NW 27TH AVENUE
Enhanced Bus Service Concepts and Environmental Plan

Work Order #GPC IV-37

PREPARED FOR

MIAMI-DADE MPO
Metropolitan Planning Organization

PREPARED BY

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(Miami-Dade MPO)

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Fort Lauderdale, Florida

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INTRODUCTION AND STUDY PURPOSE

The Miami-Dade Metropolitan Planning Organization (MPO) initiated the *NW 27th Avenue Enhanced Bus Service* (EBS) *Concepts and Environmental Plan* to build upon prior work undertaken by Miami-Dade Transit (MDT) for the "North Corridor" and further develop strategies identified in the Near-Term Transportation Plan for Miami-Dade County (2012-2015). The Near-Term Transportation Plan for Miami-Dade County sets the stage for implementing transportation improvements along People's Transportation Plan (PTP) corridors. The immediate step undertaken in this project is to enhance transit service and increase transit ridership with the implementation of rapid bus service, while working toward the long term goal of implementing rail transit.

The corridor for the NW 27th Avenue EBS project begins at the Miami Intermodal Center (MIC), located adjacent to Miami International Airport, and extends north along NW 27th Avenue from State (SR) 112 (Airport Expressway) to NW 215th Street at the Broward County Line. At the southern end of the project corridor, the MIC serves as an intermodal transportation terminal providing connectivity among Metrorail, Metrobus, Miami International Airport (MIA) via the MIA Mover, Tri-Rail (commuter rail), Amtrak (intercity rail), and Greyhound (intercity bus). At the northern end of the project corridor, a new transit terminal and park-and-ride facility will be constructed in the vicinity of NW 215th Street to serve as a transit terminal for the NW 27th Avenue EBS as well as local MDT Metrobus routes and Broward County Transit (BCT) routes. The long term vision includes the addition of transit-oriented development (TOD) at this terminal facility.

The Miami Intermodal Center will anchor the southern end of the NW 27th Avenue Enhanced Bus Service Route

Stations along the NW 27th Avenue EBS route will be spaced approximately every mile. The stations will provide enhanced passenger amenities including comfortable seating and protection from the elements and traveler information displays. The service will benefit from operational improvements including transit signal priority (TSP) and queue jumps at several key intersections. Frequent service is planned for the route consisting of 10-minute peak headway and 20-minute mid-day headway. Existing local bus service with more frequent stops will continue to operate along the corridor as MDT Route 27.

During the course of this project several key critical tasks were completed to develop the framework to advance the implementation of transit improvements in the NW 27th Avenue corridor including:

- Coordinating with stakeholder agencies such as Miami-Dade County Department of Regulatory and Economic Resources County Planning, Miami-Dade County Public Works and Waste Management Department (PWWMD) Traffic Signals and Signs Division (TS&S), and Florida's Turnpike Enterprise (FTE)
- Developing preliminary concepts for the NW 215th Street transit terminal and park-and-ride facility
- Developing project concepts and cost estimates for EBS stations
- Developing operating strategies for EBS service
- Preparing environmental documentation, as required under the National Environmental Policy Act (NEPA), consisting of a Documented Categorical Exclusion (23 CFR 771.117 (d)).

At the outset of the study, the Miami-Dade MPO designated a study advisory committee (SAC) whose members served as a steering panel to review study documents and assist in developing recommendations. The SAC met regularly throughout the course of the study, providing data and input. Representatives of the following agencies participated in the SAC.

- Miami-Dade MPO (Leading Agency)
- Miami-Dade Transit (MDT)
- Miami-Dade Citizen's Independent Transportation Trust (CITT)
- Miami-Dade County Public Works and Waste Management Department (PWWMD)
- City of Miami Gardens
- City of Opa-Locka
- Florida Department of Transportation (FDOT)

The following list summarizes various coordination activities conducted during the course of the project in chronological order.

- June 13, 2012: MDT strategy meeting
- July 5, 2012: Study Advisory Committee kick-off meeting
- August 1, 2012: Traffic Signals and Signs Division and MDT meeting
- October 3, 2012: Study Advisory Committee meeting #2
- October 22, 2012: FDOT and FTE meeting to discuss access to the NW 215th Street transit terminal and park-and-ride facility
- November 19, 2012: Study Advisory Committee meeting #3
- December 4, 2012: Calder Casino & Race Course meeting to discuss access to the NW 215th Street transit terminal and park-and-ride facility
- February 14, 2013: FDOT meeting to discuss access to the NW 215th Street transit terminal and park-and-ride facility.
- March 1, 2013: Study Advisory Committee meeting #4
- July 8, 2013: Miami-Dade MPO Transportation Planning Council (TPC)

Summary notes from these meetings are included in Appendix A.

The following sections present the project background, project description and purpose and need, station concepts, operating strategies, service plan, and capital and operations and maintenance (O&M) cost estimates for the NW 27th Avenue EBS project.

The environmental documentation for the project consisting of a Documented Categorical Exclusion, pursuant to the requirements of the National Environmental Policy Act (NEPA), is provided under separate cover.

CORRIDOR HISTORY AND BACKGROUND

The "North Corridor" area has been analyzed extensively over the last two decades with a history that includes proposals for both heavy rail (Metrorail) extension and the implementation of bus rapid transit (BRT) alternatives. A summary of the previous studies and planning efforts is provided below.

- Alternative Analysis Study, 1995
- Draft Environmental Impact Statement (DEIS), 1997
- Final Environmental Impact Statement (FEIS), 1999
- BRT Concept Evaluation Study, 2000
- Re-evaluation of the FEIS, 2002
- Supplemental Draft Environmental Impact Statement (SDEIS), 2004
- Revised FEIS, 2007
- Federal Transit Administration issued a Record of Decision (ROD) for the Metrorail extension project in April 2007 and a Finding of No Significant Impact (FONSI) was issued in November 2008
- Modal Analysis, 2009
- Near-Term Transportation Plan, 2010

In the early 1990s the Orange Line Phase II (North Corridor Metrorail Extension) was proposed. The Orange Line Phase II planned to extend the elevated heavy rail fixed guideway Metrorail service approximately nine miles in the NW 27th Avenue corridor from north of the Dr. Martin Luther King Jr. Station at NW 62nd Street to NW 215th Street at the Broward County Line.

In 1995, the Miami-Dade MPO completed the Alternatives Analysis study, which identified Metrorail/heavy rail as the Locally Preferred Alternative (LPA) for the Orange Line Phase II. FTA granted MDT approval to proceed with Preliminary Engineering for the corridor and the DEIS was completed in 1997. The DEIS was subsequently followed by the FEIS, which was completed 1999. However, the FEIS was never submitted to FTA because the one-cent sales tax referendum, intended to fund the Metrorail extension, failed.

After the failure of the one-cent sales tax referendum, the MPO and MDT began re-evaluating lower cost transit alternatives that could be financially feasible in the BRT Concept Evaluation Study (2000). As a result of this study, the LPA was revised from Metrorail to BRT. The BRT Concept Evaluation Study examined several different BRT alternatives including:

- One-lane reversible median bus lane
- Two-way busway on west side of NW 27th Avenue
- Concurrent flow northbound and southbound bus lanes
- Peak hour contra flow bus lane
- Buses in mixed traffic with TSP and queue jumps

The BRT Concept Evaluation Study concluded that (1) buses in mixed traffic with TSP and queue jumps and (2) concurrent flow northbound and southbound bus lanes should be evaluated further.

In 2002, the half-cent sales tax referendum passed. As a result, MDT and the Miami-Dade MPO refocused on Metrorail as the preferred alternative for the NW 27th Avenue corridor. The 1999 FEIS was reevaluated to address community concerns regarding the alignment and was submitted in 2004 as a Supplemental Draft Environmental Impact Statement (SDEIS). The SDEIS was approved by FTA in 2006 and the revised FEIS was approved by FTA in 2007. FTA issued a Record of Decision (ROD) for the project in 2007 and a Finding of No Significant Impact (FONSI) in 2008. However, the project received a New Starts rating of "medium-low" by FTA in 2008, as a budgetary funding shortfall was identified related to the financial capacity to maintain and operate the system.

The "medium-low" New Starts rating resulted in MDT again revisiting transit mode options in the 2009 Modal Analysis, which examined four transit modes.

- BRT
- BRT-Light/Enhanced Bus Service (EBS)
- Light Rail Transit (LRT)
- Heavy Rail Transit (HRT)

The 2009 Modal Analysis study concluded that the BRT options would be less costly to build, operate and maintain than the rail options.

In 2009 the Miami-Dade MPO's Short-Term Transit Improvement Options (SSTIO) Task Force restructured the County's bus system to focus on an incremental approach to building transit service and ridership in the County's major corridors, including the "North Corridor."

The limited stop Route 97 was replaced by the Route 297 Orange MAX service in 2012

In 2010, the Near Term Transportation Plan laid the groundwork for this *NW 27th Avenue Enhanced Bus Service Concepts and Environmental Plan.* The Near Term Transportation Plan outlined the modification of the existing limited-stop Route 97 to the enhanced Route 297 Orange MAX service, while also developing preliminary order of magnitude capital costs for the implementation of the next phase of the Enhanced Bus/BRT project. Subsequently, MDT received a $1,000,000 grant from FTA's Job Access Reverse Commute (JARC) program. This grant funding was used as operating funds for the implementation of the Route 297 Orange MAX service in 2012.

PROJECT DESCRIPTION AND PURPOSE AND NEED

Project Location

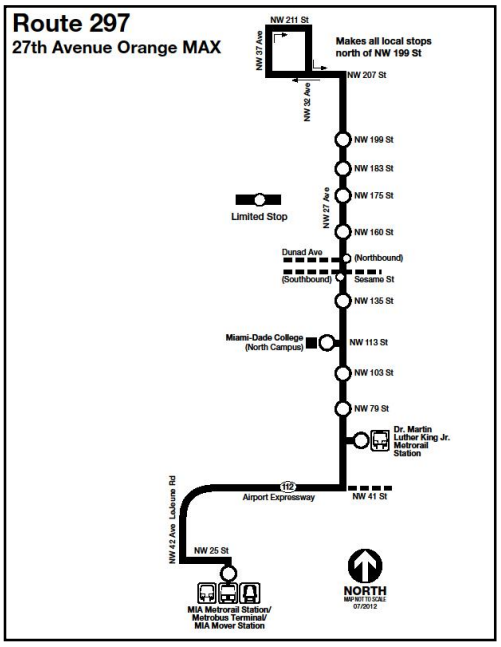
The "North Corridor" is a priority transit corridor in Miami-Dade County extending along NW 27th Avenue south from the Broward County Line at NW 215th Street to the Dr. Martin Luther King Jr. Metrorail Station near NW 62nd Street. The project limits for the NW 27th Avenue EBS project have been extended south to the Miami Intermodal Center (MIC) adjacent to Miami International Airport. The length of the study corridor is approximately 13 miles. The area is highly urbanized and major activity centers in the corridor include Miami-Dade College – North Campus (MDC), North Dade Health Center, St. Thomas University, Florida Memorial College, Miami Jobs Center, Sun Life Stadium, and Calder Casino & Race Course. See Figure 1 for a Project Location Map.

Figure 1: Project Location Map

Existing Transit Service

Route 27 provides local service in the corridor and is one of the most heavily utilized routes in the MDT system

Two MDT bus routes currently serve the NW 27th Avenue corridor. Route 27 provides local bus service between NW 211th Street to the north and Coconut Grove to the south. Route 27 operates 24 hours per day with 15 minutes headway throughout the day and longer headway (generally between 30 to 60 minutes) during overnight hours. Route 27 provides about six stops per mile, which provides a high level of accessibility for riders but results in long running times, requiring approximately 105 minutes to complete a one-way trip. Thus, Route 27 is effective for short trips but its slower travel times makes the route less effective for longer distance trips. Route 27 is one of the most heavily utilized routes in the MDT system with an average ridership of approximately 10,000 daily riders.



In July 2012, MDT implemented the Route 297 Orange MAX service in the NW 27th Avenue corridor between NW 207th Street and the MIC as Phase 1 of proposed Enhanced Bus Service. This new service replaced the prior Route 97 (27th Avenue MAX) service. The Route 297 Orange MAX service operates on weekdays between 5:30 AM and 8:00 PM with 15 minutes headway during the peak periods and 30 minutes headway during the midday. Stops are spaced at approximately one-mile intervals along the limited-stop service, resulting in enhanced travel times along the route in comparison to the Route 27. In addition, the Route 297 Orange MAX service was extended south, from the prior terminus of the Route 97 at the Dr. Martin Luther King Jr. Metrorail Station, to provide residents of the corridor a one-seat ride to the MIC.

Project Description

The NW 27th Avenue EBS project will build upon the incremental approach of improving transit service that has recently been applied to the "North Corridor" with the implementation of the Route 297 Orange MAX service, which is viewed as Phase 1 of Enhanced Bus Service. The NW 27th Avenue EBS project represents Phase 2 of proposed Enhanced Bus Service in the corridor.

The frequency of the rapid bus service in the corridor will be improved to every 10 minutes during peak periods and every 20 minutes during the off-peak. Service will be provided in new branded 60-foot articulated diesel/electric hybrid or alternative fuel buses with low-floor design for faster boarding and alighting. The buses will be equipped with Wi-Fi and provide larger seating areas with additional leg room for comfort. The buses will utilize general purpose traffic lanes; however, the proposed NW 27th Avenue EBS will benefit from transit signal priority (TSP) for improved travel time and schedule adherence. In addition, bus queue jumps will be provided at several key intersections along the corridor.

Route 297 Orange MAX represents Phase 1 of implementation of Enhanced Bus Service

Enhanced transit stations will be spaced at approximately one-mile intervals along the corridor. Passenger amenities at the stations will include improved shelters and seating along with power, lighting, and real-time arrival traveler information displays. The stations will be branded and visibly recognizable as part of the NW 27th Avenue EBS.

An end-of-the-line transit terminal and park-and-ride facility will be constructed near the Broward County Line at NW 215th Street. The transit terminal and park-and-ride facility will be built on an approximately 14-acre property owned by Miami-Dade Transit within the political jurisdiction of the City of Miami Gardens. Approximately 350 park-and-ride spaces are proposed for the facility along with kiss-and-ride/short-term parking accommodations, approximately ten bus bays, passenger seating under canopied areas, and a bus driver comfort station. The facility will serve as a transit terminal for several MDT and BCT routes and will facilitate transfers between the two systems. In addition, this facility will provide an end-of-the line layover for NW 27th Avenue EBS as well as Route 27, eliminating the two-mile turnaround presently required. The property also provides long-term transit-oriented development opportunities, and the facility will be designed in a manner to preserve space for future Metrorail station development.

MDT owns a 14-acre site at NW 215th Street that will accommodate an end-of-the line transit terminal and park-and-ride facility at the northern terminus of the NW 27th Avenue Enhanced Bus project

Purpose and Need

The NW 27th Avenue corridor has a relatively young and a high minority (African-American) population. The area is predominantly low-income and automobile ownership is low in the corridor. A high proportion of corridor residents are transit dependent. The NW 27th Avenue EBS project is intended to provide premium limited-stop transit service along the NW 27th Avenue corridor, from NW 215th Street at the Broward County Line to the MIC, to enhance mobility for area residents. Transit connections at the MIC via Metrorail provide access to activity and job centers including the Health District, Government Center, and Downtown Miami.

The NW 27th Avenue Enhanced Bus project will attract additional transit riders building toward future rail service in the corridor

NW 27th Avenue is one of the few continuous north-south arterials within Miami-Dade County. Travel patterns within the North Corridor tend to be in the north-south direction, since NW 27th Avenue serves as a primary gateway corridor between Broward County and central Miami-Dade County. Existing bus service operates in mixed-flow traffic lanes where buses often travel in congested traffic conditions, creating lengthy transit travel times and unreliable schedule adherence. The NW 27th Avenue EBS project's intelligent transportation systems (ITS) and operational improvements, including TSP and queue jumps/queue bypass lanes, will reduce travel time and improve schedule adherence.

This project will provide an attractive alternative transportation mode by connecting major activity centers in the corridor such as Miami-Dade College North Campus, North Dade Health Center, St. Thomas University, Sun Life Stadium, Walmart Supercenter, Calder Casino & Race Course, Miami Gardens City Hall Complex, Miami Jobs Corps Center, North Dade Regional Library, and Jackson North Specialty and Diagnostic Center. Route 27 along NW 27th Avenue is one of the most utilized routes in the MDT system with an average daily ridership of approximately 10,000. This project will provide a convenient alternative to driving and, based on travel forecast estimates included in the 2010 Near Transportation Plan, will attract an additional 1,200 daily transit riders, thus building ridership for future rail service in the corridor.

In response to Miami-Dade County policies, the NW 27th Avenue corridor needs a transportation alternative that will not contribute to additional ozone emissions to the local airshed and will help to maintain the County's federal designation as an air quality maintenance area for ozone. The use of diesel/electric hybrid or alternative fuel buses will result in improved fuel efficiency and carbon reduction, while promoting transit use to reduce vehicle miles traveled.

Development and redevelopment efforts within the corridor are hampered by the lack of good accessibility and mobility. Throughout the corridor there are opportunities for in-fill development and redevelopment with additional density. There is a need to provide transit services in the corridor to support current and future redevelopment efforts. Policies of Miami-Dade County encourage TOD at nodes around rapid transit stations. There are extensive opportunities for TOD in the corridor including within the Cities of Opa-Locka and Miami Gardens, both of which are supportive of these efforts. Thus, the project will provide an economic benefit to the businesses and residents of the corridor.

ENHANCED BUS SERVICE STATIONS

NW 215TH STREET TRANSIT TERMINAL AND PARK-AND-RIDE FACILITY

Overview

MDT owns an approximately 14-acre property at the north end of the NW 27th Avenue corridor which will accommodate an end-of-the-line transit terminal and park-and-ride facility. The site is located on the west side of NW 27th Avenue immediately south of the Homestead Extension of Florida's Turnpike (HEFT) within the political jurisdiction of the City of Miami Gardens.

The NW 215th Street transit terminal and park-and-ride facility will function as an intermodal transit terminal anchoring the northern end of the NW 27th Avenue EBS project. The facility will be designed to include approximately 350 park-and-ride spaces, ten bus bays including several bays large enough to accommodate 60-foot articulated buses, a bus driver comfort station, passenger seating under canopied areas, and circulation aspects including an area for kiss-and-ride. The facility will serve as a terminal for several MDT and BCT routes and will facilitate transfers between the two systems.

This facility will provide an end-of-the line layover and turnaround for the NW 27th Avenue EBS and Route 27. Presently, the northbound buses on these routes must deviate approximately one to two miles from NW 27th Avenue to turnaround to head back south. The elimination of this turnaround will provide operational efficiencies saving approximately ten minutes on each run along the routes.

The facility will also be designed in a manner to preserve opportunity for future transit-oriented development (TOD) on the site, accommodating whatever development associated with the transit use that is deemed of highest and best use. The TOD should provide complimentary uses that capitalize on proximity to a transit station. The TOD should focus and stimulate density around the transit terminal and promote the use of transit. The development of the transit terminal and park-and-ride facility at the site will act as a catalyst to help leverage the overall mixed-use development of the site.

The design needs to be flexible enough to evolve as transit matures in the future. The long term vision is that the NW 27th Avenue EBS project will build ridership in the corridor setting the stage for a future Metrorail extension. The design should be able to accommodate future connectivity to a Metrorail station on the east side of NW 27th Avenue and provide the opportunity to increase parking capacity through the addition of a parking structure.

The MDT owned-property at NW 215th Street is large enough to accommodate future TOD in addition to transit and park-and-ride facilities

Miami-Dade Department of Regulatory and Economic Resources – Land Use Planning and Transit Study

The Miami-Dade County Department of Regulatory and Economic Resources (RER) conducted a Land Use Planning and Transit Study for the MDT-owned property at NW 215th Street and NW 27th Avenue. Consistent with the Miami-Dade County Comprehensive Development Master Plan (CDMP) designation as a Community Urban Center (CUC), the site is envisioned to accommodate transit facilities and TOD, while serving as a gateway into the City of Miami Gardens.

Over the course of the Land Use Planning and Transit Study, extensive effort was made to coordinate with residents of the area, public agencies, the private sector, and stakeholders. Public meetings were held where a general project overview was provided and residents and stakeholders developed visions for the site. Participants generally indicated that vehicular access connectivity was not desired between the site and the surrounding residential neighborhood, transit uses should be situated as far away from the surrounding residences as possible and be adequately buffered, and development should be a mix between commercial and office with no residential development.

Several schematic design concepts were developed during the course of the Land Use Planning and Transit Study. Each of the concepts included the following.

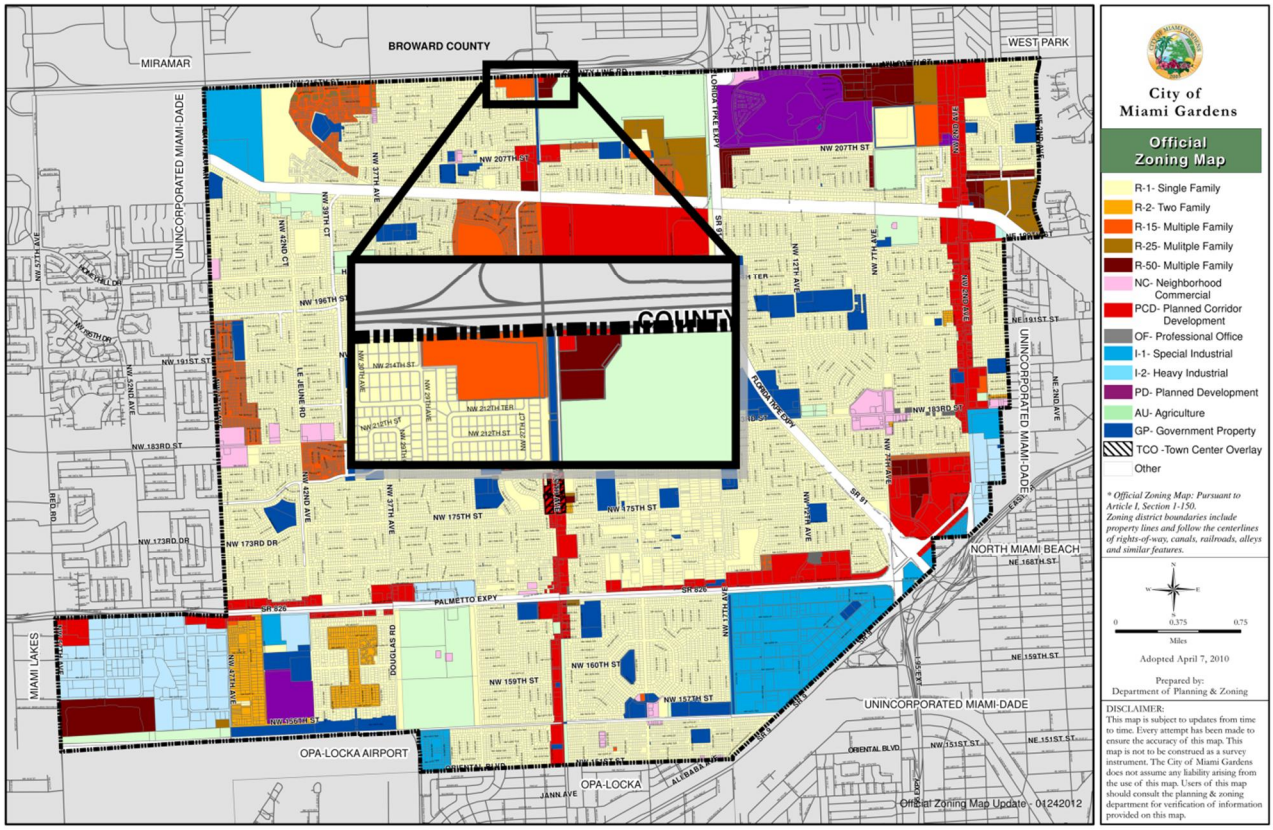
1. Higher intensity of development than the surrounding area but sensitivity to the surrounding context
2. Mixture of uses
3. Network of streets, greenspaces, and pedestrian/bicycle paths
4. Bus bays and transit facilities situated as far away from existing homes as possible
5. Access connectivity to the adjacent residential neighborhood should be limited to pedestrian/bicycle gates

Conceptual Master Plan Option developed in the Land Use Planning & Transit Study for NW 215th Street and NW 27th Avenue

Zoning Map and Future Land Use Map Designation

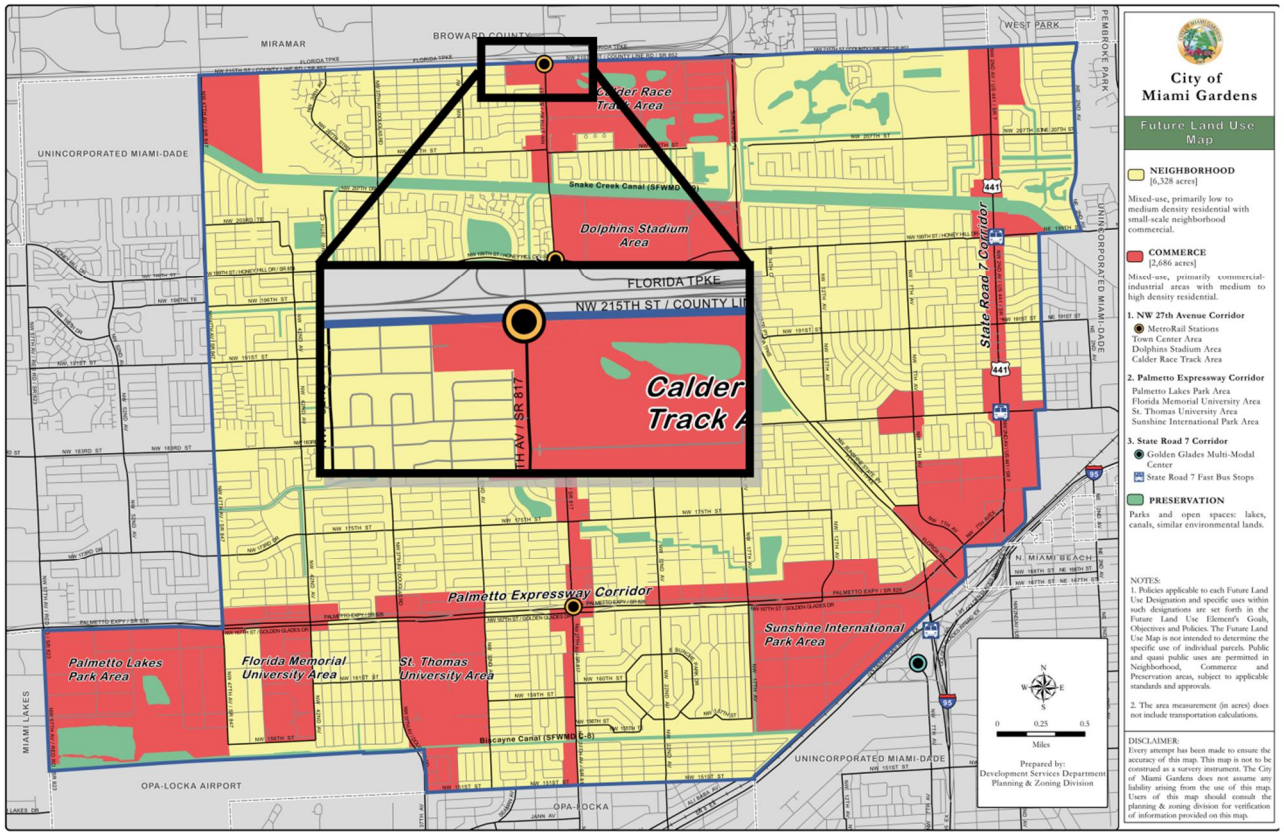
The NW 215th Street transit terminal and park-and-ride facility site is within the political jurisdiction of the City of Miami Gardens. The majority of the site is within an R-15 (Multiple Family) residential zoning district. Approximately 1 acre at the southwest corner of the site is within an R-1 (Single Family) residential zoning district. The zoning map is provided as Figure 2. The R-15 district provides for one-family attached and detached, two-family and multiple-family dwellings at low-medium densities, essential services and facilities, and select public and institutional uses. The R-1 Single-Family Dwelling Residential District provides for one-family detached dwelling units at low densities, essential services and facilities, and select public and institutional uses. Since a transit terminal and park-and-ride facility is not a use that is allowed as a matter of right in these zoning districts, City of Miami Gardens staff has indicated that the site will need to be rezoned to PCD (Planned Corridor Development).

Figure 2: City of Miami Gardens Zoning Map



The future land use map designation of the NW 215th Street transit terminal and park-and-ride facility site is Commerce. The future land use map is provided as Figure 3. According to the City of Miami Gardens Comprehensive Development Master Plan (CDMP), the Commerce land use designation is intended for planned urban commercial, industrial, and economic hubs, and the location of Commerce areas shall emphasize access to public transportation. Developing the NW 215th Street site with a transit terminal and park-and-ride facility is consistent with and will not require an amendment to the City of Miami Gardens CDMP.

Figure 3: City of Miami Gardens Future Land Use Map



Vehicular Access Considerations

FDOT maintains jurisdiction over NW 27th Avenue including access management, which controls the location and spacing of driveway connections, median openings, and traffic signals along the corridor. In the area of NW 215th Street, NW 27th Avenue is an Access Class 5 roadway with a posted speed limit of 45 miles per hour (mph). Table 1 provides a summary of minimum FDOT spacing criteria for various access connection types for an Access Class 5 roadway.

Table 1: FDOT Access Management Criteria for NW 27th Avenue (Access Class 5)

Access Type	Minimum FDOT Spacing
Minimum Connection Spacing (Right-in/right-out)	245 feet
Minimum Directional Median Opening Spacing (Right-in/right-out and left-in)	660 feet
Minimum Full Median Opening Spacing (Right-in/right-out and left-in/left-out)	1,320 feet
Minimum Signal Spacing	1,320 feet

Two other factors impact the location of vehicular access connections to the proposed NW 215th Street transit terminal and park-and-ride facility.

1. Community participants in the Land Use Planning and Transit Study led by the Miami-Dade County Department of Regulatory and Economic Resources County Planning generally indicated that vehicular access connectivity was not desired between the site and the surrounding residential neighborhood. Access connectivity to the adjacent residential neighborhood should be limited to pedestrian/bicycle gates.
2. A limited access right-of-way line associated with the HEFT extends south from the HEFT across much of the site's frontage along NW 27th Avenue. Staff from Florida's Turnpike Enterprise (FTE) indicated that vehicular access connections should not be designed to cross the limited access right-of-way line because there is opportunity to provide a connection between the site and NW 27th Avenue to the south of the limited access right-of-way line.

Twelve access alternatives were developed for the site and are summarized in Table 2. Implementation challenges associated with the access alternatives are also summarized in Table 2. Sketches depicting the access alternatives, along with a survey of the property that depicts the HEFT limited access right-of-way line, are provided in Appendix B.

Based on implementation challenges associated with FDOT access management criteria, community preferences, and the HEFT limited access right-of-way line, several of the access alternatives to the site were eliminated from further consideration. Alternatives 2C, 2D, 3A, 3B, 3C, and 3D were not considered to be viable because bus access to the site would be through the adjacent residential community.

Alternatives 1A, 2A, 4, and 5 appear to be the most viable vehicular access options for the site, as these alternatives do not require bus access through the adjacent residential community. However, even these alternatives require an FDOT access management variance for the vehicular access connection to NW 27th Avenue, as well as variances from FTE for the access connections to NW 27th Avenue and/or the HEFT off-ramp for northbound and eastbound buses exiting the site.

Preliminary Transit Terminal and Park-and-Ride Facility Concepts

Conceptual site plans were developed for the NW 215th Street transit terminal and park-and-ride facility. The schematic design concepts developed in the Miami-Dade County Department of Regulatory and Economic Resources County Planning's Land Use Planning and Transit Study were reviewed along with the input received from the community during the course of that study. Design criteria considered in the development of the conceptual site plans included:

1. Approximately 350 park-and-ride spaces
2. 10 bus bays including several bays large enough to accommodate 60-foot articulated buses
3. Passenger seating and waiting areas under canopies
4. Designated area for kiss-and-ride
5. Bus driver comfort station
6. Bus bays and transit facilities situated as far away from residences as possible
7. Buffer along the perimeter of the site adjacent to residences

8. FDOT access management criteria and HEFT limited access right-of-way line for vehicular access connections
9. Limiting access connections to surrounding residential neighborhood to only pedestrians and bicycles
10. Preserving space for future TOD
11. Preserving opportunity for future Metrorail station development and parking structure

Conceptual site plans were developed for Alternatives 1A, 2A, 4, and 5 for the NW 215th Street transit terminal and park-and-ride facility. All four alternatives require a combination of variances with FDOT and FTE, and three of the alternatives require collaboration with Calder Casino and Race Course. Processing an FDOT access management variance requires submittal of engineering plans for an FDOT permit and proceeding through a variance committee hearing. Conceptual site plans are contained in Appendix B for Alternatives 1A, 2A, and 4.

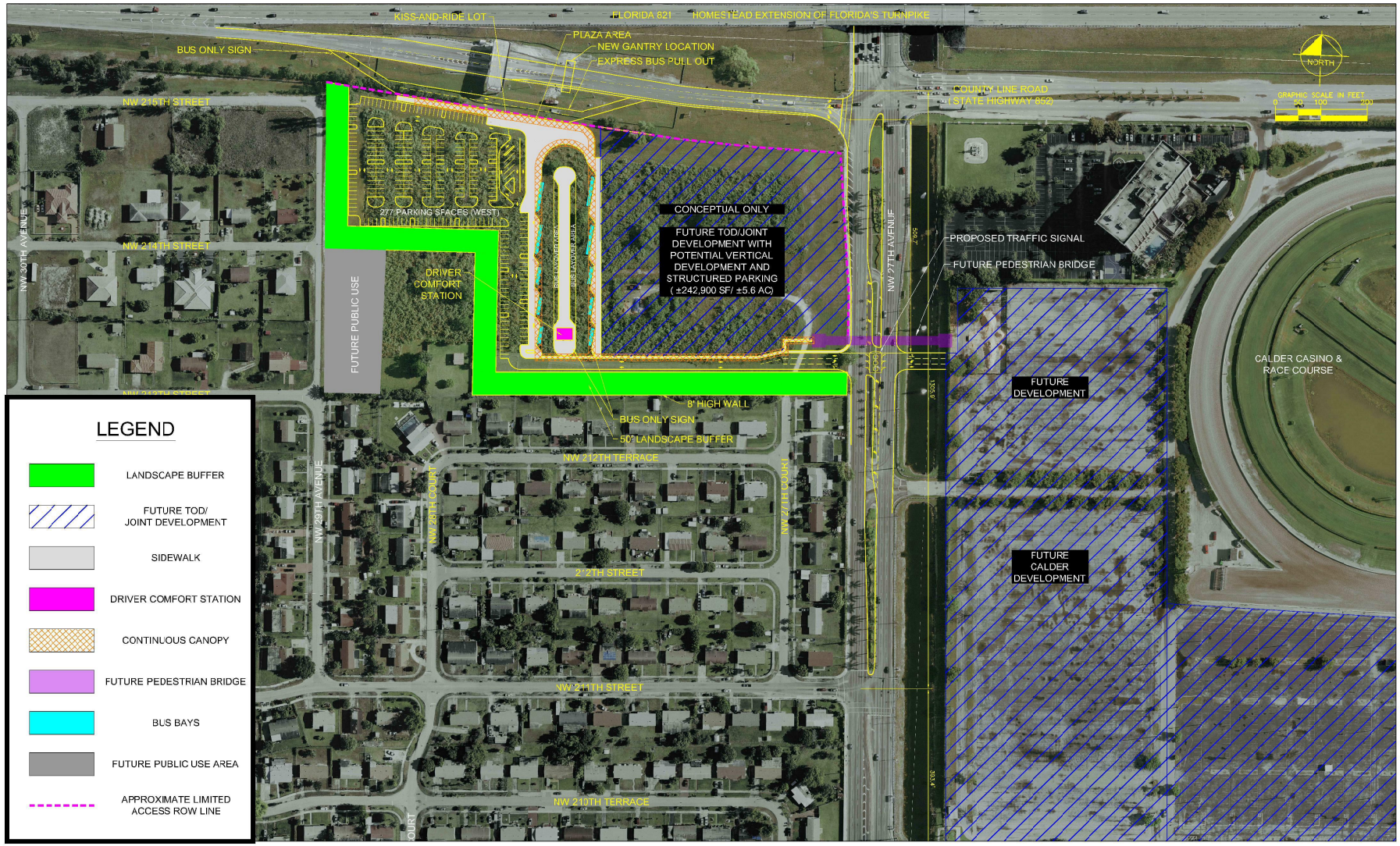
Figure 4 presents the conceptual site plan for Alternative 5, which is the preferred alternative. This alternative consists of relocating the existing northernmost Calder Casino and Race Course driveway on NW 27th Avenue to align with the vehicular access connection to the NW 215th Street park-and-ride facility. This new intersection would be signalized. A conceptual site plan was prepared for illustrative purposes to show how this alternative could work with the potential redevelopment of the Calder Casino and Race Course property, as well as also providing a future pedestrian overpass to connect the east and west sides of NW 27th Avenue. The new proposed full median opening and traffic signal on NW 27th Avenue would require an access management variance from FDOT. A direct connection with 95 Express buses would be provided along the HEFT off-ramp within FTE right-of-way.

Table 2: NW 215th Street Park-and-Ride Vehicular Access Alternatives

Alternative	Access Configuration	Implementation Challenges
1	Full signalized access at existing northbound left-turn/U-turn lane on NW 27th Avenue.	• This alternative does not meet FDOT's access management criteria and would also require crossing the HEFT's limited access right-of-way line. Therefore, variances will be required from FDOT and FTE.
1A	Directional access at existing left-turn lane: right-in/right-out and left-in. Northbound and eastbound buses exit facility onto HEFT off-ramp. North Calder Casino & Race Course driveway to remain open.	• Requires FDOT variance for directional median opening spacing. • Will require crossing the FTE limited access right-of-way line on NW 27th Avenue and at the HEFT off-ramp connection, thus requiring FTE variances.
2A	Directional access south of HEFT's limited access right-of-way line: right-in/right-out and left-in. Northbound and eastbound buses exit facility onto HEFT off-ramp. North Calder Casino & Race Course driveway to remain open.	• Requires FDOT variance for directional median opening spacing. • Will require crossing the FTE limited access right-of-way line at HEFT off-ramp connection, thus requiring FTE variance.
2B	Directional access south of HEFT's limited access line: right-in/right-out and left-in. Northbound and eastbound buses exit facility onto HEFT off-ramp. North Calder Casino & Race Course driveway to be closed.	• Requires Calder Casino & Race Course agreement to close north driveway. • May require an FDOT variance for directional median spacing. • Will require crossing the FTE limited access right-of-way line at HEFT off-ramp connection, thus requiring FTE variance.
2C	Directional access south of HEFT's limited access right-of-way line: right-in/right-out and left-in (car only). NW 27th Court bus entering/exiting access connection.	• Requires FDOT variance for directional median spacing. • Requires improvements to the northbound left-turn lane at the intersection of NW 27th Avenue and NW 211th Street. • Not consistent with community's desire to restrict vehicular access through residential neighborhood.
2D	Directional access south of HEFT's limited access right-of-way line: right-in/right-out and left-in (car only). NW 29th Avenue bus entering/exiting access	• Requires FDOT variance for directional median spacing. • Requires roadway improvements to NW 29th Avenue. • Requires improvements to the northbound left-turn lane at the intersection of NW 27th Avenue and NW 211th Street. • Not consistent with community's desire to restrict vehicular access through residential neighborhood.
3A	NW 27th Avenue: right-in/right-out NW 27th Court bus entering/exiting access	• Requires improvements to the northbound left-turn lane at the intersection of NW 27th Avenue and NW 211th Street. • Not consistent with community's desire to restrict vehicular access through residential neighborhood.
3B	NW 27th Avenue: right-in/right-out access NW 29th Avenue bus entering/exiting access	• Requires roadway improvements to NW 29th Avenue. • Requires improvements to the northbound left-turn lane at the intersection of NW 27th Avenue and NW 211th Street. • Not consistent with community's desire to restrict vehicular access through residential neighborhood.
3C	NW 27th Avenue: right-in/right-out access NW 27th Court: bus entering access HEFT off-ramp: bus exiting access	• Requires improvements to the northbound left-turn lane at the intersection of NW 27th Avenue and NW 211th Street. • Will require crossing the FTE limited access right-of-way line at HEFT off-ramp connection, thus requiring FTE variance. • Not consistent with community's desire to restrict vehicular access through residential neighborhood.

Table 2: NW 215th Street Park-and-Ride Vehicular Access Alternatives (Continued)

Alternative	Access Configuration	Implementation Challenges
3D	NW 27th Avenue: right-in/right-out access NW 29th Avenue: bus entering access HEFT off-ramp: bus exiting access	• Requires roadway improvements to NW 29th Avenue. • Requires improvements to the northbound left-turn lane at the intersection of NW 27th Avenue and NW 211th Street. • Will require crossing the FTE limited access right-of-way line at off-ramp connection. • Not consistent with community's desire to restrict vehicular access through residential neighborhood.
4	A new signalized intersection would be created aligning with a new driveway connection to the Calder Casino & Race Course property south of HEFT's limited access right-of-way line. The existing Calder Casino & Race Course northernmost driveway would be converted from a full median opening to right-in/right-out access.	• This alternative requires FDOT access management variances for full median opening spacing and signal spacing.
5	Similar to Alternative 4 with space reserved for future pedestrian overpass to connect the east and west sides of NW 27th Avenue. A direct connection with 95 Express buses would be provided along the HEFT off-ramp.	• This alternative requires FDOT access management variances for full median opening spacing and signal spacing. • Requires constructing a bus pullout lane in FTE right-of-way adjacent to the HEFT off-ramp.



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PARK AND RIDE TRANSIT TERMINAL
NW 215TH STREET AND NW 27TH AVENUE

CONCEPTUAL SITE PLAN
OPTION 5

SHEET NUMBER

4

NW 27TH AVENUE ENHANCED BUS SERVICE STATIONS

Overview

Stations along the NW 27th Avenue EBS route will be spaced approximately every mile. Passenger amenities at the stations will include improved shelters and seating along with power, lighting, ticket vending machines (TVMs), and real-time arrival traveler information displays. The stations will be branded and visibly recognizable as part of the NW 27th Avenue EBS system.

At the southern end of the project, the bus depot at the Miami Central Station (MCS) within the Miami Intermodal Center (MIC) will serve as the terminal station. Connectivity at this transportation terminal will be provided to Metrorail, Metrobus, MIA via the MIA Mover, Tri-Rail (commuter rail), Amtrak (intercity rail), and Greyhound (intercity bus).

At the northern end of the project, the new transit terminal and park-and-ride facility in the vicinity of NW 215th Street will serve as the terminal station. Connectivity at this transit terminal will be provided to local Metrobus routes, BCT routes, and 95 Express routes.

A total of 11 intermediary stations in each direction are proposed along the approximately 13-mile route between the MIC and NW 215th Street transit terminal and park-and-ride facility. NW 27th Avenue EBS stations will be constructed in the vicinity of the following cross streets:

- NW 54th Street/Brownsville Metrorail
- NW 62nd Street/Dr. Martin Luther King Jr. Metrorail
- NW 79th Street
- NW 103rd Street
- NW 113th Street/Miami-Dade College
- NW 135th Street
- Sesame Street
- NW 160th Street
- NW 175th Street
- NW 183rd Street
- NW 199th Street

Recommendations for specific station locations and station design concepts are presented next.

Station Location Determination

Station locations for the NW 27th Avenue EBS project were determined based on consideration of the following factors.

- Near-side or far-side station
  - Nearby passenger destinations
  - Lack of viable far-side location
- Distance to cross street intersection
- Station design concept (Full Station versus Slim Station)
  - Available/required right-of-way
  - Anticipated boarding levels based on existing Route 297 ridership

Several field reviews were performed during the process of identifying optimum station locations. An initial field review was performed to identify potential locations for each station. A second field review was performed with several members of the study advisory committee (SAC) to refine the viable station locations. Preliminary recommendations for station locations were then presented to the full SAC. Concerns were raised related to several of the station locations, including the preliminary recommendations for NW 183rd Street (northbound only), NW 175th Street, and NW 54th Street. A third field review was conducted to refine the recommended locations for these stations, which were subsequently endorsed by the SAC.

The following sections summarize the consideration of the factors that determined the station locations for the NW 27th Avenue EBS project.

Near-Side or Far-Side Station Locations

Stations can be located on the near-side of an intersection, on the far-side, or at mid-block. In general, far-side stations are preferable, especially when the system benefits from transit signal priority (TSP). Far-side stations facilitate the process for signal controllers to react to requests for priority and for buses to clear the intersection. Far-side stops may also lessen vehicle conflicts with right-turn vehicles that may occur at near-side stops. Finally, far-side stops also may provide gaps created by the intersection for buses to merge back into the traffic stream. On the other hand, near-side stations could result in false requests for TSP at signalized intersections when buses dwell at stations. Mid-block stations pose challenges for pedestrians trying to the cross the corridor and increase walking distance for riders transferring from routes along cross streets. Based on the above factors, the SAC determined that far-side station locations were generally preferred wherever viable.

For the NW 27th Avenue EBS project, far-side locations were identified for all the stations along the southbound direction of the route. However, due to unique considerations or constraints, near-side locations are recommended for four stations along the northbound direction of the route:

- NW 135th Street – near-side station location is recommended because the closest opportunity to locate a far-side station is approximately 400 feet north of the intersection.
- NW 175th Street – near-side station location is recommended because a viable location for a far-side station could not be identified.
- NW 183rd Street – near-side station location is recommended because the closest opportunity to locate a far-side station is approximately 450 feet north of the intersection.
- NW 199th Street – near side station is recommended due to proximity to adjacent retail development anchored by Walmart, which is the major activity center in the area.

Station Distance to Cross Street Intersection

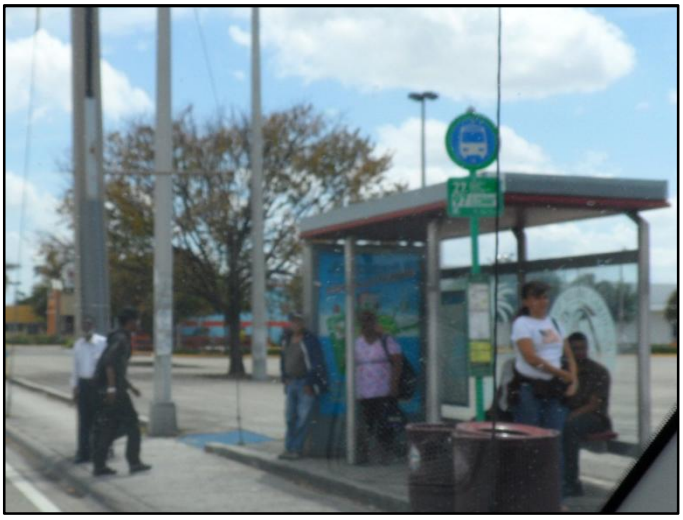
Stations should be located in close proximity to cross street intersections, so passengers transferring between routes have shorter distances to walk and are more likely to cross the corridor within the designated crosswalks at the intersections rather than at undesignated mid-block locations. The preferred location of stations is within 300 feet of the cross street intersections. Due to the presence of driveways, structures, or major activity centers, the recommended station locations exceed the 300-foot criteria for several stations along the NW 27th Avenue EBS project. However, all the recommended station locations

are within 450 feet of the cross street intersections. The station locations exceeding the 300-foot criteria from the adjacent intersection are listed below.

- Sesame Street – the recommended northbound station location is approximately 350 feet north of Sesame Street.
- NW 183rd Street – the recommended southbound station location is approximately 350 feet south of NW 183rd Street adjacent to the Carol-Mart retail development.
- NW 199th Street – the recommended southbound station location is approximately 440 feet south of NW 199th Street and the recommended northbound station location is approximately 350 feet south of NW 199th Street, adjacent to the retail development anchored by Walmart.

Station location impacts pedestrian safety as illustrated by pedestrians crossing NW 27th Avenue mid-block to access a station on the other side of the corridor

Preliminary Enhanced Bus BRT Station Design Concepts



Full station design concepts are appropriate for locations where high levels of boardings are anticipated, such as NW 183rd Street

Two station designs were developed for enhanced bus service in Miami-Dade County, which will be applied to the NW 27th Avenue EBS project. The station design concepts are a full station (see Figure 5) that has a footprint 25 feet in length and 15 feet in width and a restricted right-of-way or "slim" station (see Figure 6) that has a footprint approximately 26 feet in length and 8 feet in width. Both station concepts provide space to accommodate bicycle parking and a station marker or monument sign, which will clearly brand the stations as part of the premium enhanced bus system.

Full station design concepts are provided at station locations along the NW 27th Avenue EBS project where existing right-of-way is sufficient. In addition, full station design concepts are provided at station locations where a high level of boardings are anticipated, based on existing ridership information for the Route 297 demonstrating a minimum of 50 daily boardings at these locations. Table 3 lists the full station design concept locations along the NW 27th Avenue corridor.

Figure 5: Enhanced Bus Full Station (25' x 15') Design Concept

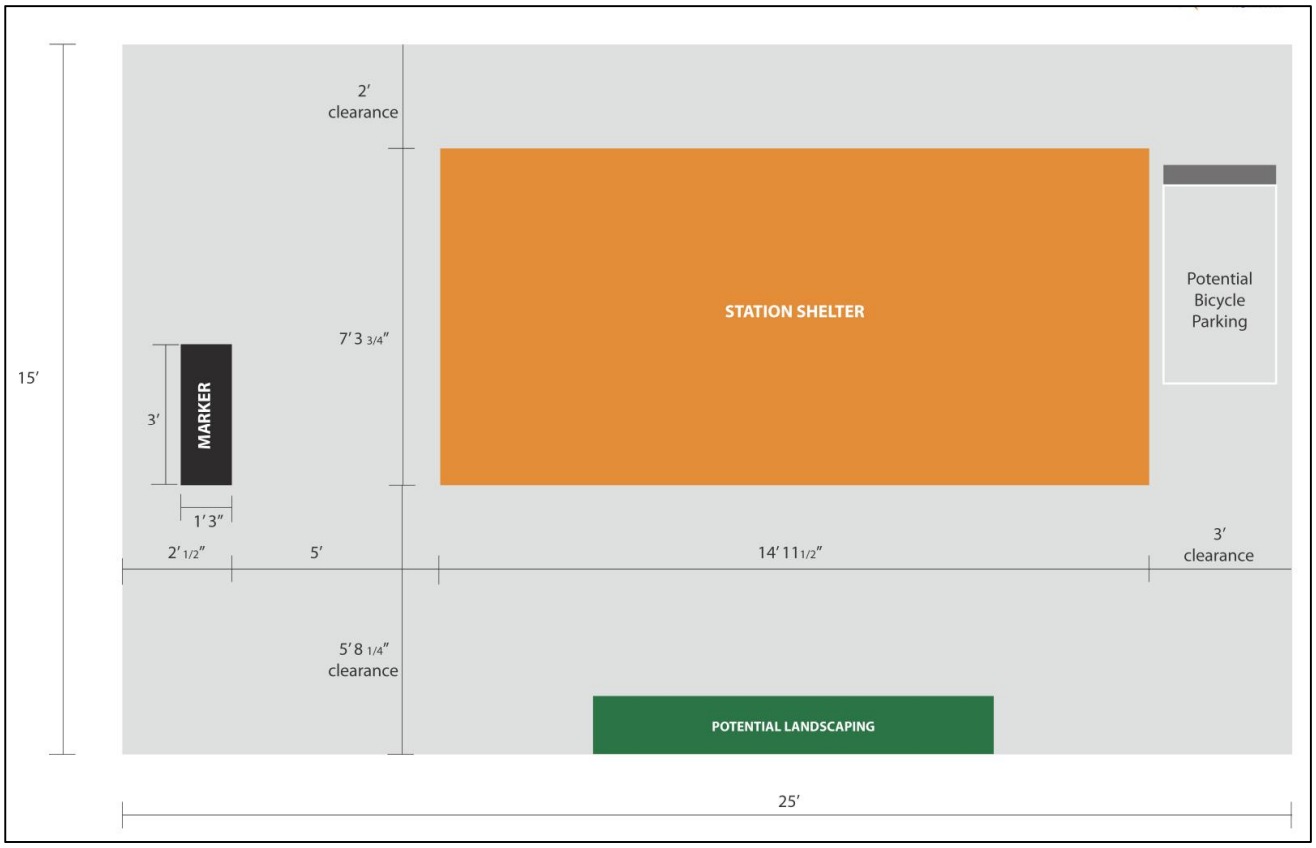


Figure 6: Enhanced Bus Slim Station (26' x 8') Design Concept

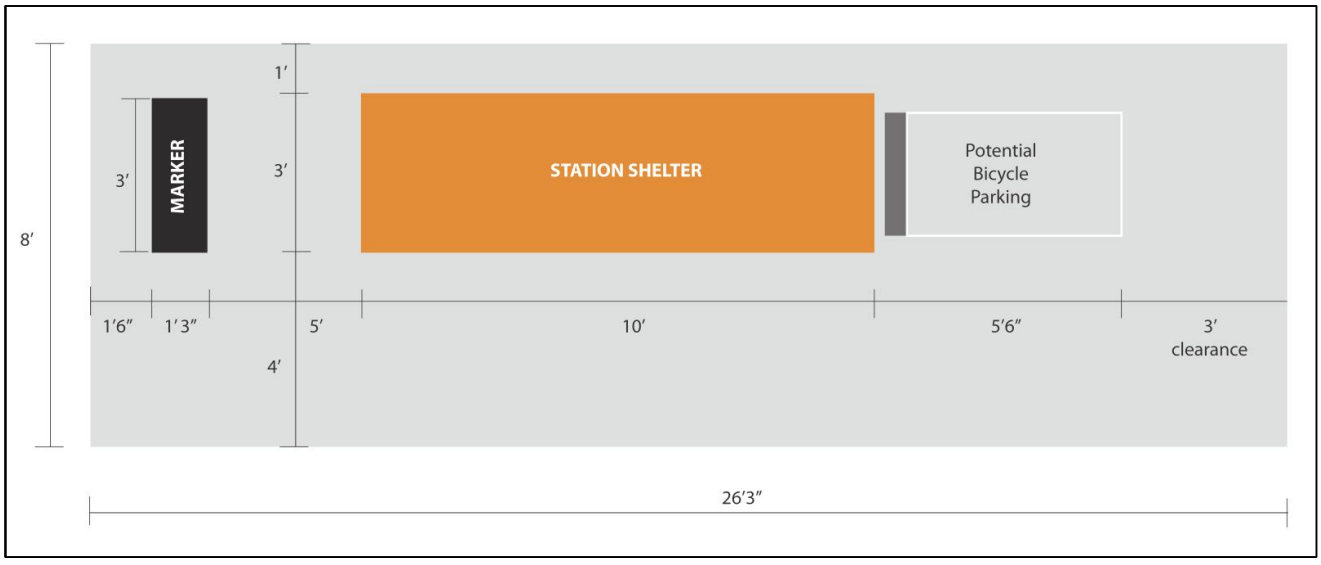


Table 3: Full Station Design Concept Locations

Station Location	Direction
NW 199th Street	Northbound Southbound
NW 183rd Street	Northbound Southbound
NW 175th Street	Southbound
NW 160th Street	Northbound
Sesame Street	Northbound
NW 113th Street/ Miami-Dade College(1)	Northbound Southbound
NW 103rd Street	Southbound
NW 79th Street	Northbound

Note: (1) At the outset of the NW 27th Avenue EBS project, the route is anticipated to access the existing transit terminal on the campus of Miami-Dade College. Long term accommodations should be secured for stations directly adjacent to NW 27th Avenue to increase the operational efficiency of the route.

Slim station design concepts are provided at station locations where right-of-way is not sufficient to accommodate a full station design concept and high levels of boardings are not anticipated based on existing boarding levels for the Route 297 at these locations. Table 4 lists the slim station design concept locations along the NW 27th Avenue corridor.

Table 4: Slim Station Design Concept Locations

Station Location	Direction
NW 175th Street	Northbound
NW 160th Street	Southbound
Sesame Street	Southbound
NW 135th Street	Northbound Southbound
NW 103rd Street	Northbound
NW 79th Street	Southbound
NW 62nd Street(1)	Northbound Southbound
NW 54th Street	Northbound Southbound

Note: (1) Slim station assumed under the existing MetroRail station.

The availability of right-of-way (R/W) was a factor considered in the selection of bus station locations along the corridor. If stations could not be accommodated within the R/W, locations were identified that did not

impact businesses by requiring the removal of parking spaces or closure of driveways. Minor R/W acquisition or easements are anticipated to be required for the proposed bus stations listed in Table 5.

Table 5: Bus Stations Requiring Minor Right-of-Way Acquisition or Easements

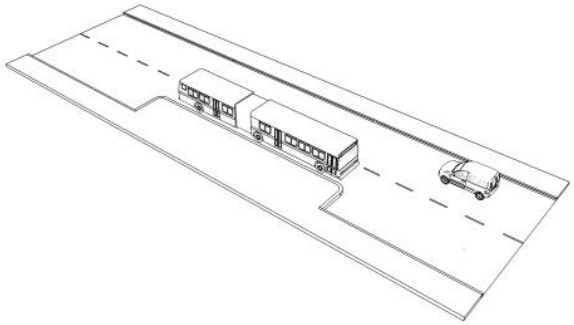
Station Location	Direction	Approximate R/W Required (Width x Length = Square-Feet)
NW 199th Street	Southbound	10' x 25' = 250'
NW 183rd Street	Northbound	9' x 25' = 225'
	Southbound	9' x 25' = 225'
NW 175th Street	Northbound	2' x 26.25' = 52.50'
NW 160th Street	Southbound	2' x 26.25' = 52.50'
Sesame Street	Southbound	2' x 26.25' = 52.50'
NW 135th Street	Northbound	3' x 26.25' = 78.75'
	Southbound	4' x 26.25' = 105'
NW 103rd Street	Northbound	3' x 26.25' = 78.75'
NW 79th Street(1)	Southbound	3' x 26.25' = 78.75'

Note: (1) R/W required if a bus bulb/curb extension is not provided.

Bus Bulbs/Curb Extensions

Bus bulbs/curb extensions increase the width of the sidewalk while narrowing the road width. Utilizing curb extensions may facilitate the installation of a transit station without the need for acquiring additional right-of-way. In addition, buses stop in the travel lane without having to weave in and out of a bus pullout lane or the curbside parking lane.

Bus bulbs/curb extensions are proposed for three station locations: NW 79th Street for both the northbound and southbound stations and for the southbound station at NW 103rd Street. Implementing a bus bulb/curb extension for the southbound station at NW 79th Street will require converting the outer southbound through lane on the approach to NW 79th Street to an exclusive right-turn lane. Graphics illustrating the locations of proposed bus bulbs/curb extensions are provided in Appendix D.



Sketch of a bus bulb/curb extension
Source: Buskap.de

NW 62nd Street/Dr. Martin Luther King Jr. Metrorail Station Enhanced Bus Station

Service will need to be restored for the elevator on the west side of the Dr. Martin Luther King Jr. Metrorail

The EBS station at NW 62nd Street is proposed to be located along NW 27th Avenue in the existing right-of-way underneath the Dr. Martin Luther King Jr. Metrorail Station. Although a transit terminal is provided along the east side of the Dr. Martin Luther King Jr. Metrorail Station, accessing this transit terminal would require deviating the route from NW 27th Avenue, thus adding travel time to the route. Locating the station directly along NW 27th Avenue will increase the operational efficiency of the route. Improvements that will be required for this station include providing concrete pads connecting to the existing sidewalks, modifying the station markers to fit and be visible underneath the Metrorail station structure, and restoring service in the elevator on the west side of the Metrorail station to provide Americans with Disabilities Act (ADA) access.

Station Location Summary

Tables 6A and 6B present information for the NW 27th Avenue EBS project station locations, including distances to cross street intersections, right-of-way information, and Route 297 daily boarding data. Individual graphics illustrating the location of each station are provided in Appendix C.

Table 6A: Southbound Station Locations Information

Cross Street	Southbound							
	Corner	Side of Intersection	Notes	Distance from Intersection	Avaliable right-of-way from back of curb	Additional right-of-way required	Route 297 Daily Average Boardings (September 2012)	Proposed Station Design
NW 199th St	SW	Far	5' sidewalk, 13' landscape/transformer area.	440'	5'	10'	99	Full Station 15' x 25'
NW 183rd St	SW	Far	Use Carol-Mart right-of-way (R/W), move bus stop closer to intersection. Existing bus stop 400 ft away from intersection.	400'	6'	9'	151	Full Station 15' x 25'
NW 175th St	SW	Far	Use frontage road if needed. 6' sidewalk, not provided south of existing bus stop. 15' width station would require using frontage road.	150'	6' plus additional 6' of grass area behind sidewalk	3' from service road travel lane	55	Full Station 15' x 25'
NW 160th St	SW	Far	Use existing landscaped area fronting Walgreens, 6' R/W. Acquire R/W	180'	6'	2'	32	Slim Station 8' x 26.25'
Sesame St (unsignalized)	SW	Far	Acquire R/W in landscaped area of Family Dollar surface parking lot. 6' sidewalk and 13' landscaped area.	100'	6'	2'	24	Slim Station 8' x 26.25'
NW 135th St	SW	Far	Acquire R/W at Elegant Beauty Supplies/Salon. 4' sidewalk and 4' landscaped area.	200'	4'	4'	38	Slim Station 8' x 26.25'
NW 113th St/ MD College			Existing bus station on campus.			0'	81	At existing station
	SW	Far	Plan future station considering campus expansion.	150'	30'	0'		Full Station 15' x 25'
NW 103rd St	SW	Far	At existing bus stop. 17' to travel lane from back of sidewalk. Provide curb extension	300'	10' plus 7' from curb to edge of travel lane	0'	29	Full Station 15' x 25'
NW 79th St	SW	Far	Existing bus stop, acquire R/W from Family Dollar or drop southbound lane as SBRT at NW 79th Street and provide curb extension.	220'	5'	3' or drop through lane	44	Slim Station 8' x 26.25'
NW 62nd St			At existing Metrorail station (No station, stop in road under metrorail station). Elevator needs to be repaired and MetroRail station access opened.	0'	8'	0'	14	No station (Assume Slim Station for Cost Development)
NW 54th St	SW	Far	8' sidewalk.	180'	8'	0'	N/A	Slim Station 8' x 26.25'

Table 6B: Northbound Station Locations Information

Cross Street	Northbound							
	Corner	Side of Intersection	Notes	Distance from Intersection	Avaliable right-of-way from back of curb	Additional right-of-way required	Route 297 Daily Average Boardings (September 2012)	Proposed Station Design
NW 199th St	SE	Near	Existing bus stop, fronting Walmart. 10' sidewalk and 10' grass area	350'	20'	0'	12	Full Station 15' x 25'
NW 183rd St	SE	Near	6' sidewalk, 9' grass area. Will require pole and sign relocation	180'	6'	9'	50	Full Station 15' x 25'
NW 175th St	SE	Near	6' sidewalk, 7' grass area.	70'	6'	2'	24	Slim Station 8' x 26.25'
NW 160th St	NE	Far	Along frontage road. 6' sidewalk and 26' grass area.	135'	6' plus 26' of grass area behind sidewalk	0'	33	Full Station 15' x 25'
Sesame St (unsignalized)	NE	Far	Along frontage road. 6' sidewalk and 16' grass area.	375'	6' plus 16' of grass area behind sidewalk	0'	21 (Ali Baba Avenue)	Full Station 15' x 25'
NW 135th St	SE	Near	Acquire easement vacant parcel/property which has cross access with Auto Zone. 5' sidewalk	240'	5'	3'	37	Slim Station 8' x 26.25'
NW 113th St/ MD College			Existing bus station on campus.				109	At existing station
	NE	Far	Acquire R/W from vacant parcel north of NW 113th Street for future station considering campus expansion.	235'	5'	10'		Full Station 15' x 25'
NW 103rd St	NE	Far	At existing bus stop, aquire R/W from Marine retail store. 95' feet between driveways.	240'	5'	3'	44	Slim Station 8' x 26.25'
NW 79th St	NE	Far	In front of Burger King, no additional R/W required. 5' sidewalk, 10' to edge of travel lane. Provide curb extension.	300'	5' plus 10' to travel lane	0'	155	Full Station 15' x 25'
NW 62nd St			At existing Metrorail station (No station, stop in road under metrorail station). Will need concrete pad to connect to existing sidewalk.	0'	25'	0'	333	No station (Assume Slim Station for Cost Development)
NW 54th St	NE	Far	8' sidewalk.	325'	8'	0'	N/A	Slim Station 8' x 26.25'

ENHANCED BUS OPERATING STRATEGIES

There are several types of transit preferential treatments that can be applied to improve the operational efficiency of BRT systems that are critical for providing the inherent "rapid" service. Two specific preferential treatments proposed for the NW 27th Avenue EBS project are transit signal priority (TSP) and queue jump (QJ) operations. TSP alters traffic signal timing at intersections to give priority to transit vehicles. A QJ lane allows transit vehicles to bypass general traffic at an intersection and is often used in conjunction with signal priority. TSP and QJ operations can be an effective method to provide time savings in corridors where it is not feasible to dedicate an exclusive travel lane to buses.

Visualization of queue jump operations illustrating a bus proceeding through an intersection ahead of general traffic

In the following sections these preferential treatment operating strategies are defined and a Concept of Operations is presented to establish parameters for the application of these operating strategies.

Definition of Transit Signal Priority and Queue Jump/Queue Bypass Lane Operations

Active transit signal priority (TSP) is the process by which benefit is provided through the traffic signals to transit vehicles operating along the corridor. The benefit can be provided through the extension of green time for buses approaching an intersection or advancing green time for buses waiting at the red phase. The use of TSP can be scheduled for all-day, during peak hours, or some other defined time period of the day.

TSP can be implemented at individual intersections or throughout an entire corridor. More advanced TSP systems can be linked to the bus schedule, only providing signal priority when a bus is behind schedule. Other options include headway consistency, where signal priority is granted if buses are behind a pre-defined headway or spacing from the prior bus. Other TSP systems provide signal priority to every bus that approaches an intersection regardless of schedule considerations, which ensures that buses not only remain on schedule but also improves their overall travel times.

TSP is different from traffic signal pre-emption, where the signal progression is interrupted. TSP modifies the normal signal operation process to better accommodate transit vehicles, whereas pre-emption interrupts the normal signal operation process for a special condition by temporarily controlling the traffic signal to facilitate the bus passing through the intersection. General purpose traffic can also benefit from TSP. When the "mainline" is given an extended green phase for the bus, all the vehicles traveling through the intersection around the bus also receive benefit.

Benefits can also be provided through the coordination or retiming of traffic signals to accommodate bus travel patterns. This approach is typically done through improvements in signal timing to provide progression for the buses and account for the differences in travel speeds between cars and buses, providing preference to buses versus cars.

Queue jump (QJ) operations allow buses to bypass general traffic at an intersection, via either an exclusive bypass lane or right-turn lane, through the use of special bus signal phasing. The buses access the bypass lane or right-turn lane and receive a special signal phase to proceed through the intersection ahead of the general traffic. Typically queue jumps from right-turn lanes are used with near-side stations and queue bypass lanes are used for far-side stations. The use of a queue jump operation can also provide a means for buses to gain an advantage over general traffic when used in conjunction with a near-side bus stop.

Goals and Objectives

Typically, a bus spends approximately 60 percent of its run time in motion, approximately 20 percent serving bus stops, and approximately 20 percent caught up in traffic signal or congestion delay. While there are a number of elements to improve the bus customer experience, the benefits of implementing priority bus treatments can include reduced bus travel times, increased schedule reliability, an enhanced public profile, operating cost savings, reduced equipment requirements, and increased transit ridership.

TSP and QJ operations can improve the person throughput of a corridor and also improve the travel time reliability for buses, thus improving their attractiveness as an alternative mode. Traditional level of service (LOS) measures do not recognize person throughput because they only account for individual vehicles. Comparing the number of people moving through a corridor rather than the number of vehicles would produce different results. Ideally, the total number of persons able to travel in a corridor will be higher with priority bus operations than without, as more people benefit from bus priority treatments than could be accommodated in cars. Implementation of TSP and QJ has resulted in significant improvements for BRT applications around the nation, while impacts to automobile traffic have been shown to be minor.

TRANSIT SIGNAL PRIORITY CONCEPT OF OPERATIONS

The purpose of this Concept of Operations (ConOps) is to define the parameters for transit signal priority (TSP) for the NW 27th Avenue EBS project. Options for TSP parameters, such as schedule adherence, maintaining consistent headways, etc. are discussed, along with options of parameters for when a request for TSP would be granted. The ConOps defines the operations of the TSP system and the control strategies that the system should be able to perform. This information defines the technical system requirements, which will in turn be used to select the most effective technological solution.

TSP System Components

TSP systems consist of three components: the priority request generator (detection device), the priority request server (signal controllers and embedded priority logic), and the support systems that allow the agencies access to data for management of the system (transit monitoring system).

There are two options for generating the priority requests: a distributed system and a centralized system. The following sections provide a general description of each option, along with a description of the option that has been selected in Miami-Dade County.

Distributed System

A distributed priority system is where the priority request is generated by the transit vehicle and is detected and served at the local traffic signal controller. This type of system is advantageous in situations where the local jurisdiction may not have their signal controllers connected to a centralized system and managed by a traffic management center (TMC). The signal controller software contains the priority logic and serves the request locally.

Centralized System

A centralized priority system is where the priority request is generated either on the transit vehicle or at the traffic signal controller. The message is transmitted to the priority request server, located within the TMC. Priority is granted to the local controller level based on direction from the TMC. This system is advantageous in situations where the local jurisdiction, such as Miami-Dade County, has their signal controllers connected to a centralized system and managed by a TMC, in real-time communication.

The central system will determine whether to request priority based on predefined conditions, such as schedule adherence, headway, conflicting calls, etc. An advantage of a centralized system is that all records of the system operation can be maintained centrally and changes can be easily implemented across all systems from the central location.

Miami-Dade County Integrated TSP CAD/AVL System

Miami-Dade County has selected a centralized priority system approach for the TSP processing. This system will be integrated with MDT's Computer Aided Dispatch/Automatic Vehicle Location (CAD/AVL) system and will be invoked from the central system at the TMC. The TSP operation calls for special logic programmed in the traffic controller installed at the signalized intersection and will be invoked when an eligible bus is detected within a defined proximity of an eligible signalized intersection.

The CAD/AVL system vendor will track the location of buses via Global Positioning System (GPS) equipment on the buses that communicate with the CAD/AVL central system software. Through this tracking feature and appropriate additional logic to be determined by MDT regarding the CAD/AVL central system software, a real-time request for TSP will be sent to the Miami-Dade County Advanced Traffic Management System (ATMS) central system software. The real-time location of the subset of buses that are requesting TSP will be updated at the transit center on a frequent basis, at least as often as once per five seconds.

Based on bus location and route definition, the CAD/AVL system will determine whether or not TSP is granted, according to rules of engagement established by the Traffic Signals and Sign (TS&S) Division of the Miami-Dade Public Works and Waste Management (PWWM) Department. When a bus is on schedule or does not meet other criteria determined by MDT, the CAD/AVL system will send a TSP cancel message to the Miami-Dade ATMS. The Miami-Dade County ATMS will then discontinue evaluating whether or not to grant TSP, as requested, along the bus's path.

TSP request related information will be sent from the CAD/AVL central system software to the Miami-Dade County ATMS central system software via a custom center-to-center (C2C) interface implemented between the two systems. The most likely implementation of this C2C interface is using National Transportation Communications for Intelligent Transportation System Protocol (NTCIP) 2306 formatting (Extensible Markup Language (XML) over web services) using Transmission Control Protocol/Internet Protocol (TCP/IP) and NTCIP 1211 data object standards. The static route, stop, and other definitions are anticipated to be communicated between the two systems using the Google transit C2C specification or a specification previously implemented by the CAD/AVL vendor for other systems. The static route and stop information will be shared between the two systems on no more frequently than a daily basis, or when this information is changed. Similar web service interfaces are preferred for sharing the static information.

TSP Logic Options

This section describes trigger options for the TSP that will be processed centrally from the Miami-Dade County ATMS system. The priority logic are the parameters defined to either grant or deny a TSP request, depending on several factors that will be discussed in this section. Advantages for each priority logic option are explored.

Headway Based

In headway based TSP operation, the priority logic is granted based on a pre-defined headway (spacing or frequency) between the buses. The headway parameter can be user defined or can be variable based on time of day, day of week or any other desired parameters. The priority logic does not utilize schedule adherence information. Instead, the bus transmits its TSP request to the intersection, and the priority request server manages the priority activity to maintain the desired headway between buses. Buses that arrive sooner than the defined headway will not receive TSP and buses that arrive later will receive the benefit of TSP.

A headway based TSP provides an advantage to buses that are behind schedule (indirectly), by maintaining a consistent headway among the bus fleet. It also tends to reduce "bunching" of buses and thus improves system efficiency. Once the first bus travels along the corridor, subsequent buses are controlled to maintain an established headway. This headway can be changed during the day based on the bus schedule.

Scheduled Based

In schedule based TSP operation, the priority logic is granted based on the actual, real-time location of the buses. Priority is granted if a bus is behind a pre-defined schedule, based on the CAD/AVL system. The CAD/AVL system must receive information from scheduling software/databases to compare the actual bus location to the bus's schedule. This function is a key component of the conditional priority system, because only late buses should receive signal priority. This system requires robust communication and an updated schedule database of the bus operations.

This approach provides efficient use of the signal priority modifications at the intersection, because priority is only granted if a bus is behind schedule.

Always On

As opposed to a conditional priority as described above for headway based and schedule based, in the "always-on" operation the priority logic is granted at all times that a bus is in operation, independent of headway or schedule. The "always on" operation can be programmed on a time of day or day of week basis. For example, TSP can always be granted during non-peak hours.

The advantage of an "always on" system is simplicity in operation and the benefit that the system can provide to the transit vehicles. This option provides maximum benefit to the buses, by providing an advantage to the bus no matter the circumstances.

TSP Signal Timing Parameters

Once priority logic has been satisfied, the controller accepts and processes the TSP priority. Typically, an "early green" or "extended green" strategy is implemented, where these strategies operate in a pair, (i.e. one or the other can be processed) depending on the time when the bus arrives at the intersection. Early green and green extension strategies are available together within TSP enhanced control environments but are not applied at the same time.

By definition a TSP capable signal controller providing an early green or green extension will not generally negatively affect signal coordination. As opposed to signal pre-emption, during a TSP operation the minimum pedestrian clearance time will not be truncated nor the minimum green times for the opposing movements will not violated.

The following is a description of TSP signal timing parameters.

Early Green

An early green strategy shortens the green time of preceding phases to expedite the return to green (i.e., red truncation) for the movement where a TSP equipped bus has been detected and the priority logic has been satisfied. This strategy only applies when the signal is red for the approaching TSP-equipped bus. Typically, the early green interval is set at approximately 10 percent of the cycle length or a maximum of 15 seconds. Depending on the typical queue length, the amount of time for the early green may be increased to allow more vehicles to gain the advantage of the early green and clear the intersection, including the bus. Since it is desired that the traffic signal cycle return back to normal operations and be in sync for

signal coordination, the length of the early green interval must be balanced in order to minimize impact to the background cycle length.

Extension of Green

A green extension strategy extends the green time for the TSP movement when a TSP-equipped bus is approaching the intersection and the priority logic has been satisfied. This strategy only applies when the signal is green for the approaching TSP equipped bus. Green extension is one of the most effective forms of TSP since a green extension does not require additional clearance intervals, yet allows a transit vehicle to be served and significantly reduces the delay to that vehicle relative to waiting for an early green or special transit phase. Typically, the extension of green interval is set to a maximum time of approximately 10 percent of the cycle length or a maximum of 15 seconds. The extension of green is truncated, once the bus clears the intersection.

Passive Signal Timing

Passive signal timing priority provides an advantage to transit vehicles traveling along a corridor without the vehicle communicating with the signal to acquire priority. This strategy is typically accomplished through improvements in signal timing to provide progression for buses and account for the differences in travel speeds between cars and buses, providing preference to buses versus cars. Typically, signal coordination is based on either prevailing speed or speed limit. With the passive signal timing, the progression is set to better match the travel speed of the buses in the corridor, which is typically lower than the prevailing speed for cars.

Optimized Coordination Timing

Optimized signal timing is an important component of an effective corridor management strategy. With the application of TSP, the signal timing along the corridor should be optimized to incorporate the changes resulting from the TSP functions. Implementation of the TSP may alter the cycle length and the sync point (beginning of the “main-street” green) along the corridor. The early green or extension of green may affect the cycle length, as this time is taken (reduced) from the minor movements or side street splits. In addition, the early green and extension of green may impact the sync point, so that the platoon of vehicles may start earlier than anticipated. This condition is called early release. Once TSP has been implemented, the overall coordination plan should be reviewed, adjusted, and fine-tuned to achieve an optimum operation for both vehicular and transit vehicles.

Optimization Process

Signal timing optimization involves modification of several elements including cycle length, number of phases, phase sequence, phase duration, and offsets, in order to achieve these objectives:

- Minimize the number of stops
- Minimize the queue length
- Minimize the delay of vehicles
- Maximize throughput

The primary reason for the implementation of TSP is to reduce travel time and the variability in travel time for buses, which share roadways with other vehicles including passenger cars and trucks. Overall corridor or

network delays impact both buses and other vehicles, and improvements in the performance of the corridor can benefit both.

Optimization of traffic signals can involve optimization of an isolated signalized intersection, optimization of traffic signal corridors, or optimization of traffic signal networks, with an increase in complexity from an isolated signal to a corridor and subsequently to a network. Optimization develops traffic signal timing plans including cycle lengths, phase duration, phase order, offsets, etc. The primary constraints in the development of an effective signal timing plan for an isolated signalized intersection are vehicular and pedestrian demands and intersection geometry. Pedestrian movements require a minimum amount of time, especially for wide intersections with multiple lanes on different approaches, which may limit the extent to which traffic signals can be optimized.

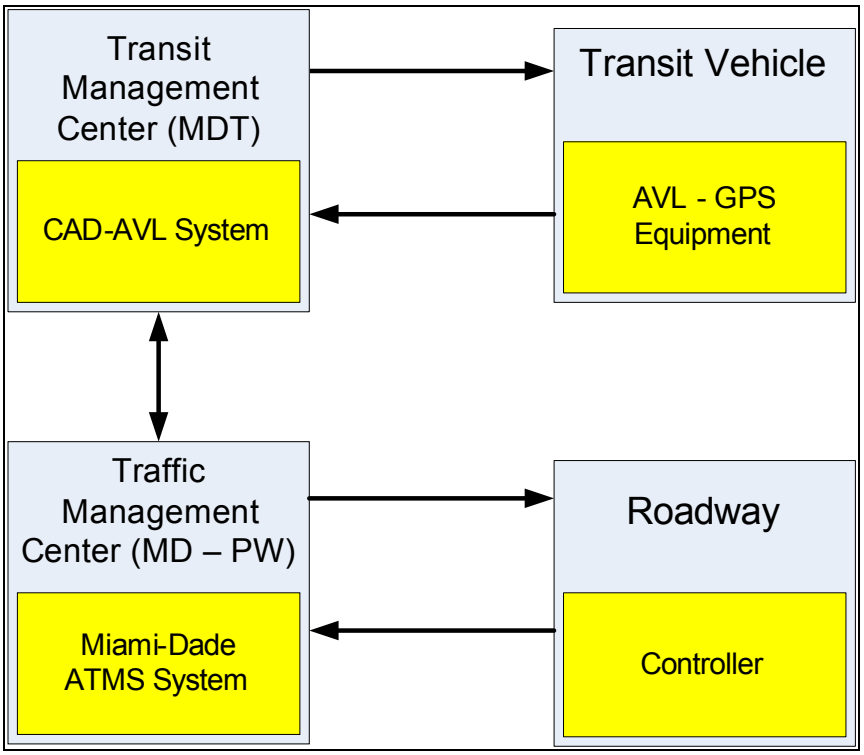
System Architecture

This section defines national ITS architecture elements that are relevant to the TSP application. To ensure that ITS deployments are coordinated and integration opportunities are maximized, the U.S. Department of Transportation (USDOT) requires the development of an ITS architecture. The ITS architecture helps identify opportunities for interagency communication to better coordinate deployment efforts and to support integration activities of multimodal transportation services. ITS architecture typically includes the following components.

- Subsystems
- Equipment packages
- Market packages
- Interconnects
- Information flows

Subsystems represent the various ITS management centers (traffic management centers), field infrastructure (signal controllers), and ITS equipment in vehicles (transit vehicle systems). Equipment packages represent discrete functional capabilities of each subsystem. Equipment packages produce, receive, or process information that supports transportation service, which are known as market packages. Market packages are comprised of multiple equipment packages and subsystems that interact to provide traffic management and other ITS services. The national ITS architecture market package that corresponds to TSP is called APTS7 - Multimodal Coordination. ITS standard development efforts for signal priority and TSP are documented in the ITS Protocol (NTCIP 1211) and Transit Communications Interface Profiles (APTA TCIP TWG 10). Figure 7 shows the TSP market package diagram.

Figure 7: APTS 7 – Multi-Modal Market Package



Operations and Maintenance

Operations

Ongoing performance monitoring and management of a TSP system requires data collection. Since the Miami-Dade ATMS is a centralized system, this function can easily be incorporated in project requirements. Ideally, the following data should be collected and maintained.

- Time the TSP call was requested
- Vehicle number (bus)
- High or low level priority request
- Specific priority routine invoked
- Range and intensity of detection signal
- When the TSP call was dropped
- Call duration period
- Priority request disposition (e.g. not granted, why not granted, when granted, etc.)

From the archived data, travel times and signal timing impacts can be calculated. There should be an agreement among the stakeholders (preferably with a memorandum of understanding or inter-agency agreement) concerning what data will be collected and how it will or will not be distributed and shared.

Both the transit agency (MDT) and the traffic engineering offices (Miami-Dade County TS&S) will need to have procedures to ensure that:

- The TSP system is operating properly
- The priority request generator (PRG) is generating priority requests
- The priority request server (PRS) is processing the requests and communicating them to the controller
- The controller is granting the appropriate priority action for the circumstances

With respect to on-board equipment, some agencies have a test bed that each bus runs through in the morning as it leaves the garage in order to validate that the on-board TSP equipment is working.

Maintenance

TSP maintenance seems to be an insignificant issue in many cases. Both on-board and field equipment seem to be reliable, requiring little maintenance. However, agreements need to be in place for the occasions in which maintenance is required. The policy should require that MDT maintain whatever is on the bus and that Miami-Dade County TS&S maintain field equipment and the ATMS system, incorporating maintenance tasks into standard maintenance activities.

Another part of the agreement should discuss and develop appropriate TSP parameters, signal optimization parameters and provisions for evaluation and update of the TSP and signal timing parameters. This organization is another reason why it is important for traffic engineering and bus operations and maintenance to be part of the stakeholder team. As mentioned, it is useful to have agreements stating the maintenance and ongoing financial policies to avoid misunderstandings or changes in attitude in case of personnel changes. Maintenance procedures should be spelled out by the equipment supplier in the provided maintenance documents. Stakeholders will need to agree on the level of spares to be initially acquired and for the ongoing financial responsibility for acquiring additional replacement components and future upgrades.

Requirements for Project

The requirements for the project fall into the following major categories:

- Vehicle detection and communication system
- Central system computer aided dispatch (CAD)/automatic vehicle location (AVL) and advanced transportation management systems (ATMS)
- TSP and signal timing parameters

Vehicle Detection and Communication System

The following are the recommended requirements of the vehicle detection and communication system.

1. Shall utilize a global positioning system (GPS) with a single antenna on the vehicle to determine vehicle location, speed, and direction.

2. Shall be able to operate within an urban environment and maintain a minimum accuracy of +/- 3 meters.
3. Shall not result in installation of equipment that will create redundant processes.
4. Shall transmit relevant bus information to the computer aided dispatch (CAD) system.

Computer Aided Dispatch (CAD)/Automatic Vehicle Location (AVL) Equipment

The following are the recommended requirements of the CAD/AVL equipment.

1. The AVL system shall transmit the following information to the CAD system. The CAD system shall transmit the same information to the ATMS for each transit priority request:

   - Transit vehicle identification number
   - Transit vehicle location (+/- 3 meters)
   - Priority request identification number
   - Vehicle speed
   - Vehicle heading
   - Passenger loading
   - In/out of service status
   - Amount of time the bus is behind or ahead of schedule
   - Route number
   - Next stop ID (if known)

2. The ATMS shall transmit the following information to the CAD/AVL system:

   - Transit vehicle identification number
   - Priority request identification number
   - Intersection asset number
   - Basic intersection description (short names)
   - Request approval/denial decision
   - Request denial reason (if request is denied)
   - Priority implementation status and actions taken by the intersection controller (if request is approved)
   - Each subsequent intersection along the route where the CAD/AVL system will receive additional messages from the ATMS system regarding approval or denial of TSP service at those intersections

3. The ATMS system shall send the transit priority call to the controller, based on the TSP and signal timing parameters.

4. The interface shall be designed and documented in an interface control document (ICED).

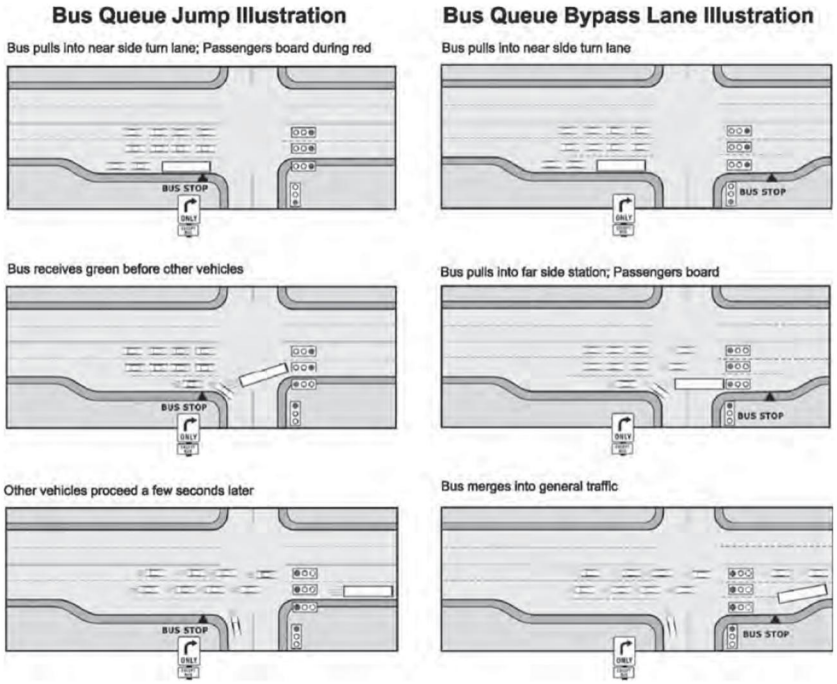
TSP and Signal Timing Parameters

The following are the general requirements for the TSP and signal timing parameters.

1. The priority logic shall be based on a headway-based system. If a transit vehicle is behind the pre-established headway by 2 minutes, a TSP shall be granted. Otherwise, the TSP shall be denied.
2. Once a priority has been granted, the traffic signal controller shall either grant an early green or extension of green, depending on the position of the bus relative to the cycle timer. If the bus is approaching the intersection during the main street red interval, then an early green shall be granted. If the bus is arriving to the intersection during the green phase and based on the speed and location of the bus will miss the green phase, a green extension shall be granted.
3. Early green shall be granted, up to 15 seconds. Extension of green shall be granted until the bus passes through the intersection or no longer than 15 seconds.
4. TSP shall not be granted back to back, (i.e. two subsequent cycles) irrespective of the directional call.
5. The controller shall reduce the green split time for subsequent phases, after the main street green, proportionally to compensate the amount of transit priority time provided to the main street. The signal shall return back to coordination, in one cycle, after the transit priority request has been granted.
6. If a QJ operation is installed, with a dedicated transit lane, then a special phase shall be inserted immediately after the active phase to serve the transit vehicle. The timing of the phase shall be appropriate to clear the bus across the intersection. A clearance interval shall be included with the phase.
7. If a QJ phase is installed in conjunction with a right-turn overlap phase, then appropriate time shall be allocated to the right-turn overlap phase to clear the queue vehicles and allow the transit vehicle to clear the intersection.

QUEUE JUMP/QUEUE BYPASS LANE OPERATIONS

Queue Jump (QJ) is a strategy where transit vehicles are provided the means to pull ahead of regular vehicular traffic that is stopped at an intersection, thereby providing the transit vehicle with an advanced green (a "jump") in relation to other vehicular traffic. QJ operations allow the transit vehicles to bypass the regular traffic, via either a separate bypass lane or via a right-turn lane, through the use of special bus signal phasing. The bypass or right-turn lane allows the bus to proceed through the intersection, bypassing traffic, to access a far-side bus stop or to continue along the corridor. The use of a QJ treatment can provide a means for transit to gain an advantage over general traffic, especially at congested intersections, where TSP is not necessarily effective, due to the level of congestion.



Queue Jump and Queue Bypass Operations
Source: TRCP Report 83

QJ can also be an effective way to provide time savings to buses in corridors where it is not feasible to dedicate a full lane as an exclusive bus lane. The bus travels in mixed traffic until it reaches the queue jump and bypasses traffic before proceeding through the intersection. While not providing the level of priority an exclusive bus lane does, the queue jump provides a time savings the bus would not otherwise receive.

QJ operations can be supported by using a "special phase" or an "overlap phase," in case of a combined bus/right-turn lane operation. With a special phase or "phase insertion," a short green phase is injected into the cycle, typically long enough for the buses to clear the intersection, where an exclusive bus lane is provided. A normal yellow interval follows the special phase.

For an overlap phase, where a bus lane and right-turn lane is combined, the phase is initiated to allow right-turn movements to clear the intersection and allow buses to proceed through the intersection. Through movement from this right-turn lane is only allowed for buses, through a specially placed signal head and regulatory sign. The overlap phase can be combined with a non-conflicting left-turn movement, thereby mitigating impacts to the overall vehicular capacity of the intersection. The amount of time required for an

overlap phase may range from 10 to 25 seconds, depending on traffic volumes and right-turn lane queue lengths.

Due to the benefits associated with QJ operation, it should be considered wherever there is an appropriate right-turn lane or room for an additional lane.

NW 27th Avenue Queue Jump/Queue Bypass Lane Locations

An analysis of the NW 27th Avenue corridor was performed to determine potential intersections for the implementation of queue jump operations. Factors considered in the analysis included (1) the level of congestion at the intersection and (2) whether an exclusive right-turn lane was available that could accommodate queue jump operations without the need for widening the right-of-way to provide an exclusive bus bay.

Traffic data including intersection turning movement counts were available from a corridor retiming project performed in 2006. Based on a review of historical traffic volumes in the corridor, it was determined that traffic volumes had not changed significantly over the past several years and that the 2006 intersection turning movement counts were still representative of traffic conditions in the corridor.

Based on the referenced traffic data, Table 7 presents the intersection level of service for the AM and PM peak hours for the NW 27th Avenue corridor. The intersection levels of service were determined with the *Synchro* traffic software program, which applied methodologies outlined in the *Highway Capacity Manual*. Intersections exhibiting operations below level of service (LOS) D were identified as candidates for queue jump operations based on existing levels of congestion that could negatively impact bus operations. The analysis indicated that the following intersections exhibit operations below LOS D.

- NW 199th Street
- NW 183rd Street
- SR 826 (Palmetto Expressway) Westbound Off-Ramp
- SR 826 (Palmetto Expressway) Eastbound Off-Ramp
- NW 119th Street
- NW 103rd Street
- NW 62nd Street

These intersections were examined to determine if exclusive right-turn lanes are available to accommodate queue jump operations without the need for additional right-of-way. Based on the availability of exclusive right-turn lanes, queue jump operations may be viable at the following intersections which exhibited existing levels of operations below LOS D.

- NW 199th Street, northbound direction (see Appendix D for illustration of concept)
- NW 119th Street, northbound direction (see Appendix D for illustration of concept)

Although the intersection level of service at NW 79th Street is LOS D, queue bypass lane operation should be considered in the northbound direction at this intersection. The queue bypass lane operation in the

northbound direction at this intersection is facilitated by an existing northbound right-turn lane of considerable length and a through travel receiving lane. A concept illustration provided in Appendix D depicts the potential queue bypass lane operation at NW 79th Street.

Table 7: Queue Jump/Queue Bypass Lane Feasibility Analysis

Cross Street	NB Right-Turn Lane Provided?	SB Right-Turn Lane Provided?	Intersection LOS AM(PM)	Provide Queue Jump/Bypass?
NW 211th Street	No	No	B(B)	No
Calder Race Track	No	No	A(A)	No
NW 207th Street	No	No	C(C)	No
NW 203rd Street	No	No	A(A)	No
NW 199th Street	**Yes**	No	D**(E)**	**Potential Jump**
NW 191st Street	**Yes**	No	B(B)	No
NW 183rd Street	No	No	D**(F)**	No
NW 175th Street	No	No	D(C)	No
SR 826 WB Off-Ramp	No	No	**E(F)**	No
SR 826 EB Off-Ramp	No	No	**F(F)**	No
NW 160th Street	No	No	A(A)	No
NW 151st Street	No	No	D(D)	No
Ali Baba Avenue	No	No	B(B)	No
Burlington Street	No	No	B(B)	No
NW 138th/NW 139th Street (Mid-Block Ped)	No	No	A(A)	No
NW 137th Street	No	No	B(C)	No
Opa-Locka Boulevard	No	No	B(A)	No
NW 135th Street	No	No	B(C)	No
NW 132nd Street	No	No	A(A)	No
NW 119th Street	**Yes**	No	**F(F)**	**Potential Jump**
NW 115th Street	No	**Yes**	A(A)	No
NW 113th Street	No	No	A(A)	No
NW 110th Street	No	No	A(A)	No
NW 105th/NW 106th Streets (Mid-Block Ped)	No	No	A(A)	No
NW 103rd Street	No	**Yes**	**E**(D)	No(1)
NW 95th Street WB	**Yes**	No	B(B)	No
NW 95th Street EB	**Yes**	No	A(B)	No
NW 87th Street	**Yes**	No	B(B)	No
NW 84th Street	No	No	A(B)	No
NW 79th Street	**Yes**	No	D(D)	**Potential Bypass**
NW 75th Street	No	No	B(A)	No
NW 71st Street	No	No	A(A)	No
NW 65th Street	No	No	A(A)	No
NW 62nd Street	No	No	**F**(C)	No
NW 60th Street	No	No	A(A)	No
NW 54th Street	No	No	C(C)	No

Note: (1) Since a far-side station will be located within 300 feet of intersection, a queue jump/queue bypass will not be provided.

SERVICE PLAN

EXISTING SERVICE CHARACTERISTICS

The NW 27th Avenue corridor is currently served by two Miami-Dade Transit (MDT) transit bus routes: Route 27 (Coconut Grove-Calder) and Route 297 Orange MAX. Route 27 provides all day (24 hours) local service and Route 297 Orange MAX provides daytime limited-stop service. The existing routes in the NW 27th Avenue corridor account for some of highest ridership and are among the most productive bus routes in the MDT system.

Route 27 provides local bus service between the Coconut Grove Metrorail Station in the south and NW 207th Street terminus in the north with approximately 110 stops in each direction. Route 27 operates in combination with a variation Route 27A, which provides service to NW 37th Avenue between NW 183rd Street and NW 207th Street at the north end of the route. Route 27/27A combined provides 15-minute headway throughout the day and longer headway (generally between 30 and 60 minutes) during overnight hours.

Route 297 Orange MAX provides limited stop service along the NW 27th Avenue corridor with 11 stops spaced at approximately one-mile intervals between the Miami Intermodal Center (MIC) and NW 199th Street. To the north of NW 199th Street, Route 297 makes all local stops along the approximately two-mile turnaround required for buses to head back in the southbound direction. Route 297 Orange MAX provides 15-minute headway during peak periods and 30-minutes headway during the off-peak.

Table 8 presents route characteristics for Route 27 and Route 297 Orange MAX. Between SR 112 (Airport Expressway) and NW 183rd Street, Routes 27 and 297 Orange MAX currently combine to provide 7.5 minute headway in the NW 27th Avenue corridor during peak periods.

Table 8: Existing Routes 27 and 297 Characteristics

Route Number	Route Miles	Run Time (Minutes)	Max. Number of Stops per Direction	Headway Peak/Off-Peak	Span of Service	Passengers per Revenue Mile	Passengers per Revenue Hour
Route 27	39.3	210(1)	105	30/30	5:17 AM - 12:08 AM	4.1(1)	48.3(1)
Route 27A	40.3	210(1)	113	30/30	24 hours	4.1(1)	48.3(1)
Route 297 Orange MAX	32.5	120	25(2)	15/30	5:30 AM -8:06 PM	1.4	22.1

Notes:
(1) Running time and productivity data is combined for Route 27 and 27A
(2) Route 297 Orange MAX makes all local stops north of NW 199th Street

Major Stop Activity Locations

Routes 27 and 297 Orange MAX serve approximately 10,000 and 1,700 average weekday total daily boardings, respectively, based upon MDT's January 2013 Ridership Technical Report. The 27th Avenue transit corridor serves trips originating within walking distance as well as connecting trips transferring from BCT in the north, other MDT routes at intersections with major east-west arterial roadways, at Miami-Dade College and Metrorail stations. Automatic Passenger Counts (APC) data reveal that the heaviest bus stop activity along the NW 27th Avenue corridor is experienced at the following locations.

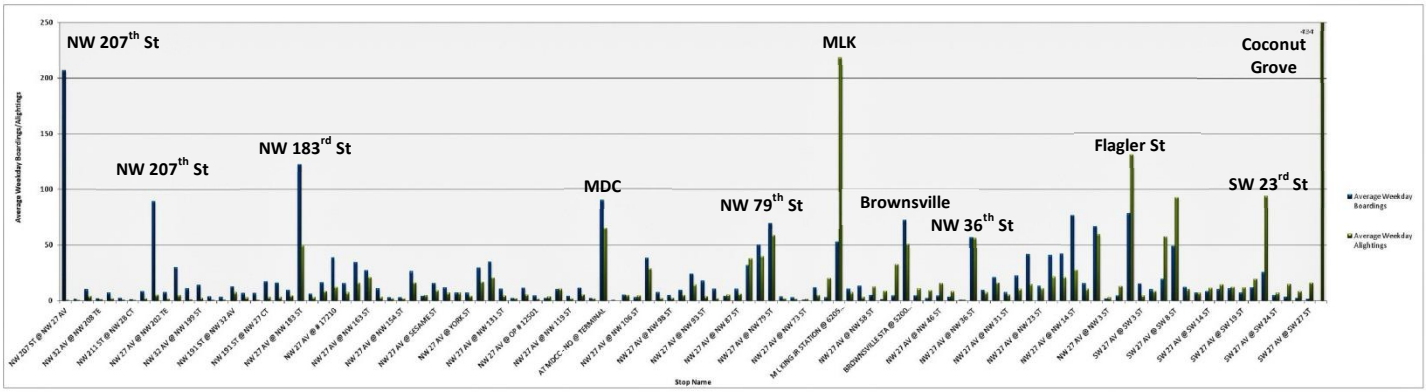
- NW 207th Street
- NW 183rd Street
- Miami-Dade College North Campus
- NW 79th Street
- Martin Luther King Metrorail Station
- Brownsville Metrorail Station (for Route 27 only)
- MIA Metrorail Station (for Route 297 Orange MAX only)

These stops account for a substantial percentage of the daily boardings and alightings along the NW 27th Avenue corridor. In particular, the six stops listed above served by Route 297 Orange MAX account for nearly 75 percent of the route's stop activity.

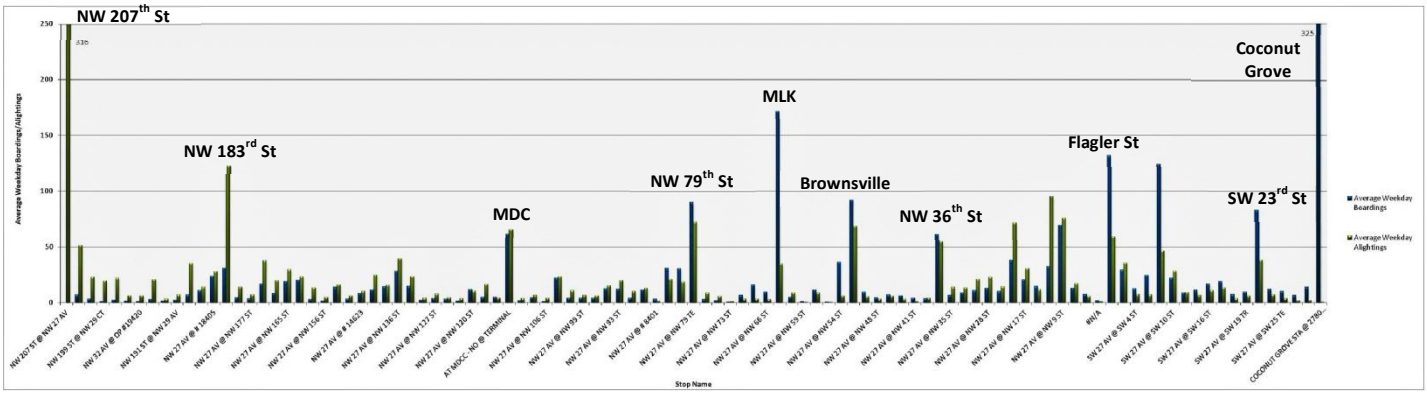
Figure 8 illustrates the daily stop activity in the southbound and northbound directions, respectively, for Route 27.

Figure 8: Route 27 Daily Stop Activity

Southbound - Average Daily Ridership



Northbound - Average Daily Ridership

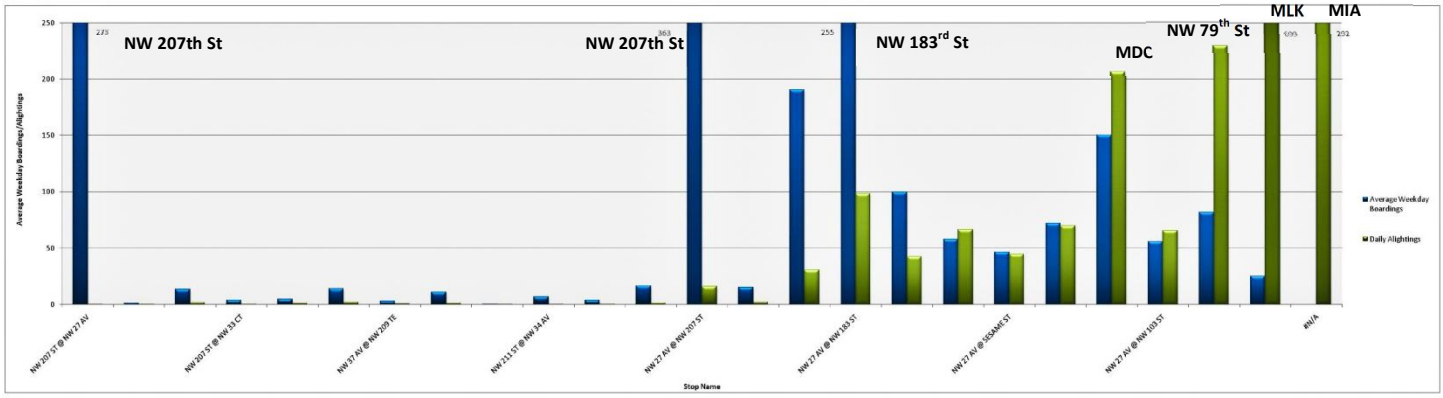


Ridership on Route 297 Orange MAX illustrates a directional trip pattern. In the southbound direction there are a greater number of boardings at stops located in the north end and a greater number of alightings at stops located in the south end of the route. Conversely, for trips in the northbound direction, there are greater number of boardings at stops located in the south end and a greater number of alightings at stops located in the north end of the route. The stop serving Miami-Dade College is the exception to the typical pattern, as this stop serves as a major destination for alightings and location for boardings in both directions.

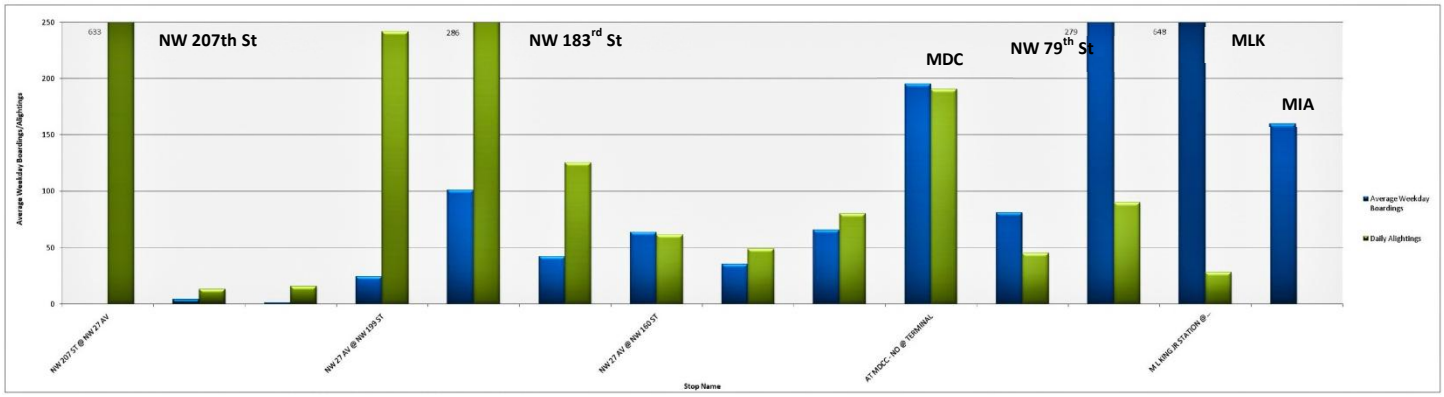
Figure 9 illustrates the daily stop activity in the southbound and northbound directions, respectively, for Route 297 Orange MAX.

Figure 9: Route 297 Orange MAX Daily Stop Activity

Southbound - Average Daily Ridership



Northbound - Average Daily Ridership



Passenger Loads

NW 27th Avenue experiences significant ridership demand throughout the day with over 11,000 daily weekday boardings for Routes 27 and 297 Orange MAX combined.

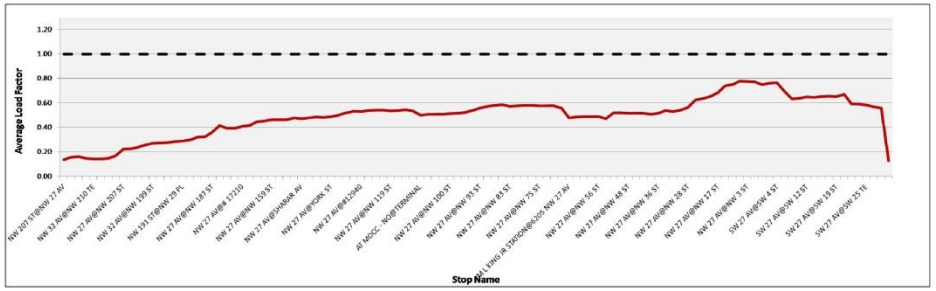
Route 27 experiences maximum load points just north of Dr. Martin Luther King Jr. Metrorail Station for buses traveling in the southbound direction and around NW 87th Street for buses traveling in the northbound direction. Load patterns are generally balanced in the northbound and southbound directions; however, the load factors are often greater during peak periods with instances where seating capacity is exceeded. Figure 10 presents average weekday load factors for Route 27.

Route 297 Orange MAX experiences lower average load factors than Route 27 throughout the service day. In particular, Route 297 Orange MAX load factors are considerably lower along the two-mile turnaround loop required for buses to head back in the southbound direction at the northern end of the route. The maximum load points for Route 297 Orange MAX are located between and NW 175th Street and Miami-Dade College North Campus for buses traveling in the southbound direction and around NW 103rd Street for buses traveling in the northbound direction. Figure 11 presents average weekday load factors for Route 297 Orange MAX.

Figure 10: Route 27 Load Factors

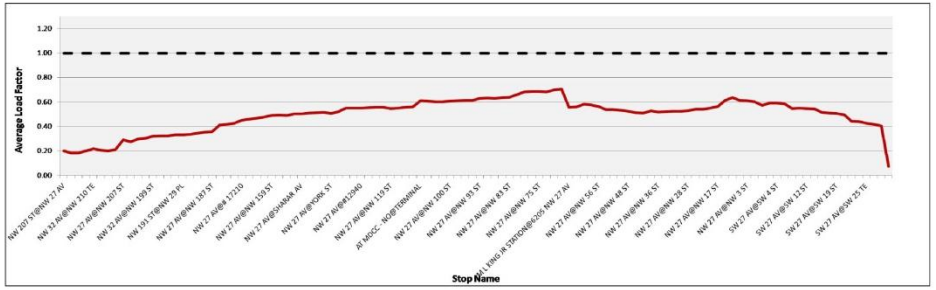
Northbound - Average AM Peak Load Factor

Southbound - Average AM Peak Load Factor



Northbound - Average Midday Peak Load Factor

Southbound - Average Midday Peak Load Factor



Northbound - Average PM Peak Load Factor

Southbound - Average PM Peak Load Factor

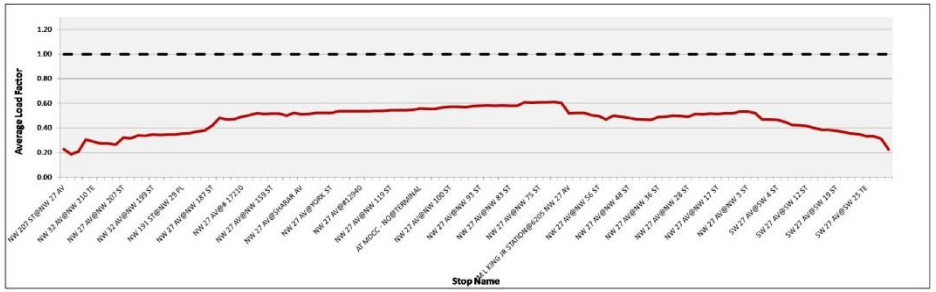
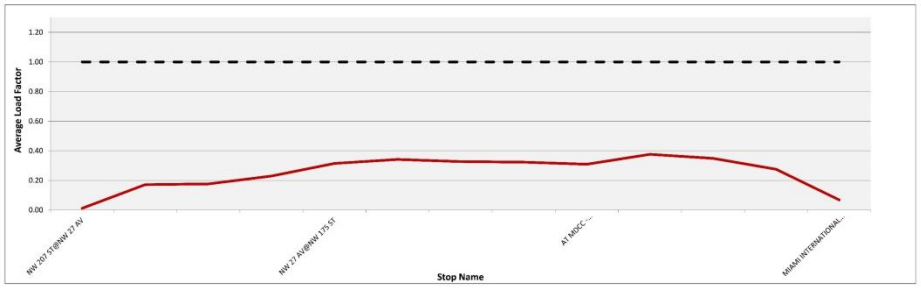
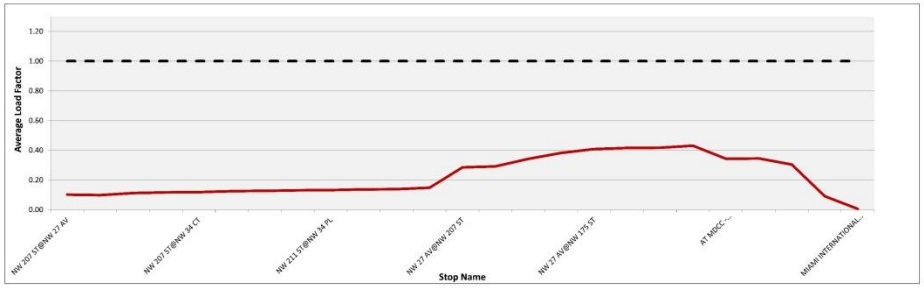


Figure 11: Route 297 Orange MAX Load Factors

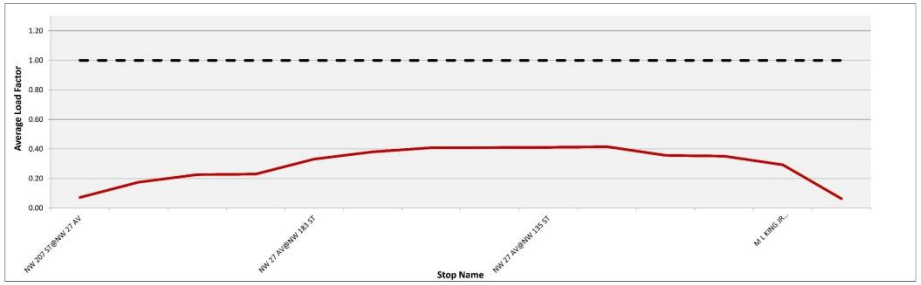
Northbound - Average AM Peak Load Factor



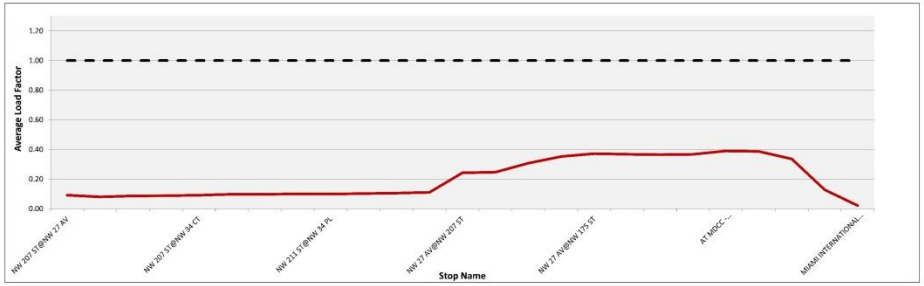
Southbound - Average AM Peak Load Factor



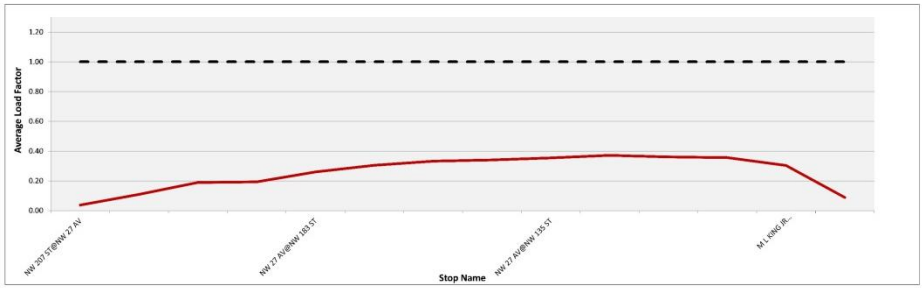
Northbound - Average Midday Peak Load Factor



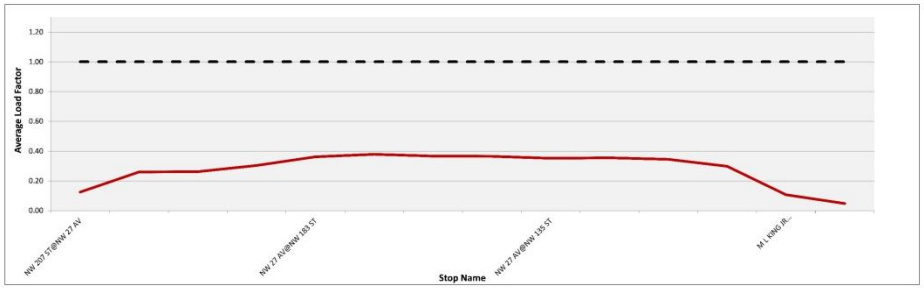
Southbound - Average Midday Peak Load Factor



Northbound - Average PM Peak Load Factor



Southbound - Average PM Peak Load Factor



EXISTING RIDERSHIP CHARACTERISTICS

Based on the Miami-Dade MPO Origin-Destination Surveys for Local Bus Service (2012) findings, the NW 27th Avenue corridor can be characterized as having a substantial proportion of passengers that use transit as their primary means of transportation. The survey findings for Route 97 – 27th Avenue MAX are representative of its successor, the new Route 297 Orange MAX.

Results of the origin-destination surveys indicate that a significant proportion of riders in the NW 27th Avenue corridor depend on transit for their daily mobility needs. Transit trips in the corridor serve travel to work, college and learning institutions, medical facilities, and shopping destinations. The lengths of one-way transit trips are spread among shorter (less than 30 minutes), moderate (30 to 60 minutes), and longer (over 60 minutes) trips. Passengers tend to prefer the limited stop service (Route 97 or its successor Route 297 Orange MAX) for more time sensitive work-based and longer distance trips, as well as for the capacity to reduce travel time.

Figures 12 through 17 present origin-destination survey findings for the NW 27th Avenue corridor.

Figure 12: Transit Dependency in NW 27th Avenue Corridor

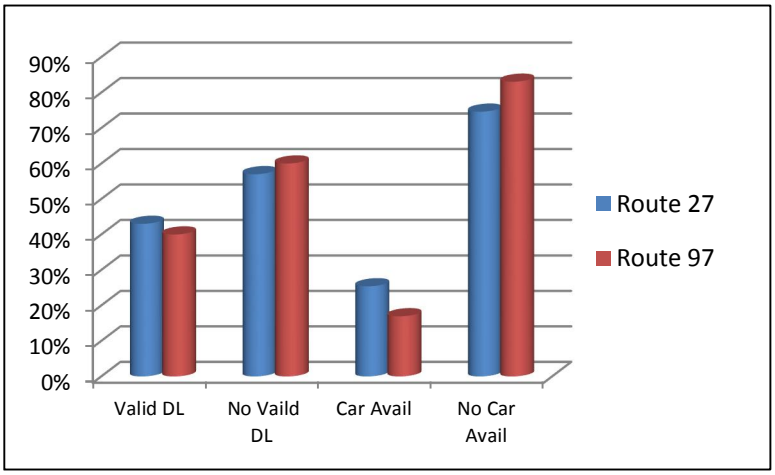
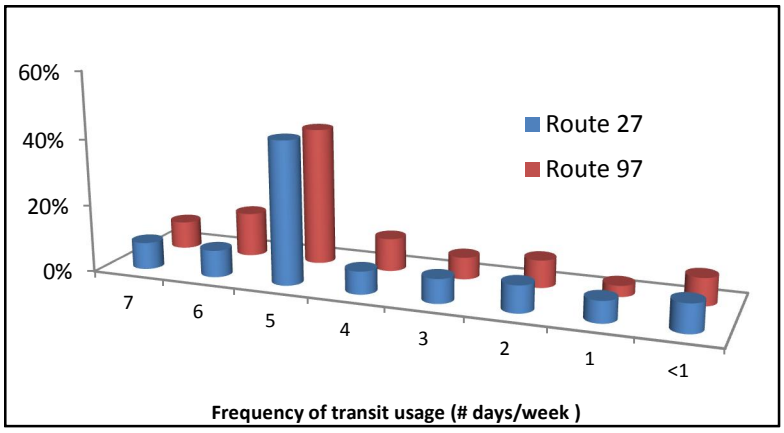


Figure 14 demonstrates that there is a high level of transit dependency among existing riders in the NW 27th Avenue corridor. Over half the riders in the NW 27th Avenue corridor do not possess a valid driver's license and over three/quarters of the riders do not have a vehicle available to meet their transportation needs.

Figure 13: Frequency of Transit Usage in NW 27th Avenue Corridor



As illustrated in Figure 13, about 60 percent of NW 27th Avenue corridor transit riders use transit for their regular weekly (five or more times) transportation needs. An additional one-fifth of passengers use transit nearly every day of the week for their travel needs.

Figure 14: Means of Transit Access in NW 27th Avenue Corridor

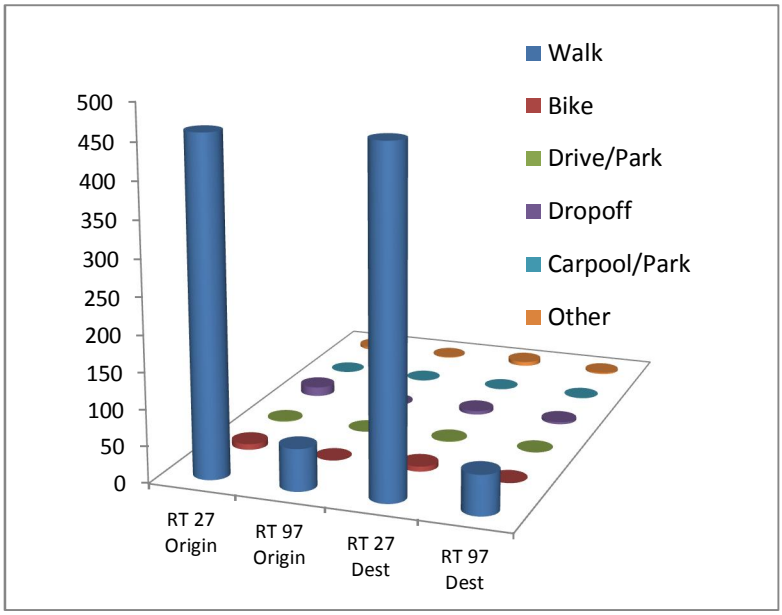


Figure 14 illustrates that most riders walk to access transit service in the NW 27th Avenue corridor.

Figure 15: Walking Distance to Transit in the NW 27th Avenue Corridor

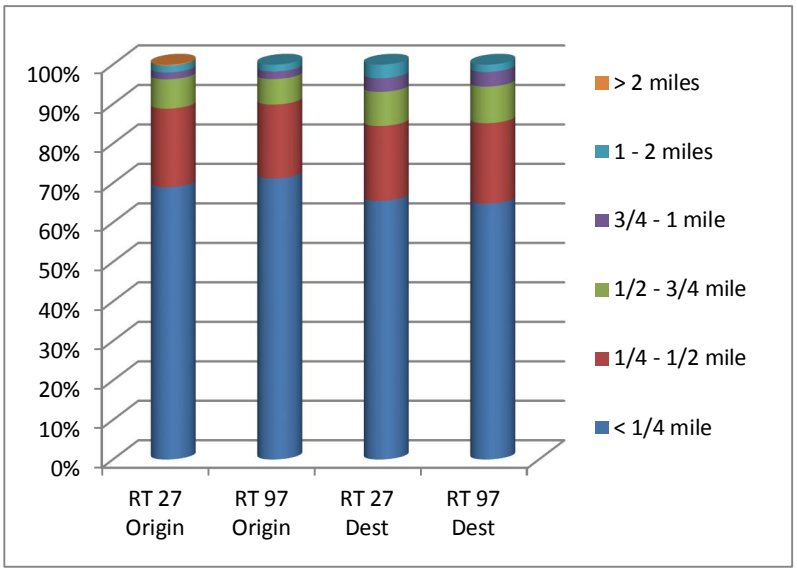
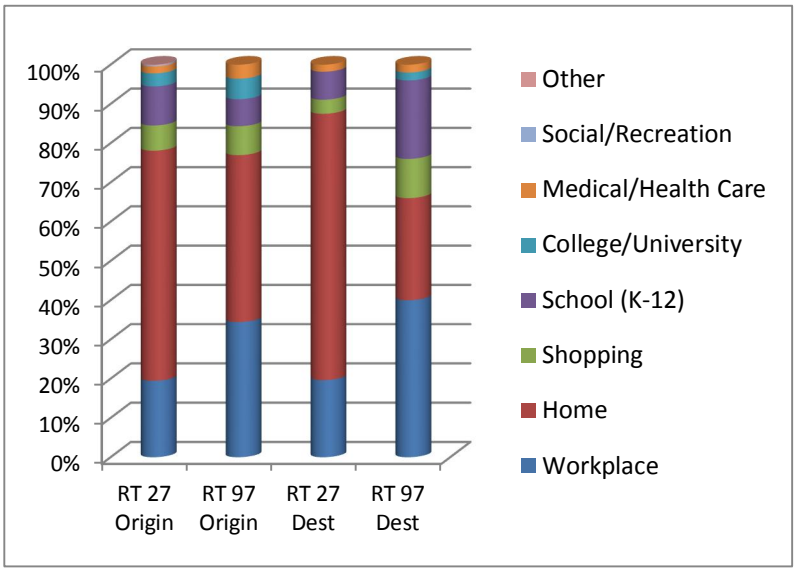


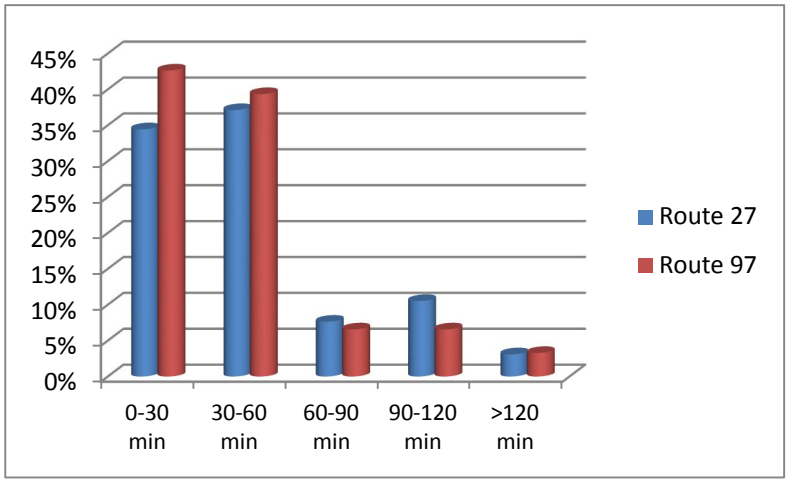
Figure 15 illustrates that nearly two-thirds of transit riders in the NW 27th Avenue corridor, who access transit by walking, walk less than a quarter-mile. Over four-fifths of the riders walk less than a half mile.

Figure 16: Transit Trip Purpose in the NW 27th Avenue Corridor



The origin-destination survey data summarized in Figure 16 reveal that the Route 97 limited-stop service accommodated a higher proportion of work trips than the local bus service provided by Route 27. Route 97 also served a larger proportion of student trips at the Miami-Dade College North Campus than Route 27.

Figure 17: Transit Trip Length in the NW 27th Avenue Corridor



As demonstrated in Figure 17, the majority of one-way transit trips in the NW 27th Avenue corridor require less than an hour. A higher proportion of the Route 97 trips require less than an hour than the Route 27, which may be reflective of the reduced travel time provided by the limited-stop service.

SERVICE CHARACTERISTICS FOR NW 27TH AVENUE ENHANCED BUS SERVICE

Transit service in the NW 27th Avenue corridor accommodates commuter needs associated with longer distance work trips, Miami-Dade College North Campus access, transfers to Metrorail, and transfers from Broward County. Additional transportation needs are also accommodated in the corridor associated with shorter distance trips for shopping, school, and health care. The heavy ridership in the NW 27th Avenue corridor and high productivity of the local Route 27, as well as the growing demand and productivity of the Route 297 Orange MAX limited-stop service demonstrates the support for additional service improvements.

Span of Service

The Route 297 Orange MAX currently operates between 5:30 AM and 8:00 PM on weekdays only. This span of service is also recommended for the NW 27th Avenue EBS. The recommended hours of operation for the NW 27th Avenue EBS are presented in Table 9.

Headways

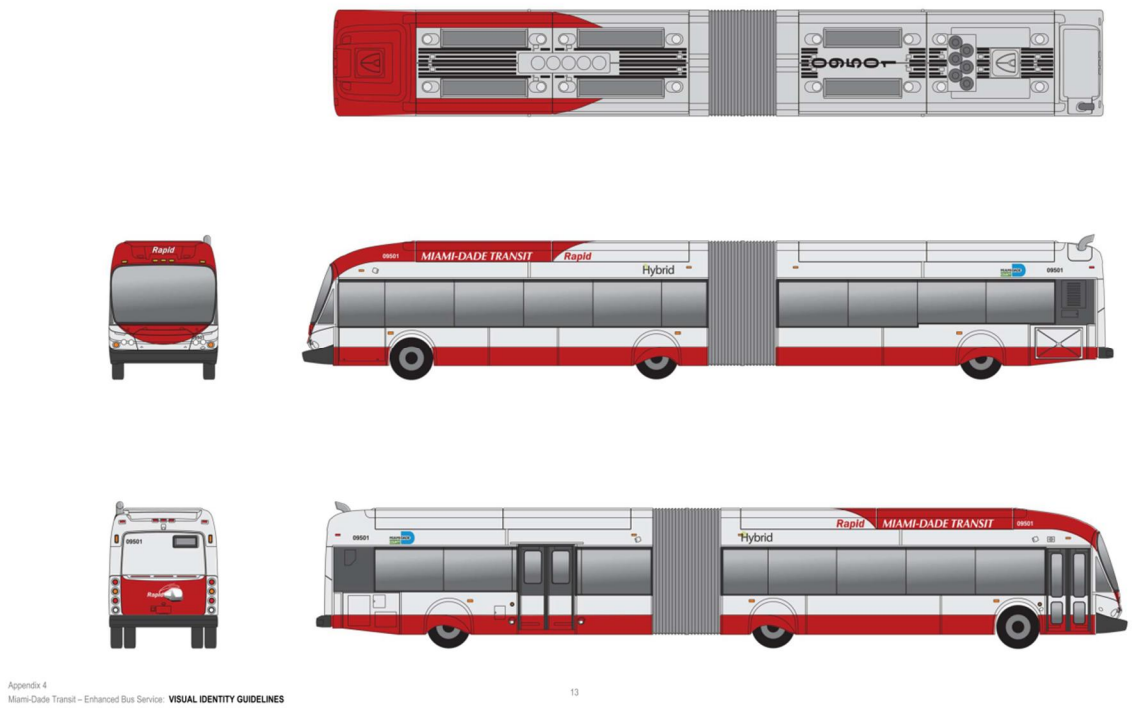
Route 297 Orange MAX currently provides 15-minute headway during peak periods and 30-minutes headway during the off-peak periods. The NW 27th Avenue corridor experiences peak morning and afternoon demands and loads, but the corridor also exhibits strong demand in the mid-day and off-peak periods, suggesting support for service improvements throughout the day. The recommended hours of operation for the NW 27th Avenue EBS are presented in Table 9.

Table 9: NW 27th Avenue EBS Service Characteristics

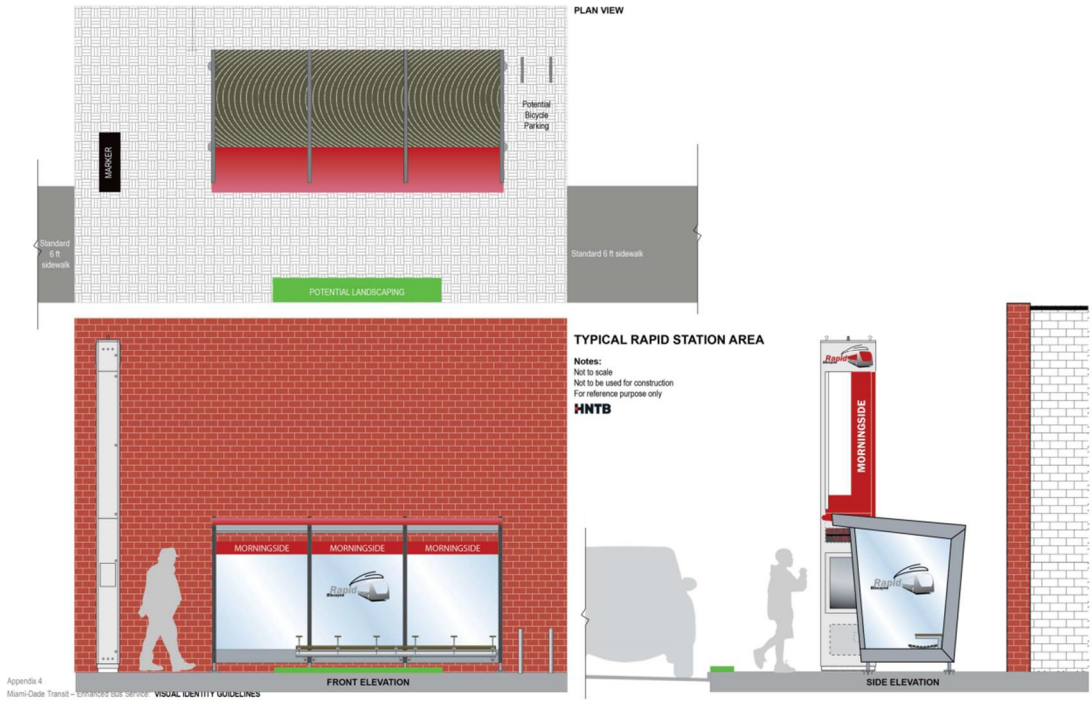
Time Period	Hours	Headway
Morning Peak Period	5:30 AM to 9:00 AM	10 minutes
Midday Period	9:00 AM to 3:00 PM	20 minutes
Afternoon Peak Period	3:00 PM to 6:00 PM	10 minutes
Evening Peak Period	6:00 PM to 8:00 PM	20 minutes

Branding

The Biscayne Boulevard EBS project developed specific branding elements including vehicle and station branding. The objective of the branding plan is to provide a clear distinction for passengers between the EBS service and other transit services.



Miami-Dade Transit's EBS Bus Branding



Miami-Dade Transit's EBS Station Branding

COSTS

CAPITAL COSTS

Capital costs were developed for the NW 27th Avenue EBS project. Capital costs will consist of the expenditures required to implement the project including the acquisition of new buses, construction of the NW 215th Street transit terminal and park-and-ride facility and intermediary bus stations, roadway infrastructure improvements, right-of-way acquisition for intermediary bus stations, deployment of transit signal priority (TSP) throughout the NW 27th Avenue corridor, and implementation of queue jumps. Costs required for preliminary engineering, design, permitting and construction engineering and inspection (CEI) are factored into the estimate. The capital cost estimate also includes a contingency to account for uncertainty in the scope of the project and the current conceptual level of project definition. As the NW 27th Avenue EBS project progresses through subsequent phases of project development and is better defined, the capital cost estimate for the project will be refined.

Table 10 presents the order of magnitude capital costs required for the NW 27th Avenue EBS project, which at this time are anticipated to be approximately $30.2 million. A description of the costs anticipated for various elements of the project is provided below.

Table 10: NW 27th Avenue EBS Capital Costs

Item	Units	Unit Cost	Total
60-foot articulated buses	11	$1,000,000	$11,000,000
NW 215th Street Transit Terminal and Park-and-Ride (1,2)	1	$4,160,000	$4,160,000
Roadway Infrastructure Improvements at NW 215th Street Transit Terminal and Park-and-Ride(2)	1	$2,975,000	$2,975,000
Stations			
Full Station (3)	11	$417,500	$4,592,500
Slim Station (3)	11	$333,500	$3,668,500
ROW Acquisition (4)	22	$140,000	$3,080,000
Queue Jumps	3	$200,000	$600,000
Bus Bulbs	3	$50,000	$150,000
Total (5)			**$30,226,000**

Notes:
(1) Cost estimate does not include cost associated with prior purchase of 14-acre site in 2010 for $5,025,000.
(2) An opinion of probable cost is provided in Appendix E.
(3) Cost estimates based on *Implementation Plan for Enhanced Bus Service along Biscayne Boulevard*.
(4) Cost estimates based on *Near Term Transportation Plan* (2010).
(5) Capital cost estimate for the project will be refined in subsequent phases of project development.

Service for the NW 27th Avenue EBS will be provided in new branded 60-foot articulated diesel/electric hybrid or alternative fuel buses with low-floor design for faster boarding and alighting. The buses will be equipped with Wi-Fi and will provide larger seating areas with additional leg room for comfort. Based on the anticipated service plan, consisting of weekday service from 5:30 AM to 8:00 PM with 10-minute

headway during peak periods and 20-minute headway during off-peak periods, 11 buses will be required for the NW 27th Avenue EBS. The anticipated cost per bus is $1 million for buses equipped with TSP hardware, based on a recent MDT purchase of articulated buses, resulting in a cost estimate of $11 million for the project for new buses.

In 2010 MDT purchased the 14-acre site proposed to accommodate the NW 215th Street transit terminal and park-and-ride facility for $5.025 million using funds generated by the County's half-cent transit surtax. Approximately 350 park-and-ride spaces are proposed for this facility along with kiss-and-ride/short-term parking accommodations, approximately ten bus bays, passenger seating under canopied areas, and a bus driver comfort station. The preliminary opinion of probable costs for the construction of the NW 215th Street transit terminal and park-and facility is approximately $4.16 million, which includes a 30 percent contingency factor to cover items requiring further scope definition such as environmental remediation. Roadway infrastructure improvements required for accessing the NW 215th Street transit terminal and park-and-ride facility include a new traffic signal, turn lane improvements, and a new bridge providing a connection to the Calder Casino and Race Course. The preliminary opinion of probable costs for the roadway infrastructure improvements is approximately $2.98 million. The Engineer's Opinion of Probable Construction Cost for the NW 215th Street transit terminal and park-and-ride facility is provided in Appendix E.

A total of 11 intermediary stations in each direction (22 stations total) are proposed along the approximately 13-mile route between the MIC and NW 215th Street transit terminal and park-and-ride facility. Two station design concepts will be implemented for the NW 27th Avenue EBS project: a full station and a restricted right-of-way or "slim" station. Both station concepts provide bicycle parking and a station marker or monument sign. Cost estimates for the two station concepts developed in the *Implementation Plan for Enhanced Bus Service along Biscayne Boulevard* will also be applied to the NW 27th Avenue EBS stations. The cost estimate for the full station concept is $417,500 and the cost estimate for the slim station concept is $333,500 including allowances for contingency and design, permitting and CEI. Full stations have been identified for 11 stations and slim stations have been identified for 11 stations. The corresponding cost estimate for the construction of stations is $8.3 million.

Minor right-of-way (ROW) acquisition or easements will be required for several stations. Specific cost estimates for ROW acquisition were not developed as part of this study; however, the unit cost for ROW acquisition for stations was estimated at $140,000 per station in the *Near Term Transportation Plan* (2010). Based on this unit cost, the estimate for ROW acquisition for the stations is approximately $3.1 million.

The NW 27th Avenue EBS will benefit from the deployment of transit signal priority (TSP) throughout the corridor for improved travel time and schedule adherence. Miami-Dade County has initiated the implementation of TSP in priority transit corridors as part of a separate project. The TSP system will be integrated with MDT's new Computer Aided Dispatch/Automatic Vehicle Location (CAD/AVL) system. Since the cost estimate for the project's buses includes TSP hardware and TSP communication system and central system software are being implemented as a separate project, no additional capital costs were assigned to the project for TSP.

Queue jump/queue bypass are proposed for the NW 27th Avenue EBS project at three locations along the NW 27th Avenue corridor. The queue jump operations will be accommodated within existing right-turn lanes at these locations and right-of-way acquisition is not anticipated. The estimated unit cost per queue jump location is approximately $200,000 to cover costs associated with signalization improvements, signage, and pavement markings, which corresponds to a total cost of $600,000 for the project.

Bus bulbs/curb extensions are proposed for three station locations for the NW 27th Avenue EBS project. The estimate unit cost per bus bulb/curb extension is approximately $50,000 which corresponds to a total cost of $150,000 for the project.

OPERATIONS AND MAINTENANCE COSTS

Operations and maintenance (O&M) costs were developed for the NW 27th Avenue EBS project. The O&M cost estimates account for general bus operations and maintenance. Service variables that impact O&M costs for bus operations include vehicle costs for fuel and maintenance, the number of peak vehicles required in service, labor costs, and other related costs. There will be additional O&M costs for the NW 27th Avenue EBS project associated with the NW 215th Street transit terminal and park-and-ride facility and the other stations along the alignment.

The NW 27th Avenue EBS route will replace the existing Route 297 Orange MAX. The NW 27th Avenue EBS will provide an increased service level in the corridor with reduced headway in both the peak and off-peak periods. The O&M costs for bus operations were estimated for the existing Route 297 Orange MAX and the NW 27th Avenue EBS route based on gross allocated cost factors. MDT's gross allocated cost for bus service as of February 2013 is $125.75 per revenue hour. Table 11 presents the annual O&M costs for bus operations for the existing Route 297 Orange MAX and the NW 27th Avenue EBS route. The incremental increase in O&M costs resulting for the implementation of the NW 27th Avenue EBS project is approximately $1.118 million annually.

Table 11: O&M Costs for Bus Operations

Route	Daily One-Way Trips	Roundtrip Mileage (1)	Speed (mph) (2)	Cycle Time (Minutes)	Daily Vehicle Revenue Hours	Annual Vehicle Revenue Hours (3)	Cost per Vehicle Revenue Hour (4)	Annual Cost for Bus Operations	Buses Required
297 Orange MAX	79	32.5	18.2	120	82	20,828	$125.75	$2,619,121	8
NW 27th Avenue EBS	117	30.5	20.0	120	117	29,718	$125.75	$3,737,039	12
Net Change								**$1,117,918**	

Notes:
(1) NW 215th Street transit terminal and park-and-ride facility eliminates two-mile turnaround currently required for Route 297 Orange MAX.
(2) Assumed 10 percent increase in travel speed for NW 27th Avenue EBS route with implementation of TSP and queue jumps along with low floor vehicles and ticket vending machines at stations for faster boarding and alighting.
(3) Assumes weekday-only service operating 254 days per year.
(4) Based on MDT's February 2013 gross allocated cost.

Consistent with the *Implementation Plan for Enhanced Bus Service along Biscayne Boulevard*, annual station O&M costs for the NW 27th Avenue EBS project were assumed to be 10 percent of their construction cost not including design, permitting and CEI. The annual O&M costs for the NW 215th Street transit terminal and park-and-ride facility are estimated to be approximately $300,000. The annual O&M costs for the 22 intermediary bus stations are estimate to be approximately $718,000.

MDT's incremental O&M costs resulting for the implementation of the NW 27th Avenue EBS project are presented in Table 12. The annual incremental increase in O&M costs associated with the NW 27th Avenue EBS project is expected to be approximately $2.136 million.

Table 12: Incremental Increase in O&M Costs for NW 27th Avenue EBS Project

Item	Annual O&M Costs
Net Change in O&M for Bus Operations	$1,118,000
NW 215th Street Transit terminal and Park-and-Ride (1)	$300,000
Bus Stations (1)	$718,000
Total	**$2,136,000**

Notes:
(1) Annual O&M costs assumed to be 10 percent of construction cost not including design, permitting and CEI.

NEXT STEPS

There are several issues that will be to be further refined and finalized during the preliminary engineering phase of the project, including:

- Processing a zoning application with the City of Miami Gardens for the NW 215th Street transit terminal and park-and-ride facility site to rezone the site to Planned Corridor Development (PCD).
- Coordinating with FDOT District Six for the access permit required for the NW 215th Street transit terminal and park-and-ride facility site's vehicular connection to NW 27th Avenue and the proposed new traffic signal at this location.
- Coordinating with the FTE's ongoing PD&E study for the HEFT from NW 57th Avenue to the Turnpike Mainline (Work Program #423373-1), regarding the proposed bus pullout lane for 95 Express buses along the HEFT off-ramp adjacent to the NW 215th Street transit terminal and park-and-ride facility site.
- Working with Miami-Dade County RER to complete an environmental Site Assessment Report NW 215th Street transit terminal and park-and-ride facility site and to comply with the site assessment directive.
- Finalizing the identification of right-of-way acquisition and/or easements required for the construction of bus stations.
- Coordinating with FDOT District Six for the approval of the bus bulbs/curb extensions identified for three of the bus stations.
- Integrating the headway based TSP operation recommended for the corridor with MDT's CAD/AVL system.
- Performing traffic operations analyses to demonstrate the effectiveness of the queue jump/queue bypass lane operations proposed for the project at three locations along the corridor.