tu-Th  
Average Weekend Day: Sa-Su

Day Parts





# Streetlight OD Data Processing

- Personal / Auto (Mode): Location-Based Services with Pass-through

Type of Travel	Origin Zone ID	TCG_OID	Hwy_ofFlag	Origin Zone Name	Origin Zone Is Pass-Through	Origin Zone Direction (degrees)	Origin Zone is Bi-Direction	Destination Zone ID	TCG_Des	Hwy_DFI	Destination Zone Name	Destination Zone Is Pass-Through	Destination Zone Direction (degrees)	Destination Zone is Bi-Direction	Day Type	Day Part	O-D Traffic (Trip Counts)	O-D Traffic (StL Index)	O-D Traffic (Calibrated Index)	Origin Zone Traffic (Trip Counts)	Origin Zone Traffic (StL Index)	Origin Zone Traffic (Calibrated Index)
Personal	1	1	0	Martin 1	no	N/A	no	1	1	0	Martin 1	no	N/A	no	0: Average Day (M-Su)	0: All Day (12am-1	69343	13273	26362	148163	28607	568
Personal	1	1	0	Martin 1	no	N/A	no	1	1	0	Martin 1	no	N/A	no	0: Average Day (M-Su)	1: Peak AM (6am-9	12030	2291	4551	25392	4963	98
Personal	1	1	0	Martin 1	no	N/A	no	1	1	0	Martin 1	no	N/A	no	0: Average Day (M-Su)	2: Mid-Day (9am-3	29055	5527	10977	63656	12245	243
Personal	1	1	0	Martin 1	no	N/A	no	1	1	0	Martin 1	no	N/A	no	0: Average Day (M-Su)	3: Peak PM (3pm-7	17518	3372	6696	39424	7583	150
Personal	1	1	0	Martin 1	no	N/A	no	1	1	0	Martin 1	no	N/A	no	0: Average Day (M-Su)	4: Evening (7pm-1	6881	1344	2669	12534	2438	48

- Commercial (Mode): Navigation-GPS

Type of Travel	Origin Zone ID	TCG_OID	Hwy_ofFlag	Origin Zone Name	Origin Zone Is Pass-Through	Origin Zone Direction (degrees)	Origin Zone is Bi-Direction	Destination Zone ID	TCG_Des	Hwy_DFI	Destination Zone Name	Destination Zone Is Pass-Through	Destination Zone Direction (degrees)	Destination Zone is Bi-Direction	Day Type	Day Part	O-D Traffic (Trip Counts)	O-D Traffic (StL Index)	O-D Traffic (Calibrated Index)	Origin Zone Traffic (Trip Counts)	Origin Zone Traffic (StL Index)	Origin Zone Traffic (Calibrated Index)	Destination Zone Traffic (Trip Counts)	Destination Zone Traffic (StL Index)	Destination Zone Traffic (Calibrated Index)
Commercial	1	1	0	Martin 1	no	N/A	no	1	1	0	Martin 1	no	N/A	no	0: Average 0: All Day	0: All Day	32633	26992	1738	72843	62932	3593	74478	65178	3584
Commercial	1	1	0	Martin 1	no	N/A	no	1	1	0	Martin 1	no	N/A	no	0: Average 1: Peak AM	1: Peak AM	7357	6051	396	15420	13054	789	14406	12311	725
Commercial	1	1	0	Martin 1	no	N/A	no	1	1	0	Martin 1	no	N/A	no	0: Average 2: Mid-Day	2: Mid-Day	17087	14193	904	36964	31582	1861	37275	32284	1830
Commercial	1	1	0	Martin 1	no	N/A	no	1	1	0	Martin 1	no	N/A	no	0: Average 3: Peak PM	3: Peak PM	7537	6168	408	15619	13063	816	17626	15045	889
Commercial	1	1	0	Martin 1	no	N/A	no	1	1	0	Martin 1	no	N/A	no	0: Average 4: Evening	4: Evening	268	232	13	1500	1456	57	2581	2693	78







# EE /EI Splits –Streetlight vs. License Plate

Diagonal removed

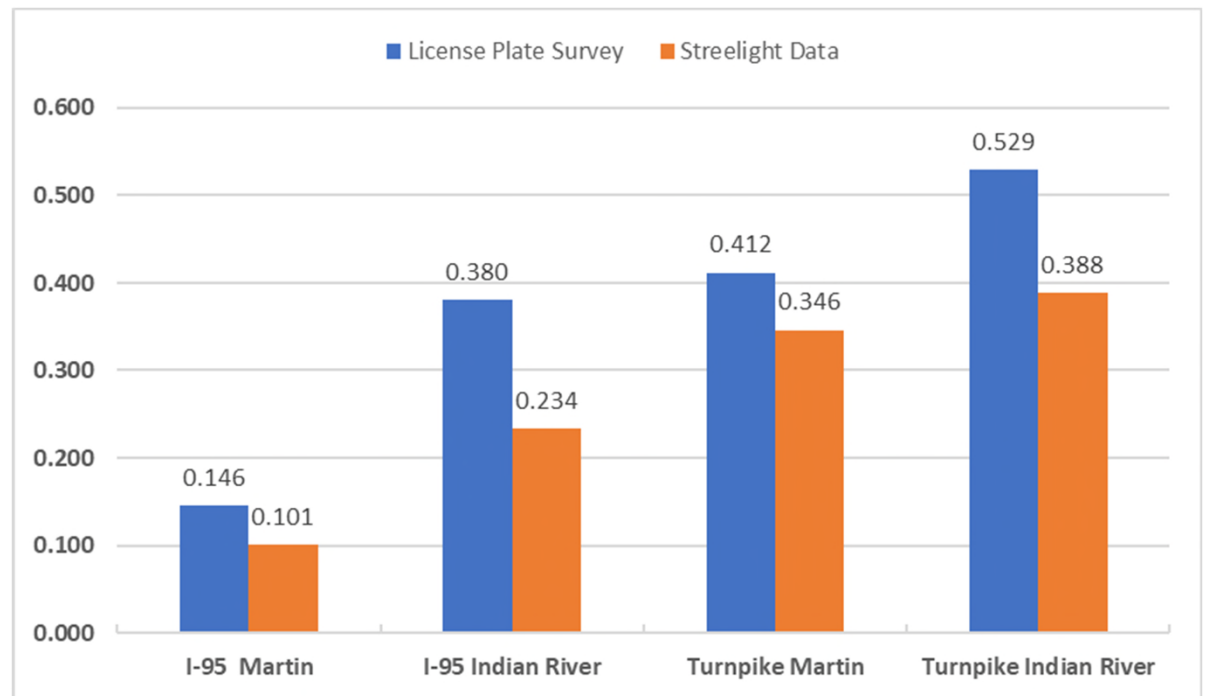
	1401	1402	1403	1407	1408	1412	1421	1422	1424	1427	1428	1430	1433	Street Light				Corradino License PCT	CTS License Plate EE PCT
	A1A External - Brevard	US 1 NB External - Brevard	I-95 NB External - Brevard	SR 60 NB External - Indian River	Turnpike NB External - Okeechobee Rd	WB Okeechoe External	Hwy External - Okeechoe	Karner External - US 441	Beeline Hwy External - Palm Beach	US 1 SB External - Palm Beach	SB External - Palm Beach	Turnpike External - Palm Beach	I-95 SB External - Palm Beach	Old Dixie Highway External - Palm Beach	total	EE AVG	1-way COUNT		
1401 A1A External - Brevard	0	89	9	2	0	6	0	0	0	2	3	26	0	137	126	2900	4.34	4.34	
1402 US 1 SB External - Brevard	66	0	26	15	0	5	0	0	0	1	9	31	0	153	175	10750	1.62	1.62	
1403 I-95 SB External - Brevard	12	48	0	181	14	265	8	11	1	14	1209	3556	1	5,320	5220	20800	25.1	38.02 31.56 60	
1407 SR 60 SB - External	8	9	153	0	0	3	1	1	0	1	23	300	0	499	483	3900	12.38	12.38	
1408 Turnpike SB External - Indian River	0	1	4	1	0	8	2	2	0	2	5753	211	0	5,984	5948	15400	38.62	52.95 45.79 81	
1412 EB Okeechoe Rd External	4	9	283	1	3	0	3	1	0	1	21	17	0	343	339	3250	10.42	10.42	
1421 Beeline Hwy External - Okeechobee	0	0	5	0	0	2	0	10	1645	8	3	120	1	1,794	1836	3600	51	51.00	
1422 Karner Hwy External - US 441	0	0	22	1	0	2	12	0	130	3	3	13	0	186	172	1150	14.91	14.91	
1424 Beeline Hwy External Palm Beach	0	0	2	0	0	0	1727	120	0	1	5	7	1	1,863	1857	3450	53.81	53.81	
1427 US 1 NB External Palm Beach	1	4	4	0	2	2	5	3	1	0	3	43	84	152	200	9750	2.05	2.05	
1428 Turnpike NB External - Palm Beach	6	8	1381	21	5592	28	8	1	2	4	0	24	0	7,075	7063	20250	34.88	41.42 38.15 70	
1430 I-95 NB External - Palm Beach	17	28	3228	245	299	13	110	6	2	57	19	0	3	4,027	4188	38000	11.02	14.56 12.79 57	
1433 Old Dixie Highway External Palm Beach	1	0	3	0	2	0	2	2	69	154	0	0	0	233	162	3350	4.82	4.82	
total	115	196	5,120	467	5,912	334	1,878	157	1,850	248	7,051	4,348	90						
Diagonal	-	-	-	-	-	-	-	-	-	-	-	-	-						
% diagonal	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%						





## Comparison of through trip (EE) percentages

### Expanded License Plate Survey vs Streetlight Data





# EI Model & Data Summary

Destination choice models with unique parameters are applied at each external station to replicate survey ATL and TLF.

Average Trip Length (miles)

Sta	Street Light		License	Model	Location	AADT2way
	EI	IE	Survey	Results		
1401	17.01	16.99	31.10	16.61	SR A1A - North of IR/ Brevard Co. Line	5,800
1402	12.56	12.63		12.37	US 1 - North of IR/ Brevard Co. Line	21,500
1403	30.08	30.39		28.97	I-95 - North of IR/Brevard Co. Line	41,600
1404				14.85	CR 507 - North of IR/ Brevard Co. Line	3,000
1407	39.99	39.65	60.79	39.34	SR 60	7,800
1408	55.69	56.62		60.62	SR 91 - Florid Tpk - North	33,000
1411				34.67	Florida Cracker Trail / CR 68	4,200
1412	33.28	33.30		35.85	SR 70	6,500
1421	36.62	37.08		35.93	SR - 710 Warfield Blvd	7,200
1422	49.68	49.75		37.07	US 441 North/ Conner's Highway	2,300
1423				36.42	US 441 South/ SR 15 to Palm Beach Count	4,600
1424	28.68	28.72		34.95	SR 710 to Palm Beach County	6,900
1425				32.95	CR 711 to Palm Beach Co.	5,000
1426				31.17	SR A1A / CR 707 to Palm Beach Co.	1,750
1427	21.92	21.77		18.76	US 1 to Palm Beach Co.	19,500
1428	31.81	32.71		30.38	SR 91 - Florida's Tpk - South	45,200
1430	30.92	27.50		30.02	24.35	I-95 to Palm Beach Co.





# Daily EE Trip Table

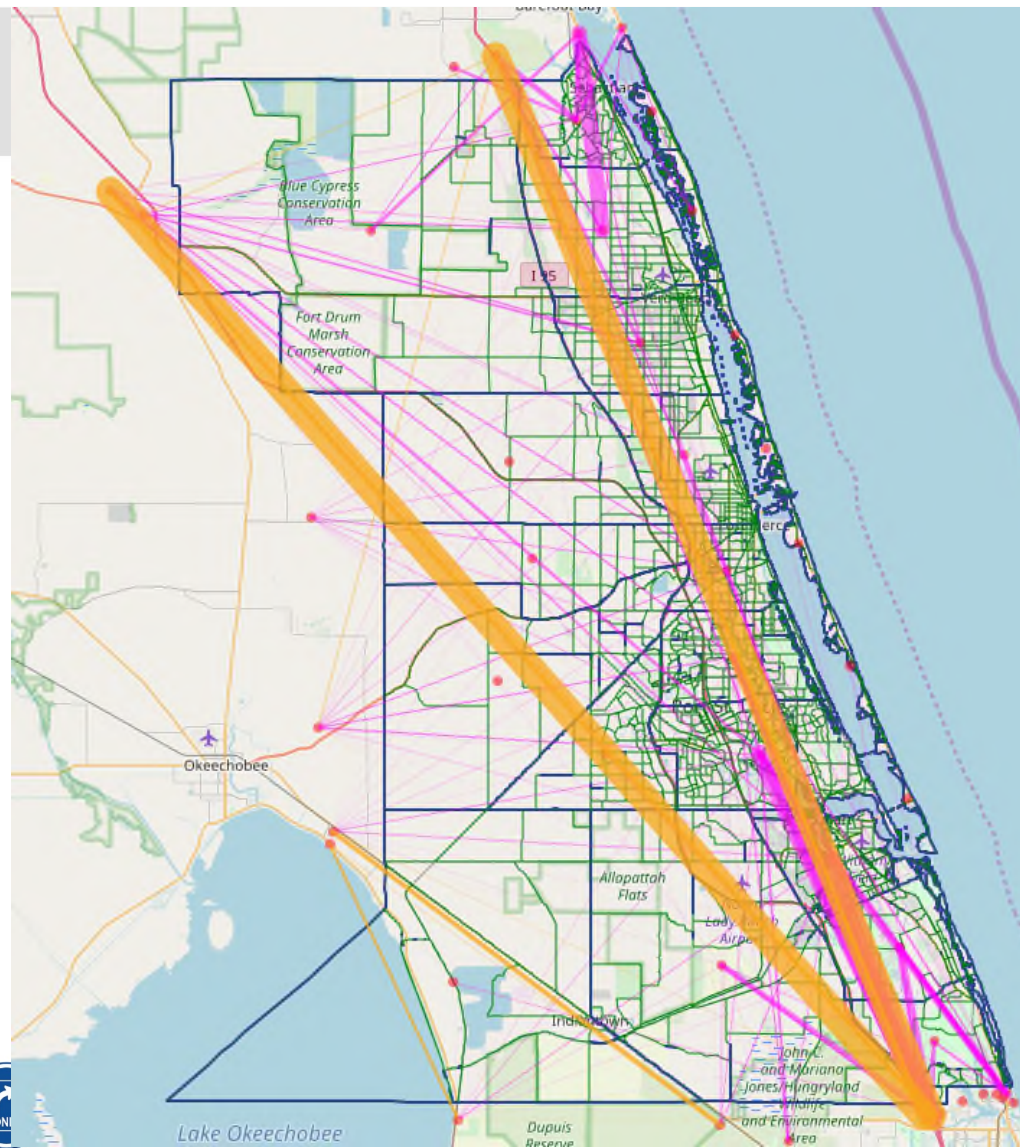
Facility Name	FTYPE	Station	Station													EE	IE	2-Way	
			1401	1402	1403	1407	1408	1412	1421	1422	1423	1424	1427	1428	1430			AADT	% EE
SR A1A - North of IR/ Brevard Co. Line	Collector	1401	-	73	19	6	-	5	-	-	1	-	3	9	25	141	2,759	5,800	4.86%
US 1 - North of IR/ Brevard Co. Line	Arterial	1402	73	-	50	9	1	4	-	-	1	-	5	9	22	174	10,576	21,500	1.62%
I-95 - North of IR/Brevard Co. Line	Freeway	1403	19	50	-	234	25	288	11	15	1	1	20	1,555	9,635	11,856	8,944	41,600	57.00%
SR 60	Arterial	1407	6	9	234	-	1	2	1	1	1	-	1	21	254	528	3,372	7,800	13.54%
SR 91 - Florid Tpk - North	Freeway	1408	-	1	25	1	-	6	1	1	1	-	6	10,133	1,540	11,715	4,785	33,000	71.00%
SR 70	Collector	1412	5	4	288	2	6	-	-	-	-	-	3	19	12	339	2,911	6,500	10.43%
SR - 710 Warfield Blvd	Collector	1421	-	-	11	1	1	-	-	12	1	1,717	17	6	117	1,884	1,716	7,200	52.33%
US 441 North/ Conner's Highway	Arterial	1422	-	-	15	1	1	-	12	-	932	124	7	2	9	1,103	47	2,300	95.91%
US 441 South/ SR 15 to Palm Beach Count	Arterial	1423	1	1	1	1	1	-	1	932	-	6	1	12	42	1,000	1,300	4,600	43.48%
SR 710 to Palm Beach County	Collector	1424	-	-	1	-	-	-	1,716	124	6	-	2	3	4	1,856	1,594	6,900	53.80%
US 1 to Palm Beach Co.	Arterial	1427	3	5	20	1	6	3	17	7	1	2	-	-	135	200	9,550	19,500	2.05%
SR 91 - Florida's Tpk - South	Freeway	1428	9	9	1,553	21	10,117	19	6	2	12	3	-	-	-	11,752	10,848	45,200	52.00%
I-95 to Palm Beach Co.	Freeway	1430	25	22	9,622	253	1,537	12	118	9	43	4	135	-	-	11,780	26,220	76,000	31.00%
<b>TOTAL</b>			141	174	11,840	528	11,697	339	1,883	1,103	1,000	1,857	200	11,770	11,796	54,328	84,622	277,900	39.10%





## EXTERNAL DESIRE LINES

- EI/IE
- External-External







## TCRPM External Models

- Fratar-based external-external model
- Destination choice EI/IE model, calibrated from the Street Light data at every station

