



**SOUTH FLORIDA EAST COAST (FEC)  
ALTERNATIVES ANALYSIS**

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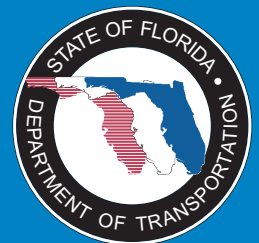
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***Modally Generic Travel Demand  
Model Testing Tech Memo***

*Prepared by:*



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**To:** Scott Seeburger

**From:** Jim Schwarzwaldner

**Date:** August 25, 2009

**Subject:** South Florida East Coast Corridor Transit Analysis Study (SFECCTA):  
Modally Generic Travel Demand Model Testing Technical Memorandum  
(Section 3.5.2.2)

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## **INTRODUCTION**

The Florida Department of Transportation (FDOT) has initiated Phase 2 of the South Florida East Coast Corridor Transit Analysis (SFECCTA) Study to improve the passenger transit services in the South Florida East Coast Corridor. Phase 2 of the SFECCTA will build upon the preliminary Alternative Analysis (AA) initiated in Phase 1 under the early scoping-ETDM process to identify one or more Locally Preferred Alternatives (LPA) within the project corridor. As part of Phase 2, FDOT will be seeking federal New Starts funding to support the implementation of the LPA(s).

In order to qualify for funding under the FTA New Starts Program, 49 USC 5309(e)(1)(A) requires that project be based upon the results of an alternatives analysis. Alternative analysis begins with a good understanding of the transportation problems in the corridor. Once known, a number of capital investment strategies, or build alternatives, will be identified and developed to meet the purpose and needs of the corridor. FTA also requires that two alternatives be considered in addition to any build alternatives. They are the no action or No-Build Alternative and the Baseline Alternative. The No-Build Alternative typically includes all regional transportation programs adopted in the region's cost-affordable Long Range Transportation Plan (LRTP). The FTA Baseline Alternative considers Transportation System Management (TSM) measures that could be taken to provide best services without major capital investment.

Evaluating the relative merits of alternatives typically involves the use of travel forecasting models. A well calibrated model is essential in generating the information necessary to conduct the costs, benefits, environmental, and land use analyses that are integral part of the AA process.

This technical memorandum documents the definitions of the modally generic transit alternatives and describes the travel demand modeling work performed to evaluate the effectiveness of these alternatives. The modally generic transit alternatives were developed based on the general service characteristics defined in Task 3.3.2. The alternative testing was conducted using the Southeast Florida Regional Planning Model, Version 6.5, SERPM 6.5. The alternative testing serves two different but related purposes. One is to evaluate the potential impacts of the different options on the FEC corridor in terms of the ridership generated. Secondly, and more

importantly, it is to assess the model's performance in response to a range of transit service assumptions including speed, headway, fare, and parking restrictions. The insight gained from the alternative testing will form the basis for refining both No-Build and build alternatives to be tested in subsequent tasks. This Technical Memorandum fulfills the requirements as specified in Task 3.5.2.2 of the Scope of Services.

Contents of this document include background information of the study and a brief description of the SERPM 6.5 model. A summary of the model results and detailed alignment and operating characteristics are provided for each alternative. In addition, future year forecasts are summarized and analyzed for each alternative identified. And finally, a sensitivity analysis is conducted by examining the ridership elasticity with regard to headway, fare, speed, and parking restrictions.

## **BACKGROUND**

As mentioned earlier, the FEC corridor is currently conducting an alternatives analysis (AA). As defined by law, AA is the first step of the New Starts project development process. It is also the local forum for evaluating costs, benefits, and impacts of a range of transportation alternatives designed to address the mobility and other problems in the project corridor. AA is considered complete with the selection of a LPA to advance into Preliminary Engineering (PE). Final design is the last phase of New Starts project development during which the project is prepared for construction.

The initial focus of the AA is on the identification of problems within the FEC corridor that may be alleviated by the provision of transit. A summary of some of the problems identified in the corridor include: rapid population and employment growth, land uses not conducive to economic development, limited mobility options between travel markets, and traffic congestion. A detailed analysis and summary of problems within the FEC corridor is addressed and documented in the Purpose and Needs document prepared for Task 3.2. Another necessary component of the alternatives analysis is the identification of reasonable alternatives. Identification of reasonable alternatives is comprised of defining a No-Build, Baseline and Build alternatives. The purpose of developing the modally generic transit alternatives is to assist in the development of the Build Alternatives.

By definition, the Federal Transit Administration (FTA) states that a No-Build Alternative should include those transportation facilities & services likely to exist in the forecast year. There are two primary sources available for determining transportation projects that are likely to exist in the future. They are the adopted Long Range Transportation Plan Cost Feasible (CF) Network and the Existing plus Committed (E+C)/TIP/Local Capital Improvement plans. For this memorandum, the initial No-Build Alternative utilizes the locally adopted CF as a base with the addition of projects from the E+C/TIP that are not included in CF plan. This base network was selected because FTA requires a minimum 20 year planning horizon. In this case for this task, the 2030 CF network satisfies that criterion and it is the current regionally adopted network.

For comparison purposes, the highway and transit CF networks' lane mileages were compared to the validation year (2005) network. Overall, the CF highway network assumes a 16 percent increase in lane mileage and the CF transit network has an approximate 12 percent increase in route miles over the planning horizon. The network comparisons are detailed in **Table 1** and **2**, respectively.

**Table 1: SERPM 6.5 Highway Network Comparison**

Lane Miles	2005	2030 CF	CHANGE
Freeways	1,258	1,420	13%
Arterials	8,910	10,308	16%
Local Roads	3,462	3,676	6%
Ramps	349	384	10%
HOV Lanes	108	214	97%
Toll Roads	771	1,169	52%
<b>TOTAL</b>	<b>14,859</b>	<b>17,170</b>	<b>16%</b>

**Table 2: SERPM 6.5 Transit Network Comparison**

Route Miles	2005	2030 CF	Change
Palm Beach	1,113	1,124	1.0%
Broward	2,107	2,415	14.6%
Miami Dade	3,643	4,091	12.0%
Tri-Rail/FEC	147	245	66.7%
<b>TOTAL</b>	<b>7,010</b>	<b>7,865</b>	<b>12.2%</b>

## **SERPM 6.5**

The travel demand forecasting tool used in the analysis for this task is the Southeast Regional Planning Model (SERPM) 6.5 which is validated to year 2005 conditions. SERPM6.5 is a traditional four-step model that is comprised of Palm Beach, Broward and Miami-Dade Counties. Furthermore, SERPM 6.5 is a time of day, multimodal travel demand model. Utilizing a time-of-day (TOD) model improves travel demand estimations by accounting for the fluctuations in travel behavior, traffic congestion, and traffic and transit operations throughout the day. Specifically, the time of day modeling consists of peak and off-peak periods which are defined as follows:

1. AM-Peak Period (6:30-9:30 am)
2. PM-Peak Period (3:30-6:30 pm)
3. Off-peak Period (9:30 am – 3:30 pm, 6:30 pm – 6:30 am)

SERPM6.5's multimodal capabilities provide the capacity to estimate trips for the following modes:

1. Automobiles
2. Trucks
3. Local Bus
4. Express Bus
5. Limited Stop Express Bus
6. Light Rail
7. Heavy Rail
8. Commuter Rail

### *Transit Components*

The SERPM 6.5 has 4 main transit components; transit access, transit path, mode choice, and transit assignment. Transit access builds the connectors to transit stops and stations. Specifically, this step provides the ability to build walk access connectors, drive access connectors, and transfer connectors. The transit path step finds the best path of travel as well as the calculated lowest cost. Furthermore, the mode choice component determines the total number of trips made by each mode listed above. Lastly, the transit assignment process assigns the transit trips calculated by the mode choice module to a given transit route.

### *Transit Speed*

One of the primary inputs required for transit modeling is transit speed. The SERPM 6.5 permits the coding of transit speed through two methods, exclusive right-of-way (ROW) and shared ROW. Using exclusive ROW allows the user to "hard code" the transit speed on a link-by-link basis. Typically, these speeds are based on published schedules of a given transit agency. For shared ROW, transit speeds are a function of the congested highway speed. Transit modeling using the shared ROW depends upon several different auto-transit speed relationship curves. In general, auto-transit speed relationship curves are available by area type/facility type combinations for both the peak and off-peak periods.

### *Transit Fares*

When performing transit demand modeling there are 3 fare structures available with the SERPM 6.5. One way to assess transit fares is by offering free service. This option is used for Tri-Rail feeder buses as well as the Metro-Mover. Another option is the use of a flat fare system. This system charges a full price boarding fare for the first boarding and a reduced fare is charged for each subsequent transfer. Lastly, a zone-based fare system can be used. A zone-based fare system charges a fare based on the number of fare zones traversed.

### *Park-N-Ride Lots*

An important aspect of transit modeling is the provision of park-n-ride lots because they allow for automobile access. Park-n-ride lots are manually coded into the transit network. In SERPM 6.5, the variable ACTIVEFLAG allows the model to perceive park-n-ride access at the station level. If this flag is turned off, then no auto access is permitted. The coding of park-n-ride lots consists of the following inputs:

1. Service miles (maximum roadway distance allowed)
2. Number of parking spaces (for informational purposes only)
3. Peak and off-peak period parking costs
4. Peak and off-peak terminal times

### *Model Improvements*

Based upon a review conducted by FTA, SERPM6.5 was upgraded to address the issues raised by FTA during the review process. One of the major upgrades was a revised zonal structure designed to properly represent transit accessibility. In addition, the mode choice structure of SERPM6.5 was modified. This modification included the separation of local buses from premium and limited stop routes, the addition of BRT/LRT as a new mode, Metro-Mover and Metrorail are defined as two distinct modes, and bus and Metro-over were added to the Park-and-Ride and Kiss-and-Ride categories. Additional modifications included the following:

1. Micro-coding of multimodal transfer stations (e.g. Tri-Rail-Metro-Bus)
2. Revised both walk access and auto access programs.
3. Improved bus-auto speed relationships
4. Revised transit path building parameters

**MODEL ASSUMPTIONS**

A zone based fare structure was assumed for the new FEC services. Tri-Rail currently operates under a zonal fare system and this is represented in the model. For a zone based system, fares are assessed based on the number of fare zones traversed. In other words, the more fare zone boundaries a transit rider crosses, the greater the fare. For all conceptual alternatives, a total of 7 fare zones were developed. The FEC alternatives utilized 2 distinct fare structures for the analysis, Urban Mobility (UM) and Premium Transit (PT). The UM fare structure was based on local bus service; whereas, the Premium Transit structure was developed based on the Tri-Rail system. The fares for each zone are detailed in **Table 3**. Furthermore, the fare zone locations are shown in **Figure 1**.

**Table 3: FEC & Tri-Rail Zonal Fare Structure**

# of Fare Zones Traveled	Tri-Rail	Proposed FEC	
		Urban Mobility	Premium Transit
1	\$2.00	\$1.50	\$2.00
2	\$3.00	\$2.00	\$3.00
3	\$4.00	\$2.50	\$4.00
4	\$4.50	\$3.00	\$4.50
5	\$5.00	\$3.50	\$5.00
6	\$5.50	\$4.00	\$5.50
7		\$4.50	\$6.00

A flat fare system is also used. This system charges a full-price boarding fare for the first boarding and a reduced fare is charged for each subsequent transfer. The assumed boarding fares for the flat fare system are summarized in **Table 4**. Moreover, the transfer fares are summarized in **Table 5**.

In addition to transit fares, park-and-ride lots were assumed for the FEC corridor. Park-and-Ride lots were provided at each station for all alternatives. The exception is Alternative 3C which does not have park-and ride access. Park-and-ride access was omitted from this alternative for sensitivity testing purposes. Finally, transit speeds for each option were assumed based on the overall travel speed for the corridor. The assumed speeds were based most favorable transit technology available. The transit speed assumptions are detailed in the **Appendix**.

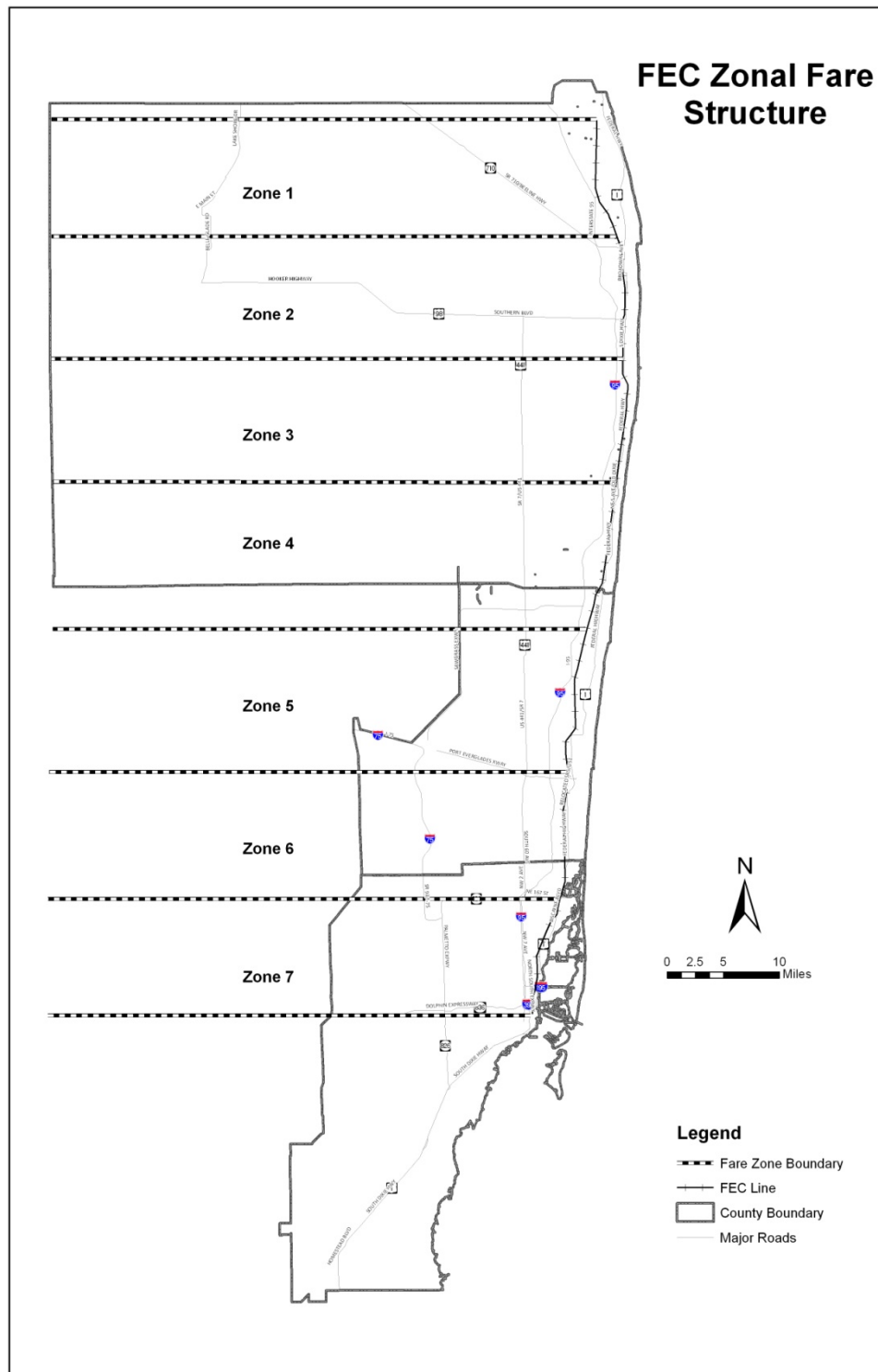
**Table 4: Boarding Fares**

Agency	Fare
PalmTran	\$1.25
PalmTran Pass	\$3.00
BCT	\$1.00
BCT Pass	\$2.50
Metrobus	\$1.50
MetroExpress	\$1.85
Metrorail	\$1.50
Metro-Mover	Free

**Table 5: Transfer Fares**

Agency	Fare
PalmTran Transfer	-
BCT Transfer	-
Miami-Dade Transit (MDT) to BCT	\$0.50
MDT Transfer	\$0.50
MDT to Express	\$0.85

Figure 1: FEC Fare Zone Locations



## MODALLY GENERIC TRANSIT ALTERNATIVES

For this analysis, three general stopping options were selected for the FEC Corridor: Urban Mobility, Automobile Competitive, and Revised Urban Mobility Option. First, the Urban Mobility (UM) option consists of higher station densities, frequent stops, and slower maximum authorized speeds. This option is an all-local service which was designed with the intention of encouraging local patronage by providing greater station stop densities that allow for greater pedestrian access and egress.

For the UM option, two alternatives were developed, 1A and 1B respectively. With respect to station stops, each alternative is identical in that each is comprised of 84 stations, provides local service only, assumes an Urban Mobility fare structure, maximum authorized speeds of 60 mph, a calculated average speed of 29 mph, and park-and-ride access at the station locations. The two alternatives differ based on their assumed headways. Alternative 1A assumes headways of 10 minutes in the peak period and 20 minutes in the off-peak while Alternative 1B assumes headways of 15 minutes in the peak period and 30 minutes in the off-peak. The UM option is detailed in **Table 6** and graphically depicted in the **Appendix**.

The second option developed for this study is the Automobile Competitive (AC) option. In contrast to the UM option, the AC option is proposed to have lower station densities and fewer stops, which should allow for higher transit speeds; therefore, making it more competitive with the dominant, automobile mode.

Four variations of the AC option were developed. Each alternative provides a combination of both express and local service with the exception of Alternative 2C which is local service only. Moreover, each alternative assumes the following:

- 42 Local Stations
- 17 Express Stations (if applicable)
- 80 mph Maximum Authorized Speed
- 39 mph Calculated Average Local Service Speed
- 54 mph Calculated Average Express Speed (if applicable)
- Park-N-Ride Access (all stations)

Headways and fares vary across alternatives. Alternative 2A assumes peak and off-peak headways of 10 and 20 minutes for express service. In addition, it assumes peak and off-peak headways of 20 and 30 minutes for local service. Alternative 2B utilizes peak headways of 15 minutes and off-peak headways of 30 minutes for express service. For local service, headways for peak and off-peak are 30 and 60 minutes, respectively. Alternatives 2A and 2B were modeled based on the Premium Transit fare structure described in the preceding sections.

Alternative 2C only assumes local service headways, which are 10 minutes in the peak period and 20 minutes in the off-peak. This alternative was also tested according to the Urban Mobility fare structure. Finally, Alternative 2D's local service headways are 10 minutes in the peak period and 20 minutes in the off-peak. Express service headways are 20 and 30 minutes during the peak and off-peak times of the day. The AC option is detailed in **Table 6** and graphically depicted in the **Appendix**.

The third option is the Revised Urban Mobility (RUM) option. A total of 4 alternatives were created for this option. RUM is, as the name implies, a variant of the UM option in that it is primarily local service. The exception is Alternative 3B which also assumes express service. The RUM option provides higher station densities and more frequent stops than the AC option, though less frequent stopping and therefore higher speeds than the UM option. This option is expected to attract current riders using nearby parallel local bus services. Each alternative assumes the following:

- 61 Local Stations
- 17 Express Stations (if applicable)
- Urban Mobility Fare Structure
- 80 mph Maximum Authorized Speed
- 33 mph Calculated Average Local Speed
- 54 mph Calculated Average Express Speed (if applicable)
- 10 minute Peak Headways for Local Service
- 20 minute Off-peak Headways for Local Service
- 10 minute Peak Headways for Express Service (if applicable)
- 20 minute Off-peak Headways for Express Service (if applicable)

Only Alternative 3C prohibits park-n-ride access to stops. The RUM option is detailed in **Table 6** and is graphically depicted in the **Appendix**.

**Table 6: Modally Generic Transit Alternative Assumptions**

Alternative	# of Stations (Exp, Local)	Type of Service	Combined Headway at Express Stations (pk/op)	Headway Local (pk/op)	Fare Level	Maximum Allowable Speed (mph)	Avg. Speed (Exp./Local, mph)	Parking at Stations
UM 1A	84	Local Only	-	10/20	UM	60	29L	Yes
UM 1B	84	Local Only	-	15/30	UM	60	29L	Yes
AC 2A	17E, 42L	Exp & Local	10/20	20/30	PT	80	54E/39L	Yes
AC 2B	17E, 42L	Exp & Local	15/30	30/60	PT	80	54E/39L	Yes
AC 2C	42L	Local Only	-	10/20	UM	80	39L	Yes
AC 2D	17E, 42L	Exp & Local	10/20	20/30	UM	80	54E/39L	Yes
RUM 3A	61	Local Only	-	10/20	UM	80	33L	Yes
RUM 3B	17E, 61L	Exp & Local	5/10	10/20	UM	80	54E/33L	Yes
RUM 3C	61	Local Only	-	10/20	UM	80	33L	No
RUM 3D	61	Local Only	-	10/20	UM	60	33L	Yes

## **RIDERSHIP FORECASTS**

Using the SERPM 6.5 travel demand forecasting model, each of the aforementioned alternatives were tested based on the assumptions and attributes mentioned previously. It should be noted that the model results are for screening purposes only as the SERPM 6.5 has known deficiencies. More accurate forecasts will be developed at a later stage using a new and improved SERPM 6.6 model.

A review of the model results indicates that Alternative 3B generates the highest daily ridership with an estimated 160,691 transit trips. Conversely, Alternative 2B generates the lowest daily ridership with just 29,000 in forecasted transit riders. Based on the results, the FEC corridor can expect a range of daily ridership estimated between 29,000 and 160,000 daily transit trips.

Analysis of the alternatives on a system-wide basis indicates that Alternative 3B encourages the greatest amount of overall transit ridership with an estimated 1,284,144 daily transit trips. In general, the FEC corridor induces increases in ridership for all other transit modes over the Base scenario. The specific modal exceptions are the express bus and Tri-Rail services which experience decreases in ridership over the base condition. These decreases are not unexpected as they compete for ridership with the FEC corridor. The ridership estimates for the FEC as well as transit system as a whole is summarized in **Table 7** below.

**Table 7: Future Year (2030) Transit Ridership Forecasts**

Alt.	FEC	Tri-Rail	Metrorail	Regular Bus	Express Bus and Others	Metro-mover	System-wide
BASE	-	23,888	229,486	705,928	73,096	33,035	1,065,433
1A	140,677	13,534	233,670	746,320	69,716	35,314	1,239,231
1B	95,502	15,737	232,567	727,567	69,027	34,460	1,174,860
2A	64,265	12,891	230,776	723,432	65,858	34,667	1,131,889
2B	29,000	16,909	229,522	709,582	68,877	33,493	1,087,383
2C	126,722	11,042	227,856	758,894	63,596	35,748	1,223,858
2D	94,325	12,283	233,190	746,936	63,961	35,748	1,186,443
3A	147,464	9,452	236,285	759,262	66,830	35,216	1,254,509
3B	160,691	8,088	239,516	772,407	67,011	36,431	1,284,144
3C	104,531	13,371	235,345	750,653	68,494	34,572	1,206,966
3D	139,330	10,174	235,807	752,716	66,489	34,930	1,239,446

One of the primary reasons for developing the aforementioned ten alternatives was to assess the reasonableness of the model's performance. Specifically, variables were tested (i.e. – headways, fares, and speeds) at different increments to gauge how incremental changes in these variables would affect the overall ridership.

First, the UM option alternatives 1A and 1B were developed and tested to evaluate how headway changes would impact ridership. Initially, Alternative 1A was developed with assumed headways of 10 minutes (peak) and 20 minutes (off-peak). These headway assumptions were tested against Alternative 1B, which assumed a 50 percent increase in headways (Peak - 15 minutes, Off-peak – 30 minutes). Model output shows that the headway increase for Alternative 1B results in a 32 percent decrease in estimated ridership. The effect of headways was also examined for the AC option alternatives 2A and 2B. For these alternatives, the testing results show that the headway differences result in a 55 percent decrease in ridership from 2A to

2B. These testing results indicate that the model is very sensitive to changes in headways.

In addition to testing the effects of headway changes, the model's performance was also tested for changes in transit fares. Two fare structures, PT and UM, were developed for this analysis. The PT structure was intended to be analogous to premium transit; whereas, the UM was designed to represent local service. For this comparison, Alternatives 2A and 2D were tested. Alternative 2A was modeled using the PT fare structure and Alternative 2D assumed the UM fare structure (low). Model results show that with the changes in fare, an estimated 32 percent change in ridership can be expected.

A significant difference between the UM alternatives and the AC alternatives is the number of transit stations. The UM option is comprised of twice as many local stations (84) as the AC option (42). In order to assess the impact of the number of stations, Alternatives 1A and 2C were compared. Based on the comparison, it is estimated that a 100 percent increase in transit stations will result in an estimated 10 percent increase in ridership. This result suggests that the model is relatively insensitive to the number of transit stations. To further test the number of transit stations, the RUM option was used. This option was developed as a 'middle ground' in terms of number of stations. In other words, the RUM option consists of 61 stations, which is considered a more reasonable number. A comparison was made between Alternative 2C and Alternative 3A. Model results show that a difference of approximately 14 percent can be expected. The results of this comparison confirm that the ridership forecasts are modestly impacted by the number of transit stations within a certain range of stations.

Using the RUM option as a basis, the model's performance based on transit speed changes was analyzed. For this analysis, Alternatives 3A and 3D were chosen. These alternatives had an assumed maximum allowable speed of 80mph and 60mph, respectively. Model results suggest that the difference in speed between the two alternatives amounts to an estimated 5.5 percent change in transit ridership. This indicates that the model is fairly insensitive to maximum speed if the difference is between 60 and 80 mile per hour.

Finally, station area parking was assessed. Alternatives 3A and 3C were compared. According to the analysis, allowing parking at the station locations results in a transit ridership increase of 29 percent. Therefore, it can be reasonably assumed that the model is sensitive to the provision of parking. It can also be assumed that a significant number of persons would use the service even if parking were unavailable. These riders would either walk to the train, take a feeder bus, or be dropped off and picked up by someone driving a car.

## ELASTICITY ANALYSIS

An elasticity analysis was conducted on various attributes used in the FEC's Modally Generic Alternatives analysis. The elasticity analysis focused on determining the elasticity of certain variables assumed in transit demand modeling. The demand elasticity measures the percent change in ridership relative to percent change in an input variable, expressed as a decimal. For example, if the ridership increases by 50 percent when the headway decreases by 80 percent, the elasticity with regard to headway would be -0.625, calculated by dividing 50 percent by minus 80 percent. Generally speaking, when the elasticity is smaller than one, it is said to be inelastic. If it is larger than one, it is said to be elastic. Direct demand elasticity was assessed for transit fare, headways, transit speed, parking, and the number of stations.

First, the elasticity of transit service headways was tested. Local service headways were tested for Mid-Point Elasticity between Alternatives 1A and 1B as well as 2A and 2B. The computed elasticity for Alternatives 1A and 1B was -0.96. This elasticity value indicates that with a 1 percent increase in headways, a 0.96 percent decrease in transit ridership can be expected. By comparison, the elasticity value of -1.51 for Alternative 2A and 2B indicates that a 1 percent increase in headways for the AC option I result in a 1.51 percent decrease in transit ridership. In each case, the Mid-Point Elasticity value indicates that the model or forecasted ridership is elastic with regard to (WRT) transit service headways.

In addition, the model shows that the ridership is relatively elastic WRT transit fare with a mid-point elasticity value of -1.06. In other words, a 1 percent increase in transit fare may result in a 1.06 percent decrease in ridership. On the contrary, , the model appears to be inelastic WRT transit speed with an elasticity of 0.20 and WRT the number of transit stations with an elasticity of 0.03. The elasticity of ridership WRT parking could not be calculated because the input variable is a logical variable (Yes or No). Nevertheless, the model shows that without parking at all stations, the ridership will drop by more than 29 percent. The results and assumptions of the sensitivity analysis are summarized in **Table 8**.

**Table 8: Sensitivity Analysis Summary**

Attributes	Alternative 1	Alternative 2	P1-Input Variable for Case 1	P2-Input Variable for Case 2	Q1-Output Variable for Case 1	Q2-Output Variable for Case 2	Mid Point Elasticity <sup>a</sup>	Observed Elasticity <sup>b</sup>
Headway 1	1A	1B	10/20	15/30	140,677	95,502	-0.96	(-0.58,-0.36)
Headway 2	2A	2B	20/30	30/60	64,265	29,000	-1.51	
Transit Fare	2A	2D	\$4.30 <sup>c</sup>	\$3.00 <sup>c</sup>	64,265	94,325	-1.06	(-0.80,-1.00)
Speed	3A	3D	80.0	60.0	147,464	139,330	0.20	-
No. of Stations	1A	3D	84	61	140,677	139,330	0.03	-
Parking	3A	3C	Yes	No	147,464	104,531	-29.1%	49% ('08) 34% ('07) <sup>d</sup>
a. Mid Point Elasticity = $\frac{(Q_2 - Q_1)(P_1 + P_2)}{(Q_1 + Q_2)(P_2 - P_1)}$								
b. Sources: 1. Journal of Public Transportation, Vol. 7, No.2, Page 44, 2004. 2. Summary of Elasticities, Journal of Transport Economics and Policy, Table 15, pp.114-115, 1981a								
c. Average fare for all zones								
d. 2007 and 2008 Tri-Rail Survey Park-and-Ride Access Mode								

## **SUMMARY**

Utilizing a zone based fare structure, each modally generic alternative was modeled based on the assumptions detailed in this report. According to the analysis, the FEC corridor can expect a range of ridership estimated between 29,000 (Alt. 2B) and 160,000 (Alt. 3B) daily transit trips. A review of these relative ridership estimates across alternatives appears to be reasonable.

Overall, the SERPM 6.5 model seems to respond appropriately with respect to fares, headways, maximum speeds, and parking. The sensitivity analysis conducted for this exercise indicates that the model is very sensitive to headway and fare changes. Conversely, the model is relatively inelastic with regard to the number of stations. It is recommended that additional research be conducted on fare elasticity as a newer model, SERPM 6.6A, is used to estimate ridership for Modally Specific Alternatives, which is a separate task.

## **APPENDIX**

**Modally Generic Transit Option #1: Urban Mobility Option**

Assumes 60 mph maximum allowable speed, EMU, 30 second dwell and 7% scheduling pad

	Station	Cumulative Distance (Miles)	Segment Length (Miles)	Segment Transit Travel Time (with Pad)	Cumulative Travel Time	Segment Velocity (MPH)
1	MIA Government Center	0.0				
2	MIA NE 11 St	0.7	0.7	0:01:43	0:01:43	23
3	MIA NE 20 St	1.6	1.0	0:02:02	0:03:45	29
4	MIA NE 31 St	1.9	0.2	0:01:12	0:04:57	11
5	MIA NE 39 St	2.8	0.9	0:02:01	0:06:58	28
6	MIA NE 54 St	3.7	0.9	0:01:58	0:08:56	27
7	MIA NE 61-62 St	4.3	0.5	0:01:35	0:10:31	21
8	MIA NE 71 St	4.8	0.5	0:01:32	0:12:04	20
9	MIA NE 79 St	5.3	0.5	0:01:34	0:13:37	20
10	ELP NE 87 St	5.8	0.5	0:01:34	0:15:11	20
11	MIS NE 96 St	6.5	0.7	0:01:42	0:16:53	23
12	BSP NE 116 St	8.4	1.9	0:03:03	0:19:56	38
13	NMI NE 125 St	8.5	0.1	0:01:03	0:20:59	8
14	NMI NE 135 St	9.2	0.7	0:01:45	0:22:44	24
15	NMB NE 151 St	10.4	1.1	0:02:14	0:24:58	31
16	NMB NE 163 St	11.2	0.8	0:01:51	0:26:50	26
17	AVE NE 185 St	12.7	1.5	0:02:36	0:29:26	35
18	AVE NE 193-203 St	13.5	0.8	0:01:55	0:31:21	27
19	AVE NE 209 St	14.3	0.8	0:01:48	0:33:09	25
20	HAL E Hallendale Beach Blvd	15.3	1.0	0:02:04	0:35:14	29
21	HLY Pembroke Av	16.1	0.8	0:01:51	0:37:05	26
22	HLY Washington St	16.6	0.6	0:01:35	0:38:41	21
23	HLY Hollywood Blvd	17.1	0.5	0:01:32	0:40:13	20
24	HLY Johnson St	17.7	0.6	0:01:37	0:41:50	21
25	HLY Taft St	18.2	0.5	0:01:32	0:43:22	20
26	HLY Sheridan St	18.7	0.5	0:01:32	0:44:54	20
27	DAN Dania Beach Blvd	19.9	1.2	0:02:19	0:47:13	32
28	FLL Terminal Dr	21.0	1.1	0:02:13	0:49:26	31
29	FTL SW 24 St	22.8	1.7	0:02:51	0:52:16	36
30	FTL SE 17 St	23.3	0.6	0:01:35	0:53:52	21
31	FTL SW 9 St	24.0	0.7	0:01:42	0:55:34	23
32	FTL Government Center	24.8	0.8	0:01:55	0:57:28	27
33	FTL Sistrunk (NW 6th)	25.4	0.6	0:01:39	0:59:07	22
34	FTL Sunrise Blvd	26.1	0.6	0:01:42	1:00:49	23
35	FTL NE 15th Street	26.8	0.7	0:01:46	1:02:35	24
36	WLT NE 26 St	27.7	0.9	0:01:58	1:04:33	27
37	OAK Oakland Park Blvd	28.2	0.5	0:01:34	1:06:07	20
38	OAK NE 38 St	28.7	0.5	0:01:32	1:07:40	20
39	OAK Commercial Blvd	29.7	1.0	0:02:06	1:09:46	29
40	OAK NE 56 St	30.2	0.5	0:01:32	1:11:18	20
41	OAK Cypress Creek Rd	30.7	0.5	0:01:32	1:12:50	20

	Station	Cumulative Distance (Miles)	Segment Length (Miles)	Segment Transit Travel Time (with Pad)	Cumulative Travel Time	Segment Velocity (MPH)
42	PMP McNab Road	31.2	0.5	0:01:32	1:14:23	20
43	PMP SW 6 St	32.5	1.3	0:02:24	1:16:46	33
44	PMP E Atlantic Blvd	32.7	0.2	0:01:10	1:17:56	10
45	PMP Copans Rd	34.8	2.0	0:03:10	1:21:06	38
46	PMP E Sample Rd	35.7	1.0	0:02:03	1:23:09	29
47	DRF SW 10 St	37.9	2.2	0:03:21	1:26:30	39
48	DRF E Hillsboro Blvd	38.9	1.0	0:02:02	1:28:33	29
49	BOC Camino Real	40.6	1.7	0:02:51	1:31:24	36
50	BOC Palmetto Park Rd	41.3	0.7	0:01:45	1:33:09	24
51	BOC Glades Rd	42.1	0.7	0:01:46	1:34:55	24
52	BOC NW 20 St	42.5	0.4	0:01:25	1:36:20	17
53	BOC NW 51 St	44.4	1.9	0:03:02	1:39:22	38
54	BOC Jeffery St	44.8	0.5	0:01:32	1:40:54	19
55	BOC Hidden Valley Blvd	46.0	1.2	0:02:17	1:43:11	31
56	DLR Linton Blvd	47.5	1.5	0:02:36	1:45:47	35
57	DLR Atlantic Av	49.0	1.5	0:02:35	1:48:22	34
58	GST Gulfstream Blvd	51.1	2.1	0:03:15	1:51:36	39
59	BYN SE 15 Av	52.7	1.6	0:02:43	1:54:19	35
60	BYN Boynton Beach Blvd	53.7	1.0	0:02:04	1:56:24	29
61	BYN Royal Palm Dr	55.1	1.3	0:02:27	1:58:50	33
62	LAN Hypoluxo Rd	56.7	1.6	0:02:43	2:01:33	35
63	LAN Lantana Rd	57.8	1.1	0:02:11	2:03:44	30
64	LKW 6 Av	59.3	1.6	0:02:42	2:06:26	35
65	LKW Lake - Lucerne Avs	59.9	0.5	0:01:34	2:07:59	20
66	LKW 10 Av N	60.6	0.8	0:01:48	2:09:47	25
67	WPB Forest Hill Blvd	62.5	1.9	0:03:02	2:12:50	38
68	WPB Southern Blvd	63.9	1.4	0:02:31	2:15:21	34
69	WPB Belvedere Rd	65.0	1.0	0:02:06	2:17:27	29
70	WPB Okeechobee Blvd	66.0	1.0	0:02:04	2:19:32	29
71	WPB Government Center	66.6	0.6	0:01:39	2:21:10	22
72	WPB Palm Beach Lakes Blvd	67.3	0.8	0:01:48	2:22:58	25
73	WPB 23-25 St	68.1	0.8	0:01:48	2:24:47	25
74	WPB 45 St	69.3	1.2	0:02:17	2:27:04	32
75	RVB 13 St	70.8	1.5	0:02:36	2:29:40	35
76	RVB Blue Heron Blvd	71.4	0.6	0:01:39	2:31:19	22
77	LPK Park Av	72.6	1.2	0:02:20	2:33:39	32
78	NPB Northlake Blvd	73.3	0.7	0:01:42	2:35:21	23
79	PBG PGA Blvd	76.1	2.8	0:04:00	2:39:21	42
80	PBG Hood Rd	77.5	1.4	0:02:30	2:41:51	34
81	JUP Donald Ross Rd	78.8	1.3	0:02:24	2:44:15	32
82	JUP Frederick Small Rd	79.2	0.4	0:01:25	2:45:40	17
83	JUP Toney Penna Dr	81.8	2.6	0:03:47	2:49:27	41
84	JUP Indiantown Rd	82.3	0.5	0:01:32	2:50:59	20
	Total	82.3	N/A	N/A	2:50:59	29

<b>Modally Generic Transit Option #2: Automobile Competitive: Express Service</b>						
Assumes 80 mph maximum allowable speed, DMU, 30 second dwell and 7% scheduling pad						
	<b>Station</b>	<b>Cumulative Distance (Miles)</b>	<b>Segment Length (Miles)</b>	<b>Segment Transit Travel Time (with Pad)</b>	<b>Cumulative Travel Time</b>	<b>Segment Velocity (MPH)</b>
1	MIA Government Center					
2	MIA NE 11 St	0.7	0.7	0:01:50	0:01:50	22
3	MIA NE 79 St	5.3	4.6	0:05:16	0:07:06	53
4	NMB NE 163 St	11.2	5.9	0:06:17	0:13:24	56
5	HLY Pembroke Av	16.1	4.9	0:05:30	0:18:54	53
6	FLL Terminal Dr	21.0	5.0	0:05:34	0:24:27	54
7	FTL Government Center	24.8	3.8	0:04:36	0:29:03	49
8	PMP E Atlantic Blvd	32.7	7.9	0:07:56	0:36:59	60
9	DRF SW 10 St	37.9	5.2	0:05:44	0:42:44	54
10	BOC Palmetto Park Rd	41.3	3.4	0:04:18	0:47:01	47
11	DLR Linton Blvd	47.5	6.2	0:06:33	0:53:34	57
12	BYN Boynton Beach Blvd	53.7	6.2	0:06:31	1:00:05	57
13	LAN Hypoluxo Rd	56.7	2.9	0:03:56	1:04:01	45
14	WPB Forest Hill Blvd	62.5	5.8	0:06:16	1:10:17	56
15	WPB Government Center	66.6	4.1	0:04:49	1:15:06	50
16	PBG PGA Blvd	76.1	9.5	0:09:12	1:24:18	62
17	JUP Indiantown Rd	82.3	6.2	0:06:33	1:30:50	57
	Total	82.3	N/A	N/A	1:30:50	54

**Modally Generic Transit Option #2: Automobile Competitive: Local Service**

Assumes 80 mph maximum allowable speed, DMU, 30 second dwell and 7% scheduling pad

	Station	Cumulative Distance (Miles)	Segment Length (Miles)	Segment Transit Travel Time (with Pad)	Cumulative Travel Time	Segment Velocity (MPH)
1	MIA Government Center					
2	MIA NE 11 St	0.7	0.7	01:50	0:01:50	22
3	MIA NE 39 St	2.8	2.1	03:12	0:05:02	40
4	MIA NE 61-62 St	4.3	1.4	02:38	0:07:40	33
5	MIA NE 79 St	5.3	1.0	02:16	0:09:56	27
6	MIS NE 96 St	6.5	1.2	02:24	0:12:20	30
7	BSP NE 116 St	8.4	1.9	03:02	0:15:22	38
8	NMI NE 125 St	8.5	0.1	01:05	0:16:28	8
9	NMB NE 163 St	11.2	2.7	03:42	0:20:09	43
10	AVE NE 193-203 St	13.5	2.3	03:23	0:23:33	42
11	AVE NE 209 St	14.3	0.8	01:59	0:25:31	23
12	HLY Pembroke Av	16.1	1.8	02:58	0:28:29	36
13	HLY Hollywood Blvd	17.1	1.1	02:16	0:30:45	28
14	HLY Sheridan St	18.7	1.6	02:46	0:33:31	34
15	DAN Dania Beach Blvd	19.9	1.2	02:28	0:35:58	30
16	FLL Terminal Dr	21.0	1.1	02:21	0:38:20	29
17	FTL SE 17 St	23.3	2.3	03:23	0:41:43	40
18	FTL Government Center	24.8	1.5	02:42	0:44:25	33
19	FTL Sunrise Blvd	26.1	1.3	03:00	0:47:24	25
20	WLT NE 26 St	27.7	1.6	02:49	0:50:13	35
21	OAK NE 38 St	28.7	1.0	02:16	0:52:29	27
22	PMP E Atlantic Blvd	32.7	4.0	04:48	0:57:17	50
23	PMP Copans Rd	34.8	2.0	03:06	1:00:24	39
24	DRF SW 10 St	37.9	3.2	04:07	1:04:31	46
25	BOC Palmetto Park Rd	41.3	3.4	04:18	1:08:49	47
26	BOC NW 20 St	42.5	1.1	02:21	1:11:10	29
27	DLR Linton Blvd	47.5	5.1	05:39	1:16:49	54
28	DLR Atlantic Av	49.0	1.5	02:42	1:19:30	33
29	BYN Boynton Beach Blvd	53.7	4.7	05:20	1:24:51	53
30	LAN Hypoluxo Rd	56.7	2.9	03:56	1:28:47	45
31	LKW Lake - Lucerne Avs	59.9	3.2	04:08	1:32:55	46
32	WPB Forest Hill Blvd	62.5	2.6	03:42	1:36:37	43
33	WPB Belvedere Rd	65.0	2.5	03:32	1:40:09	42
34	WPB Government Center	66.6	1.6	02:49	1:42:58	34
35	WPB 23-25 St	68.1	1.5	03:14	1:46:11	28
36	WPB 45 St	69.3	1.2	02:24	1:48:36	30
37	RVB 13 St	70.8	1.5	02:42	1:51:17	33
38	NPB Northlake Blvd	73.3	2.5	03:34	1:54:52	42
39	PBG PGA Blvd	76.1	2.8	03:49	1:58:41	44
40	JUP Donald Ross Rd	78.8	2.7	03:44	2:02:25	43
41	JUP Toney Penna Dr	81.8	3.0	03:59	2:06:24	45
42	JUP Indiantown Rd	82.3	0.5	01:41	2:08:04	18
	Total	82.3	N/A	N/A	2:08:04	39

**Modally Generic Transit Option #3: 61 Station Urban Mobility Option**

Assumes 60 mph maximum allowable speed, EMU, 30 second dwell and 7% scheduling pad

	Station	Cumulative Distance (Miles)	Segment Length (Miles)	Segment Transit Travel Time (with Pad)	Cumulative Travel Time	Segment Velocity (MPH)
1	MIA Government Center					
2	MIA 11th Street	0.7	0.7	0:01:43	0:01:43	23
3	MIA 29th Street	2.2	1.5	0:02:39	0:04:22	35
4	MIA 39th Street	2.8	0.6	0:01:39	0:06:00	22
5	MIA 54th Street	3.7	0.9	0:01:58	0:07:58	27
6	MIA 61-62nd Street	4.3	0.5	0:01:35	0:09:34	21
7	MIA 79th Street	5.3	1.0	0:02:06	0:11:39	29
8	MIS 96th Street	6.5	1.2	0:02:16	0:13:55	31
9	BSP 116th Street	8.4	1.9	0:03:03	0:16:58	38
10	NMI 125th Street	8.5	0.1	0:01:03	0:18:01	8
11	NMB 151st Street	10.4	1.9	0:02:59	0:21:00	37
12	NMB 163rd Street	11.2	0.8	0:01:51	0:22:52	26
13	AVE 185th Street	12.7	1.5	0:02:36	0:25:28	35
14	AVE Aventura Mall (195th St)	13.3	0.6	0:01:39	0:27:07	22
15	HAL SE 5th Street	15.0	1.7	0:02:49	0:29:56	36
16	HAL Pembroke Road	16.1	1.1	0:02:11	0:32:07	30
17	HLY Hollywood Boulevard	17.1	1.1	0:02:08	0:34:14	30
18	DAN Sheridan Street	18.7	1.6	0:02:41	0:36:55	35
19	DAN Dania Beach Boulevard	19.9	1.2	0:02:19	0:39:14	32
20	FTL FLL Terminal	21.0	1.1	0:02:13	0:41:27	31
21	FTL SW 17th Street	23.3	2.3	0:03:26	0:44:53	40
22	FTL SW 9th Street	24.0	0.7	0:01:42	0:46:35	23
23	FTL Government Center	24.8	0.8	0:01:55	0:48:30	27
24	FTL Sistrunk	25.4	0.6	0:01:39	0:50:08	22
25	FTL Sunrise	26.1	0.6	0:01:42	0:51:50	23
26	WLT NE 26th Street	27.7	1.6	0:02:44	0:54:34	36
27	OAK NE 38th Street	28.7	1.0	0:02:06	0:56:41	29
28	OAK Commercial Boulevard	29.7	1.0	0:02:06	0:58:47	29
29	PMP McNab Road	31.2	1.5	0:02:36	1:01:23	35
30	PMP Atlantic BLD	32.7	1.5	0:02:36	1:04:00	35
31	PMP Copans Road	34.8	2.0	0:03:10	1:07:09	38
32	PMP Sample Road	35.7	1.0	0:02:03	1:09:13	29
33	DRF SW 10th Street (Sawgrass)	37.9	2.2	0:03:21	1:12:34	39
34	DRF Hillsboro Bld	38.9	1.0	0:02:02	1:14:36	29
35	BOC Palmetto Park Road	41.3	2.4	0:03:36	1:18:12	41
36	BOC Glades Road	42.1	0.7	0:01:46	1:19:59	24
37	BOC NW 20th Street	42.5	0.4	0:01:25	1:21:24	17
38	BOC NW 51st Street	44.4	1.9	0:03:02	1:24:26	38

	Station	Cumulative Distance (Miles)	Segment Length (Miles)	Segment Transit Travel Time (with Pad)	Cumulative Travel Time	Segment Velocity (MPH)
39						
40	DLR Atlantic Avenue	49.0	1.5	0:02:35	1:31:25	34
41	BYN Woolbright Road (SE 15 Av)	52.7	3.7	0:04:58	1:36:22	45
42	BYN Boynton Beach Boulevard	53.7	1.0	0:02:04	1:38:27	29
43	LAN Hypoluxo Road	56.7	2.9	0:04:10	1:42:36	42
44	LAN Lantana Road	57.8	1.1	0:02:11	1:44:47	30
45	LKW Lake - Luzerne	59.9	2.1	0:03:15	1:48:02	39
46	LKW 10th Ave N	60.6	0.8	0:01:48	1:49:50	25
47	WPB Forest Hill Bld	62.5	1.9	0:03:02	1:52:52	38
48	WPB Southern Bld	63.9	1.4	0:02:31	1:55:24	34
49	WPB Belvedere Road	65.0	1.0	0:02:06	1:57:30	29
50	WPB Okeechobee Bld	66.0	1.0	0:02:04	1:59:34	29
51	WPB Government Center	66.6	0.6	0:01:39	2:01:13	22
52	WPB Palm Beach Lakes Bld	67.3	0.8	0:01:48	2:03:01	25
53	WPB 23-25th Street	68.1	0.8	0:01:48	2:04:49	25
54	WPB 45th Street	69.3	1.2	0:02:17	2:07:07	32
55	RVB 13th Street	70.8	1.5	0:02:36	2:09:43	35
56	LPK Park Avenue	72.6	1.8	0:02:59	2:12:42	37
57	NPB Northlake Boulevard	73.3	0.7	0:01:42	2:14:24	23
58	PBG PGA Boulevard	76.1	2.8	0:04:00	2:18:24	42
59	JUPDonald Ross Road	78.8	2.7	0:03:53	2:22:17	42
60	JUP Toney Penna Drive	81.8	3.0	0:04:13	2:26:30	43
61	JUP Indiantown Road	82.3	0.5	0:01:32	2:28:02	33
	Total	82.3	N/A	N/A	2:28:02	33

Figure 1: Urban Mobility (UM) Option

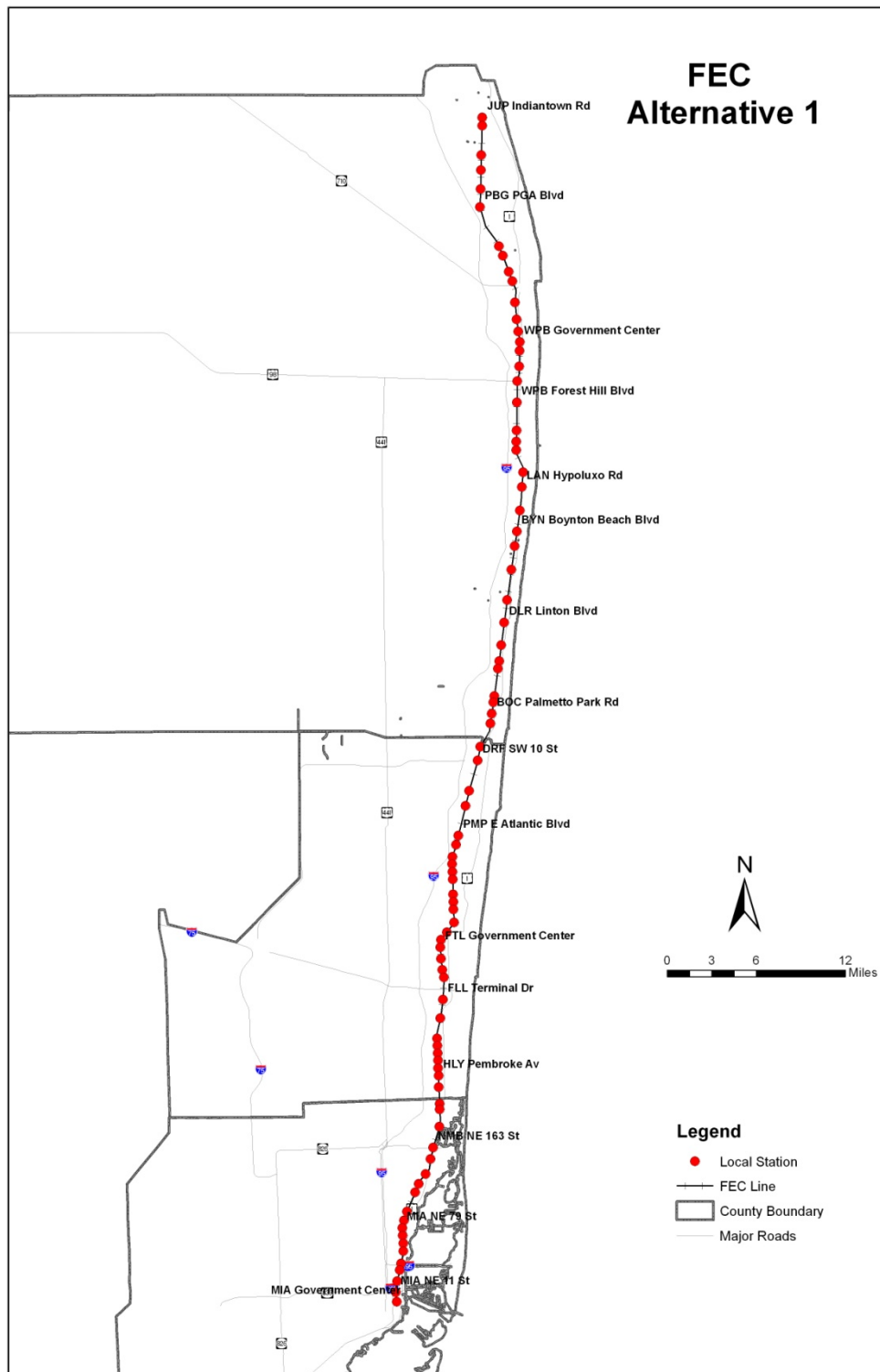


Figure 2: Automobile Competitive (AC) option

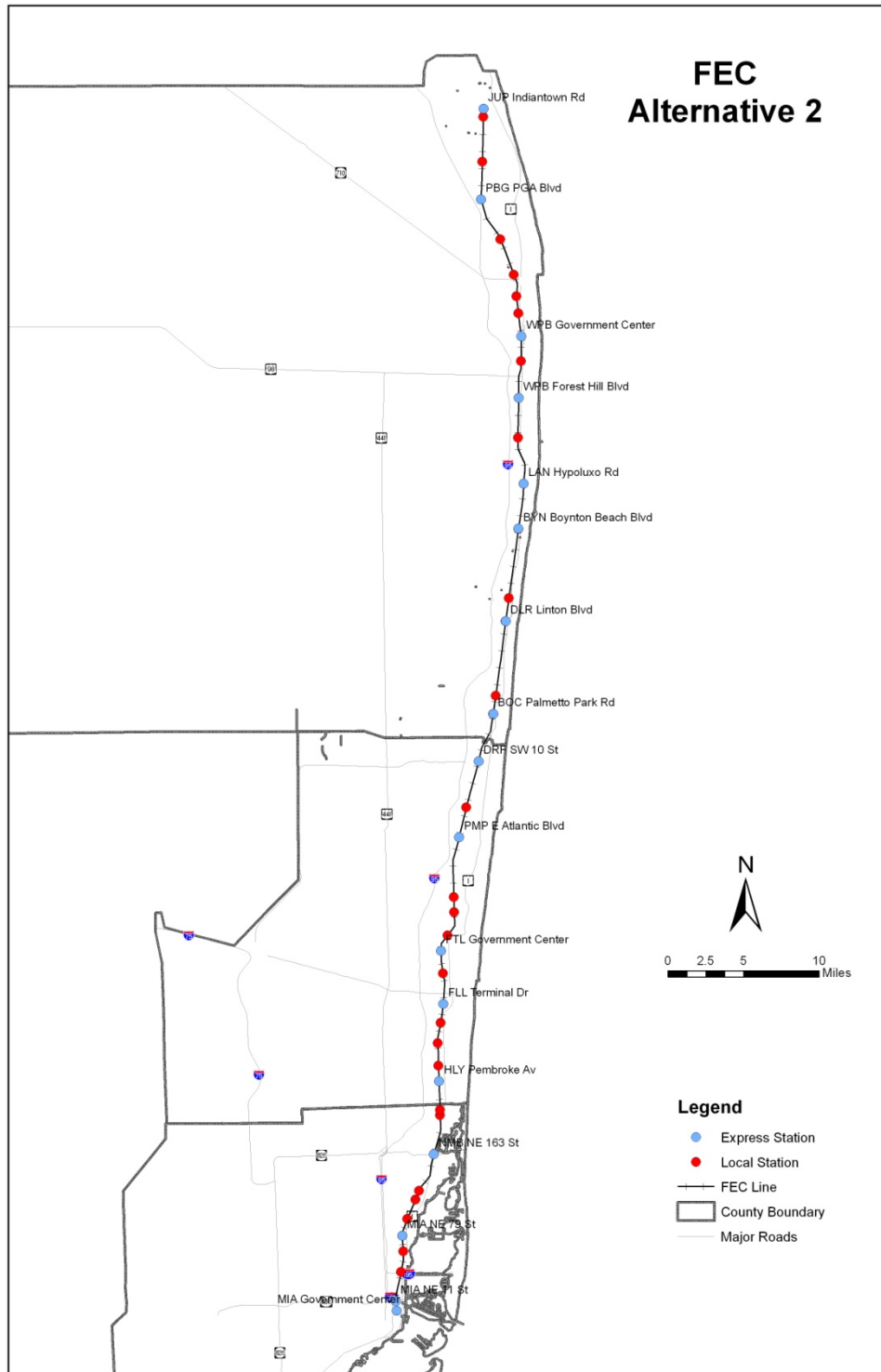


Figure 3: Revised Urban Mobility Option

