POMPANO EDUCATION CORRIDOR TRANSIT STUDY –

TRANSIT SERVICE ALTERNATIVES WITH CAPITAL AND O&M COSTS

TECHNICAL MEMORANDUM #3

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July 2015

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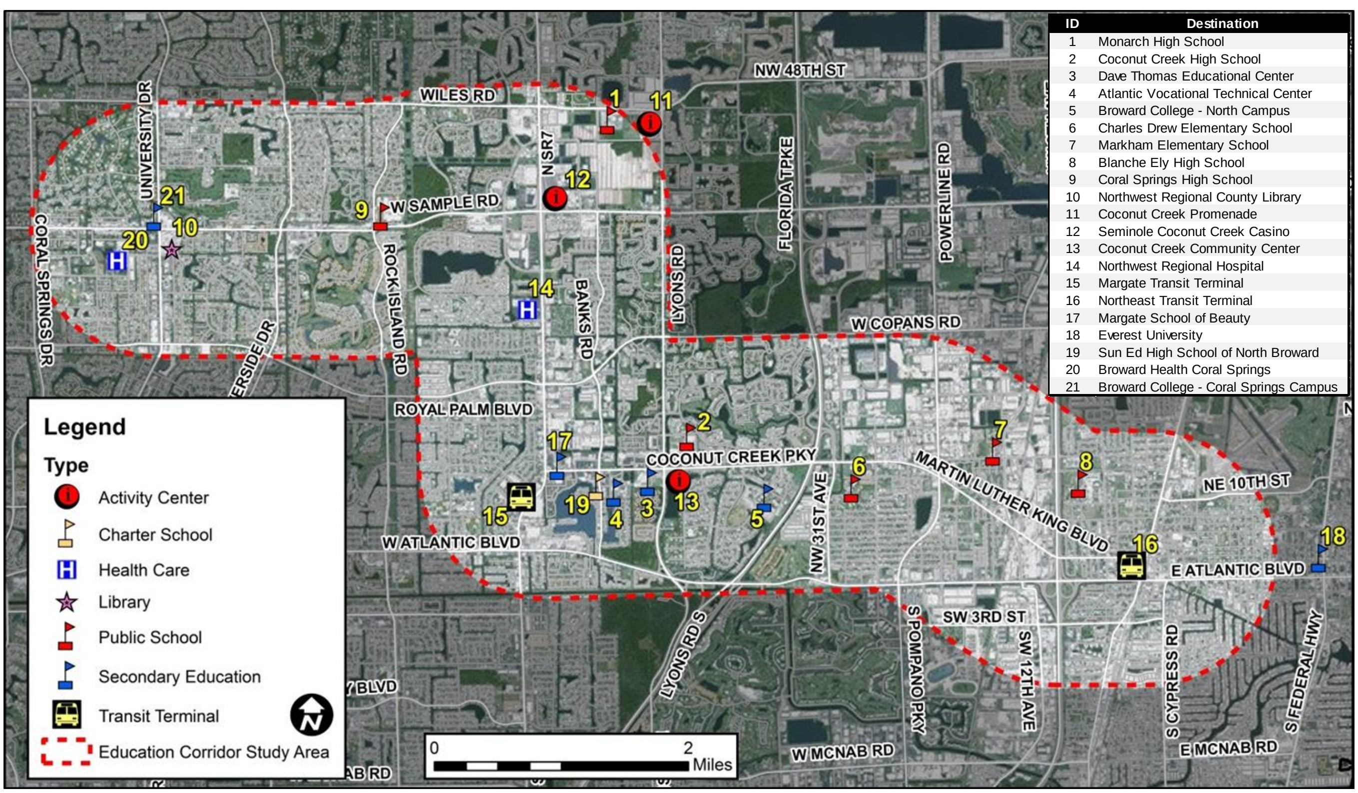
1.0 INTRODUCTION

The Broward County Metropolitan Planning Organization (MPO) has retained HNTB to conduct a study to determine the feasibility of a transit shuttle or circulator to improve access to the educational facilities among four municipalities: Pompano Beach, Margate, Coconut Creek, and Coral Springs. There is existing community bus and fixed route bus service in each of these cities. The fixed route service is provided by Broward County Transit (BCT). All of the cities except Coconut Creek separately contract the operations and maintenance of their respective community bus service to Limousines of South Florida (LSF). Coconut Creek operates their community bus service in-house.

The purpose of the community bus services, as defined by BCT in their 2014 Transit Development Plan, is to promote and advocate economic development and livability through transit investments. This unique service provides the vital first / last mile connection for residents, whether their destination is a shopping center, school, or a connection to a BCT route. The community bus service is meant to compliment BCT service with coordinated transfer points.

The general area for this study extends from University Drive in Coral Springs to the Northeast Transit Facility on MLK, Jr. Boulevard in Pompano Beach. The three major roads within the study area include Sample Road, SR 441, and Coconut Creek Parkway. A map of the study area with key destinations such as schools, community centers, and other public institutions is presented in Figure 1.

Figure 1 – Pompano Education Corridor Study Area



This technical memorandum outlines the various alignment options that have been developed, along with their associated capital and operations and maintenance costs. Stop spacing and vehicle capacity options will also be discussed in relation to their effects on the overall service plan and costs for a potential new alignment for the proposed circulator.

2.0 PROPOSED SERVICE PLAN

The proposed alignments and accompanying service plan that have been developed were guided by the objectives collectively developed by the cities. Each city has a representative on the project management team. These objectives included:

- Improved transit access for educational institutions
- Support for the planned development/mobility hubs and activity centers
- A continuous east-west transit service

The existing BCT fixed transit service within the study area operates mainly along major roadway corridors and is not very well integrated with some of the major activity centers along the education corridor. In addition, the existing community buses generally do not cross municipal boundaries and instead focus around their respective downtown termini. The existing community bus routes within these cities have limited connections to each other and provide service within sixty-minute headways.

Existing BCT routes run along major arterials, offering "transfers" where two different routes intersect. Sometimes these transfer locations consist of a simple bus stop and bench, while other transfer locations are much more enhanced, such as the Northeast Transit Terminal in Pompano Beach that has bus bays, covered pedestrian waiting areas, schedule information, security, and other amenities.

Currently, a minimum of two transfers are required if someone desired to travel from downtown Coral Springs (Sample Road / University Drive) to downtown Pompano Beach (MLK, Jr. Boulevard / Dixie Highway) using public transit. This transit rider would start the trip by taking BCT Route 34 across Sample Road and transfer to either BCT Route 19 or Route 441 at SR 7. The transit rider would then take Route 19 or Route 441 south to Coconut Creek Parkway and transfer to Route 62, which would then ultimately take them to Pompano Beach. This hypothetical trip currently requires two transfers. Requiring two transfers is extremely time consuming for passengers because these transfers are often not coordinated, meaning that each transfer could take 30 minutes or more. Capturing choice riders is difficult with these kinds of trip scenarios and wait times.

To address the need expressed by the cities in their goals of establishing new service, a new bus circulator service is desired to serve all four cities, preferably without a forced transfer. This new shuttle would also provide frequent transit service to each of the cities' (revitalized) downtown areas, further augmenting the downtown development efforts.

This new circulator service with premium-level service should also be tailored to meet the needs of the various educational institutions along the corridor. Most trips to or from schools occur during the non-peak hours when compared to traditional work-related trips. Understanding the unique transportation needs of students, such as class scheduling and when they most need service, will be critical to developing a service plan that meets the needs of the community.

2.1 Span of Services and Frequency

A study by researchers at San Jose State University[1] recently found that by controlling for factors such as the presence of other transit services, population density, gas prices, and demographics, the number one indicator for bus ridership are bus service levels. It turns out that there is a direct relationship between the cities that cut service and the cities that saw the largest drops in ridership. On the other hand, cities that have invested in improved transit service saw increases in ridership. Based on data from US urbanized areas with at least one million residents, these studies also pointed out that ridership is more dependent on service levels than the other way around. The study concluded that ridership is most dependent on the quality of service – particularly how often it runs, how quickly, and for how much of the day.

In order for a new circulator service to be successful in meeting the objectives set out by the cities, a robust service plan with frequent service and late operating hours is required. Anticipating limited available funding, the proposed service plan can be phased in over time until the desired levels of service are reached. One caution with this approach would be the "first impressions" riders and citizens would get with the initial service. This tradeoff will be further examined when analyzing funding sources and implementation strategies. A more detailed look at the cost implications for providing varying frequencies and / or spans of service is included later in this memo.

The proposed weekday service frequencies and span for a new circulator are:

- 6am to 9am – every 10 minutes
- 9am to 3pm – every 15 minutes
- 3pm to 6pm – every 10 minutes

[1] http://transweb.sjsu.edu/PDFs/research/1101-transit-bus-demand-factors-in-US-metro-areas.pdf

- 6pm to 8pm – every 15 minutes
- 8pm to 11pm – every 30 minutes

The proposed weekend service frequencies and span are:

- 8am to 9pm – every 15 minutes
- 9pm to 11pm – every 30 minutes

These service levels would result in 74 daily trips on the weekdays and 56 daily trips on the weekends. For comparison purposes, existing community bus routes provide 60 minute headways that offer approximately 10 trips or less on the weekdays. Most existing community bus routes do not provide weekend service at all. Current community buses generally do not provide service beyond the PM peak period (usually around 6 pm), which limits the ridership potential. Students, workers, or anyone else needing to commute after the PM peak period are unable to currently rely on community buses. Therefore, the proposed service plan should recommend late evening service, even if this late evening service must be phased in over time.

The design of the level of service has a direct impact on the number of vehicles needed and their associated service costs. These costs will be further detailed later in this memo.

2.2 Route Alignments

Using ReMix (formerly known as TransitMix), a new transit service planning software, various route alignments and service plans were developed to compare costs. For comparison purposes, two different service types were developed, each with their own number of variations: the no-transfer alternative(s) and the one-transfer alternative(s). Despite the cities for a service plan with no forced transfers, a one-transfer alternative was developed to compare to the no-transfer alternative, which is still less than the two or three transfers currently required using BCT fixed bus routes and/or community buses.

During the project management team meeting of April 23, 2015, the project management team was able to visualize these potential route alignments that were developed while automatically displaying the estimated operational costs for each. Any modifications suggested to the proposed route alignments during the meeting were depicted instantly, which immediately changed the estimated costs. This functionality allowed the project management team to better understand the cost implications for any route alignment or service adjustments.

The proposed alignments will be evaluated using criteria established by the project management team to select a preferred alignment. (This process will be completed and documented in Tech Memo 5.)

2.2.1 No-Transfer Alternatives

A variety of alignments were developed that provide direct service from Coral Springs to Pompano Beach that take into account service to major educational institutions, trip attractions/producers, current BCT ridership trends, future planning efforts, and other operational considerations. Each alignment alternative varies based on how it circulates through each of the four cities' downtown areas and whether direct service is provided to Broward College's North Campus. All alternatives are bi-directional. Note that the circles along the alignment do not necessarily correlate to stop locations; they merely help establish the alignment along the map.

These alignments, along with the one-transfer alternative alignments, will be evaluated using criteria to ultimately select a preferred alignment. These criteria will consider the ridership potential, community impact, travel time, cost, and traffic impacts for each alternative alignment. This evaluation will be further detailed in Tech Memo 5.

The table below describes some basic characteristics for each no-transfer alternative to better illustrate the similarities and differences between them. Total route mileage ranges from 24.42 to 33.4 miles. Routes that deviate more within each of the four downtown areas and / or directly serve Broward College have more total route mileage. Directly associated with total route mileage is total service area, which is defined as the total area within 1/4 mile of the proposed alignment. Because alignment 1F has the greatest total service area, it is not surprising that alignment 1F also has the most people living within 1/4 mile of the proposed alignment.

Most of these alignments are very similar and are slightly different from one another. Many of the proposed alignments serve the same major ridership generators. The major ridership locations included all the key destinations identified in Tech Memo 1 as well as any clusters (typically at an intersection) of existing bus stops with high levels of ridership. Key destinations also include future mobility hubs. Connecting to these mobility hubs is pivotal for improving the integration between the various transit services. Alignments 1C and 1E do not directly serve the future Margate Transit Terminal, while alignment 1F extends further south to Atlantic Boulevard serving an existing transit stop cluster with high ridership.

Table 2 – No-Transfer Alternative Alignment Characteristics

No-transfer Alternative Alignments							
Criteria	1A	1B	1C	1D	1E	1F	1G
Service Coverage - area (sq.mi.) 1/4 mile from bus stop	6.8	7.1	6.1	6.5	6.4	8.1	6.9
Service Coverage - population 1/4 mile from bus stop	12,321	14,454	8,209	10,170	8,322	19,075	15,916
Route Mileage (roundtrip)	27.6	29.3	24.4	25.2	26.0	33.4	28.2
# of Major Ridership Locations	15	15	14	15	14	16	15

Figure 3 – Alternative 1a

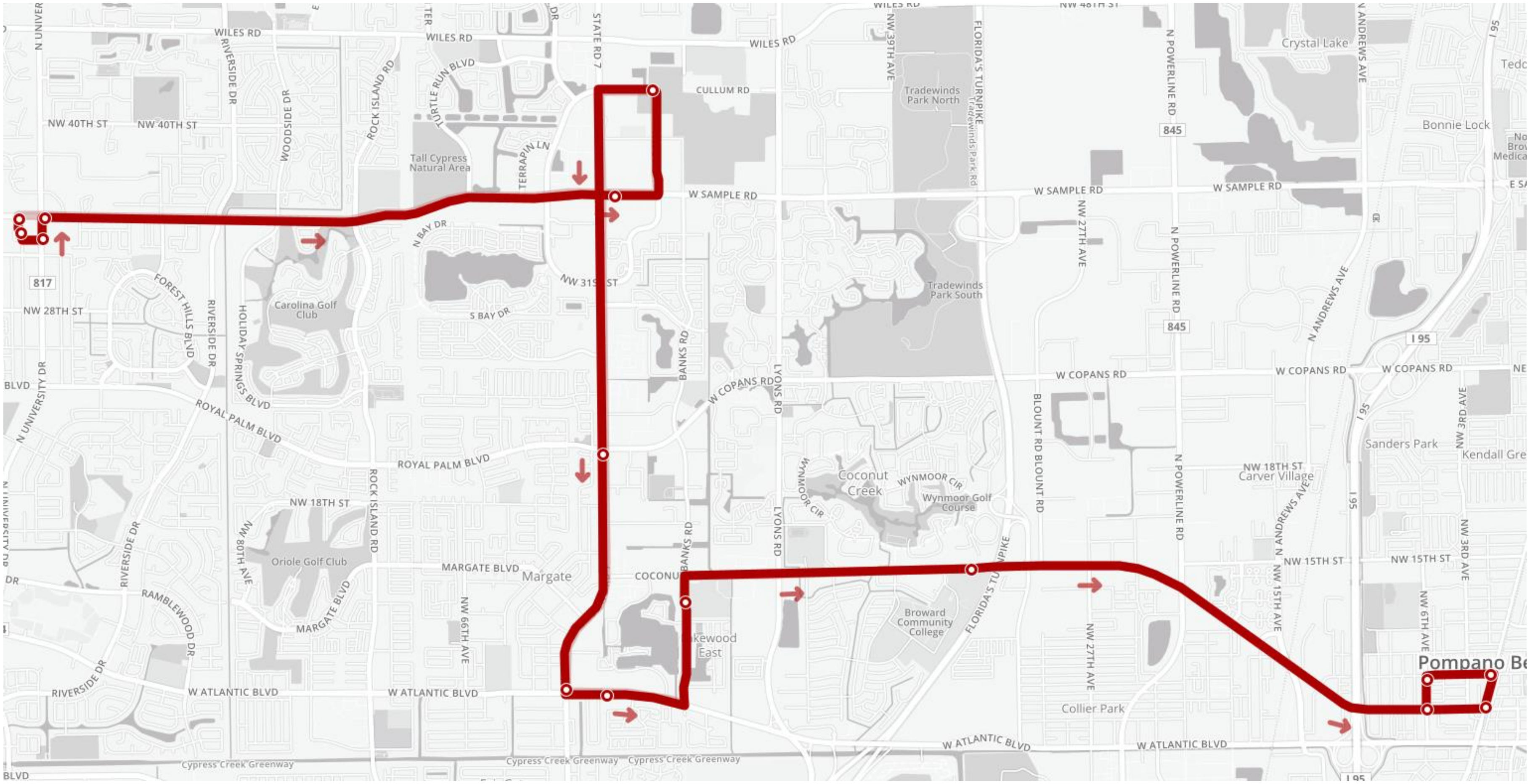


Figure 4 – Alternative 1b

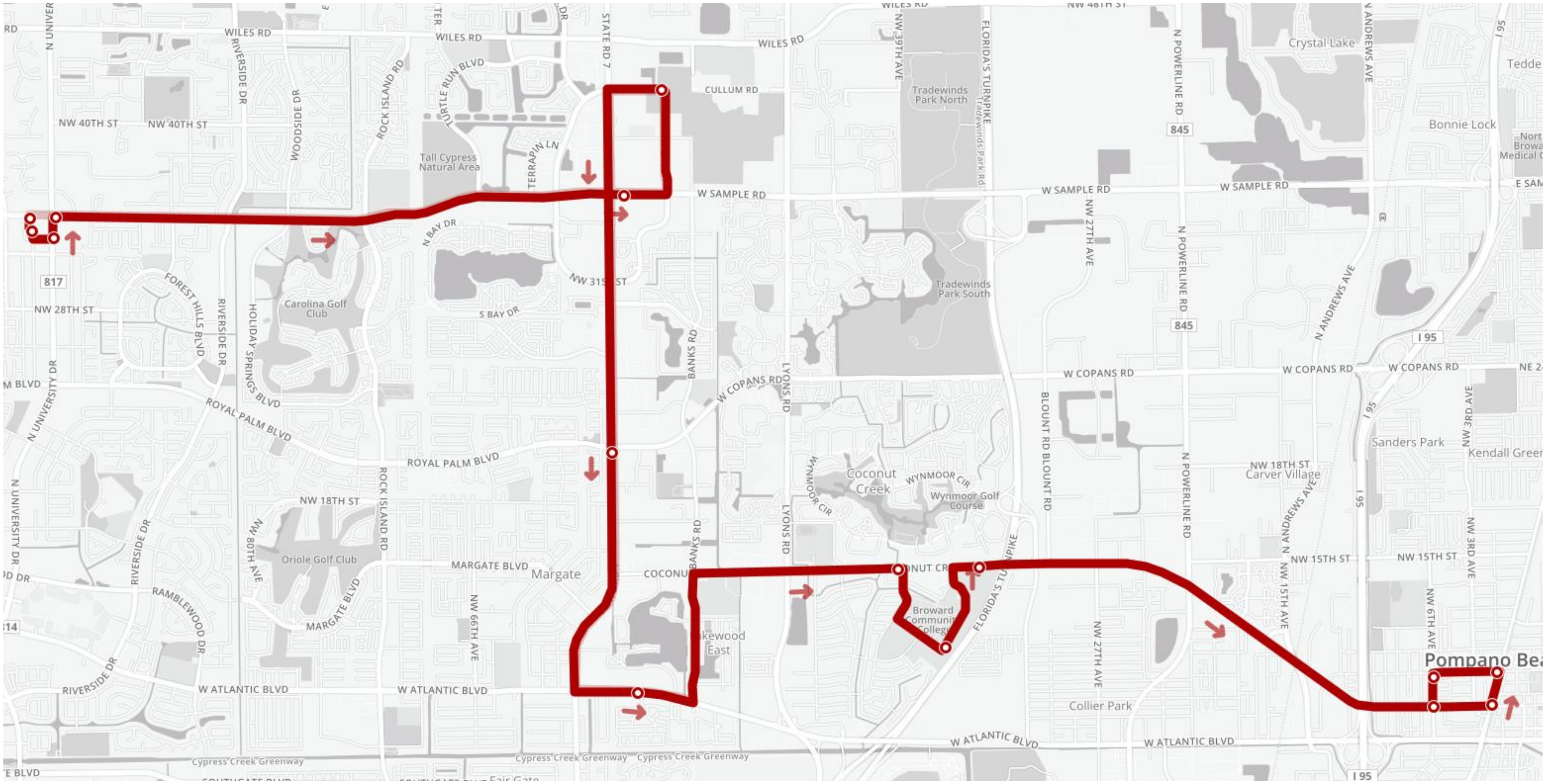


Figure 5 – Alternative 1c

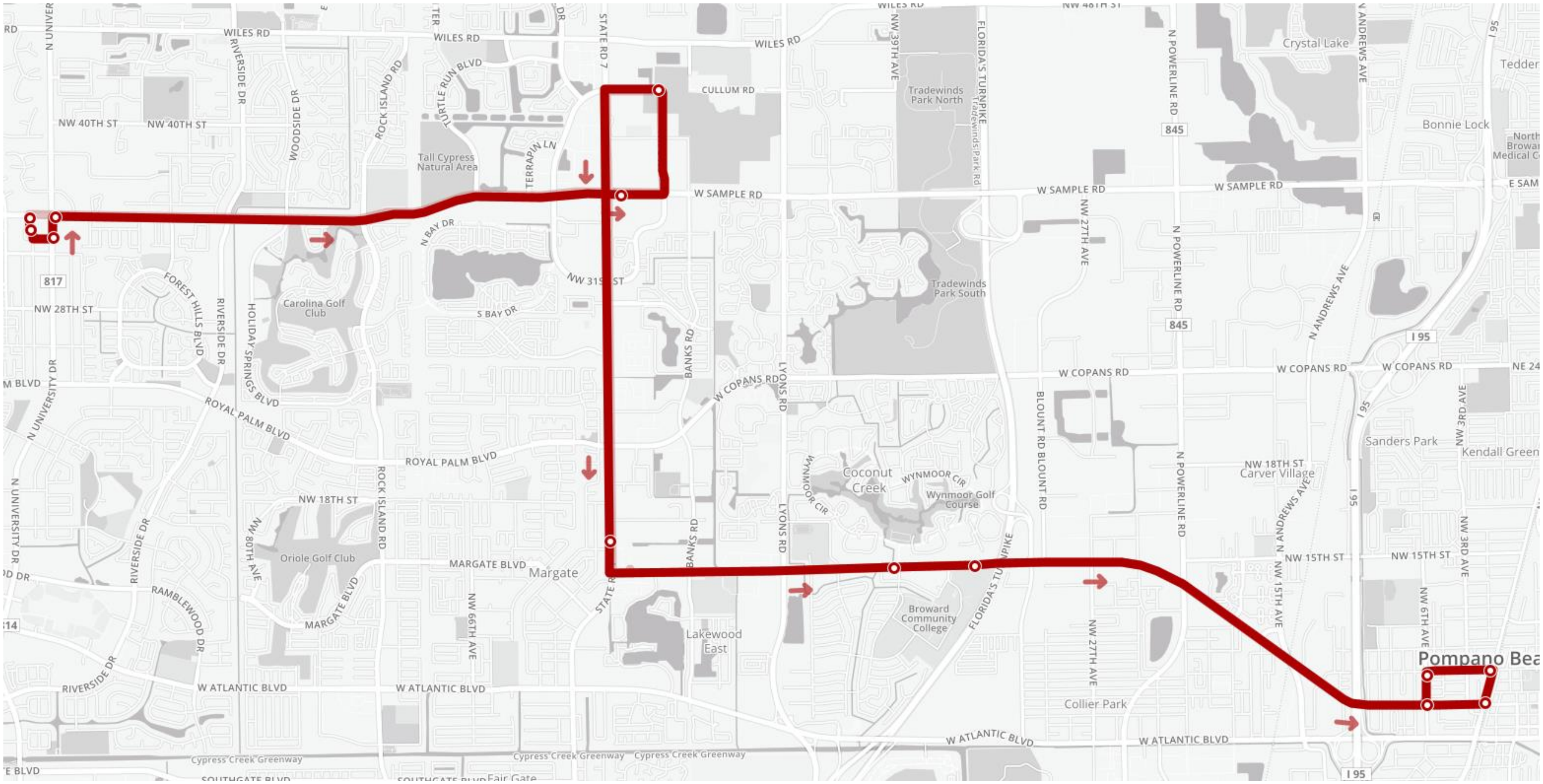


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Figure 6 – Alternative 1d

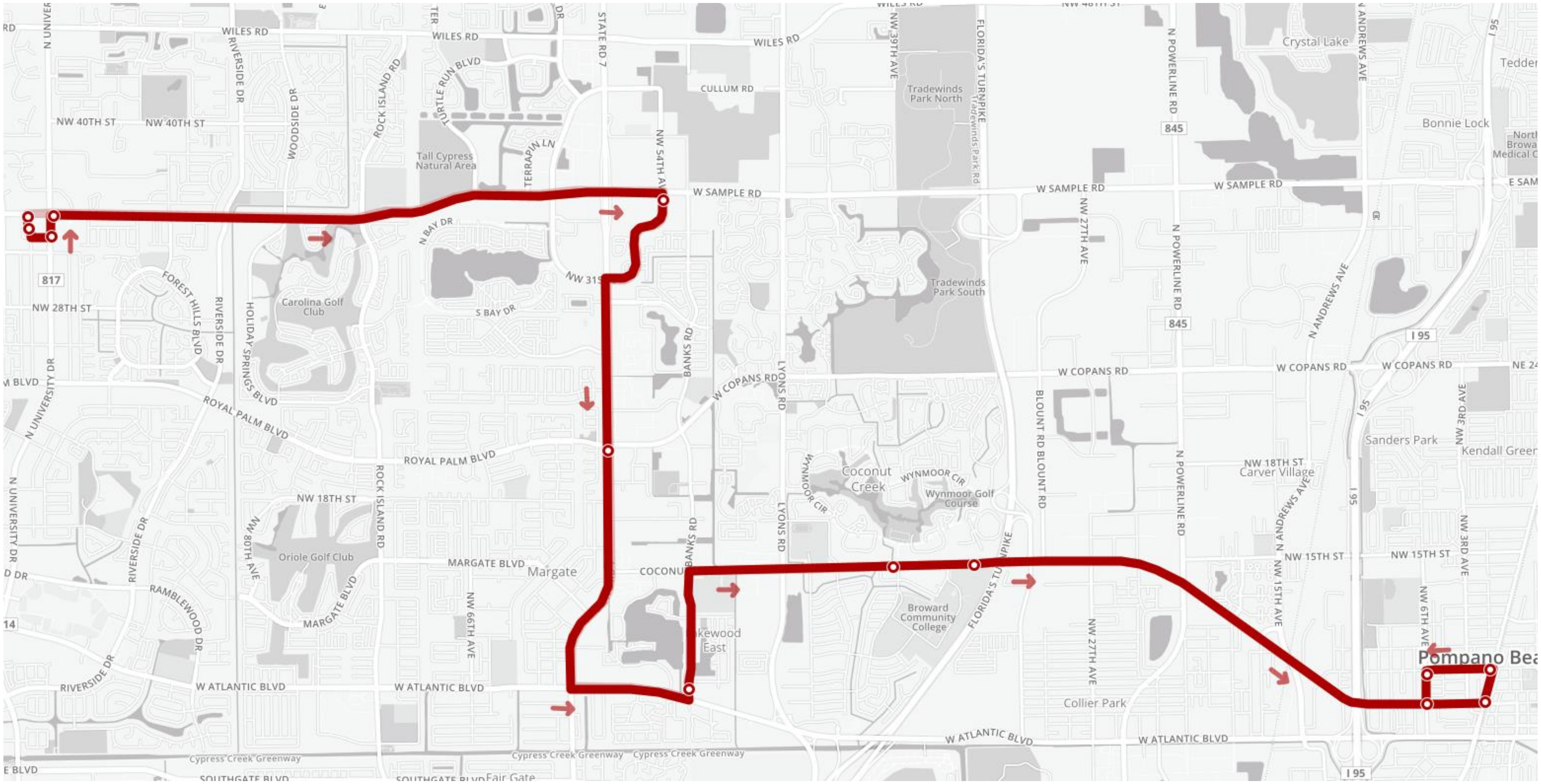


Figure 7 – Alternative 1e

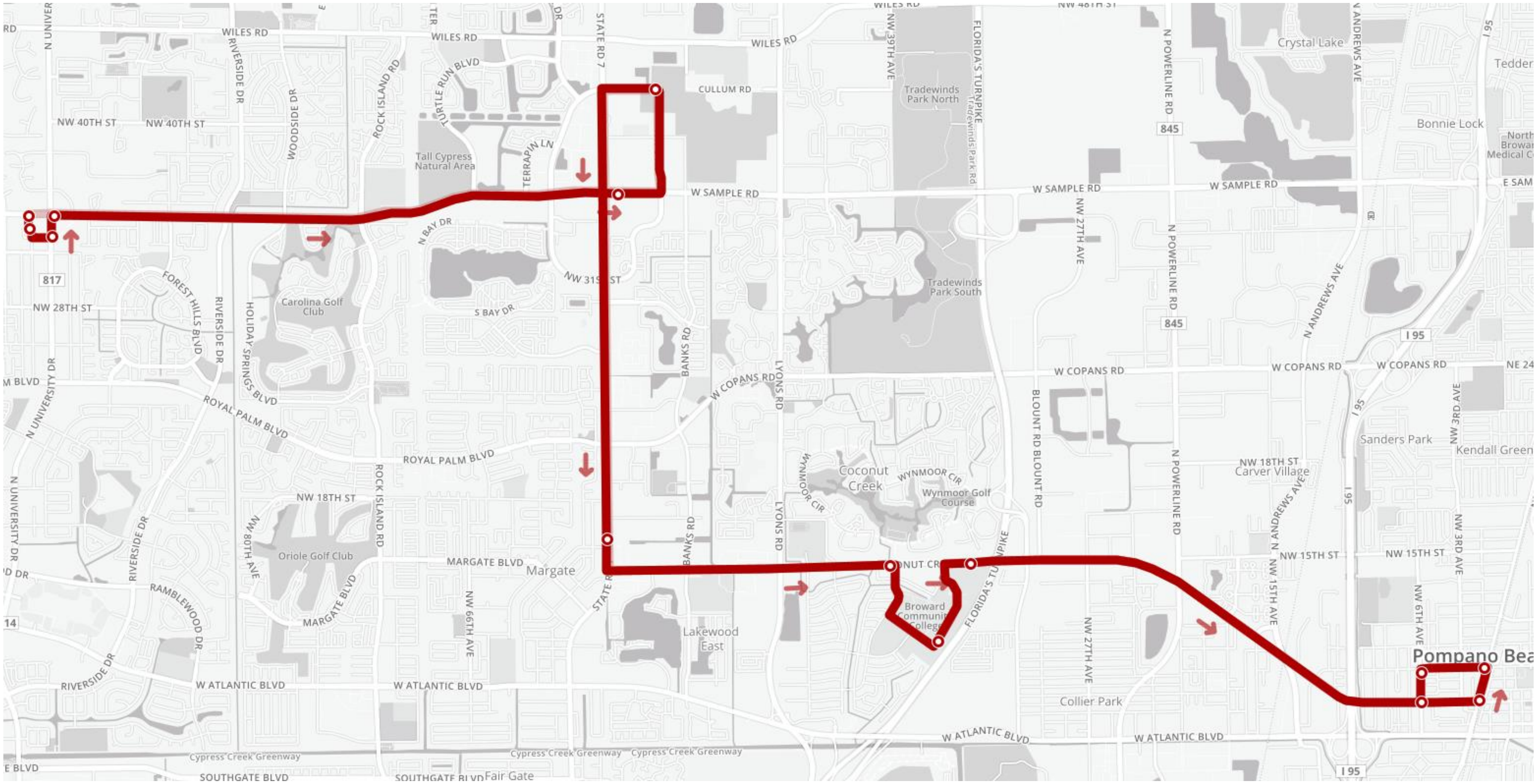


Figure 8 – Alternative 1f

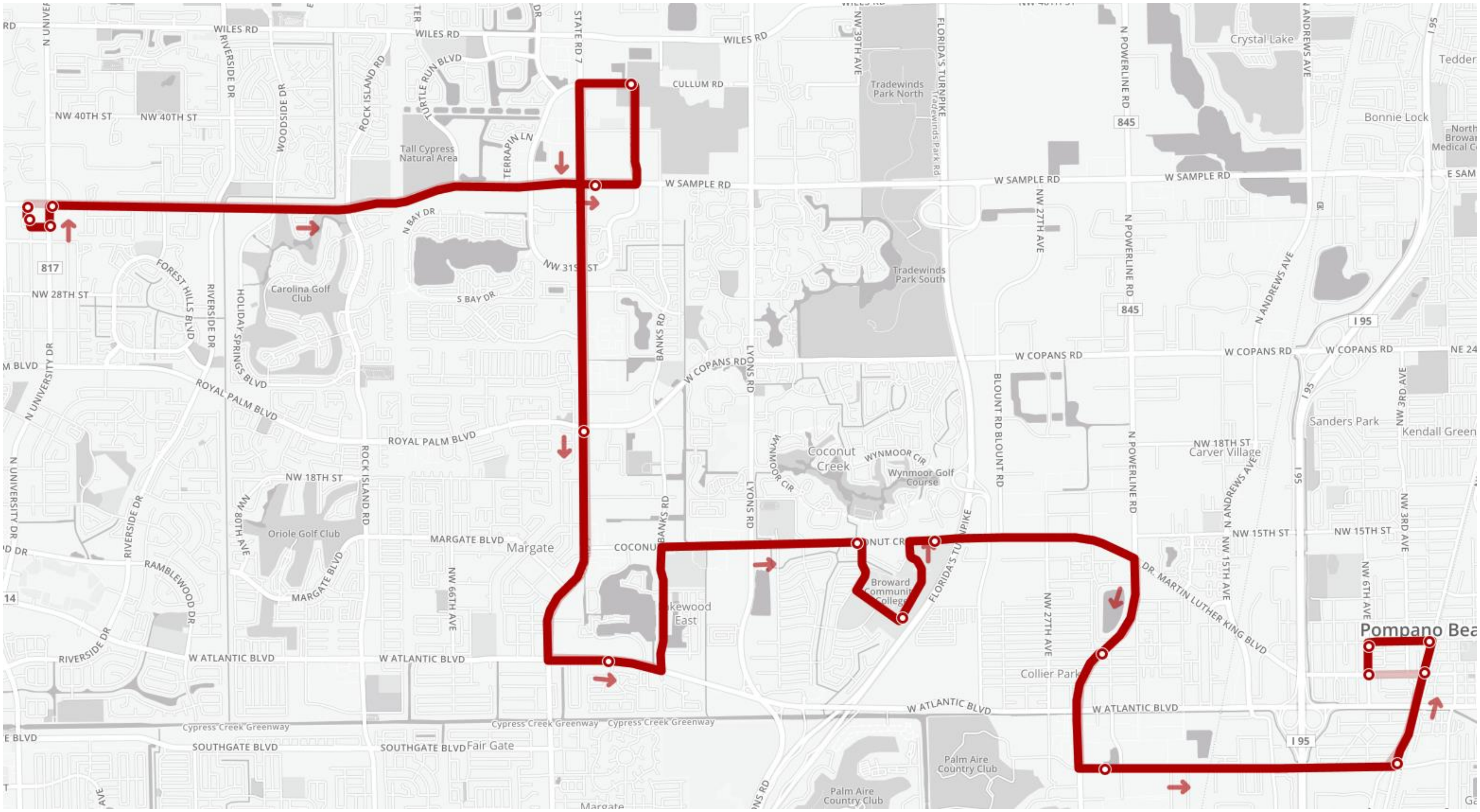
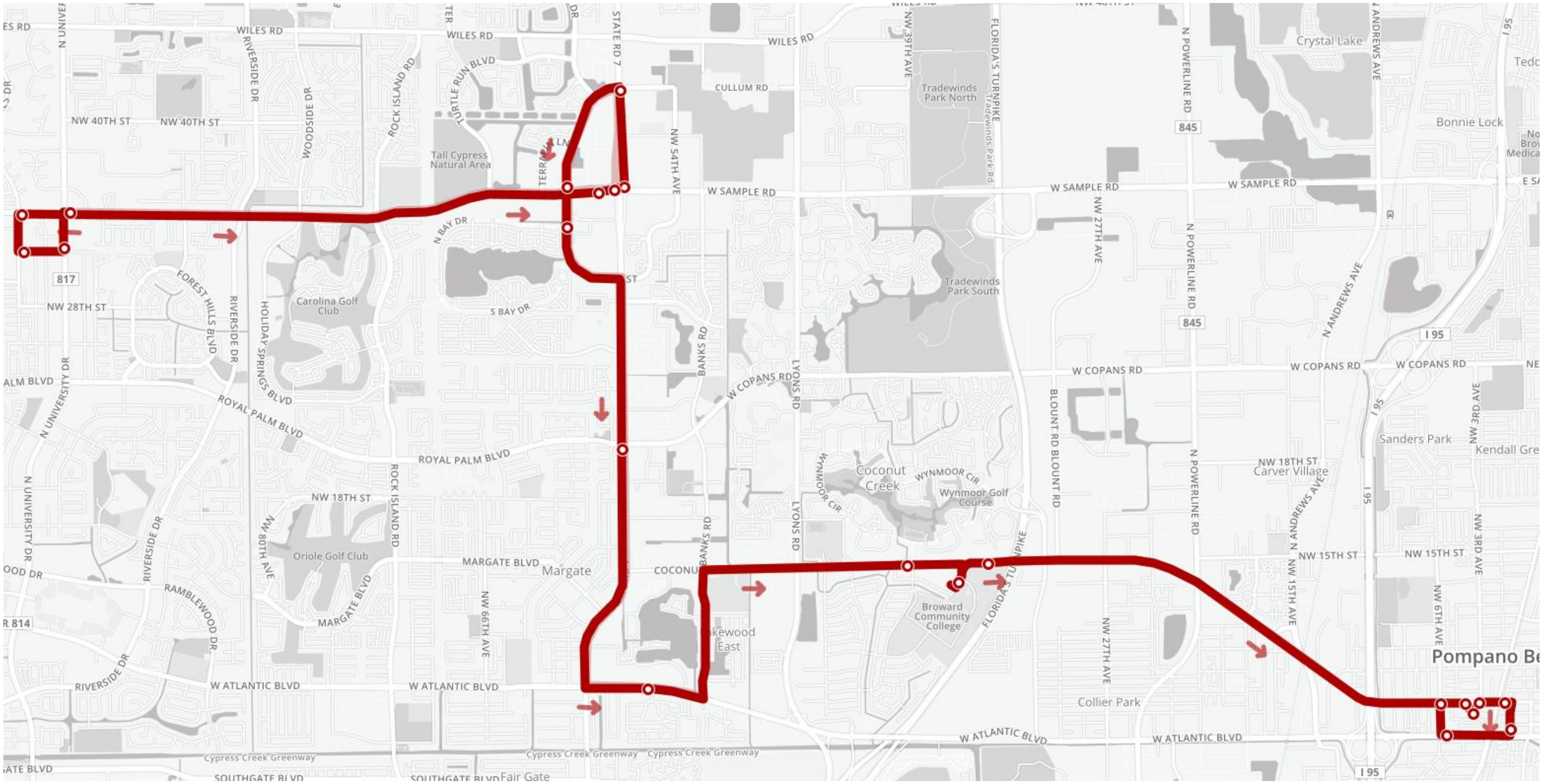


Figure 9 – Alternative 1g



2.2.2 One-Transfer Alternatives

The one-transfer alternative is a combination of two new routes – one of which serves the area between Coral Springs and Margate, and the other route serving the areas between Coconut Creek and Pompano Beach. The one-transfer alternatives would require riders attempting to travel between Coral Springs and Pompano Beach (or points in between) to transfer along SR 7 between Coconut Creek Parkway and Sample Road.

The two service routes, when overlaid onto each other, provide duplicative service along SR 7 (which is currently served by BCT fixed route service). Overlapping two routes along SR 7 would increase costs as compared to the no-transfer alternative, but would provide a higher level of transit service along SR 7 – which has been designated a transit-oriented corridor by the Broward County Future Land Use Plan. Overlapping transit service would also cut the proposed headways in half along SR 7. For example, if headways are ten minutes, then a bus should arrive at a SR 7 stop every 5 minutes for the one-transfer alternatives. Note that some of the alternative alignments proposed have additional duplicate service beyond SR 7 depending on the proposed alignments within both Coconut Creek and Margate.

The MPO identified mobility hub locations in their 2035 Long Range Transportation Plan (LRTP) and specifically identified a 'gateway hub' at Sample Road and SR 7 as well as a 'community hub' at Atlantic Boulevard and SR 7. Mobility hubs are located at specific transit access points with frequent transit service and high development potential. These hubs focus on providing enhanced passenger and pedestrian amenities that offer a secure and comfortable environment for safe and easy transfers between routes.

Although the MPO is still evaluating the locations and characteristics of the identified mobility hubs, it is recommended as a part of this study to keep the two locations identified within the study corridor. It may be recommended to move the Atlantic / SR 7 'community hub' to Margate Boulevard / SR 7 or Coconut Creek Parkway / SR 7 depending on the alignment selected for this proposed service.

Two alternatives were developed for the route serving Coral Springs and Margate; three different alternatives were developed for the route serving the area between Coconut Creek and Pompano Beach. When combining an alternative from the first route with an alternative from the second route, six different routing combinations are possible. These proposed route alignments take into account the same considerations as the no-transfer alternatives such as major destinations, location of schools, and other operational characteristics.

The proposed service span for the no-transfer alternative is the same as the proposed service span for the one-transfer alternative. The only difference between the no-transfer and one-transfer alternative is the service frequency along SR 7, where, as mentioned previously, service is duplicated (more stops) for the one-transfer alternative.

As noted earlier, these alternatives will be evaluated using criteria to ultimately select a preferred alignment. These criteria will consider the ridership potential, community impact, travel time, cost, and traffic impacts for each alternative alignment.

The table below describes some basic characteristics for each one-transfer alternative to better illustrate the similarities and differences between them. Total route mileage ranges from 32.19 to 38.01 miles. One-transfer alternative alignments have more total route mileage than the no-transfer alternative alignments because there is duplicated service along SR 7. Total service area for the one-transfer alternative alignments ranges from 6.43 to 7.27 square miles, similar to the no-transfer alternatives except Alternative 1F (8.133 sq. mi.). Because alignment 2C has the greatest total service area, it is not surprising that this alignment also has the most people living within 1/4 mile.

Most of these proposed route combinations are quite similar and are only slightly different from other route combinations, which is evident by the number of major ridership generators served. Alignments 2C and 2F travel further south along SR 7 to Atlantic Boulevard before looping back to Coconut Creek Parkway via Banks Road, which serves an existing cluster of high ridership stops at Atlantic Boulevard.

Table 10 – One-Transfer Alternative Alignment Characteristics

Criteria	One-transfer Alternative Alignments					
	2A	2B	2C	2D	2E	2F
Service Coverage - area (sq.mi.) 1/4 mile from bus stop	6.4	6.7	7.3	6.9	7.2	7.2
Service Coverage - population* 1/4 mile from bus stop	11,859	13,327	15,764	12,680	13,753	14,500
Route Mileage (roundtrip)	32.2	33.5	37.1	33.3	34.9	38.0
# of Major Ridership Locations	14	14	15	14	14	15

Figure 11 – Alternative 2a

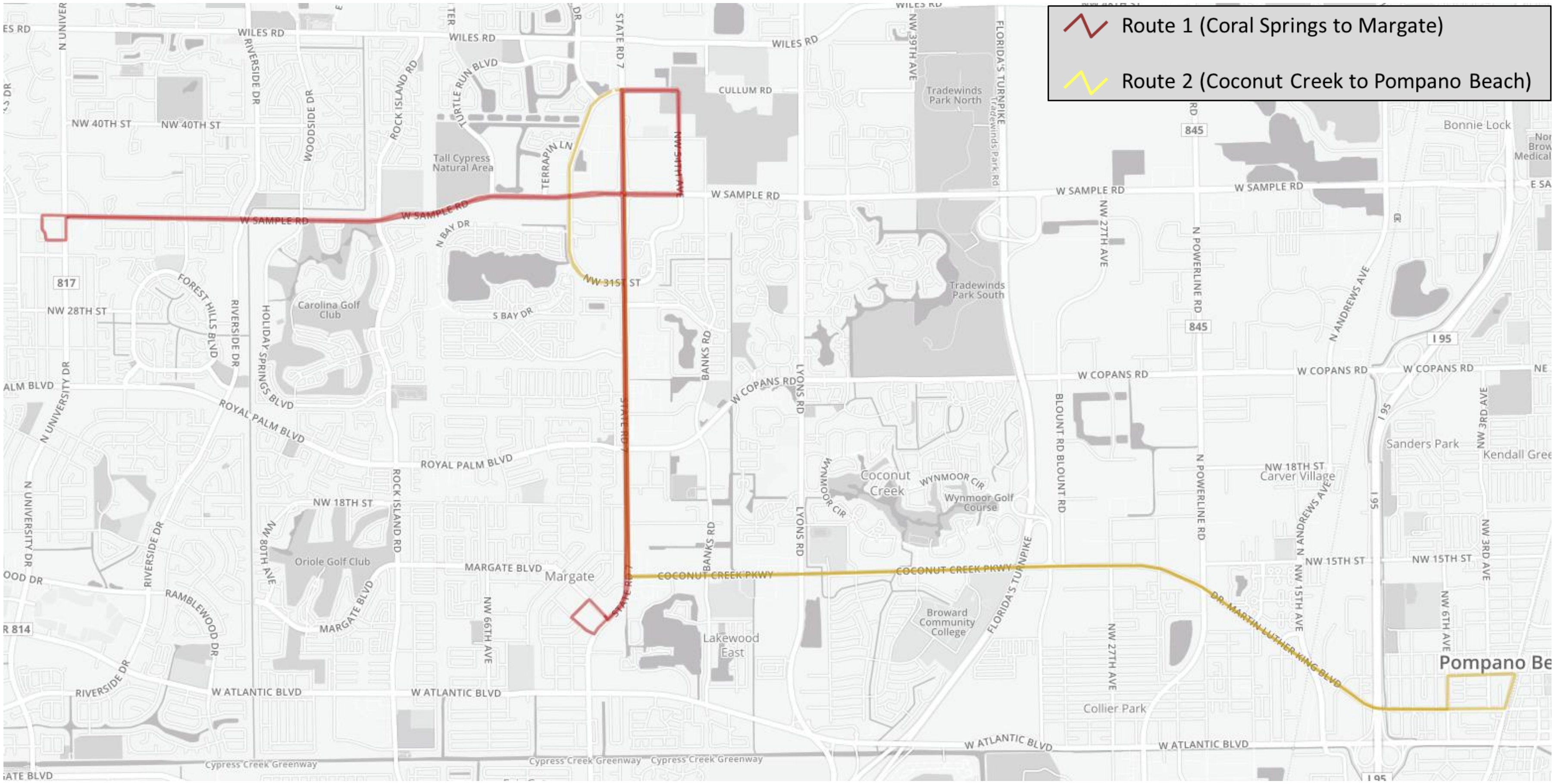


Figure 12 – Alternative 2b

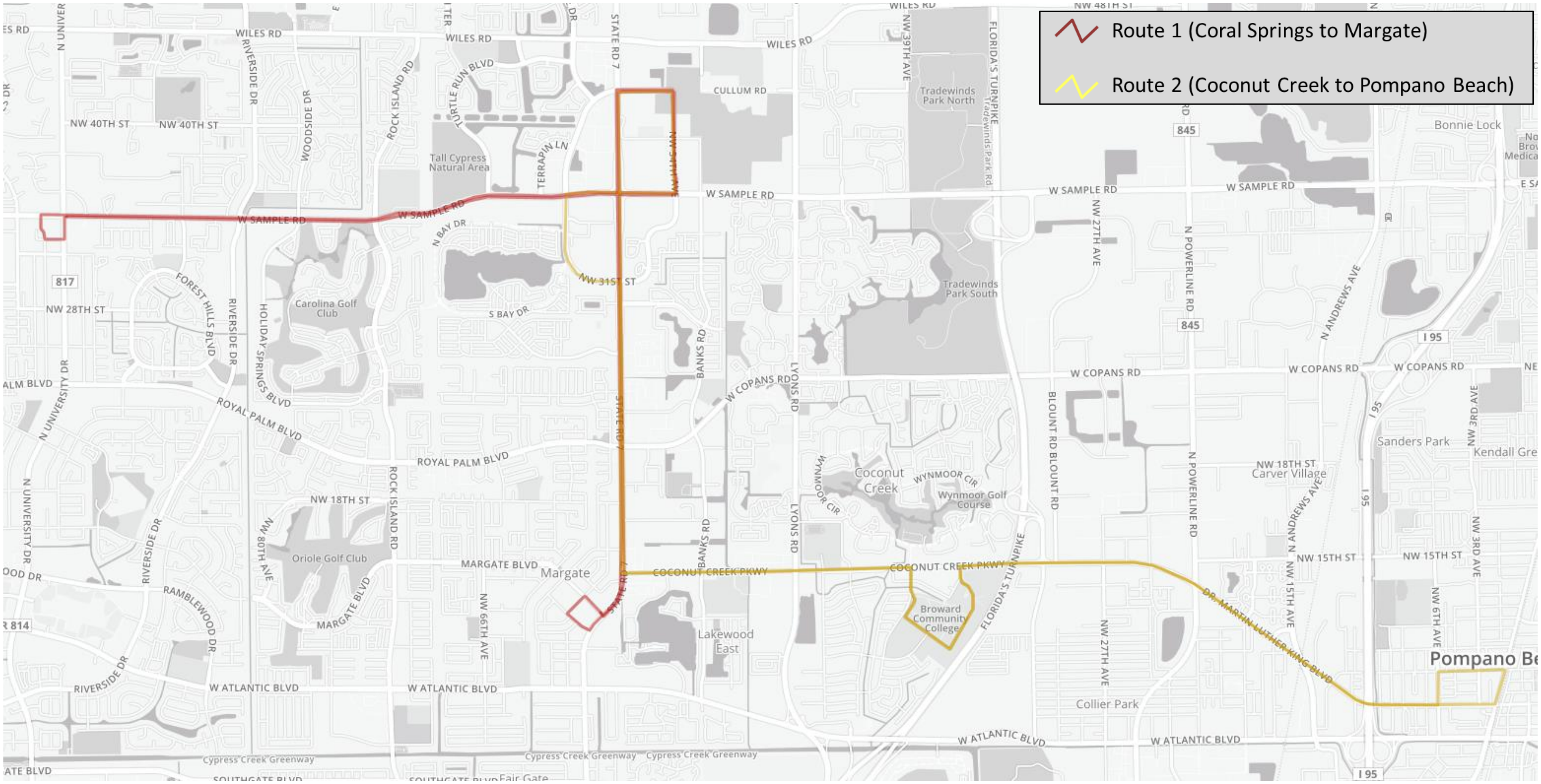


Figure 13 – Alternative 2c

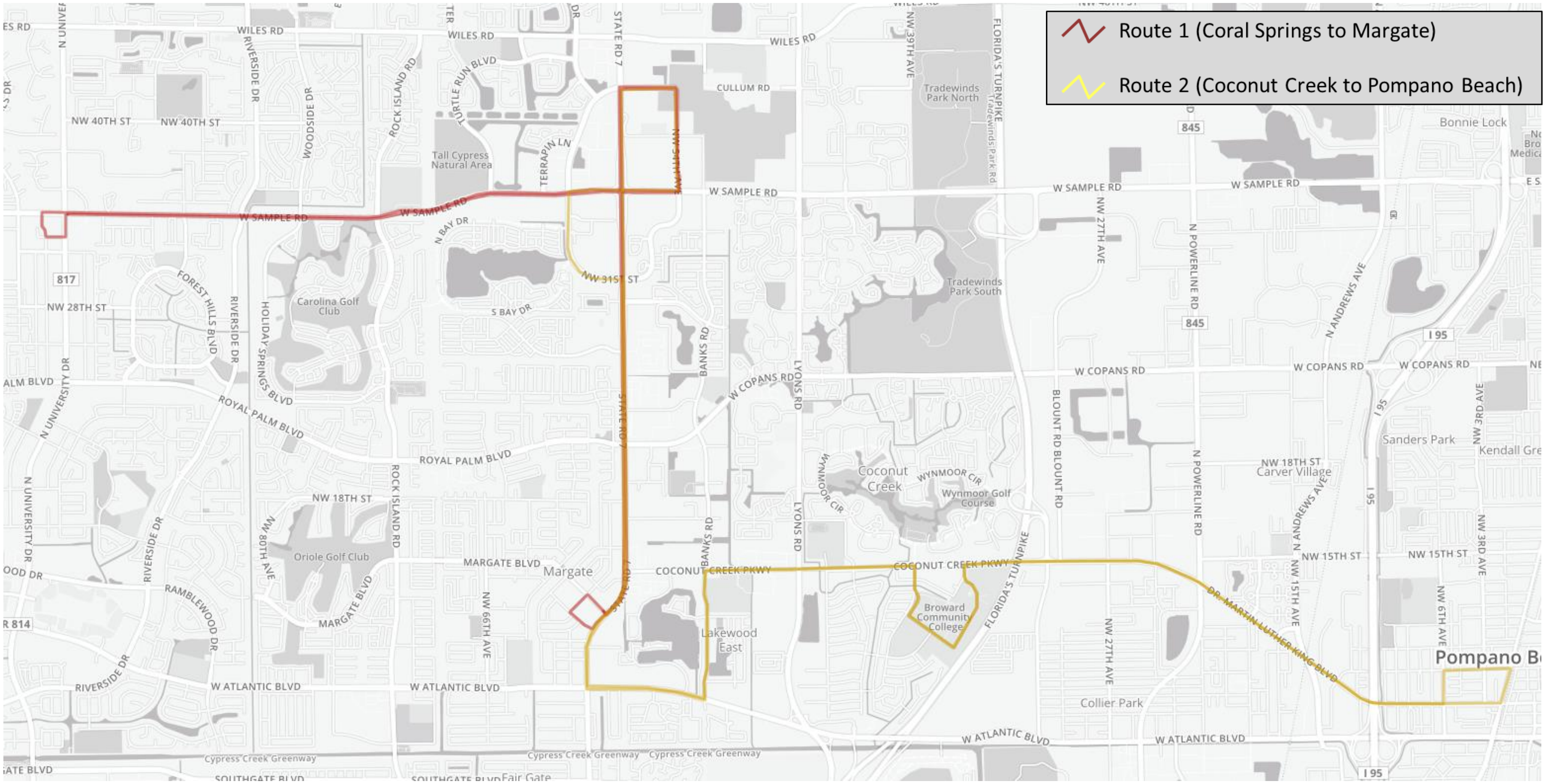


Figure 14 – Alternative 2d

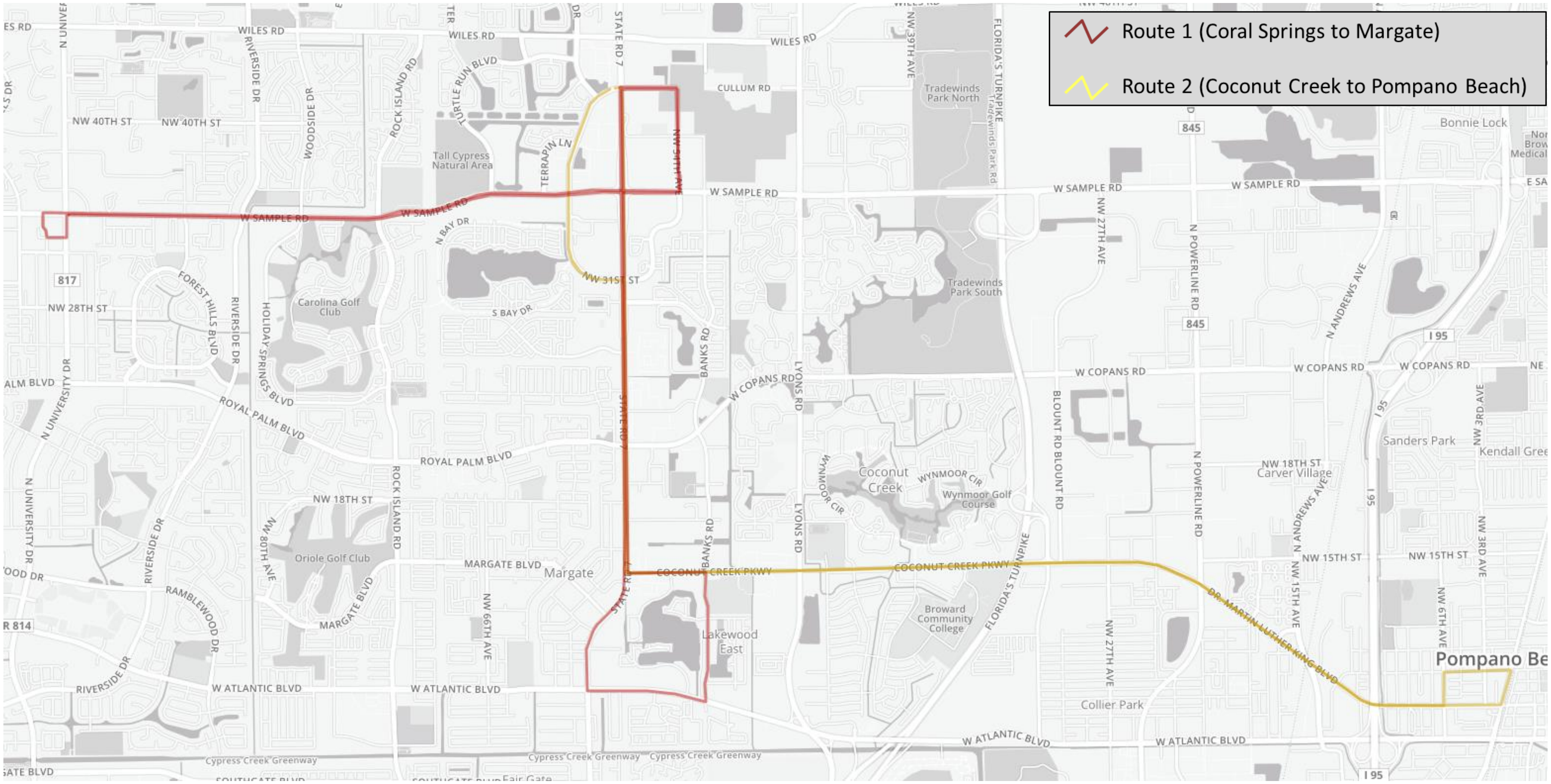


Figure 15 – Alternative 2e

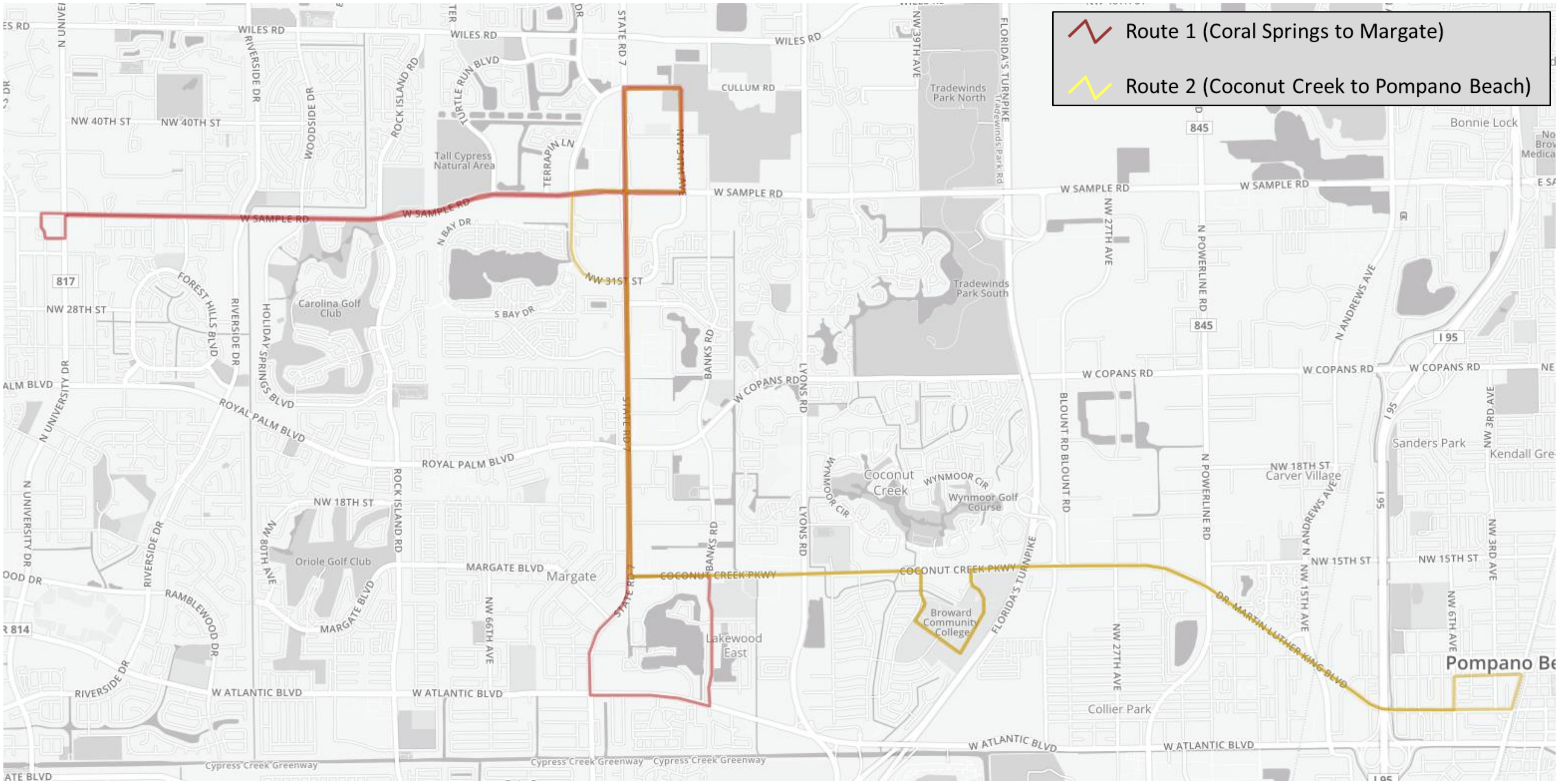
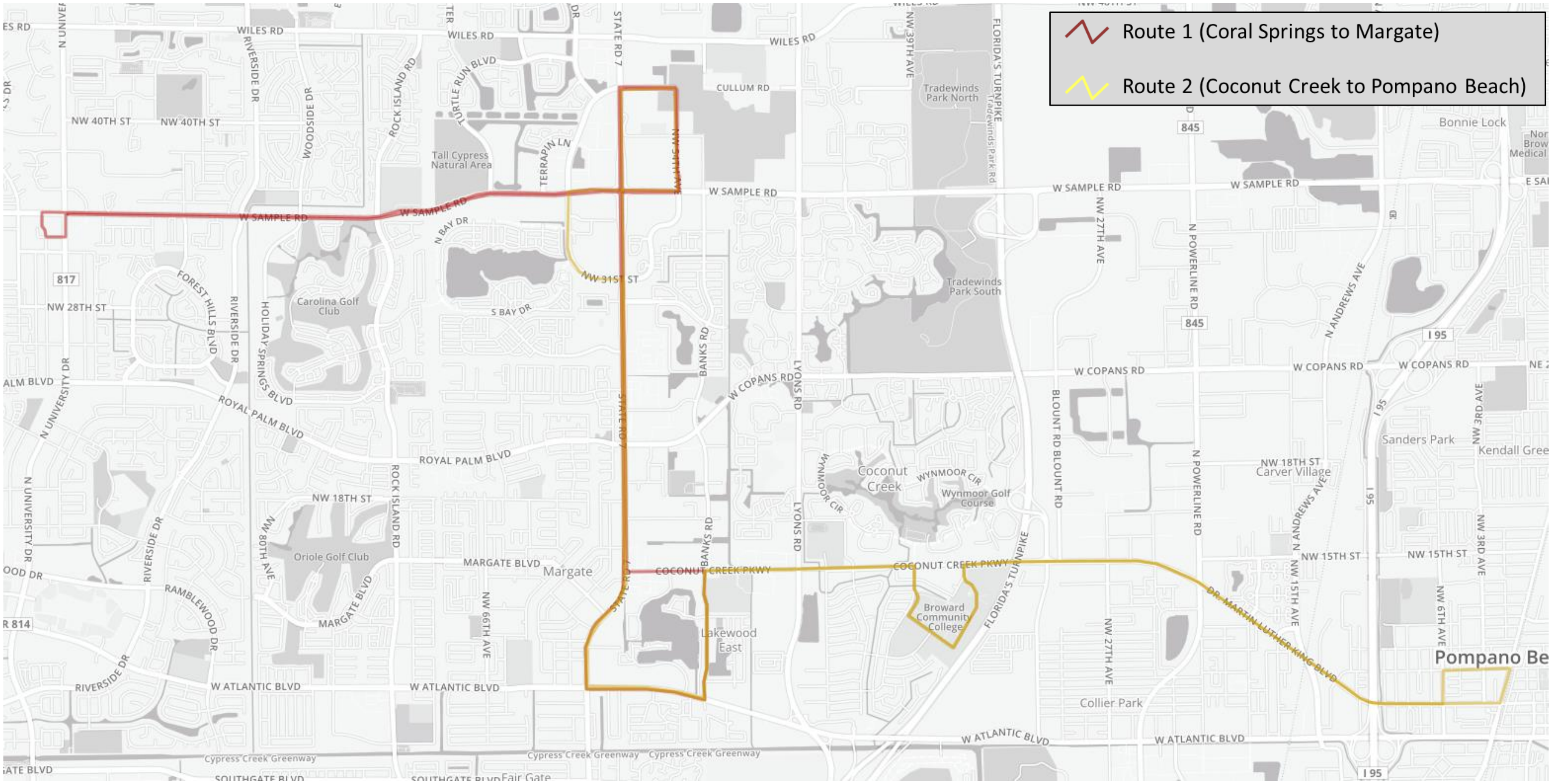


Figure 16 – Alternative 2f



2.3 Station/Stop Locations

The cities have expressed a desire for flexibility in bus stop locations to serve the various mobility needs of the community. Therefore, this study process will establish comprehensive guidelines to provide enough flexibility when determining station locations which can maximize the effectiveness of the proposed circulator/bus service. These guidelines strive to maximize ridership potential while considering the impacts to the community, travel time and speed, and cost.

2.3.1 Establishing Guidelines

Stop locations and the spacing between stops will always depend on individual circumstances, however it is assumed and expected that riders can walk at least a 1/4 mile to access a stop. Choices for stop locations will determine access to pedestrian crossings, transfer to other transit services, access to major destinations, employment opportunities, and other activity centers.

The guidelines for locating stops weigh a number of factors, and are considered in this order:

- *Transfer Locations:* Stops should be included at every intersection where there is a potential to transfer to another existing or planned transit service.
- *Existing High Ridership Stops:* Stops should be included at existing stop locations that have high levels of ridership, whether at an intersection or at a mid-block location.
- *At Major Trip Generators:* Stops should be included at all educational institutions, major transit trip generators, activity centers, employment centers, and high density residential areas.
- *"Filling in the Gaps":* Stops should be included between the stops that were recommended by the three previous guidelines if spaced far enough apart. The spacing for these gap-filling stops is determined by the level of density. Urban areas, especially within central business districts, typically have stops every 850 – 1,000 feet, while more rural areas can justify stops every mile. Due to the varying character of the study area, stop spacing will be governed by a combination of density, demographic, land use, and other factors. Because riders are expected to walk up to 1/4 mile to access the stop, the largest gap between stops should not exceed a 1/2 mile.

Each stop location will present a unique set of issues that need to be considered. The following is a checklist of the most common and important considerations when selecting specific stop locations:

- *Safety:* Places where riders wait, board, and alight for the bus, must be safe. One of the most important considerations for stop locations is safety and the avoidance of conflicts that would otherwise impede bus, auto, or pedestrian flows. This includes safe street crossings, adequate lighting, and adequate sight distance and visibility for both bus drivers and motorists.
- *Travel Time Delays:* Determining the proper location of stops involves choosing among farside, nearside, and mid-block stops. The locations of stops in relation to signalized intersections impacts travel time and vehicular traffic. If there are signals at every intersection or stop, alternating between nearside and farside will take advantage of signal synchronization and speed up travel times.
    - Farside stop locations are preferred in most cases for signalized intersections because they result in fewer traffic delays, fewer conflicts between buses and pedestrians, greater

bus maneuvering, and improved sight distances for pedestrians and motorists. In general, farside stop locations are preferred when the bus is able to stop outside of the travel lane at intersections, if the bus turns at the intersection, or if the intersection has many right turns.

- In general, nearside stop locations are preferred if nearside curb extensions prevent vehicles from turning right in front of the bus.

- Mid-block stop locations are less desirable than stops at intersections because of the safety issues for pedestrians crossing the street. In general, mid-block stop locations would only be recommended if blocks are too long to have all stops at intersections, if there are major trip generators not served by stops at intersections, or if there are existing mid-block pedestrian crossings such as a refuge island or flashing beacons. Atlantic Technical College is situated mid-block along Coconut Creek Parkway and features flashing beacons to alert drivers to the possibility of pedestrians crossing the street, seen in the image to the right.

- *Service Quality Tradeoffs:* There is an inherent tradeoff between the number of stops and the overall travel time and speed. Fewer stops mean faster and more efficient service. With limited public budgets, providing fewer stops also enables each stop to include more amenities and adjacent infrastructure. Walking distances are increased with fewer stops, which could be a deterrent for elderly riders or people not willing to walk longer distances.

- *Physical Environment:* When selecting stop locations, the need for station amenities such as benches and bus shelters must be considered. Ideally, locations with enough public right of way to accommodate these amenities are preferred. There needs to be adequate curb space for the number of buses expected at one time. Adjacent pedestrian and bicycle connections to the stop need to be addressed as well. Final designs of the stop need to include Americans with Disabilities Act (ADA) standards which include slope, satisfactory sidewalk widths, and other required accommodations.

2.3.2 Potential Stop Locations

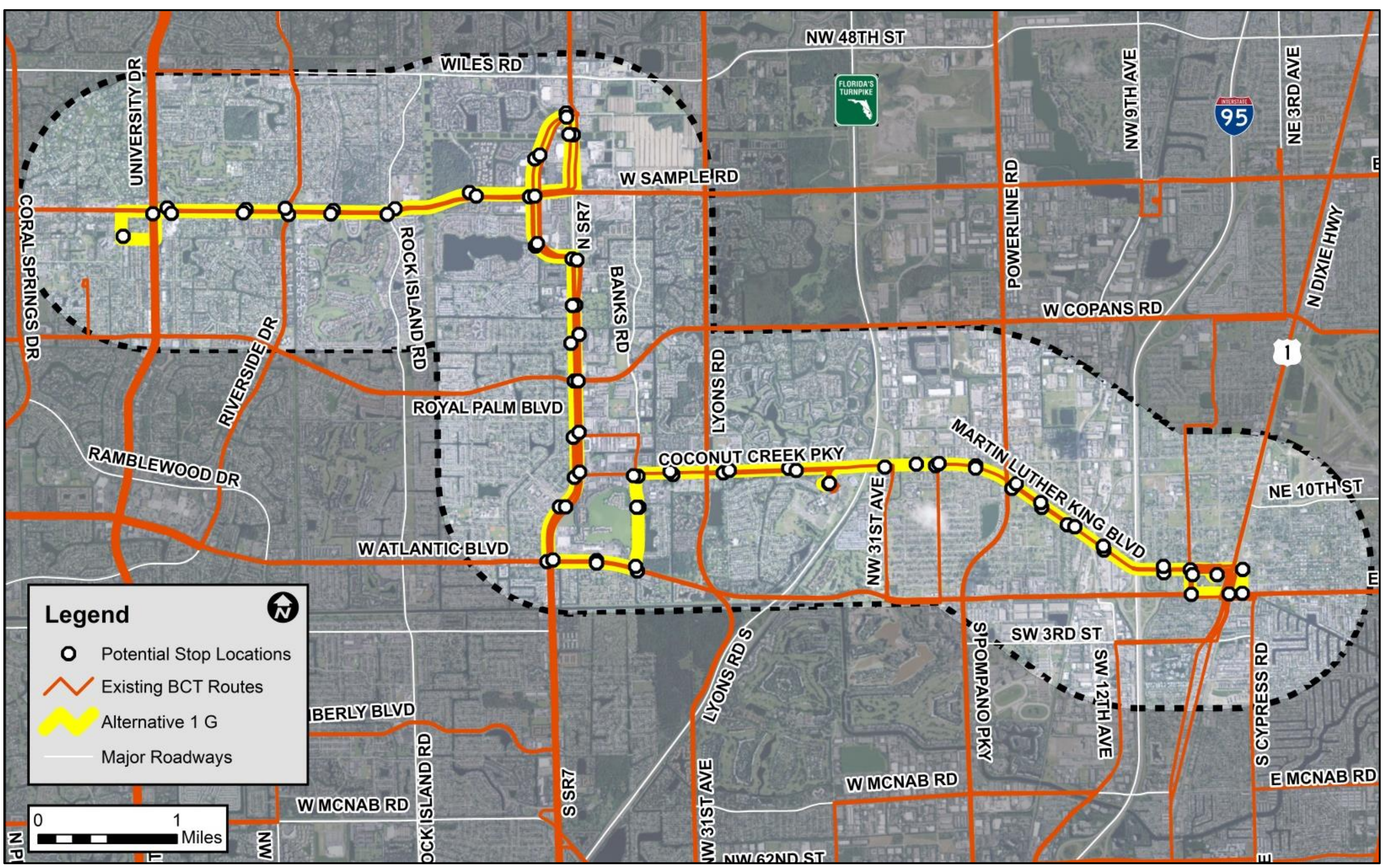
These guidelines were used to determine stop locations for the proposed circulator/bus service. As previously mentioned, the evaluation criteria identified in Tech Memo 2 will be used to select a preferred alignment, whether a no-transfer or a one-transfer alternative alignment. This evaluation will be further documented in Tech Memo 5. Alternative 1G was used as the preliminary alignment for determining stop locations. Many of the stop locations for Alternative 1G would be the same for the other alignments, because all of the proposed alignments serve Sample Road, SR 7, and Coconut Creek Parkway at a minimum. If a different alignment (whether no-transfer or one-transfer) is selected as the preferred alignment, additional stop locations will be identified while eliminating proposed stop locations that no longer serve the preferred alignment.

Figure 15 illustrates these potential stop locations. Using the guidelines which were highlighted above, a total of 79 individual bus stop locations were identified. At most locations, a pair of bus stops was proposed – one for each direction of service, typically across from one another unless there were physical constraints, such as an on-ramp to the Turnpike. Certain stop locations, usually at either end of the alignment, did not include a paired stop serving the other direction.

There were a total of 36 individual bus stop locations (18 pairs) based on the potential to transfer to other existing transit services. There were an additional eight individual bus stop locations that did not offer the potential to transfer to an existing transit service yet were identified based on the high level of existing ridership. Another eight individual bus stop locations were identified that would directly serve some major destinations within the study area such as schools, hospitals, and casinos.

After these 52 stop locations were identified, it was clear that there were significant gaps between proposed stops. Without adding additional stops in between, the walking distance to access some of the stops may be more than 1/4 mile for some potential riders. Therefore, supplementary stop locations were identified so that the spacing between each stop never exceeded 1/4 mile. Using this methodology, 27 more proposed stops were identified, mostly at an existing BCT stop if possible.

Figure 17 – Proposed Stop Locations



The segment of Sample Road between Rock Island Road and Turtle Run Boulevard does not adhere to this stop spacing methodology due to the lack of existing destinations and ridership potential. Note that a pair of stops is proposed outside of Coral Springs High School.

Some stop locations, such as the pair proposed along SR 7 just north of Sample Road, are in need of enhanced pedestrian infrastructure to accommodate safe access. These stops would serve the Coconut Creek Casino, identified as a major destination within the study area, but would currently drop passengers off / pick passengers up in a very inhospitable environment for pedestrians. This stop would be designed as a mid-block stop location because there is no signal here. Therefore in order for this stop to be realistically implemented, attention must be given to the pedestrian amenities and associated infrastructure.

There is currently a study underway that is assessing the needs of the Sample Rd / SR 7 interchange. This needs assessment evaluates the existing traffic patterns, transit service, and bicycle and pedestrian facilities at this interchange with the overall goal to identify potential locations for a transit mobility hub, improve pedestrian facilities and connectivity, and improve existing transit service and coverage.

This is just one example of a bus stop requiring infrastructure improvements. As identified in Tech Memo 2, there are numerous existing and proposed bus stop locations that do provide the adequate level of comfort and safety for passengers as well as pedestrians. General cost estimates for the recommended infrastructure improvements within this corridor are provided later in this Tech Memo.

2.4 Service Characteristics

2.4.1 Travel Time

The total travel time is a function of numerous variables, but mostly influenced by the number of stop locations, the level of transit service provided (frequency), and the type / size of vehicle used. Whether a fare is charged for the proposed service also impacts travel time by the amount of time needed for passengers to board and alight the vehicle. As mentioned previously, there is an inherent trade-off between the total travel time and the number of stop locations.

The type of vehicle used impacts travel time by directly impacting the time needed for passengers to board and alight the vehicle. Standard vehicles used for circulator bus service typically have one door that is shared by passengers boarding and alighting. Some of these standard vehicles used for community bus service in Broward County have stairs to enter and exit, which not only adds time for boarding and alighting passengers, but can also pose accessibility problems for disabled passengers.

Similarly to section 2.3.2, Alternative 1G was used as the preliminary alignment for determining travel time through the study corridor. This alternative is relatively representative of all the no-transfer routes, considering it is close to the average total route length (27.8 miles). Travel time for the one-transfer alternatives would collectively be higher than the no-transfer alternatives simply because the one-transfer alternatives have two different routes compared to the one route of the no-transfer alternatives. Each individual route for the one-transfer alternatives has fewer total route miles and less total travel time, but these routes do not serve the entire study area.

Alternative 1G has a total of 28.2 roundtrip route miles. This route was driven multiple times during a field review to determine the likely travel time for the service. This field review, although mimicking the likely operational characteristics of the community bus (travel in the outside lane, not exceeding the speed limit, etc.), did not include stopping at any transit stops, and therefore did not include the time needed for passengers to board and alight. The Google maps' directions tool was also used to help determine travel times. Using field review time trials and direction information from Google maps, the average time to travel from Pompano Beach to Coral Springs along the 1G Alignment was 45 minutes; the average time to travel from Coral Springs to Pompano Beach along the 1G Alignment was 41 minutes. Therefore, the total roundtrip time is approximately 86 minutes, which translates to just over 20 miles per hour. This estimated travel time is similar to that of a personal automobile.

But in order to more accurately predict the total roundtrip travel time for the community bus, the amount of time spent at each transit stop for boarding and alighting passengers (dwell time) must be factored in. Stops with high ridership levels will require more dwell time than stops with low ridership levels. There are a total of 79 proposed transit stops for the 1G Alignment – 44 stops at a transfer location with an existing BCT service or at an existing high ridership location, eight stops that directly serve major destinations, and 27 other stops that help to reduce the spacing between stations to ideally less than 1/2 mile. Vehicles that use one door for both boarding and alighting and use traditional farebox collection tend to require more dwell time at stops.

For the purposes of estimating the total roundtrip travel time for the proposed 1G Alignment, the 52 stops that offer a transfer to another existing service or serve an existing high ridership stop will be assumed to average 30 seconds of dwell time per stop, while the remaining 27 stops that typically have lower ridership will be assumed to average 15 seconds of dwell time per stop. It is also assumed that each trip will only stop at half of the high ridership stops and half of the low ridership stops. Therefore, the 52 'high ridership' stops will add 13 minutes to the roundtrip travel time and the 27 'low ridership' stops will add roughly four minutes for a total of 17 dwell time minutes per roundtrip.

By including dwell time to the total roundtrip time, the proposed 1G Alignment would reach nearly 103 minutes, resulting in an average speed of 16 mph. This average, which now includes dwell time, is nearly 17% slower than the automobile.

The table below details the estimated travel time using 16 mph as the average roundtrip speed for all the proposed routes. Note that the proposed alternatives 2A – 2F include two different routes, therefore the estimated travel time is aggregated for both routes.

Figure 18 – Estimated Roundtrip Travel Times

Proposed Alignment	Route Miles (roundtrip)	Estimated Travel Time (minutes)
1A	27.63	101
1B	29.26	107
1C	24.42	89
1D	25.21	92
1E	26.04	95
1F	33.4	122
1G	28.22	103
2A	32.19	118
2B	33.53	123
2C	37.06	136
2D	33.31	122
2E	34.8	127
2F	38.01	139

2.4.2 Capacity

Capacity of any transit service is both a function of the level of service provided and the size of the vehicle. There are a number of different vehicle types that can be considered to operate this proposed service. All of the current community bus routes operate with small buses, also known as cutaway buses or body-on-chassis vehicles. Coconut Creek's buses are slightly larger with a capacity of 30 passengers compared to the other three municipalities' buses that have a capacity of 20 passengers.

When determining what type of vehicle to operate the proposed service, a number of factors should be considered such as the capital costs, the operations and maintenance costs, and the overall attractiveness. Attractiveness in this sense can be measured different ways such as looks, comfort, utility, and maintainability to name a few. Based on needs for the proposed community bus service for the education corridor, the vehicle selected should provide a comfortable ride that is easily accessible for all passengers. Vehicles with low floors and multiple doors for boarding and alighting are preferred.

There is a statewide bus procurement contract through the Transit Research Inspection Procurement Services (TRIPS) program. The program is managed by the FDOT and administered by the Center for Urban Transportation Research (CUTR). The TRIPS program [formerly Florida Vehicle Procurement Program (FVPP)] has been in existence since 1995, providing agencies with the means of procuring quality vehicles at the lowest possible price. TRIPS, on behalf of agencies within the state of Florida, establishes a statewide Purchasing Agreement for the manufacture and delivery of transit vehicles.

Listed below are some of the current vehicle types and their characteristics which are available through the FDOT TRIPS Program for purchase. Several vehicles are available through the TRIPS program which are similar to the vehicles currently being operated by the four municipalities. This list only includes vehicles with capacities at or above the current vehicle fleets. The table below lists the weight, height, seating capacity, price, and number of possible wheelchair positions for each vehicle. Each vehicle has an expected minimum life of 5 years and / or 200,000 miles. For comparison purposes, the City of Miami trolleys utilize a 32' Freightliner MB-65 Series at a cost of $187,606 each with a seating capacity of 25 passengers.

Table 19 – Vehicles Available through TRIPS

Small-Cutaway Low-Floor Vehicles available through TRIPS					
Option	Model	GVWR / Length	Seating Capacity*	Price	Wheelchair Positions
A	Chevrolet 3500 Chassis	12,300 lbs / 21'	6 - 12 (15)	$109-100 - $131,800	1
B	Chevrolet 4500 Chassis	14,200 lbs / 23'	6 - 12 (23)	$117,000 - $150,000	1 - 3
C	International 25,500	25,500 lbs / 26' - 36'	12 - 26 (32)	$158,400 - $209,600	1 - 2

* - ( ) indicates number of seats without wheel chairs

Many of the vehicles available through the TRIP program have multiple floor layouts, seating options, and several paint schemes. This will allow the vehicle to stand out from existing services with a unique branding and identity while providing the level of comfort demanded from riders. There are additional options available that can be added on the vehicle such as ITS equipment, wi-fi capabilities, BRT exterior package upgrade for enhanced branding, bike rack options, and other equipment.

In terms of purchasing the vehicle, the two main options are to have them provided by the private contractor or for a public agency (either BCT, one of the municipalities, or another amalgamation of agencies such as a TMA) to purchase them. There are pros and cons to each, which will be discussed further in Section 4.2. Many of the community bus vehicles currently in use by the four municipalities were purchased by the private contractor, and therefore differ from the three vehicles listed above.

3.0 EVALUATION OF EXISTING BCT FUNDING AGREEMENT

BCT operates community bus service in partnership with 18 local Broward municipalities. The goal of the community buses is to free the larger fixed-route buses to travel along major thoroughfares while serving the residential areas. Through an interlocal agreement, BCT provides capital and/or operating assistance. Wheelchair-accessible community buses can be purchased by BCT and leased annually to the municipality for $10.00 per vehicle as an option. BCT provides an operating stipend of $15.00 per revenue service hour, per vehicle, to assist with maintenance and operations. For those cities that contract for service operations or provide their own wheelchair-accessible vehicle, a $13,295.20 capital cost allowance per year, per vehicle in revenue service, is provided.

This capital and/or operating funding assistance from BCT is available to any municipality that successfully applies for it. The application includes six eligibility requirements which all must be satisfied. These requirements include a statement of need that demonstrates community support, addresses an existing problem or supports established goals. The proposed route should have headways less than 45 minutes and has at least two connections with other existing public transit service, while BCT gives preference to proposed routes with faster headways and more connections.

This application process has some challenges that need to be considered. The most challenging obstacle is funding. BCT typically accepts applications only when County funding is available. Also, as a part of the application and selection process, BCT requires that any new or modified community bus route 'minimally' duplicate an existing transit service to receive funding. This is particularly challenging for this study's proposed service, because much of the route duplicates an existing BCT route, albeit three different routes along three different corridors that currently require a transfer. And because this proposed service extends into four different municipalities, there may be an issue determining who should be the applicant or whether there should be a joint participation agreement (JPA). In the end, BCT can only contract with one city as the lead.

SFRTA currently operates shuttle bus service that feeds their commuter rail for each station. As a part of the due diligence effort, SFRTA was contacted to determine whether they could be included in any future JPA or TMA. Unless the proposed community bus directly serves a Tri-Rail station, SFRTA would not be able to help operate or fund the service.

3.1 Opportunities for Cost Savings

There are some strategies to lower costs for providing the proposed service, which will be briefly described in this section. A more detailed analysis for cost savings, funding opportunities, and organizational strategies will be included in Technical Memorandum #6.

The most obvious opportunity for cost savings would be to consolidate the community bus contracts for these four municipalities into just one contract that simply based on economies of scale, could lower the service costs for all the routes. Currently, each city has their own individual contract as well as their own in-house administrator for managing the service. If some form of collective contract can be created, there would only be the need for one total administrator for all four municipalities, again saving on annual operational costs.

Another strategy would be to partner will major institutions such as Broward College, that have a vested interest in the service, and ultimately, the success of service. A robust transit service that offers frequent headways would be an additional marketing advantage for institutions like Broward College to use to recruit future students. It is common for colleges and universities to assess a transit user fee that is wrapped in with the tuition costs. Depending on how the proposed alignment and operating plan serve Broward College, it may be possible to partner with Broward College to offset some of the capital and operating costs.

How the vehicles used for service are purchased is another source for possible cost savings. Whether they are provided by the contractor or through one of the public agencies will likely impact the contracted cost per service hour (if the service is contracted out). This will be described further in section 4.2.

Lastly, the existing community bus routes that are underperforming could be modified or eliminated to save operational costs. These potential savings could be allocated to the newly proposed service as a way to lower the lower the proposed operational costs.

4.0 COST ESTIMATES AND COMPARISON

This section details the estimated costs for all of the proposed community bus service alignments including capital costs, operations and maintenance (O&M) costs, and the necessary and relevant infrastructure improvement costs.

A detailed analysis of the cost comparison between contracted community bus services versus local procurement will be included as a part of Tech Memo 5. This analysis will consider the cost of both the vehicles and the service. The estimated costs from the proposed operating plans will be compared against maintaining existing costs.

4.1 Operations and Maintenance (O&M) Costs

Currently, the community bus services for Pompano Beach, Coral Springs, and Margate are contracted out to a third party operator – Limousines of South Florida (LSF); Coconut Creek operates its own community bus service. The cost per service hour is generally the same for all the municipalities except for Pompano Beach, whose rate of $32.71, nearly 25% less than the other three municipalities. Collectively, these four municipalities pay nearly $1.5 million annually to operate and maintain the existing community bus service, with Coconut Creek making up over 1/3 of that total.

Table 20 – Existing Community Bus Service O&M Costs

City	Cost / Service Hour	Annual Service Hours	Annual O&M Cost
Pompano Beach	$32.71	8,064	$263,773.44
Coconut Creek	$45.13	12,341	$556,949.33
Coral Springs	$43.16	6,596	$284,683.36
Margate	$44.96	7,263	$326,544.48
		TOTAL	**$1,431,950.61**

The operations and maintenance (O&M) costs for the various no-transfer and one-transfer alternatives were calculated assuming a cost of $45.00 per service hour. This assumed hourly service cost is an average of the existing service cost excluding Pompano Beach.

The table below shows the number of buses required, annual O&M costs, and the annual service hours for each alternative based on the proposed headways and service span described in section 2.1 once fully implemented (which is 10 minute peak, 15 minute off peak, 30 minutes evening during the weekdays; and 15 minutes most of the day and 30 minutes late evening on weekends). Not included in the tables are the required spare vehicles, which equal 20 percent of the total number of vehicles required for service. Currently, the community bus headways for the four municipalities a part of this study are 60 minutes. For comparison, the City of Miami's trolleys offer 15 minute headways throughout most of the day for all of their routes.

Table 21 – O&M Cost Estimates for Proposed Alignments

	No-transfer Alternative Alignments						
	1A	1B	1C	1D	1E	1F	1G
Capital Cost (# of buses)	13	13	11	12	12	15	13
Operational Cost ($ million)	2.56	2.56	2.22	2.29	2.29	2.86	2.56
Annual Service Hours	56,867	56,867	49,272	50,784	50,784	63,480	56,867

	One-transfer Alternative Alignments					
	2A	2B	2C	2D	2E	2F
Capital Cost (# of buses)	16	17	18	16	17	18
Operational Cost ($ million)	3	3.23	3.51	3.16	3.39	3.67
Annual Service Hours	66,584	71,807	78,012	70,173	75,396	81,601

As highlighted in table 18, the annual O&M costs for any of the no-transfer alternative alignments are nearly double the combined costs for all the existing community bus service in the four municipalities (Table 17). The annual O&M cost for all of the one-transfer alternative alignments is even higher.

As was mentioned in section 2.1, it may be necessary to phase the service plan until reaching the ideal service levels. For example, if the headways were changed to 15 minutes during the peak, 20 minutes during the off peak and most of the day on the weekends, and 30 minutes during the late evenings, over 23% of the annual O&M cost for any of the alternatives would be saved. The table below shows the O&M costs for the no-transfer and the one-transfer alternative alignments with this modified service plan.

Table 22 – O&M Cost Estimates for Proposed Alignments: Reduced Headways #1

	No-transfer Alternative Alignments						
	1A	1B	1C	1D	1E	1F	1G
Capital Cost (# of buses)	9	9	8	8	8	10	9
Operational Cost ($ million)	1.96	1.96	1.69	1.69	1.69	2.19	1.96
Annual Service Hours	43,641	43,641	37,558	37,558	37,558	48,742	43,641

	One-transfer Alternative Alignments					
	2A	2B	2C	2D	2E	2F
Capital Cost (# of buses)	10	11	12	11	12	13
Operational Cost ($ million)	2.26	2.49	3.51	2.33	2.56	2.67
Annual Service Hours	50,212	55,435	57,929	51,724	56,947	59,441

If the headways were further reduced to 20 minutes during the peak, 30 minutes during the off peak and most of the weekends, and hourly headways late evenings, over 44% of the annual O&M costs for the original service plan of any alignment would be saved. The table below shows the O&M costs for the no-transfer and the one-transfer alternative alignments with this further modified service plan.

Table 23 – O&M Cost Estimates for Proposed Alignments: Reduced Headways #2

	No-transfer Alternative Alignments						
	1A	1B	1C	1D	1E	1F	1G
Capital Cost (# of buses)	7	7	6	6	6	8	7
Operational Cost ($ million)	1.42	1.42	1.14	1.14	1.14	1.48	1.42
Annual Service Hours	31,475	31,475	25,392	25,392	25,392	32,987	31,475

	One-transfer Alternative Alignments					
	2A	2B	2C	2D	2E	2F
Capital Cost (# of buses)	8	9	10	8	9	9
Operational Cost ($ million)	1.71	1.77	1.94	1.71	1.77	1.94
Annual Service Hours	37,924	39,436	43,147	37,924	39,436	43,147

4.2 Capital Costs

The capital costs associated with implementing a new circulator bus service includes the provision of vehicles, facilities, and other equipment. In general when contracting out for bus service, it is usually more efficient if the vehicles are provided by the transit agency or municipality. This is preferable because the agency or municipality usually has access to federal and state funding that private contractors do not which can help offset the costs of acquiring vehicles. It is also common for private contractors to recoup the costs associated with purchasing and financing vehicles and facilities through higher hourly rates. But this is not always the case. Some contracted transit providers supply their own vehicles, which tends to increase the contracted hourly service rate to the municipality / transit agency.

Industry experience, interviews with private contractor managers, and recent literature suggest that private contracting of community bus services can reduce costs, but probably only operating costs. Private service contractors who must purchase/provide the vehicles have a higher cost per service hour in order to recoup the capital costs for vehicles. Capital costs and the provision of buses and any necessary facilities are the greatest challenges to the contracting initiative, because private companies are not able to use federal or state grants to secure buses. Therefore, public agencies can save money over the lifetime of the service contract (by contracting a lower cost per service hour) by providing vehicles to the private contractor. Regardless of how and who operates the proposed service, to be most cost-effective, the vehicles should be provided through the public agencies to take advantage of potential cost savings over the long term. Agency ownership of vehicles also provides more flexibility when changing operators.

The number of vehicles required varies between six (in the 2nd iteration of reduced headways) to as many as 18 vehicles (in the original one-transfer alternative with premium headways). These numbers represent the number of buses needed to operate the service during the peak period. Regardless of the service plan selected and the number of vehicles needed, one spare vehicle is required for every five vehicles in operation in case of breakdowns or accidents.

Considering the spare vehicles required, the total number of vehicles required could range from seven to 22 depending on the alignment and service plan selected. Ten out of the twelve existing community bus routes in these four municipalities use only one vehicle; the two routes in Coconut Creek however use two vehicles per route. So there are a total of 14 vehicles serving the 12 routes. The costs of the three different vehicle options from the TRIPS program presented in section 2.4.2 ranges between $109,100 and $209,600 per vehicle, with ranges for each vehicle depending on the options selected. The table below show the potential ranges in cost depending on the number of vehicles required. At a minimum, approximately $764,000 would be needed (7 vehicles) while as much as $4.6 million would be required if selecting the vehicle with the highest cost and the most vehicles (22).

Table 24 – Estimated Vehicle Costs

Vehicles Required	Lowest Cost: $109,100	Highest Cost: $209,600
7	$763,700	$1,467,200
10	$1,091,000	$2,096,000
12	$1,309,200	$2,515,200
15	$1,636,500	$3,144,000
18	$1,963,800	$3,772,800
22	$2,400,200	$4,611,200

4.3 Proposed Infrastructure Costs

Infrastructure improvements related to the study corridor that improves mobility, safety, and accessibility to transit must also be considered, especially in terms of related costs. This section will provide a brief overview of the planning-level cost estimates for installing bike lanes, improving sidewalks and crosswalks, and providing enhanced amenities at existing and/or proposed bus stop locations. A more detailed analysis of this improvements and how they address or mitigate existing infrastructure deficiencies is documented in Technical Memorandum #2. Table 25 below lists the bicycle infrastructure needs for the study corridor.

Table 25 – Bicycle Infrastructure Improvements Estimated Costs

Corridor Segment	Limits	Needs	Unit Cost	Construction Estimate
Sample Road	From Riverside Dr. to SR 7	None identified	-	-
SR 7	From Copans Dr. to Coconut Creek Pkwy.	Provide bike lanes: Widen to outside; relocate curb & gutter; 0.7 miles	$1.7 M / Mile	$1,200,000
Coconut Creek Pkwy.	From SR 7 to Banks Rd.	Provide bike lanes: Widen to outside; 0.4 miles	$900,000 / Mile	$360,000
	From Banks Rd. to Broward Campus N.	None identified	-	-
	From Broward Campus N. to FL Turnpike	Provide bike lanes: Widen to inside; replace median with barrier wall; 0.5 miles	$2 M / Mile	$1,000,000
Dr. Martin Luther King, Jr. Blvd.	From FL Turnpike to I-95	Provide bike lanes: Widen to outside; add curb & gutter; 2.1 miles	$1.7 M / Mile	$3,570,000
	From I-95 to Dixie Hwy.	Provide bike lanes: Widen to outside; 0.7 miles	$900,000 / Mile	$630,000
			TOTAL:	$6,760,000

Sample Road has existing bicycle lanes in both directions, despite not being up to the most recent FDOT standard of 7 foot wide protected bicycle lanes on state facilities.

In order to provide a bicycle lane in each direction along SR 7 between Copans Drive and Coconut Creek Parkway, the curb and gutter would need to be relocated. This would have a total estimated construction cost of $1.2 million. There are on-going complete streets improvements programmed along Coconut Creek Parkway that are extending the recently completed enhancements westward to SR 7. These enhancements include improved crosswalks, bicycle lanes, and landscaping. Bicycle lanes are recommended near Broward College, which would help to strengthen the local bicycle network. The existing roadway would be widened to the inside (repurposing existing median) in order to accommodate bike lanes in each direction. This 1/2 mile of bike lanes in either direction along with median construction costs would total near $1 million.

There are no existing bicycle facilities along Martin Luther King, Jr. Boulevard. Our recommendation would be to provide protected bicycle lanes from the Florida Turnpike to Dixie Highway. The segment between the Florida Turnpike and I-95 would have a total estimated cost of $3.57 million, which includes curb and gutter added where missing currently. Less roadway reconstruction is required for bike lanes east of I-95 for a total estimated cost of $630,000.

Table 26 lists the recommended crosswalk and sidewalk improvements along with their associated costs.

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Table 26 – Pedestrian Infrastructure Improvements Estimated Costs

Corridor Segment	Limits	Needs	Unit Cost	Construction Estimate
Sample Road	From University Dr. to Riverside Dr.	Improve Crosswalks at NW 85th Avenue	$20,000 EA	$20,000
SR 7	From Sample Rd. to Copans Dr.	Provide crosswalks at NW 24th Street	$20,000 EA	$20,000
	From Copans Dr. to Coconut Creek Pkwy.	Provide crosswalks at NW 18th Street	$20,000 EA	$20,000
Coconut Creek Pkwy.	From Banks Rd. to Lyons Rd.	Provide two mid-block crossing with RRFB.	$60,000 EA	$120,000
Dr. Martin Luther King, Jr. Blvd.	From FL Turnpike to Powerline Rd.	Provide sidewalks on both sides 0.85 miles	$220,000 Mile	$190,000
			TOTAL:	$370,000

Three specific crosswalk locations were identified for improvements: Sample Road at NW 85th Avenue, SR 7 at NW 24th Street, and SR 7 at NW 18th Street. Each of these improvements is estimated to cost $20,000. Two separate mid-block crossing locations are recommended along Coconut Creek Parkway that would better serve the many educational institutions present there. Each mid-block crossing has an estimated cost of $60,000 for a total of $120,000. Martin Luther King, Jr. Boulevard between the Florida Turnpike and Powerline Road does not currently have sidewalks on either side of the road. Installing sidewalks in this segment would have a total cost of approximately $190,000.

Table 27 – Transit Infrastructure Improvements Estimated Costs

Corridor Segment	Limits	Transit Route No.	Transit Stops with Shelters	Transit Stops with Benches	Transit Stops w/o Facilities	Needs
Sample Road	From University Dr. to Riverside Dr.	34, Blue	4		7	Upgrade with 7 benches
	From Riverside Dr. to Rock Island Rd.	34, Blue, As, A, C	2	2	3	Upgrade with 3 benches
	From Rock Island Rd. to US 441	34, A	4	1	3	Upgrade with 3 benches
US 441	From Sample Rd. to Copans Dr.	19, 441, A, South	4	2		None
	From Copans Dr. to Coconut Creek Pkwy.	19, 441, 60, As, A, South	4	5		None
Coconut Creek Pkwy.	From US 441 to Banks Rd.	60, D, South		1	1	Upgrade with 1 bench
	From Banks Rd. to Broward Campus N.	60, South	7	3	2	Upgrade with 2 benches
	From Broward Campus N. to FL Turnpike	60			1	Upgrade with 1 bench
Dr. Martin Luther King, Jr. Blvd.	From FL Turnpike to Powerline Rd.	60, Red		2	2	Upgrade with 2 benches
	From Powerline Rd. to I-95	60, Blue, Red		12		None
	From I-95 to NW 6th Ave.	60, Blue, Red		3		Upgrade with 1 bench
	From NW 6th Ave. to Dixie Hwy.	42, 60, Blue, Red, Green	3	1		None

There are a total of 26 existing bus stop locations along Sample Road between University Drive and SR 7. Of these 26 stop locations, 13 locations only have a sign and do not include a shelter or a bench. All of the existing bus stop locations along SR 7 between Sample Road and Coconut Creek Parkway have either a transit shelter and/or a bench. Of the 15 existing bus stop locations along Coconut Creek Parkway between SR 7 and the Florida Turnpike, four locations only have a sign and do not include a shelter or a bench. And lastly, of the 24 existing bus stop locations along Martin Luther King, Jr. Boulevard between the Florida Turnpike and Dixie Highway, 3 locations only have a sign and do not include a shelter or bench. Therefore at a minimum, it is our recommendation to provide benches at existing stop locations that do not currently have one, resulting in a total of 20 locations. Assuming a high-end unit cost per bench (that includes installation) of $3,000, approximately $60,000 would be needed to provide benches at all the existing stop locations lacking benches. Shelters will be recommended at existing or proposed stop locations with high ridership, defined by BCT as more than 100 daily average boardings.

The total estimated cost for related infrastructure improvements is approximately $7,190,000 which includes crosswalks, bicycle lanes, sidewalks, and benches. Additional infrastructure improvements may be recommended to address additional needs as the final route and stop locations are selected. Other costs such as maintenance and storage facilities and administrative costs are not included in this technical memorandum, but will be considered later in this study.

The additional funding that would be required along with the potential funding opportunities will be assessed and summarized in Tech Memo 6.