Metromover System Expansion Study

Final Report

Work Order #GPC V-16

Prepared for:
MIAMI-DADE MPO
Metropolitan Planning Organization

PM260013.13

Prepared by:
Kimley»Horn

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September 2014

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1.0 Introduction

Established in 1986 and expanded in 1994, the Metromover is a free automated people mover (APM) system operated by Miami-Dade Transit (MDT) serving Downtown Miami's Central Business District, Brickell, and Arts/Entertainment neighborhoods. The Metromover provides connections to the County's heavy rail rapid transit system, Metrorail, at the Government Center and Brickell stations. The ongoing growth and development of Downtown's Brickell and Arts/Entertainment districts presents an opportunity to provide greater connectivity and enhanced transit service to Downtown Miami's increasingly pedestrian oriented residents, workers, and visitors. Ridership has doubled in the last decade, from fewer than 15,000 passengers daily in 1999 to roughly 30,000 passengers today.

1.1 Study Need

With the dramatic increase in Metromover ridership over the last decade and the recent development in key areas of downtown Miami, feasible options to connect future Metromover passengers to a new urban downtown lifestyle through an expanded Metromover System is clearly needed. The downtown area, originally populated by offices and retail, has now become home to 200,000 residents and 190,000 employees, creating a vibrant urban area central to Miami-Dade County. This urban core creates a high demand for efficient and reliable transportation options, such as the Metromover.

1.2 Study Purpose

The goal of this initiative is to quickly and proficiently assess the feasibility of expanding the Metromover System to connect the underserved markets while maintaining an efficient operation. During this study, viable options for system expansion were conceptualized and evaluated to provide greater system accessibility to Metromover users and improve system efficiency within Downtown Miami, Brickell, and the Arts/Entertainment areas.

1.3 Organization of Report

The Metromover Expansion study report is divided into the following major sections:

- 1.0 Introduction
- 2.0 Study Coordination
- 3.0 Data Collection
- 4.0 Feasibility Assessment
- 5.0 Concept Alternatives Development
- 6.0 Refined Expansion Plan
- 7.0 Implementation Strategies
- 8.0 Summary and Conclusions

The Appendices contains copies of presentations given during the study and other project documents created throughout the study.

2.0 Study Coordination

The Study Advisory Committee (SAC) was created with representatives from the following agencies:

- Miami-Dade Metropolitan Planning Organization (MPO)
- MDT
- Florida Department of Transportation (FDOT)
- Miami-Dade Regulatory and Economic Resources (RER) Department
- Miami-Dade Public Works and Waste Management (PWWM)
- City of Miami
- Miami Downtown Development Authority (DDA)

The SAC provided guidance for the study by reviewing the study deliverables and providing input. The SAC met three times during the course of the study. The first meeting of the SAC was held on January 24, 2014. The presentation and discussion topics included a study introduction, project methodology, data collection summary, and survey logistics. The goal of the initial SAC meeting was to provide the project background and initiate the concept development process. The second SAC meeting was held on March 31, 2014 and included a workshop to brainstorm expansion concept alternatives. The presentation and discussion topics included a summary of the survey results, the concept alternatives brainstorming, and a discussion of the proposed screening criteria. The third meeting of the SAC was held on June 30, 2014. The presentation and discussion topics included a summary of the feasibility assessment, a presentation of the refined concept alternative, and a review of the draft report. Copies of the SAC presentations and the sign-in sheets are included in Appendix A.

At the conclusion of the SAC meetings, the study findings were presented to the Transportation Planning Council (TPC) in September, 2014. The presentation included a summary of key data collection results, a summary of the concept alternatives development process, and specific recommendations. A copy of the presentation given at the TPC meeting is included in Appendix B.

3.0 Data Collection

The data collection effort consisted of three tasks: review of available studies, systems review, and a Metromover passenger sampling survey.

3.1 Review of Available Studies

Several studies have been completed by a variety of agencies that reference Metromover expansion. A high-level review of these studies was completed to identify potential Metromover expansion concepts that have previously been considered. The goal of the review was to use the available information to help create the foundation upon which to build the concept alternatives for the Metromover Expansion study. In summary, the following studies were reviewed:

- *2025 Downtown Miami Master Plan,* Miami Downtown Development Authority, October 2009
- Miami Comprehensive Neighborhood Plan, City of Miami, January 2013
- Downtown Miami Intermodal Terminal Feasibility Study, Miami Dade MPO, December 2013
- Bay Link Phase 2 (Miami-Miami Beach Transit Connector Study, Miami-Dade MPO, December 2004
- Beach Corridor Transit Connection Study, Miami-Dade MPO, Ongoing
- *PortMiami 2035 Master Plan,* PortMiami, November 2011
- Transit Options to PortMiami Feasibility Assessment, Miami-Dade MPO, June 2013
- Miami-Dade County Transit Development Plan, Miami-Dade Transit, September 2013
- Miami-Dade 2035 Long Range Transportation Plan, Miami-Dade MPO, October 2009

In summary, the reviewed studies identified intermodal centers, recommended connections to the Metromover, and discussed Metromover expansion options at a very high level, such as closing the Brickell and Omni Loops. However, with the exception of the *Transit Options to PortMiami Feasibility Assessment,* the studies do not provide detailed information regarding expansion routes or other specific information related to a Metromover expansion.

The reviewed studies are summarized below. The purpose of each study reviewed is presented as well as any consideration of the Metromover system (specifically expansion thereof).

3.1.1 2025 Downtown Miami Master Plan

Agency: Miami DDA
Date: October 2009
Link: http://www.miamidda.com/pdf/DDA_Master_Plan_2009_LR.pdf

As stated on their website, the Miami DDA is an independent public agency of the City of Miami funded by a special tax levy on properties in its district boundaries. The goals of the Miami DDA are as follows:

- "Enhance Miami Downtown's position as the Business and Cultural Epicenter of the Americas;
- Leverage Miami Downtown's Beautiful and Iconic Tropical Waterfront;
- Elevate Miami Downtown's Grand Boulevards to Prominence;
- Create Great Streets and Community Spaces; and
- Promote Transit and Regional Connectivity."

The intention of the Miami DDA's Downtown Miami Master Plan is to connect and maximize the potential of the Central Business District (CBD), the Arts and Entertainment District, Brickell and Miami's waterfront by providing specific action oriented implementation items to increase the livable conditions of downtown, encourage private sector investment, and ensure the proper investment of public funds.

To achieve the above goals, the Master Plan features a variety of projects to be implemented. Those projects related to Metromover are as follows:

- Provide connections to Metromover, Metrorail, the existing Brickell Shuttle, the existing Seaport Connector and the proposed Miami Streetcar to provide a visitor-friendly trolley, linking major origin and destination points, as illustrated in Figure 1.
- Reopen Bicentennial Park Metromover Station to redevelop Bicentennial Park into a major international waterfront park and museum complex, as illustrated in Figure 2 and Figure 3.

- Develop a viable downtown intermodal center at the Government Center or Overtown Metrorail Stations to connect existing and future transit systems, including Metrorail, Tri-rail, Metromover, streetcar, Bay Link, trolley and light rail. A rendering of the Miami Intermodal Center is shown in Figure 4 as an example.
- Expand Metromover to close the Brickell and Omni Loops to promote neighborhood level transit such as streetcar, expanded Metromover, and trolley, and improve regional connectivity, as illustrated in Figure 5. The approximate Metromover station locations are also shown.

Figure 1: Proposed Trolley Route (Source: 2025 Downtown Miami Master Plan, October 2009)

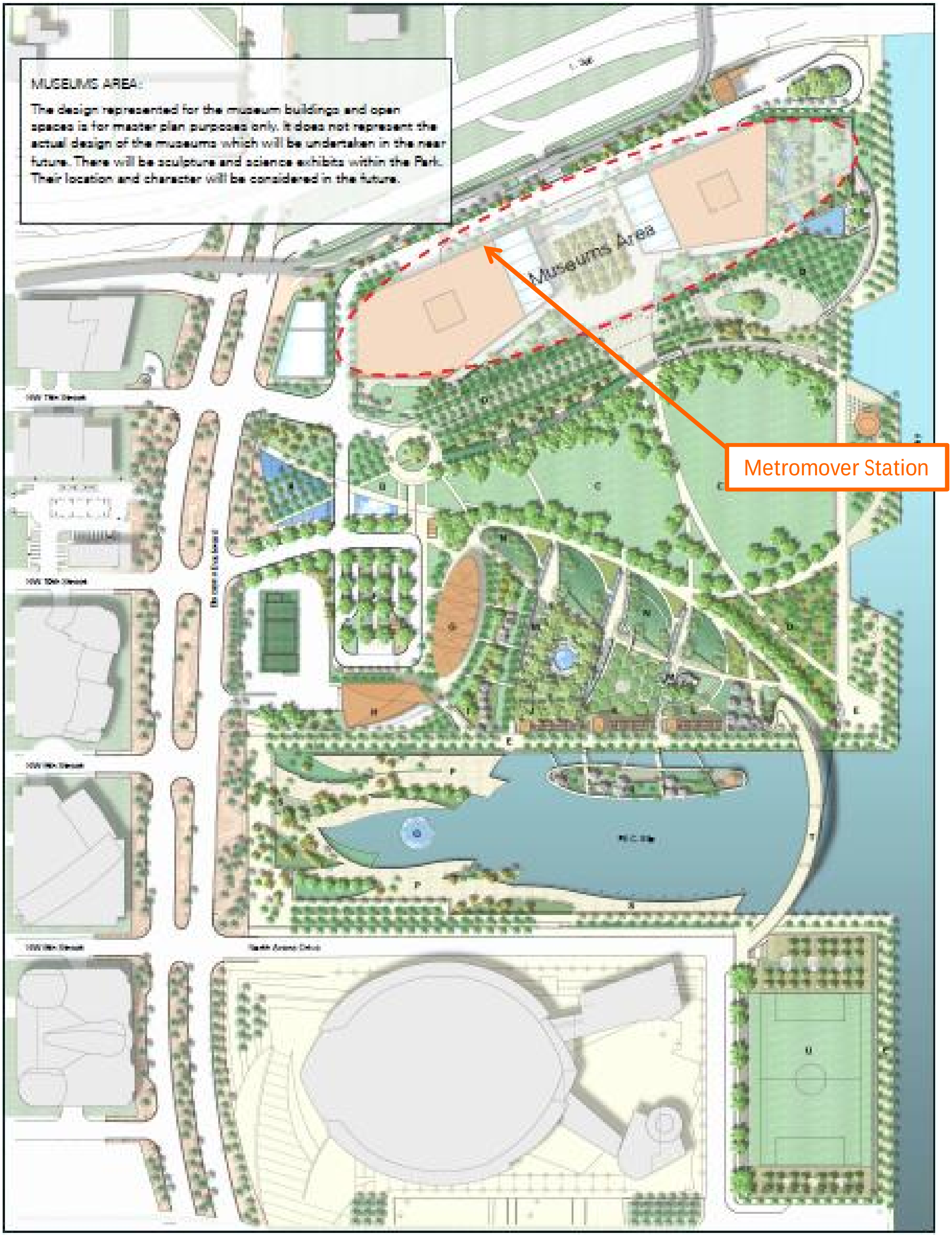

Figure 2: Museum Park Miami, Illustrative Plan (Source: http://www.miamigov.com/planning/docs/plans/MP/Conceptuals.pdf)

Figure 3: Museum Park Miami (Source: 2025 Downtown Miami Master Plan, October 2009)

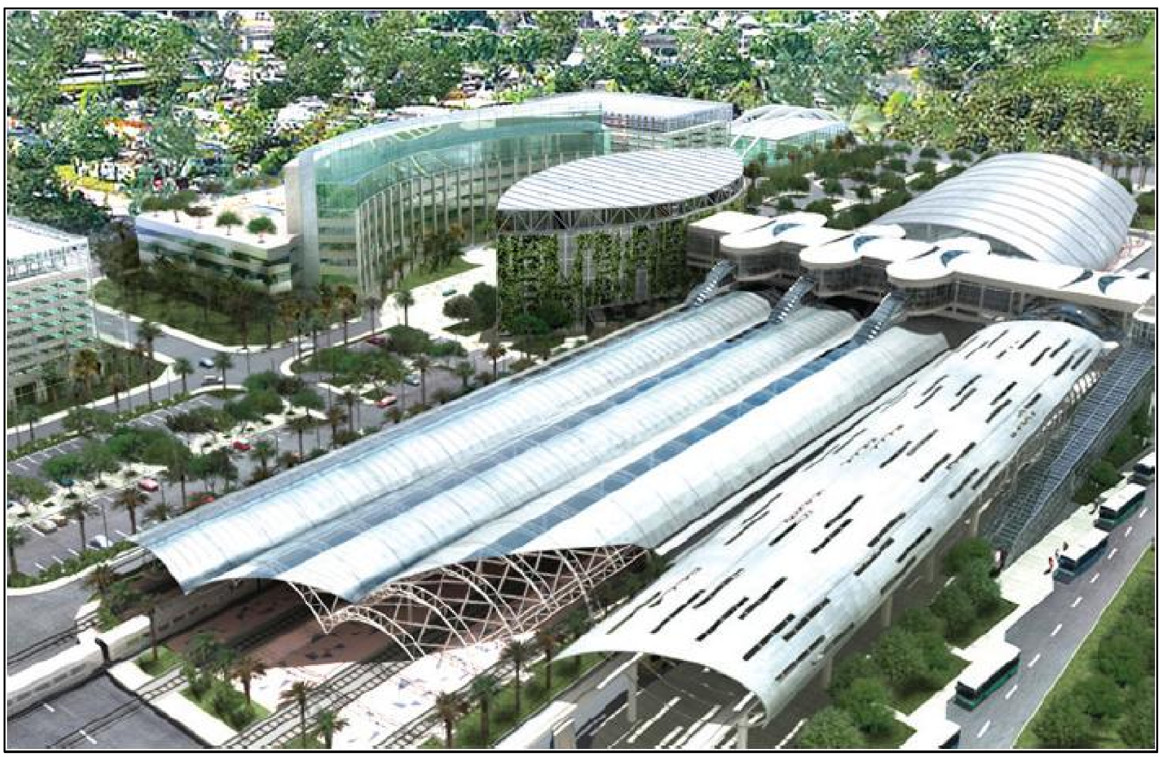

Figure 4: Miami Intermodal Center (Source: 2025 Downtown Miami Master Plan, October 2009)

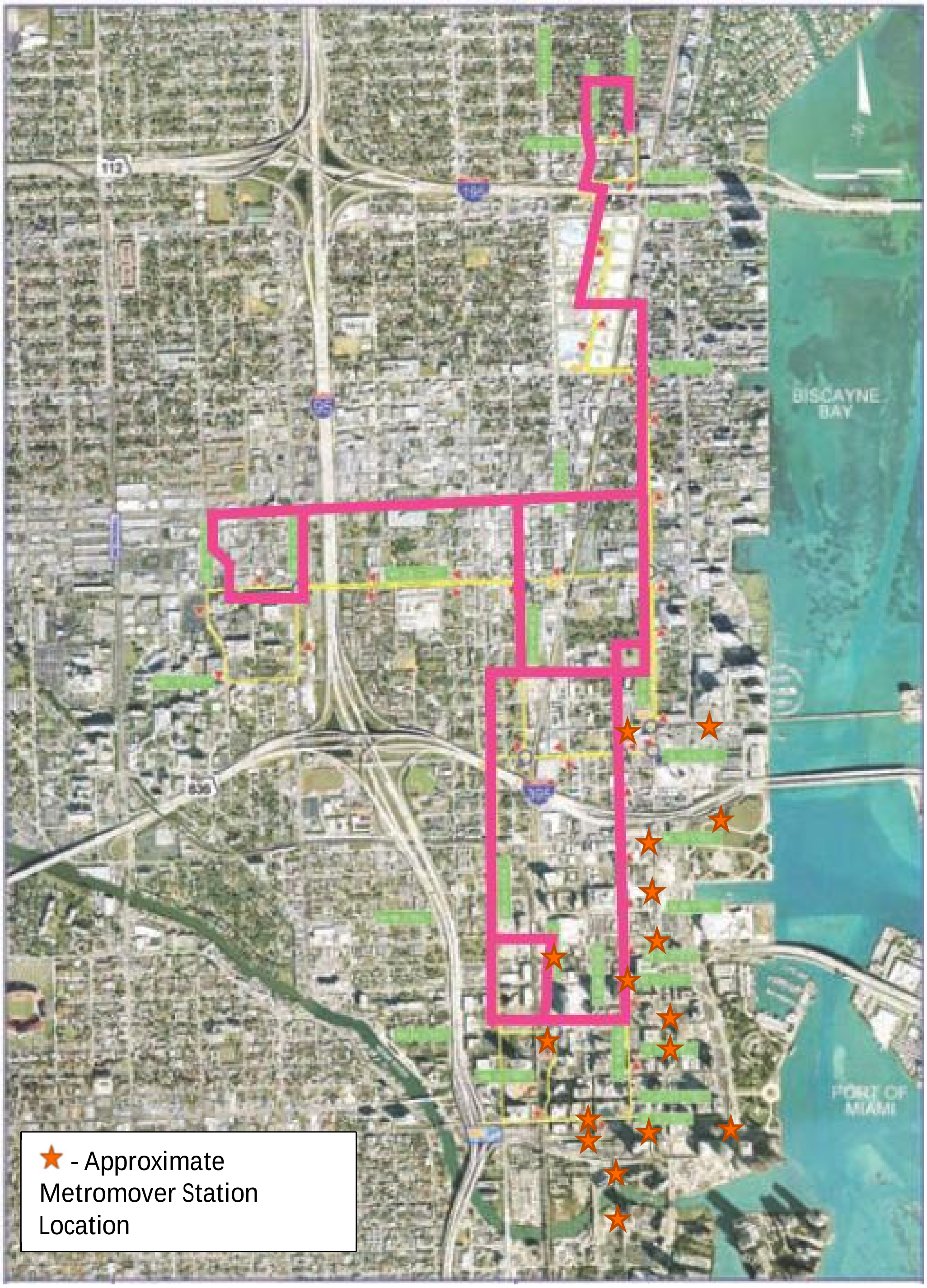

Figure 5: Proposed Miami Streetcar Route (Source: 2025 Downtown Miami Master Plan, October 2009)

3.1.2 Miami Comprehensive Neighborhood Plan

Agency: City of Miami
Date: January 2013
Link: http://www.miamigov.com/planning/docs/plans/MCNP_January2013.pdf

The goal of the transportation element of the Miami Comprehensive Neighborhood Plan (MCNP) is to maintain an effective and cost efficient traffic circulation network within the City of Miami. This transportation network will provide transportation for all persons, facilitate commercial activity, be consistent with neighborhood plans, support economic development, conserve energy, and protect and enhance the natural environment.

Development within the City of Miami requires the provision of:

- public transit and paratransit services that serve existing and future land uses;
- safe and convenient passenger transfer terminal facilities;
- coordination of public transit with existing and future land uses; and
- accommodation of special needs of the City of Miami's Transportation Disadvantaged (TD) population.

As per Policy TR-1.5.7, to achieve an effective public transit system, the City of Miami shall request the Miami-Dade County to include an appropriate public transit system in its transportation plan to connect the Seaport and the Southeast Bayshore Drive to Metromover.

3.1.3 Downtown Miami Intermodal Terminal Feasibility Study

Agency: Miami-Dade MPO
Date: December 2013
Link: https://onedrive.live.com/view.aspx?resid=CB30042F1B5FAF4F!3304&app=WordPdf

The purpose of the Downtown Miami Intermodal Terminal Feasibility Study was to evaluate the implementation of an Intermodal Terminal in downtown Miami that integrates transportation modes, including Metromover, economic development, and traffic circulation. Geographic Information System (GIS) analysis was used to identify desirable locations for the Intermodal Terminal. Eight scheme concepts were developed and evaluated. The recommended concept locates the Downtown Intermodal Terminal north of Government Center, southeast of the intersection between NW 2nd Avenue and NW 3rd Street. This location is west of the existing

Metromover and Metrorail guideways. An illustrative rendering of the proposed terminal is provided in Error! Not a valid bookmark self-reference..

Figure 6: Rendering of Downtown Miami Intermodal Terminal (Source: Downtown Miami Intermodal Terminal Feasibility Study, December 2013)

3.1.4 Bay Link Phase 2, Miami-Miami Beach Transportation Corridor Study

Agency: Miami-Dade MPO and Federal Transit Administration
Date: December 2004
Links: https://onedrive.live.com/view.aspx?resid=CB30042F1B5FAF4F!2983&app=WordPdf; https://onedrive.live.com/view.aspx?resid=CB30042F1B5FAF4F!2984&app=WordPdf; https://onedrive.live.com/view.aspx?resid=CB30042F1B5FAF4F!2985&app=WordPdf; https://onedrive.live.com/view.aspx?resid=CB30042F1B5FAF4F!3309&app=WordPdf; https://onedrive.live.com/view.aspx?resid=CB30042F1B5FAF4F!2986&app=WordPdf; https://onedrive.live.com/view.aspx?resid=CB30042F1B5FAF4F!2987&app=WordPdf; https://onedrive.live.com/view.aspx?resid=CB30042F1B5FAF4F!2988&app=WordPdf

Transit studies began in the late 1980's to identify premium, high capacity transit options to connect downtown Miami to the Miami Beach and Convention Center areas. In 1988, a *Miami-Beach Light Rail Feasibility Study* was completed. In 1992, Dade County completed a *Priority Corridors Transitional Study*. In 1995, the *East-West Multimodal Corridor Study Draft Environmental Impact Statement (DEIS)* was completed. In 2002, the *Miami-Miami Beach Transportation Corridor (Bay Link) Study* was completed. The 2002 Bay Link Study evaluated Metromover expansion as a preliminary alternative to connect downtown Miami to Miami Beach, but during the screening process the technology was refined to light rail or streetcar technology.

The Bay Link Phase 2 study was initiated in 2004 with a study goal of refining the adopted Locally Preferred Alternative (LPA) (Figure 7), and completing the Preliminary Engineering/Final Environmental Impact Statement (PE/FEIS) for submittal to the Federal Transit Administration (FTA).

Figure 7: Bay Link Adopted Locally Preferred Alternative (Source: Bay Link Phase 2, Miami-Miami Beach Corridor Study, Preliminary Engineering Scope of Services, September 2004)

During the Bay Link Phase 2 PE/FEIS, the originally adopted LPA was refined. Refinements to the LPA included shifting alignments and station locations, adding stations, and adding counterclockwise loop configurations (Figure 8). The Refined LPA added approximately eight miles of route length to total 18 miles, and adding an additional 17 stations to total 42 stations. The additional stations and route length resulted in a capital cost increase of $53M to total $482.7M. The corresponding operations and maintenance (O&M) cost also increased approximately $2M to total $12.1M. All of the aforementioned costs are in 2004 dollars.

Figure 8: Refined LPA (Source: Bay Link Phase 2, Miami-Miami Beach Corridor Study, Locally Preferred Alternative Report, September 2004)

3.1.5 Beach Corridor Transit Connection Study

Agency: *Miami-Dade MPO*
Date: *Ongoing study*
Links: *https://onedrive.live.com/view.aspx?resid=CB30042F1B5FAF4F!3365&app=WordPdf*; *https://onedrive.live.com/view.aspx?resid=CB30042F1B5FAF4F!3324&app=WordPdf*; *https://onedrive.live.com/view.aspx?resid=CB30042F1B5FAF4F!3127&app=WordPdf*

The Beach Corridor Transit Connection Study is an ongoing MPO study. The study purpose is to update key elements of the 2004 Bay Link Phase 2 Study and further refine the LPA. Other study goals include refining the potential extensions, identifying stations and maintenance facility locations, identifying the vehicle technology, updating cost estimates, and developing a financial plan with a clear consensus on the implementation approach. The study will also conduct a high-level environmental screening. The study includes LPA refinements that provide connections to the Metromover, but Metromover expansion was not specifically addressed as a part of this study.

As of July 2014, three Policy Executive Committee (PEC) meetings have occurred. The PEC envisions a Bay Link system with convenient transfers, initial connections between downtown and Miami Beach with a phased implementation strategy, wireless technology for the vehicles traveling on exclusive transit lanes (Figure 9), and a clear differentiation between the Bay Link service and the existing premium transit service. To achieve this vision, several LPA refinements have been identified and include a variety of direct connections, operational loops, circulation loops, and independent lines.

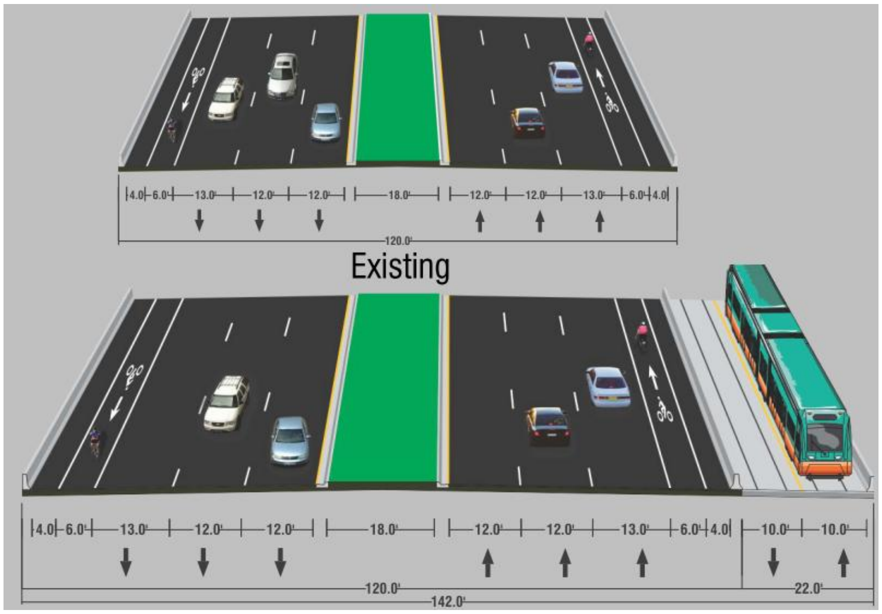

Figure 9: Typical Bay Link Section for MacArthur Causeway, Exclusive Transit Lane (Source: Beach Corridor Transit Connection Study, PEC Meeting Presentation, April 2, 2014)

The Bay Link vehicles are anticipated to be a light rail or streetcar vehicles. The study is currently completing research on available wireless technologies that do not require the overhead power sources typical of many light rail/streetcar systems. The latest proposed route consists of a combination of a direct connection (Figure 10) route, and an operational loop including Alton Road route (Figure 11). The Bay Link Phase 2 study screened Metromover as an alternative technology, but ultimately selected a light rail/streetcar system. As part of this study, the direct connection route was reassessed for Metromover technology. The technical memorandum summarizing the assessment is provided in Appendix C.

Figure 10: Direct Connection Route, Alignment and Operating Plan (Source: Beach Corridor Transit Connection Study, PEC Meeting Presentation, April 2, 2014)

Figure 11: Operational Loop + Alton Route, Alignment and Operating Plan (Source: Beach Corridor Transit Connection Study, PEC Meeting Presentation, April 2, 2014)

3.1.6 PortMiami 2035 Master Plan

Agency: Seaport Department of Miami-Dade County
Date: November 2011
Link: http://www.miamidade.gov/portmiami/master-plan.asp

The PortMiami 2035 Master Plan is a planning tool used to update the PortMiami Master Plan Sub-element of the County's Comprehensive Development Master Plan (CDMP). It was prepared simultaneously with the County's Evaluation and Appraisal Report which analyzes if the Port is meeting its goals, policies, and objectives.

No Metromover projects are discussed in document, but a multimodal center was included in the preferred concept. The preferred concept is shown in Figure 12 with the multimodal center highlighted.

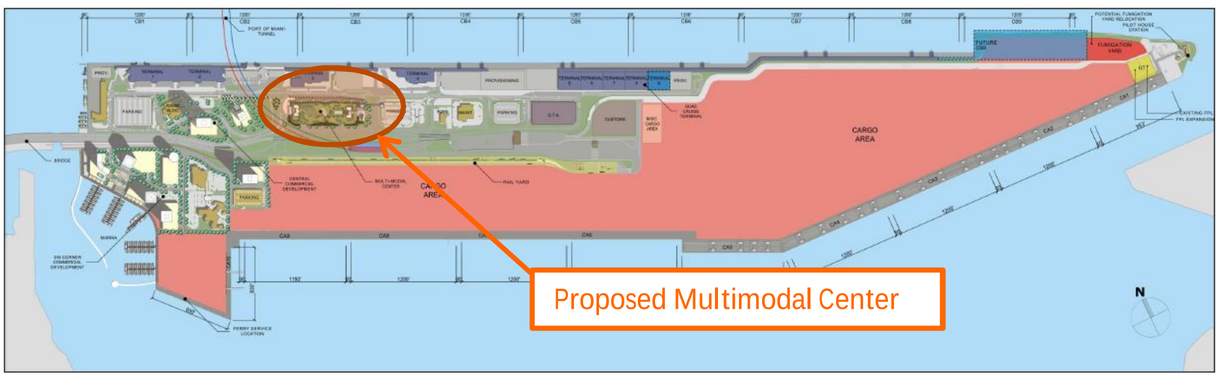

Figure 12: Preferred Concept (Source: PortMiami 2035 Master Plan)

3.1.7 Transit Options to PortMiami Feasibility Study

Agency: Miami-Dade MPO
Date: June 2013
Link: https://skydrive.live.com/view.aspx?resid=CB30042F1B5FAF4F!2974&app=WordPdf&wdo=2

The "Transit Options to PortMiami Feasibility Study" was performed by the Miami-Dade MPO to examine the potential for providing a transit connection between PortMiami and downtown Miami. As PortMiami is continuously expanding its intermodal capabilities, the need for transportation and parking are also increasing. A new transit connection to PortMiami would reduce roadway traffic, reduce emissions due to idling, and enhance air quality in the region. In the downtown Miami area, Metromover is one of the most used transportation systems. Currently, Metromover does not provide services to PortMiami. The current Metromover system map is shown in Figure 13.

Figure 13: Metromover Map - Downtown Miami (Source: Miami-Dade Transit)

The study evaluated eight Tier 1 alternatives including Commuter Rail Service, Metrorail, Metromover, and light rail/streetcar). The Metromover alternatives include:

- Metromover shuttle between the Freedom Tower Station and PortMiami
- Metromover shuttle between Metrorail Overtown Station and PortMiami
- Metromover Outer Loop extension from the Freedom Tower Station
- Metromover Inner/Outer Loop extension from the College North Station

After the Tier 1 evaluation, the alternatives including Metromover shuttle from Freedom Tower and Metromover extension from the College North Station were dropped. A Tier 2 evaluation of the alternatives concluded that the Metromover shuttle from Overtown Station alternative did not exhibit any fatal flaws and had relatively low capital and O&M costs. The Metromover alternative is shown in Figure 14.

Figure 14: Tier 2 Metromover Alternative (Source: Transit Options to Port Miami Feasibility Study, June, 2013)

3.1.8 Miami-Dade County Transit Development Plan

Agency: MDT
Date: September 2013
Link: http://www.miamidade.gov/transit/transit-development-plan.asp

Miami-Dade County's website describes its Transit Development Plan (TDP) as representing a 10-year strategic vision for MDT to promote the operation of an efficient, responsive, and financially sustainable transit system. Major components of the TDP include:

- Annual Performance
- Service Operations
- Capital Program
- Funding

Miami-Dade's TDP shows no planned service extensions or expansions of the existing Metromover system within the plan years of Fiscal Year (FY) 2014 to FY 2023. The Metromover Fiber Replacement Project and Uninterrupted Power Supplies are included in the TDP with committed budgets of $441,000 and $850,000, respectively. Both projects are proposed for implementation in FY 2013/2014.

The TDP also lists Infrastructure Renewal Program (IRP) needs, which are partially funded up until the plan horizon of 2023. Proposed Metromover related IRP projects are as follows:

- Metrorail and Metromover Train Wash: $300,000 for 2016;
- Metromover Station Ceiling Signage Cabinet Replacement: $1,080,000 for 2014 through 2017;
- Metrorail and Metromover Regulatory Signage Replacement: $200,000 for 2014 through 2017;
- Metrorail/Metromover Vehicle Signage Replacement: $560,000 for 2014 through 2017;
- Metromover Lighting: $2,310,000 for 2015 through 2016;
- Metrorail Station Refurbishment/Door Replacement at Metromover: total of $7,030,000 for 2014, 2015, and 2017;
- Metromover Wayside Overhaul: $25,105,080 for 2014;
- Metromover Inner Loop Guideway Painting: $11,630,000 for 2014; and

- Metromover Omni Extension Guideway Painting: $9,590,000 for 2014 through 2016.

The TDP annual update indicates that MDT does not project an increase in service levels for Metromover between FY 2014 to FY 2023.

3.1.9 Miami-Dade 2035 Long Range Transportation Plan

Agency: Miami-Dade MPO
Date: October 29, 2009 (update expected in 2014)
Link: http://www.miamidade2035transportationplan.com/docs/MD2035LRTP_Final%20Report_Web.pdf

The federal government requires every MPO to adopt a Long Range Transportation Plan (LRTP) and update it every five years. The LRTP shows all transportation projects (all modes) for which full funding is reasonably expected (*Cost Feasible*). The LRTP also includes unfunded projects that may be funded if additional funding becomes available. Miami-Dade's current LRTP was adopted in 2009; an update is expected in 2014.

The 2035 LRTP's only reference to expanding Metromover is in the unfunded list of priority projects, in which an extension to the Brickell Loop was stated. Extension of the Brickell Loop appearing on the list of unfunded projects means that the need for the project has been established, but funding to plan and implement the project have not yet been identified; there is no assurance that said funds will ever be identified. It is worth noting the 2040 LRTP is expected to include a project that closes the Metromover Brickell and Omni Loops.

The LRTP lists the following fully funded transit projects that connect with existing Metromover/Metrorail stations:

- Coral Way-Brickell Trolley (Brickell Metrorail/Metromover Station to Ponce de Leon Boulevard)
- Coral Way-Brickell Trolley (Brickell Metrorail/Metromover Station to Omni Arena)

Other references to Metromover within the 2035 LRTP include:

Safety Programs

- Replacement of the existing Computer Aided Dispatch/Automated Vehicle Locator (CAD/AVL) system on transit vehicles (including Metromover)
- Replacement of the existing multi-mode fiber at Steven P. Clark Center, 5th Floor

Security Programs

- Provide CCTV surveillance of the Metromover platform and station areas

Unfunded Priority Projects

- Premium transit connecting the Metromover/Metrorail station with Marlins Park

Survey

As part of the LRTP an online survey was completed to complement the public involvement sessions held throughout the County. One of the survey questions related to mode choice. As illustrated in Table 1, the survey indicated the Metromover had the least amount of users for the purpose of getting to work and going shopping.

Table 1: On-line Survey, Mode Choice Results (Source: LRTP, October, 2009)

	Get to Work?	Travel to Shop?	Get where you are going when not working or shopping?
Walk	29	44	55
Ride a bicycle	57	36	72
Drive a car	424	531	483
Carpool	10	4	8
Metrorail	67	5	12
Metrobus	38	20	24
US-1 Busway	5	10	0
Downtown Metro Mover	0	1	0
Tri-Rail	11	0	0
Friend or family member gives me a ride	14	12	10
Total	655	663	664

3.2 Summary of Preliminary Concepts

The limited information from the study review was complemented with additional information gathered during the first SAC meeting to develop seven preliminary concept alternatives:

- Close Brickell Loop
- Extend south along Brickell
- Beach Connection
- Close Omni Loop
- Marlins Park Connection
- North Connection
- PortMiami Connection

A layout of the preliminary concept alternatives is provided in Figure 15.

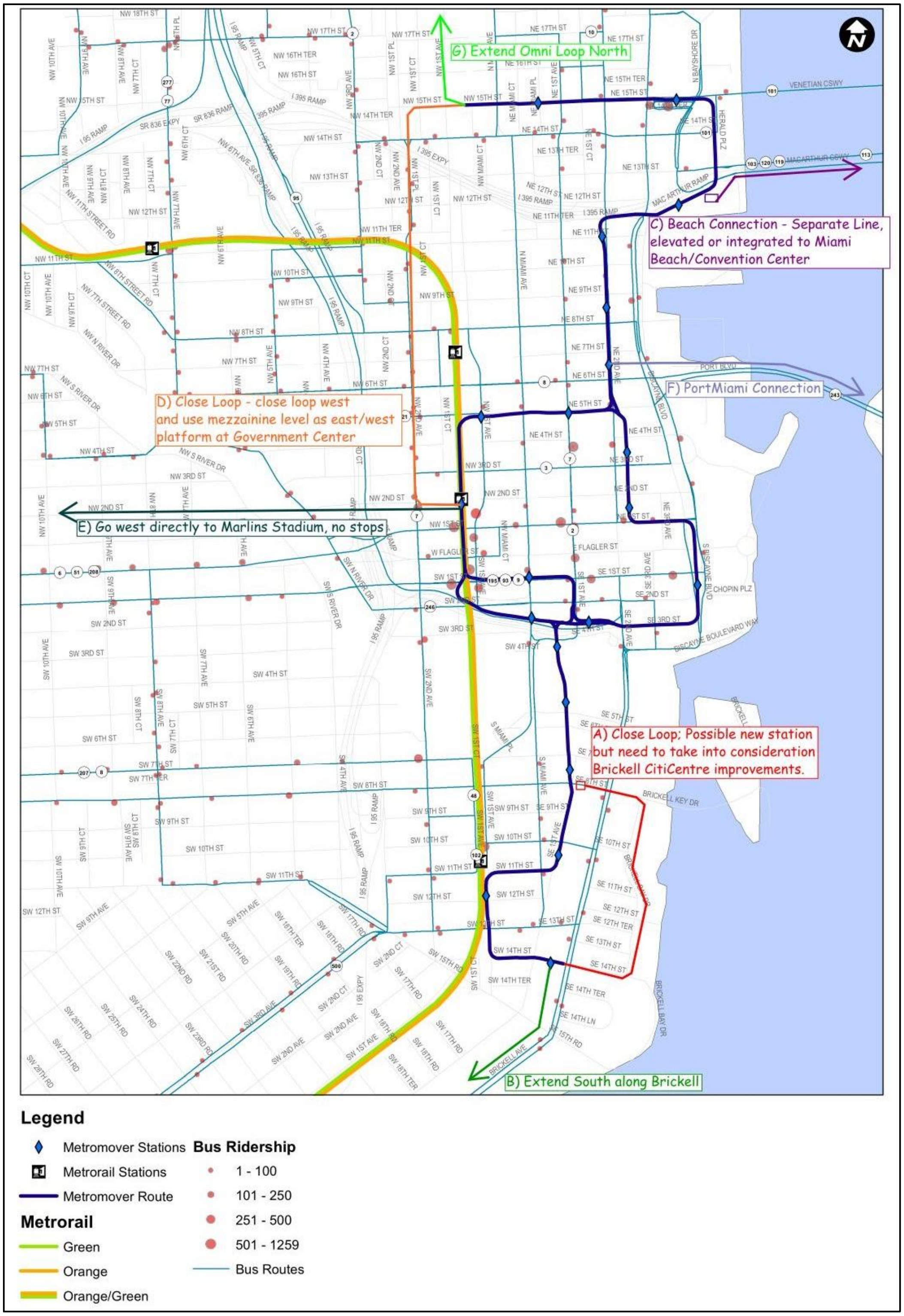

Figure 15: Preliminary Concepts

3.3 System Review

In addition to the review of available studies, a review of similar APM systems in a downtown setting was also conducted. The Metromover is an automated/driverless rubber-tired people mover system located in an urban setting. The system review was limited to similar rubber-tire systems operating in downtown, urban settings. The system review also includes a summary of similar technologies developed by other manufacturers with vehicles of similar sizes to the Metromover.

3.3.1 Worldwide Systems

Figure 16 provides a summary of similar systems implemented worldwide. The information within the figure was obtained from the International Association of Public Transport (UITP), the European equivalent of American Public Transportation Association (APTA). The systems within this figure represent systems with (1) unattended train operations (UTO) or systems that do not have drivers, (2) public transportation providers (i.e. no airports, small people mover systems etc.), and (3) have a minimum train capacity of more than 100 passengers per train.

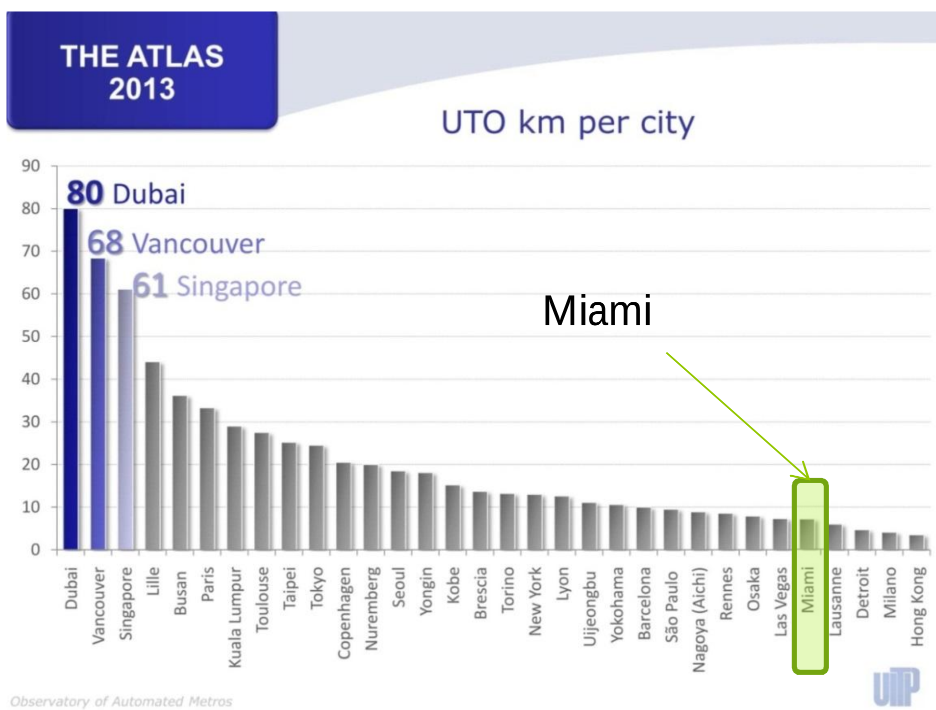

Figure 16: Urban APM Systems Worldwide (Source: International Association of Public Transport. Observatory of Automated Metros, 2013 Data and Activities)

As evidenced by Figure 16, the majority of implemented, urban APM systems are international. There are only a few systems in the United States (US) that appear on the list:

- Las Vegas: Las Vegas Monorail 3.9 miles (6.4 km)
- Miami: Metromover 4.4 miles (7.1 km)
- Detroit: Detroit People Mover 2.9 miles (4.7 km)
- New York: AirTrain JFK 8.1 miles (13 km)

3.3.2 Technologies

Many of the US systems use a different technology than the Metromover vehicles. The original Metromover vehicle was the C100 vehicle, named because of its nominal capacity of 100 passengers. This specific APM system design has been owned by multiple companies, and the name evolved to be the CX100 vehicle, and then the Innovia vehicle for later versions. Currently, the Metromover vehicle design is owned and manufactured by Bombardier.

Typically, APMs, regardless of the technology or manufacturer, are defined by the following characteristics:

- Driverless/Fully automated
- Operate on fixed guideway (usually elevated)
- Vehicles have rubber tires on concrete or steel surface

APM manufacturers distinguish themselves from their competition by identifying competitive advantages in cost, delivery time, vehicle design, power consumption, braking and propulsion systems.

The Metromover was placed in service in 1986. The original design and installation of this system was provided by Westinghouse Transportation Division. The distinguishing design feature of this self-propelled vehicle was that the center guidebeam extends below the running surfaces of the vehicles rubber tires, as shown in Figure 17. This unique vehicle/guideway interface design has by necessity been retained for all subsequent versions of the vehicle over the past 25 years.

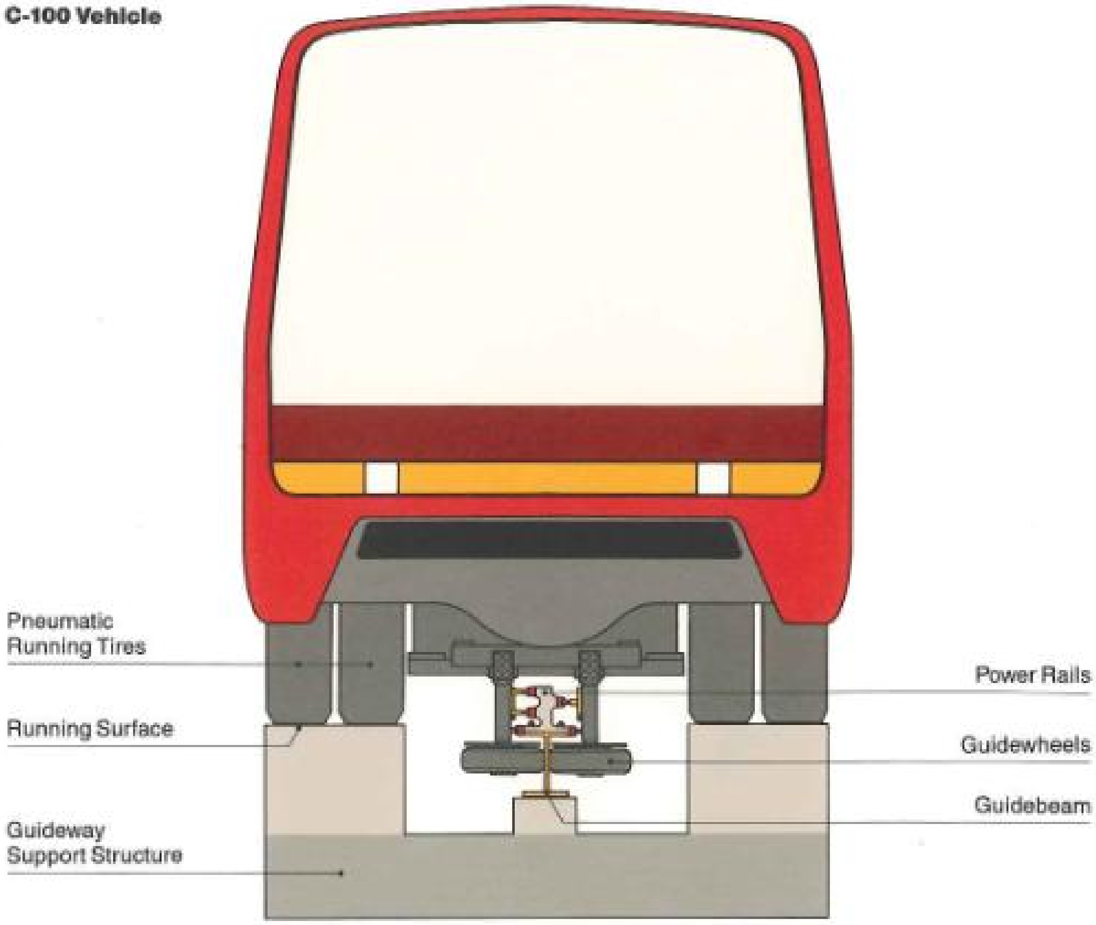

Figure 17: Guidebeam Interface (Source: AEG Westinghouse - now Bombardier, 1990)

Bombardier has designed a wholly new rubber-tired APM system design that has the center guidebeam placed above the running surface. The first installation of the new system was supplied to the Dallas/Fort Worth International Airport as the APM system connecting the terminals. This new design was original technology called the Bombardier "Innovia" system, but it cannot operate on the Miami Metromover because the vehicle/guideway interface is different than the Miami vehicles. However, Bombardier continues to supply to transit properties like MDT new vehicles that match the vehicle/guideway design of the original equipment. Currently, Bombardier is manufacturing brand new state-of-the-art APM vehicles that match the Metromover's original CX100 guideway interface under the name of Innovia APM 100 (Figure 18).

Figure 18: Metromover Vehicle - Bombardier's Innovia APM 100 (Source: bombardier.com)

Bombardier is also now offering other automated transit systems under the general brand name of "Innovia". These different guideway technologies including the new vehicle/guideway interface APM system described above, the LIM propulsion railcar system called the Innovia Metro system, and the Innovia Monorail System. Any brand new APM system offered by Bombardier would be limited to one of these three different designs.

Figure 19 through Figure 24, in addition to the Innovia APM 100 vehicle (Figure 18), provide pictures of APM vehicles identified in the system review with vehicles of similar size to the Metromover's Bombardier Innovia APM 100 and operate in urban environments. However, not all are self-propelled vehicles with onboard electric traction motors. Figure 20 and Figure 22 are actually cable-drawn vehicle systems, which can be designed to have "detachable grip" connections allowing them to transfer between drive cables at stations as they progress along the transit alignment (such as the new Bay Area Rapid Transit (BART)/Oakland Airport Connector system). Most manufacturers of similar APM vehicles emphasize that some aspects of the physical make-up of the vehicles are customizable based on the location of the system and the system owner's preferences.

Figure 19: Mitsubishi Heavy Industries' Crystal Mover (Source: mhi.co.jp)

Figure 20: Doppelmayr Cable Car APM (Source: dcc.at/doppelmayr)

Figure 21: Kobelco Automated Guideway Transit (Source: kobelco.co.jp/English)

Figure 22: Poma's MiniMetro (Source: Urbanway by Poma)

Figure 23: Siemen’s VAL (French for Automatic Light Vehicle) (Source: Cityval for an Expanded Vision by Siemens)

Figure 24: Alstom Transport APM (Source: lausanne lrt - line 2 by Systra)

3.3.3 Systems Matrix

The high-level research conducted during the system review examined and compared information made available via the manufacturers' and system owners' websites and publications. Additionally, independent third-party reports and publications were used to verify information. As certain publications were intended to serve advertising purposes, some of the information presented emphasized the positive attributes of the technologies being showcased. The research also found, on some occasions, more than one manufacturer taking credit for implementing a single APM system. This was apparent in scenarios where manufacturers worked together to implement an APM system or line. If required, an additional level of research will have to be performed to delineate the specific role of the respective entities in those cases.

In lieu of limiting the system review to only Bombardier vehicle technology, the review also included systems from other manufacturers. However, the review focused on driverless technology with rubber tire vehicles traveling on a fixed concrete or steel guideway to be consistent with the Metromover system operations. As part of the system review, the key system features were summarized and compared in Table 2 including:

- System – name of system/service/transit line
- Location – geographical location of system/service/transit line
- Purpose – need the system/service/transit line satisfies
- Began Operation – the year revenue service commenced
- Technology – system/vehicle manufacturer
- Size – length of system/service/transit line and number of vehicles
- Expansion – available information of extending lines beyond opening
- Ridership – passenger trips as presented by reporting entity

Table 2: System Matrix

System	Location	Purpose	Began Operation	Technology	Size (miles/fleet)	Expansion	Ridership[1]
Metromover	**Miami, FL**	**Downtown circulator, distributor, and collector for transit system**	**1986/1994**	**Bombardier Innovia 100**	**4.4 miles**	**Yes, in 1994 from 1.9 miles, north and south**	**9.5M annually; 31,000 daily**
Guangzhou Metro	Guangzhou, China	Connects the central business district with the rapidly growing business and trade area in addition to metro transit network	2010	Bombardier Innovia 100	2.4 miles/ 14 vehicles	No	9,000 hourly
Bukit Panjang LRT Line	Bukit Panjang, Singapore	Serves as a feeder line to rapid transit stations, bus interchanges, local recreational facilities, commercial complexes, and schools	1999	Bombardier Innovia 100	4.9 miles/ 19 vehicles	Number of cars to be increased in 2014 to reduce headways; system length to remain unchanged	51,000 daily
Skyway Express	Jacksonville, Florida	Connects points of interest (i.e. convention center, community college)	1989/1999	Bombardier Small Monorail (originally VAL, technology changed as a part of expansion)[2]	2.5 miles/ n/a	System extended from 0.7 miles to 2.5 miles; change in technology upon extension of line due to breakdown in negotiations with MATRA, not necessarily dissatisfaction with technology	2,000 daily
Sengkang Light Rapid System	Sengkang, Singapore	Feeder to existing multimodal hubs	2002	Crystal Mover	6.6 miles/ 18 vehicles	n/a	n/a
Punggol Light Rapid Transit	Punggol, Singapore	Feeder to existing multimodal hubs	2004	Crystal Mover	7.33 miles/ 23 vehicles	n/a	n/a
Oakland Airport Connector	Oakland, California	Connects transportation hub to international airport	Projected 2014	Doppelmayr Cable car	1 mile/ 4, 3-car trains	No	Projected 3,500 hourly
MGM City Center Shuttle	Las Vegas, Nevada	Connects high traffic attractions	2009	Doppelmayr Cable car	0.4 Miles/ 2, 4-car trains	No	6,000 hourly
Rinkai Line / Yurikamome	Tokyo, Japan	Runs along waterfront to encourage urban redevelopment	1995	Kobelco	9.2 miles/ 6 vehicles	Yes, in 2006 and 2007	140,000 daily
Port Island Line (Port Liner)	Kobe, Japan	Connects man-made island to mainland and airport	1981	Kobelco	6.7 miles/ 6 vehicles	Extended to Kobe Airport in 2006 with original technology	n/a
Busan Line 4	Minam, South Korea	Connects two towns	2011	Kobelco	7.9 miles/ 6 vehicles	n/a	n/a
MiniMetro	Perugia, Italy	Connects two towns (hillside)	2008	POMA	n/a / 25 vehicles	n/a	3M annually
MiniMetro	Oeiras, Portugal	Intra-city transit	2004	POMA	0.7 miles/ 2 vehicles	Planned details not yet available	1,170 hourly
POMA 2000	Laon, France	Connects railway station with points of interest	1989	POMA/OTIS	0.9 miles/ 3 cars	Used components of prior tram system that POMA 2000 replaced	n/a
Lille Line 1	Lille, France	Links towns with city center, transit hub and park-n-ride lots	1983	VAL	8 miles / 45 vehicles	Expansion currently being planned to satisfy demand	45.8M annually
Lille Line 2	Lille, France	Links towns with city center, transit hub and park-n-ride lots	1994/2000	VAL	20 miles / 98 vehicles	Fully designed line was built in 3 phases using VAL technology throughout	50.5M annually
Rennes Line A	Rennes, France	Links historic city center with activity centers and main facilities (hospitals, university, and transit hub)	2002	VAL	5.2 miles/ 16 vehicles	Line B (12.6 miles) under construction using VAL technology; to open in 2018	120,000 daily
Paris Metro Line 1	Paris, France	Serves popular destinations. Paris' oldest "metro" line	1900	Alstom/VAL	10.3 miles/ 49 Vehicles	Transitioned from drivers to fully automated line between 2009 and 2012	213M annually
Lausanne Metro (Line 2)	Lausanne, Switzerland	Intra-city transit with connections to regional and national transit	1890 / 2008	Alstom	3.7 miles / 15 vehicles	In 2008 cogwheel metro car system replaced and line extended an additional 3 miles	26M annually
Paris Metro Line 14	Paris, France	Intra-city travel, connections with transit hubs	1998	Alstom/VAL	5.6 miles / 8-car train sets	Initial extension in 2003; additional line extending northward planned for 2015 (including 14 additional trains) to alleviate demand on other lines	45,000 daily
Metro Line D (Lyon)	Lyon, France	Connects two towns separated by mountains and rivers	1992/1997	VAL	8 miles/ 36 vehicles	Extension to south adding 3 stops, then extension to north adding 2 stops	21,000 hourly

Notes:
n/a – not available
[1]Ridership shown based on available information and does not take into account service hours
[2]Jacksonville's Automated Skyway Express' transition from VAL to Bombardier's monorail was reported in *Downtown People Movers – History and Future Cities* by W. Sproule and W. Leder (APM-ATS 2011, ASCE 2012).

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3.3.4 System Review Summary

In summary, the system review found that Miami is unique and the majority of fully automated urban transit systems are located outside the US. There are some similar systems in the US, but most US systems consist of different technology. Further, the designation of APM has historically been applied to local district circulator applications such as the Metromover, or in airport applications. Thus the term "APM" is generally not used for a subregional or regional scale transit systems and the term "automated transit system" is becoming common for such line haul applications. Some of the systems described in the matrix are local district circulator APM systems, and some are subregional corridor type automated transit systems, such as the Paris Metro Line 1 and the lines in Lille, France. The length of the system shown in the matrix often implies this functional difference. It is noted that the Metromover's 4.4 mile length establishes it as one of the longer APM systems, especially within the US.

In addition, there are very few similar systems that have been expanded. The expanded systems identified include Jacksonville, Florida; Lille and Paris France; and Lausanne, Switzerland. This indicates that although systems are not frequently expanded, expansion can successfully occur with good planning and engineering.

Worldwide, the installation of fully automated transit systems is accelerating rapidly. This in turn increases the competition as new manufacturers enter the field and reduces the costs and the technology matures.

3.4 Metromover Passenger Survey

MDT collects extensive information on Metromover ridership using automated passenger counter (APC) information. However, there is very limited data available on the passenger and trip characteristics of the Metromover ridership. To supplement the available boarding data, a one-day sampling survey was conducted at select Metromover stations to collect information on trip purpose and passenger characteristics. In addition, origin/destination information was collected to identify the trips within and between four "zones" of the Metromover service areas: North, South, East, and West.

3.4.1 Survey Locations

The Metromover average boardings by station from the September 2013 MDT Ridership Technical Report were reviewed to identify the Metromover stations that had the highest ridership within each of the four zones. The ridership report with the zone groups is provided in Figure 25. Seven stations were identified as high ridership stations representative of the individual zones. Figure 26 shows the survey locations and zones.

METROMOVER
AVERAGE BOARDINGS BY STATIONS

	STATIONS	AVERAGE WEEKDAY	AVERAGE SATURDAY	AVERAGE SUNDAY	LABOR DAY BOARDINGS	TOTAL BOARDINGS
	School Board	711	596	578	499	19,986
	Omni	2,730	2,208	1,576	1,753	73,069
North Zone	Bicentennial Park	-	-	-	-	-
	Eleventh Street	295	254	192	174	8,043
	Park West	288	279	201	207	8,080
	Freedom Tower	363	432	260	140	10,430
	Government Center	9,111	2,820	1,841	1,900	204,596
West Zone 1	Miami Avenue	850	515	349	338	21,146
	Third Street	298	266	146	180	7,922
	Knight Center	788	385	297	289	19,076
East Zone	Bayfront Park	2,144	2,061	820	314	55,530
	First Street	1,552	1,245	1,039	942	42,161
	College/Bayside	2,572	1,770	1,264	1,133	65,977
	College North	1,393	461	349	262	31,709
West Zone 2	Wilkie D. Ferguson	809	564	397	372	20,796
	Riverwalk	711	506	327	336	18,210
	Fifth Street	522	371	218	154	13,176
South Zone	Eighth Street	993	532	338	338	24,022
	Tenth Street	965	791	436	409	25,046
	Brickell	2,837	1,849	1,346	1,261	72,116
	Financial District	1,431	689	420	436	33,913
	Total	**31,362**	**18,591**	**12,395**	**11,437**	**775,004**

Note: Miami Avenue, Riverwalk and Wilkie D. Ferguson stations contain estimates based on other data within September 2013; Knight Center station contains estimates based on two previous years.

Station for Data Collection

Zone Grouping

September 2013 17

Figure 25: High Ridership Stations for Survey Zones (Source: MDT, http://www.miamidade.gov/transit/library/rtr/2013-09-Ridership-Technical-Report.pdf)

Figure 26: Survey Locations

3.4.2 Survey Process

A survey was developed for the Metromover passengers to obtain background information on Metromover patrons, use tendencies, trip patterns, and ultimately solicit their opinion on potential Metromover expansion. A survey was designed that captured key ridership and trip characteristics including:

- Origin/Destination patterns
- Trip purpose
- Access/Egress mode
- Frequency of use
- Extension options
- Zip code
- Gender

Figure 27: Survey Effort

The survey length was targeted to achieve results within the anticipated Metromover headway. As such, the survey was designed to be completed within one minute, estimating approximately six to eight seconds per survey question. The survey resulted in eight total questions, with one question including a follow-on question. The surveyors also captured additional data (gender, station location, and response willingness) outside of the active survey response time, resulting in a total of eleven survey questions. The survey questions are provided in Figure 28.

MIAMI-DADE COUNTY

Miami-Dade Metromover Passenger Survey

Survey Serial No: ___________

QUESTIONS CAPTURED BY SURVEYOR INDEPENDENTLY PRE-SURVEY

1. ***Are you willing to answer 8 brief survey questions? All your information will be kept completely CONFIDENTIAL.***
   - *a. Yes*
   - *b. No*

2. ***What Metromover station are you currently at?***
   - *a. School Board*
   - *b. Adrienne Arsht Center*
   - *c. Government Center*
   - *d. Bayfront Park*
   - *e. College/Bayside*
   - *f. Brickell*
   - g. Financial District

"OFFICIAL" SURVEY QUESTIONS

3. **Where did you BEGIN this one-way trip? (Check ONE only)**
   - a. Your **Workplace**
   - b. Other Office/Meeting
   - c. Your **Home**
   - d. Shopping
   - e. School (K-12)
   - f. College / University (students only)
   - g. Medical / Health Care
   - h. Social / Recreational
   - i. Other ________________ (airport, hotel, etc.)

4. **Where will you GET OFF THE Metromover? (Check ONE only)**
   - a. School Board (North)
   - b. Adrienne Arsht Center (North)
   - c. Museum Park
   - d. Eleventh Street (North)
   - e. Park West (North)
   - f. Freedom Tower (North)
   - g. College North (West)
   - h. Wilkie D. Ferguson Jr. (West)
   - i. Government Center (West)
   - j. Miami Avenue (West)
   - k. Third Street (West)
   - l. Knight Center (East)
   - m. Bayfront Park (East)
   - n. First Street (East)
   - o. College/Bayside (East)
   - p. Riverwalk (South)
   - q. Fifth Street (South)
   - r. Eighth Street (South)
   - s. Tenth Street/Promenade (South)
   - t. Brickell (South)
   - u. Financial District (South)

5. **Where will you END this one-way trip? (Check ONE only)**
   - a. Your **Workplace**
   - b. Other Office/Meeting
   - c. Your **Home**
   - d. Shopping
   - e. School (K-12)
   - f. College / University (students only)
   - g. Medical / Health Care
   - h. Social / Recreational
   - i. Other ____________________ (airport, hotel, etc.)

6. **Did you use any of the following modes to get to the Metromover station?**
   - a. Metrorail
   - b. Bus
   - c. Car/Taxi
   - d. Bicycle
   - e. Walk Only
   - f. Other:____________________

7. **Will you use any of following modes after leaving the Metromover? (Check ONE only)**
   - a. Metrorail
   - b. Bus
   - c. Car/Taxi
   - d. Bicycle
   - e. Walk Only
   - f. Other:____________________

8. **Would you like to see the Metromover add another stop?**
   - a. Yes
   - b. No

8.a If Yes to 8, then where?

____

9. **How many days per week do you typically use Metromover?**

   ☐ 7 ☐ 6 ☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐ < 1

10. **What is the zip code of your primary residence?**

    ________________________(enter US zip code or note international)

QUESTIONS CAPTURED BY SURVEYOR INDEPENDENTLY POST-SURVEY

11. **Gender**

    ☐ Male ☐ Female

Figure 28: Survey Questions

The survey was conducted on Wednesday, February 12, 2014. The survey was completed using iPads (Figure 29) allowing the surveyors to capture the data quickly and efficiently. IPad technology also improved the data consolidation process, improving the accuracy and efficiency of the data. The final survey took approximately 30 to 45 seconds to complete.

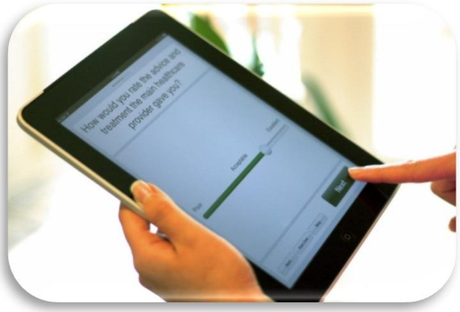

Figure 29: IPad Survey

3.4.3 Survey Results and Findings

The results and findings are illustrated in pie graphs and other illustrative diagrams, followed by their interpretation and significance. As shown in the following sections, the survey captured the intended audience: regular users (home/work trips) that frequently use the system, many of whom live in the downtown area.

Response Rate

A short survey along with clear communication of the number of survey questions resulted in a survey response rate that exceeded target expectations. A total of 1,193 people were approached, of which 75% (898 people) agreed to participate in the survey; leaving only 25% (295 people) that did not agree to participate.

The number of responses was compared to the February 2014 Metromover average boardings by station from the MDT Ridership Technical Report[1]. The seven surveyed stations had an average weekday ridership of 23,926 boardings in February 2014. Based on this ridership, approximately 5.0% of the boarding passengers at the surveyed stations were intercepted and 3.8% of the boarding passengers at the surveyed stations responded to the surveys. As previously mentioned, the seven surveyed stations were the higher activity stations. The total average weekday boarding for all stations in February 2014 was 34,696. Based on this ridership, approximately 3.4% of all boarding passengers were intercepted and 2.6% of all boarding passengers responded to the survey. This represents an excellent response rate and an effective survey effort for a one-day sampling survey.

[1] http://www.miamidade.gov/transit/library/rtr/2014-02-Ridership-Technical-Report.pdf

Trip Purpose

Trip purpose information was collected through two survey questions related to the start and end points of the trips. The majority of trips began from home (49%) and work (24%). Similarly, work (29%) and home (31%) based trips are the primary trip destination. The results are summarized in Figure 30 and Figure 31.

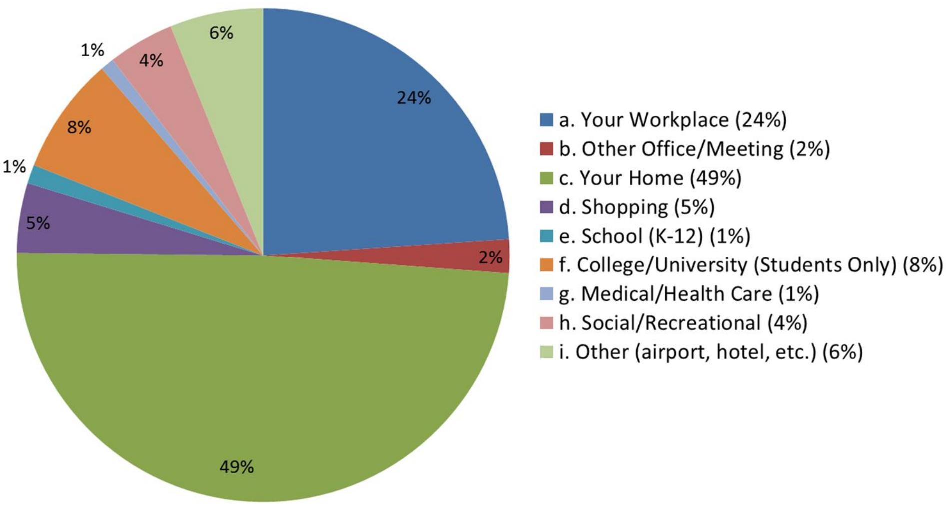

Figure 30: Trip Purpose, Start of One-Way Trip (Origin)

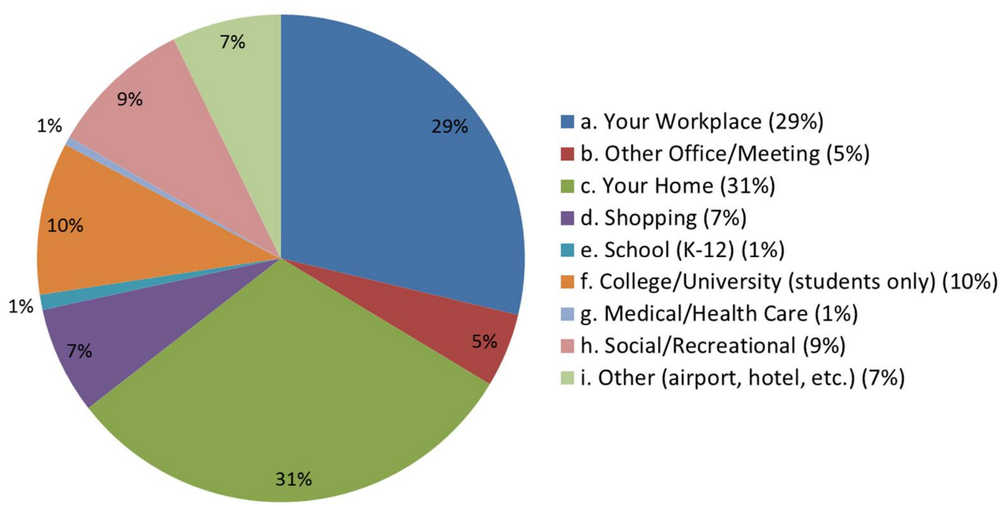

Figure 31: Trip Purpose, End of One-Way Trip (Destination)

Zip Code Data

The respondents were also asked the zip code of their primary residence. Figure 32 shows that the majority of passengers live in the downtown area, but there are passengers that live throughout Miami-Dade County.

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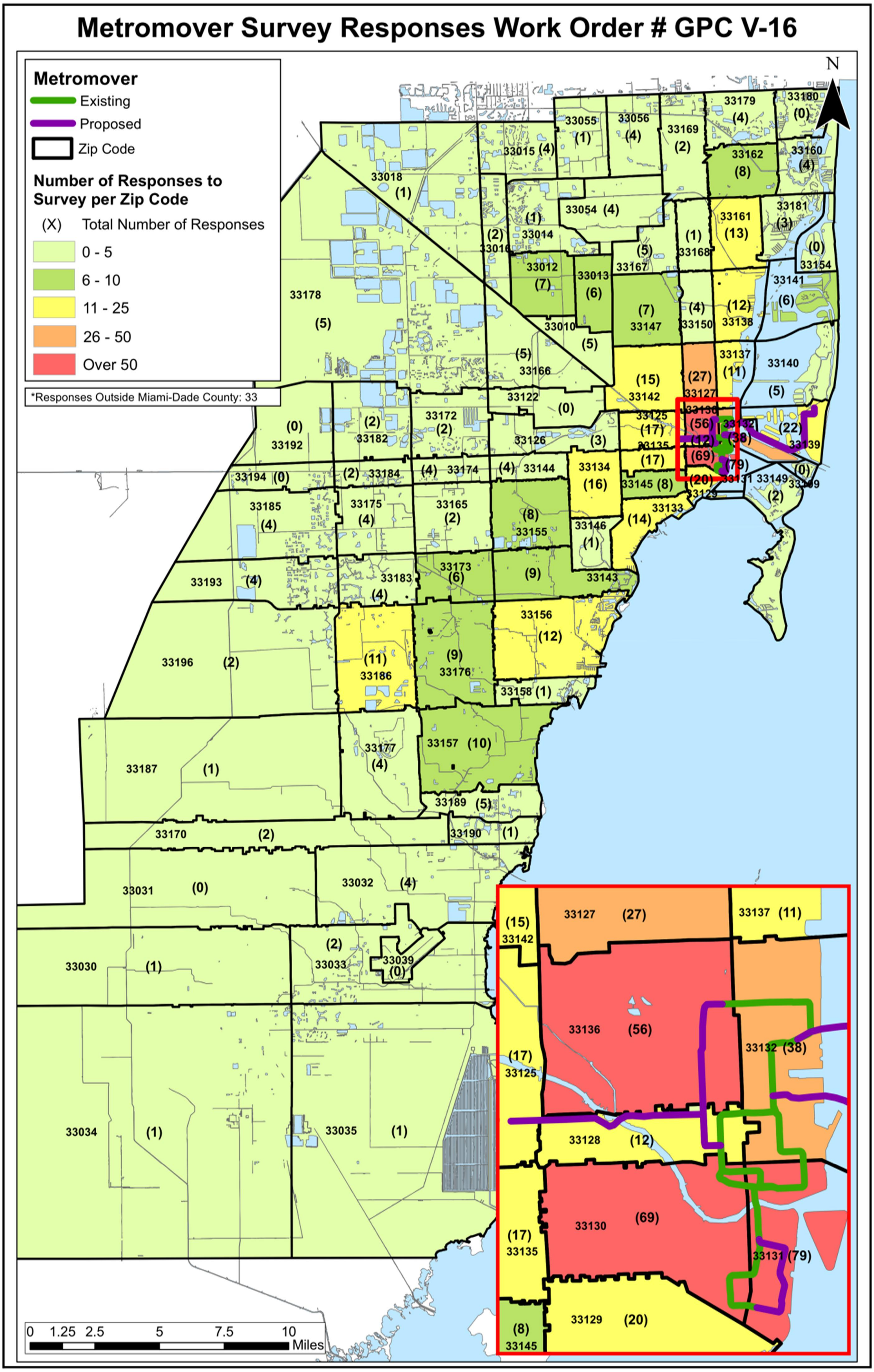

Figure 32: Zip Code of Primary Residence

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Ridership Frequency

Survey participants were also asked how many days per week they typically use Metromover. Figure 33 shows the majority of survey participants (66%) use the Metromover at least five days per week.

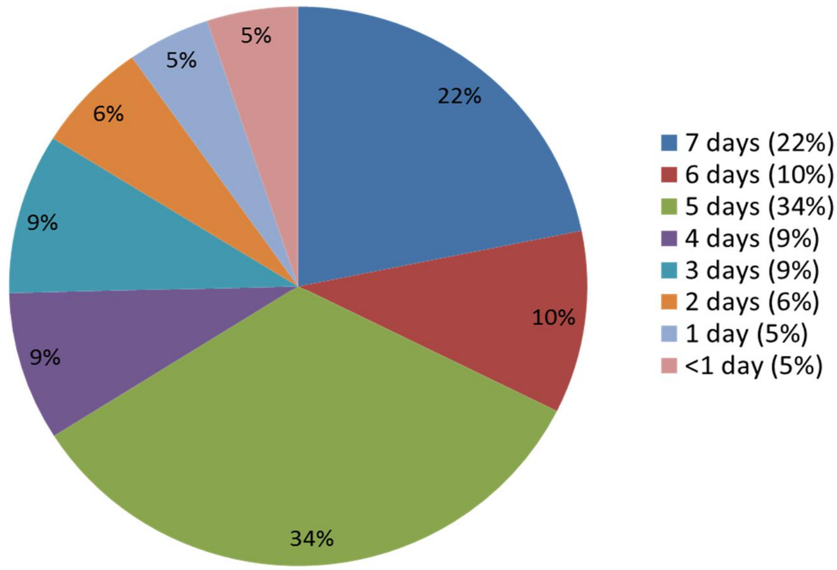

Figure 33: Ridership Frequency, Trips per Week

Travel Mode

Survey participants were asked the modes used to travel to the Metromover station as well as the modes they will use after finishing their Metromover trip. Table 3 shows the access and egress modes had similar values. The large majority of passengers walked to and from the Metromover stations, but there was also a large percentage that connected to bus and rail.

Table 3: Modes To/From Metromover

Mode	Accessing Responses (Percent)	Egress Responses (Percent)
Walk Only	368 (41%)	411 (46%)
Metrorail	226 (25%)	209 (23%)
Bus	187 (21%)	175 (19%)
Car/Taxi	65 (7%)	60 (7%)
Bicycle	10 (1%)	10 (1%)
Other	42 (5%)	33 (4%)

Origin/Destination

The surveys focused the origin/destination (OD) information by zone to further understand trip patterns of the Metromover passengers. The results categorized by zone in which the trip originated are illustrated in Figure 34 through Figure 37. Figure 38 collectively shows all the possible trip patterns and quantifies the proportions of each. Table 4 summarizes the results of the OD distribution between zones.

From the North Zone, the highest movement (54%) is from north to west, with the remaining zones fairly balanced. From the South Zone, a high percentage (50%) remains within the zone. From the West Zone, the highest movement (34%) is to the east, with the second highest (29%) to the south. From the East Zone, the highest percentage (39%) is to the west, but there is also a high movement (33%) to the north. Layering the trip patterns from each zone shows that the highest movement is between the east and the west, most likely due to the location of Government Center in the West Zone. Figure 38 also shows a significant number of passengers that remain in the South Zone (10%). In summary, the OD Distribution results identify that the passengers are using the Metromover as an urban circulator.

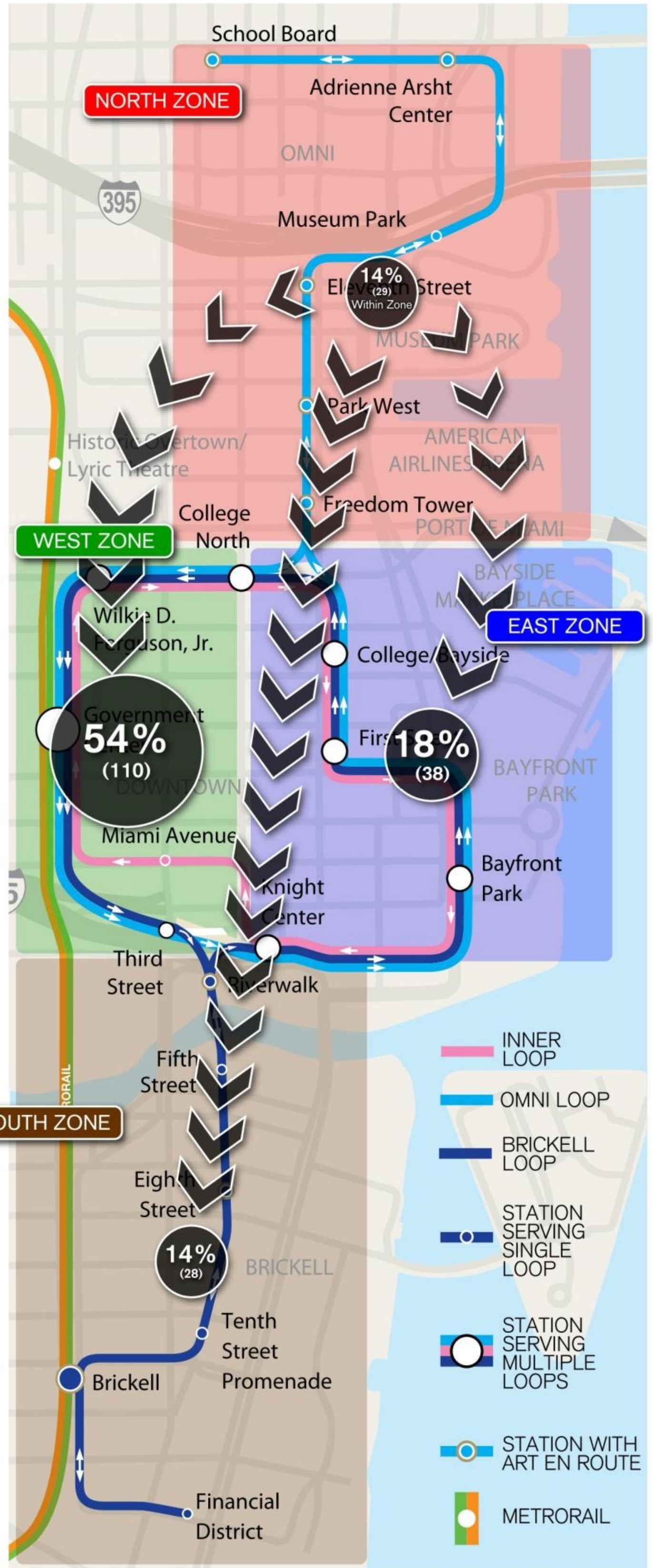

Figure 34: North Zone Distribution

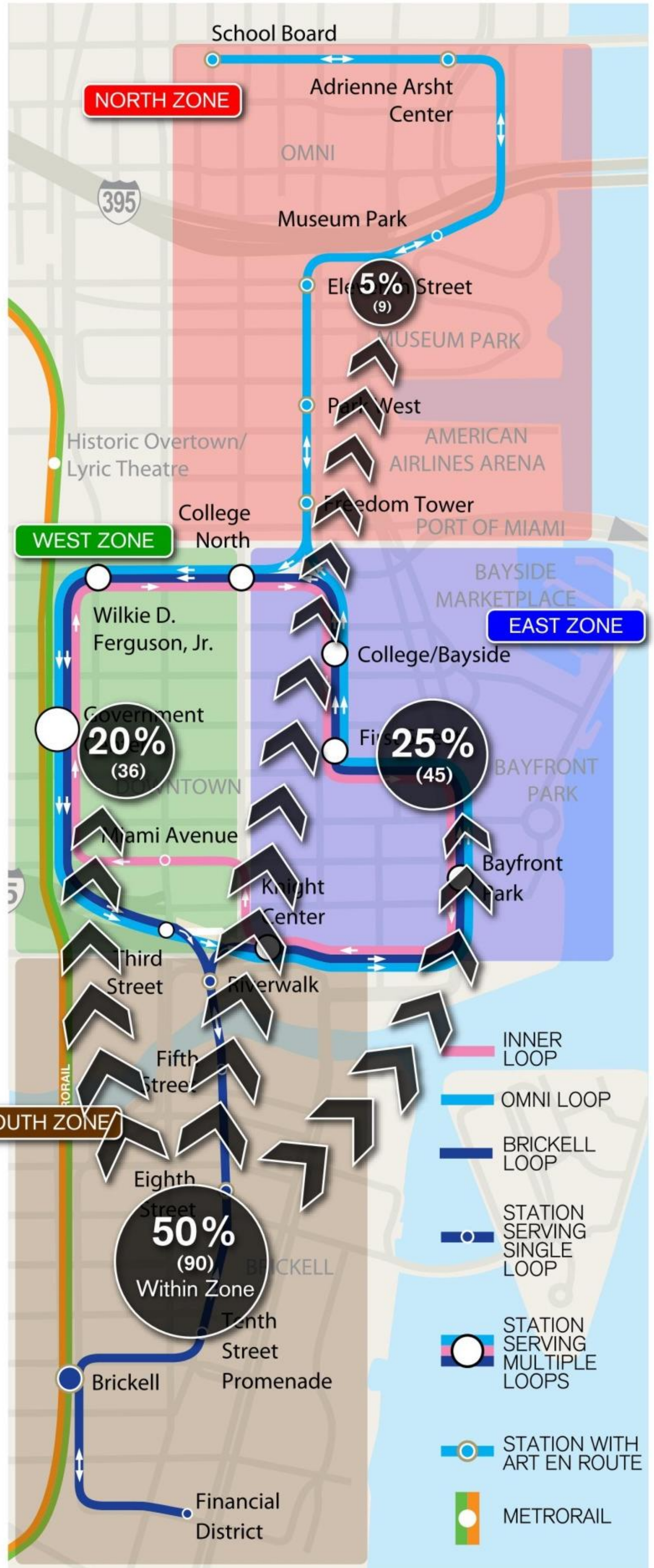

Figure 35: South Zone Distribution

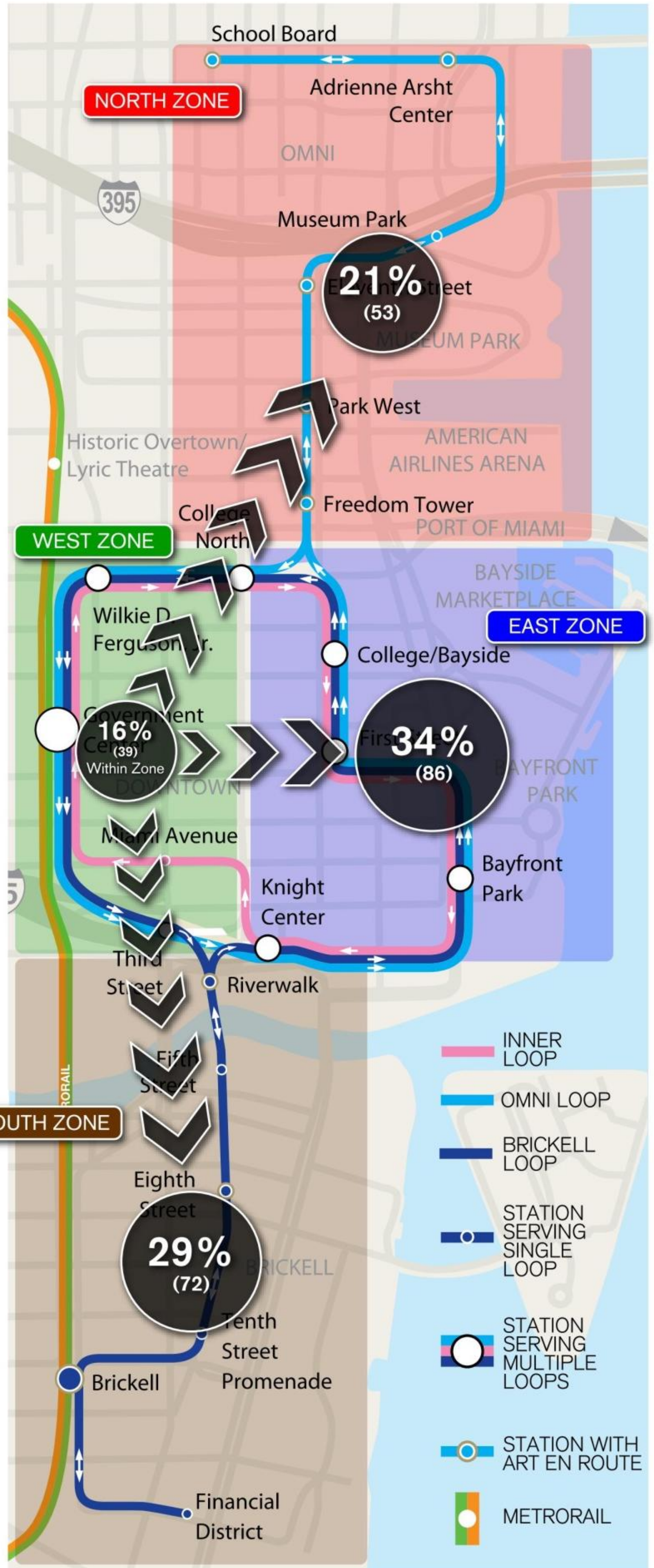

Figure 36: West Zone Distribution

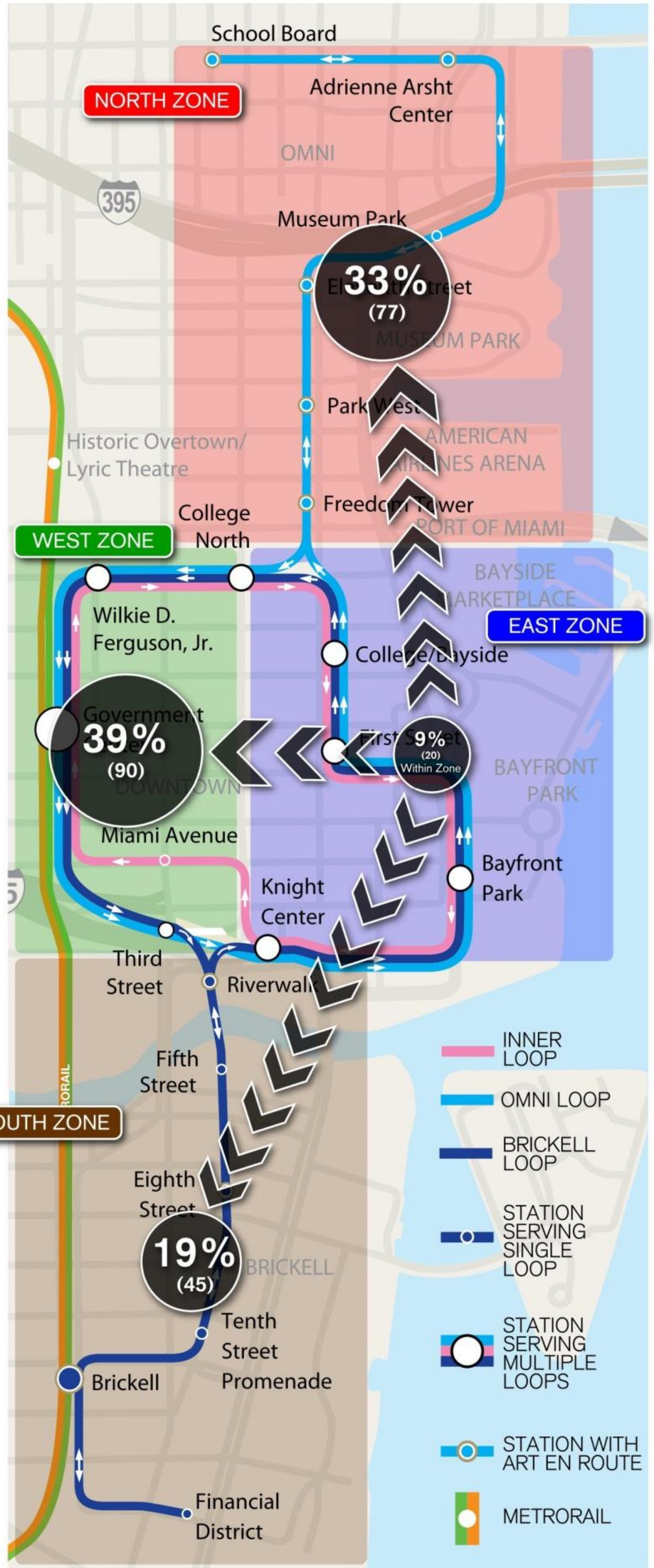

Figure 37: East Zone Distribution

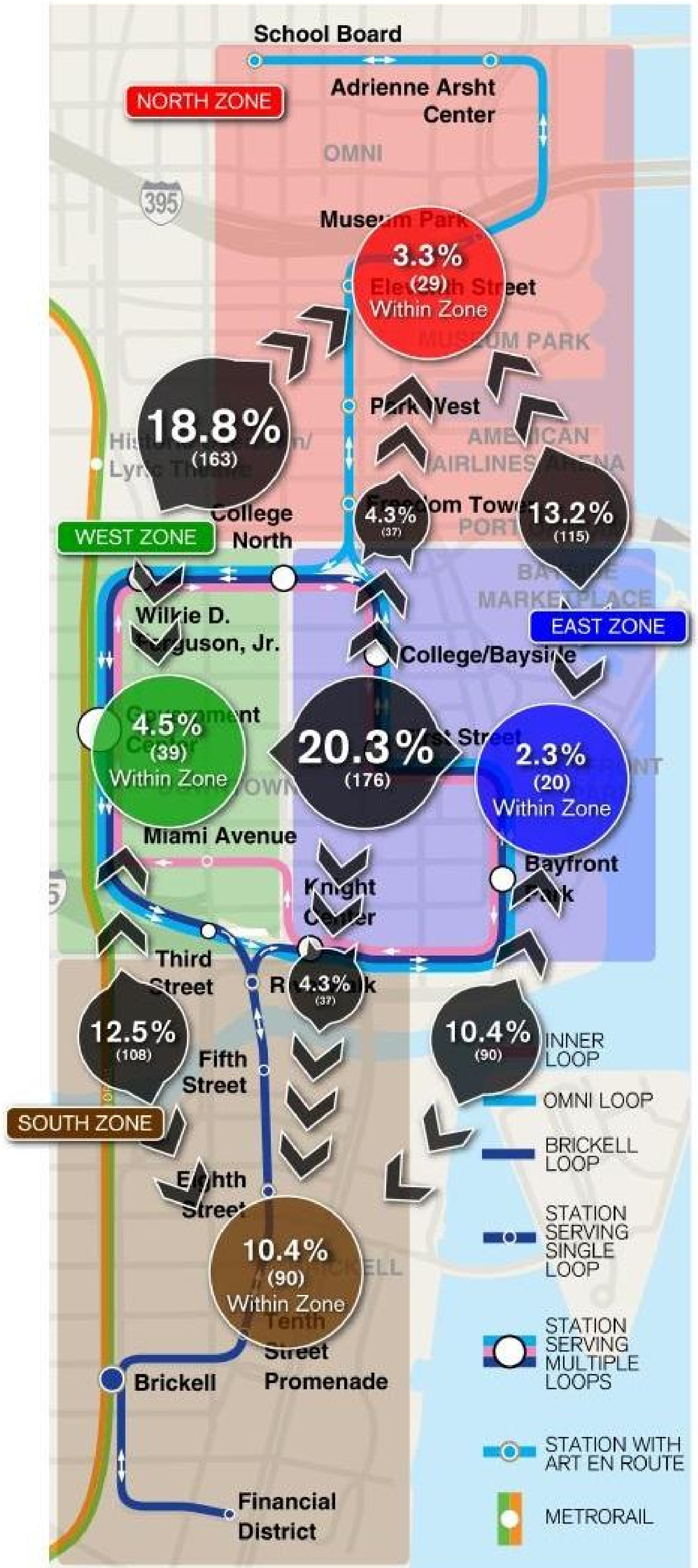

Figure 38: Overall Distribution

Table 4: Survey Origin-Destination Summary Table

Destination \ Origin		North: School Board	North: Adrienne Arsht Center	East: College/ Bayside	East: Bayfront Park	West: Government Center	South: Brickell	South: Financial District	Total to Destination
North	School Board		5	2	1	20	0	2	**30**
North	Adrienne Arsht Center	11		38	24	26	3	2	**104**
North	Museum Park	1	1	0	1	3	0	0	**6**
North	Eleventh Street	0	1	0	4	1	0	0	**6**
North	Park West	0	0	2	2	2	0	2	**8**
North	Freedom Tower	2	8	1	2	1	0	0	**14**
Subtotal		**29**		**77**		**53**	**9**		
East	College/ Bayside	14	7		10	23	3	8	**65**
East	First Street	3	0	1	1	6	3	2	**16**
East	Bayfront Park	5	7	6		45	9	11	**83**
East	Knight Center	1	1	0	2	12	5	4	**25**
Subtotal		**38**		**20**		**86**	**45**		
West	College North	5	8	0	9	23	2	4	**51**
West	Wilkie D. Ferguson Jr.	1	1	2	8	7	0	1	**20**
West	Government Center	45	47	21	43		11	17	**184**
West	Miami Avenue	1	0	3	2	3	0	1	**10**
West	Third Street	2	0	2	0	6	0	0	**10**
Subtotal		**110**		**90**		**39**	**36**		
South	Riverwalk	0	2	1	8	3	5	3	**22**
South	Fifth Street	1	1	0	1	4	1	4	**12**
South	Eighth Street	2	0	0	2	8	5	2	**19**
South	Tenth Street/ Promenade	1	1	2	1	8	3	5	**21**
South	Brickell	6	12	12	12	39		40	**121**
South	Financial District	1	1	5	1	10	22		**40**
Subtotal		**28**		**45**		**72**	**90**		
Total from Origin		**102**	**103**	**98**	**134**	**250**	**72**	**108**	**867**

Note: This table removes the surveys that reported the same to/from station

Metromover Expansion

The survey respondents were also asked their opinion on Metromover expansion and if they would like to see another stop added to the Metromover. Surprisingly only 36% (315 people) responded "yes", with a majority of 64% (564 people) responding "no" to the proposed expansion. When questioned further, many of the "no" respondents clarified that they did not see a need for expansion indicating the Metromover serves its purpose well as an urban circulator.

The expansion question had a follow-up for those that responded "yes" to adding another stop. Figure 39 highlights the top responses for expansion ideas.

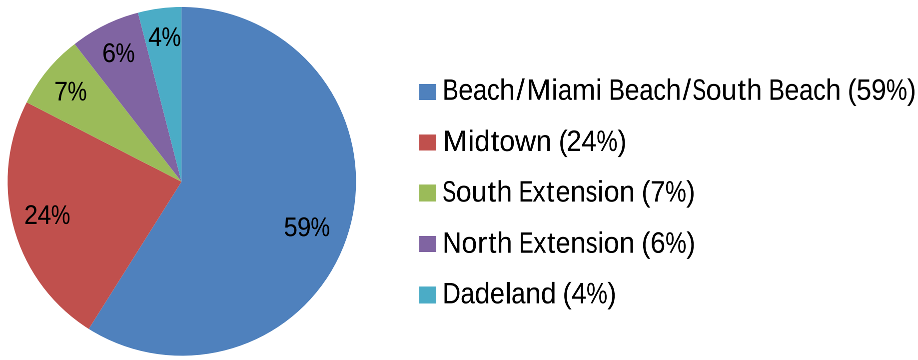

Figure 39: Top Responses for Metromover Expansion

As a reminder, the sampling survey focused on regular commuters that frequently use Metromover. The survey did not capture an event day at either the American Airlines Arena or Marlins Park. If an event or other peak condition day was surveyed, the results may have been dramatically different to this question.

Gender

The gender of the survey respondents was not a separate question, but answered by the surveyor at the survey completion. The results were balanced with 476 males (53%) and 422 females (47%) completing the survey.

4.0 Feasibility Assessment

One of the primary purposes of this MPO study was to identify expansion concept alternatives for the Metromover. A workshop was conducted to facilitate the development of the concept alternatives. The workshop used a charette-style forum to efficiently identify a large number of alternatives in a short period of time. The preliminary concept alternatives were then refined using quantitative and qualitative metrics.

4.1 Workshop

A workshop was held as part of the second SAC meeting to develop alternative concepts. During the workshop the attendees were distributed into small pre-assigned groups. The groups were assembled to provide agency diversity within each group.

Figure 40: SAC Workshop

Each group worked independently to brainstorm concept alternatives. The brainstorming session focused on expansions in four cardinal directions: north, south, east, and west. Over 40 concept alternatives were developed during the workshop. The concept alternatives from the workshop are provided in Appendix D. At the conclusion of the brainstorming exercise each group shared their ideas and discussed the key features, benefits, and challenges of each of the concept alternatives.

4.2 Field Review

Following the workshop, a field review was conducted by Kimley-Horn and MPO staff representatives on April 1, 2014. The team included an APM design engineer from Kimley-Horn that provided a high-level assessment of the constructability and other potential constraints along the proposed routes. The field review team walked and drove the proposed routes to the north, south, east, and west to identify and assess potential infrastructure constraints and obtain a first-hand understanding of the alignment environment. The information gained during the field review was used in the qualitative assessment. The photo log from the field review is included in Appendix E.

4.3 Qualitative Assessment

During the field review several criteria were evaluated and assessed along the proposed routes: infrastructure constraints, geometric constraints, constructability, and the pedestrian environment.

4.3.1 Infrastructure Constraints

Major infrastructure constraints impact the feasibility of the concept alternatives. Large, elevated structures or significant waterways crossings will increase the complexity of the alignment and increase the cost of construction. Infrastructure constraints, such as the Miami River and I-95, exist in many of the preliminary concepts. During the field visit, these constraints were conceptually assessed.

4.3.2 Geometric Constraints

Geometric constraints incorporate constraints such as narrow street widths (Figure 41), a high number of overhead utilities, or other aspects of the route that would require tight radius turns. Tight radius turns increase the complexity of the construction, impact the traveling speed of the Metromover vehicles, and impact passenger comfort. During the field review the routes were reviewed to assess if tight turns were required, or if the alignment was primarily a direct, straight route.

Figure 41: Narrow Street Width

The street right-of-way was visually observed to assess the ability accommodate the routes and in particular the turning radius. The transition points that occur with potential infrastructure constraints were also observed, such as the connection point adjacent to the Miami River crossing. The number of overhead utilities that exist along sections of the route was also observed (Figure 42). For the aerial Metromover routes, overhead utilities will need to be relocated adding to the cost and increasing the expansion complexity.

Figure 42: Overhead Utilities

4.3.3 Constructability

Taking into account the major infrastructure constraints and the overall route environment, a high-level comparison of constructability was assessed for the concept alternatives. With rail crossings, phasing and maintenance of traffic (MOT) could prove challenging and the utility relocations, if required, could be problematic. The density of buildings along routes will also increase the complexity of construction. In contrast the longer linear alignments, with lower density of existing development, lend to a higher constructability.

4.3.4 Pedestrian Friendly Environment

The survey indicated a large majority of people walked to the Metromover stations, so the pedestrian friendly environment was a factor in the evaluation. During the field review, the overall pedestrian environment was observed, taking into account pedestrian features such as decorative crosswalks, visible pedestrians in the area, and wide sidewalks at certain intersections. (Figure 43, Figure 44).

Figure 43: Financial District Station, Pedestrians

The qualitative pedestrian friendly assessment was supplemented with a quantitative assessment as described in the section below.

4.4 Quantitative Assessment

GIS was used to complement the qualitative assessment using quantitative metrics. A variety of metrics were evaluated using GIS data: residential population, residential density, bus ridership, and proposed development. Online walk scores were also reviewed to obtain a quantitative assessment of the pedestrian environment. In addition, high-level order of magnitude costs were developed to provide a comparison between concept alternatives.

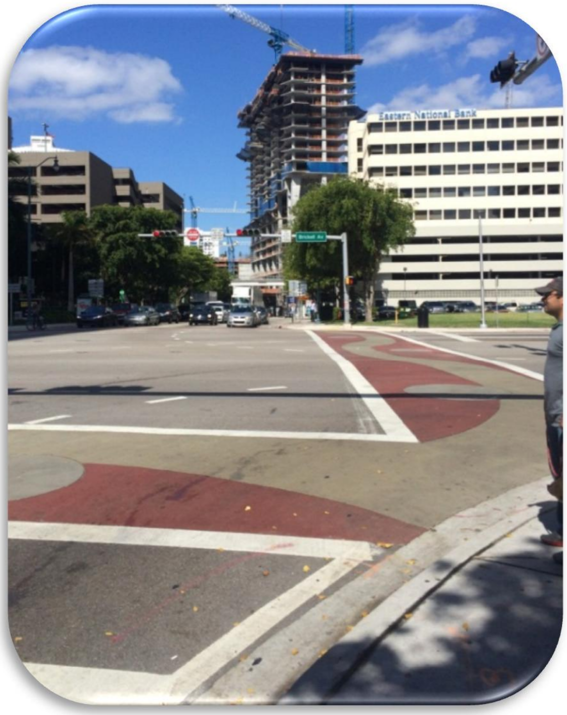

Figure 44: Decorative Crosswalk

4.4.1 Residential Population

The 2010 US Census data was used to evaluate the residential population within 0.15-miles on either side of the proposed Metromover route. Since the survey indicated a large percentage of the Metromover trips were home/work trips, the residential density is a useful evaluation metric for screening the benefits of the proposed Metromover concept alternatives.

To calculate this metric, the total residential population within the 0.15-mile buffer was divided by the proposed route length to determine a normalized population per mile and compare the concept alternatives.

4.4.2 Average Corridor Density

To complement the residential population calculations, an additional calculation on average density was developed. Again, the 2010 US Census data was used to determine the population densities within 0.15-miles on either side of the proposed Metromover route. Then the average density was calculated by averaging all the census block densities along the proposed corridor.

Although average corridor density is also based on population, this metric takes into account the density along the overall corridor. A corridor could have a high population per mile value with one very high population area. The overall rankings are similar to the residential population per mile, but there were slight rank improvements for some of the alternatives when corridor density was assessed.

4.4.3 Bus Ridership

GIS data on the bus boarding and alighting activity was also available. To evaluate this metric, the boarding and alighting activity within 0.25-miles on either side of the corridor were totaled. The total bus ridership was then divided by the proposed corridor length to identify bus ridership per mile. Again, the survey showed a large percentage of people walking to the stations, but there was also a large percent of people that came from bus/rail. For the screening process it was beneficial to evaluate the ability of a concept alternative to provide connections to other transit modes.

4.4.4 Proposed Development

The Miami DDA provided a GIS shapefile that identified proposed and under construction development information within the downtown area. The GIS data included information related to hotel, mixed-use, residential, residential/hotel, and retail development. Evaluating the future development areas benefits the concept alternatives assessment, as the survey identified home/work trips as the primary trip purpose.

4.4.5 Length

GIS was used to approximately calculate the proposed length of each of the Metromover concept alternatives. The length was used to normalize some of the quantitative metrics for a comparative "per-mile" metric.

4.4.6 Walk Score®

To complement the observed pedestrian environment, a walk score numerical value was obtained for the concept alternatives using the Walk Score® website (www.walkscore.com). Walk Score® provides walkability assessments for a variety of communities, including Miami, through the use of a point system. This website provides a public access walkability index assigning a numerical value of 1 to 100 to addresses throughout United States. Table 5 provides an overview of the breakdown used by Walk Score®.

Table 5: Walk Score® Ranges

Walk Score®	Description
90–100	Walker's Paradise Daily errands do not require a car
70–89	Very Walkable Most errands can be accomplished on foot
50–69	Somewhat Walkable Some errands can be accomplished on foot
25–49	Car-Dependent Most errands require a car
0–24	Car-Dependent Almost all errands require a car

Scores are dependent on the availability of walking routes and distances to destinations such as grocery stores, schools, parks, restaurants, and retail areas. Areas with amenities within a five minute walk, approximately ¼-mile, are given maximum points while areas requiring further walk distances with limited amenities are given a lower point score. No points are given to areas with a 30 minute walk time or higher.

Overall, Miami scored an average Walk Score of 76 out of 100 and is considered the 5th most walkable large city in the US, according to WalkScore.com. Data resources used by Walk Score® include Google, Education.com, Open Street Map, the U.S. Census, Localeze, and places added by the Walk Score® user community. The average walk score along the proposed route was calculated and compared between alternatives. To quantify the walkability along each corridor alignment the designated walk scores were collected and averaged for several locations, within a 0.25-mile buffer along each route. Graphics were also generated to map the walk scores along the route.

4.4.7 Relative Capital Costs

For the feasibility assessment, comparative capital costs were developed to rank the concept alternatives. An order of magnitude unit cost per guideway length was developed for standard guideway and difficult/constrained guideway that travels over the freeways and water crossings. Additional costs were added to account for stations, systems, and vehicle costs. Using these budgetary estimates, a relative cost for each concept alternative was determined.

5.0 Concept Alternatives Development

From the 40 workshop alternatives, six concept alternatives were identified with concepts in each of the cardinal directions (Figure 45). The six refined concept alternatives were analyzed in a feasibility assessment completed using both qualitative and quantitative metrics. The qualitative metrics were evaluated during a field review of the refined concept alternatives. This analysis was complemented using a quantitative assessment using GIS data. The assessment for the concept alternatives is summarized below.

Figure 45: Concept Development

5.1 North Concept Alternatives

During the workshop 16 concepts were identified for a north extension. During the initial feasibility assessment and field review, the 16 concepts were refined into two north concepts: North Extension and North Loop.

5.1.1 North Extension Concept Alternative

The first concept alternative is the North Extension shown in Figure 46. The proposed concept extends west from the existing north terminus of the Metromover, the School Board Station. The route travels west along NW 15th Street and then turns right to travel north on NW 2nd Avenue. The route continues north until NW 24th Street where it turns east. The route travels east along NW 24th Street until N. Miami Avenue. At N. Miami Avenue the route turns left to head north until NW 32nd Street. The route continues east along NW 32nd Street until Biscayne Bay where it turns left to head north. The route continues north along Biscayne Boulevard until NE 39th Street where it turns west. The final segment of the route travels west along NE 39th Street until it terminates at the intersection of NE 39th Street and NE 1st Court.

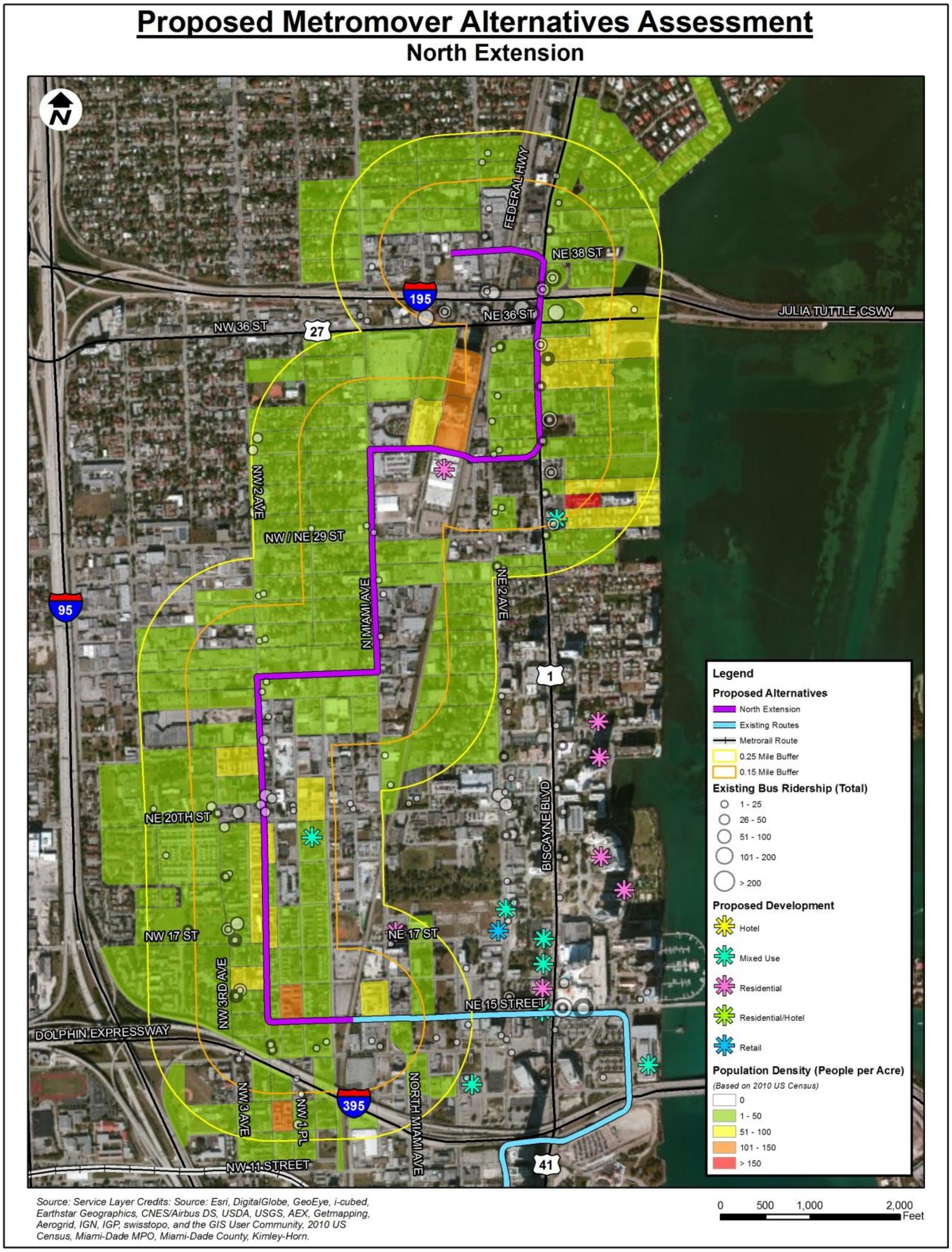

Figure 46: Metromover Concept Alternative, North Extension

Qualitative Assessment

One of the greatest benefits of the North Extension is that it connects several developing areas such as Wynwood, Overtown, Edgewater, Mid-town, the Design District, and other revitalized industrial areas supporting the redevelopment potential of the area. This alignment also provides for the distribution of passengers traveling from other commuter lines: Coastal Link, Tri-Rail, etc. There is even the potential to add a park-n-ride lot at the new north terminus.

However to access these areas, the alignment has three rail crossings (Figure 47) that each require a 25 foot vertical clearance. The rail crossings are surmountable, but are considered an infrastructure constraint. In addition, during the field review narrow streets in some areas were observed with a high number of overhead utilities along certain sections resulting in constructability constraints along this route. Furthermore, the alignment does not provide access to the densest areas along Biscayne Boulevard, since it uses a parallel north route along NW 2nd Avenue.

Figure 47: Rail Crossing Location

As previously mentioned the North Extension provides access to several revitalized industrial areas and would support and enhance the redevelopment potential of the area. In these new areas, such as Wynwood, there exists a great pedestrian environment. However, these areas are connected with areas not as conducive to pedestrians. As additional development occurs, this will improve, but right now there are some sections of the route that are not pedestrian friendly.

The North Extension is a line-haul route, meaning it travels all the way to the north, turns around, and comes back. The survey found the Metromover is used as an urban circulator. The line-haul route does not facilitate circulation as well as other routes.

A summary of the qualitative metrics is provided below:

- Infrastructure Constraints – rail crossings at several locations
- Geometric Constraints – narrow street widths, overhead utilities
- Constructability – challenging MOT with rail crossings, utility relocations required
- Pedestrian Environment – varies throughout route

Quantitative Assessment

GIS was used to obtain the residential population and density within 0.15 miles of either side of the proposed route. Bus ridership and proposed development within 0.25 miles of either side of the proposed route was also identified. The GIS metrics for the North Extension are summarized below.

- Residential Population
  - 8,782 people along 2.59 mile route
  - 3,391 people per mile
- Average Corridor Density
  - 14.2 people per acre
- Bus Ridership
  - 5,877 boardings/alightings along 2.59 mile route
  - 2,269 boardings/alightings per mile

Development

GIS was also used to identify the proposed development along the route. Along the North Extension, there are five major residential developments in the pre-construction phase, under construction or nearing completion within a 0.25-mile buffer of the proposed alignment, adding over 1,500 new residential units. Seven additional developments are planned or have recently been announced that are proposed to add over 1,400 additional residential units, over 59,000 square feet of office and retail space, and 40 additional hotel units. This results in a total of 12 developments along the 2.6 mile route.

Pedestrian Environment

In addition to the high-level qualitative assessment, a quantitative assessment for the pedestrian environment was completed using the Walk Score® website (www.walkscore.com). The walk scores for the North Extension ranged from 71 to 89 with an average score of 82. The average score of 82 was above the Miami City average of 76. A map of the walk scores is provided in Figure 48.

Cost Estimates

Order of magnitude cost estimates were developed for the North Extension. The first component of the cost was the guideway length. This route has the longest length at 2.6 miles. Of the total length, approximately 1,200 feet are considered difficult/constrained guideway that travels over the rail crossings. A unit cost of $15K per foot was assumed for the standard guideway length, and a higher unit cost of $30K per foot was assumed for the difficult/constrained guideway construction. An additional cost for the supporting columns was also added to the guideway estimate.

In addition to the guideway costs, estimates were applied to account for the stations, systems, and vehicle costs. Based on the additional 2.6-mile guideway length, 11 new stations were assumed with a total of 19 new vehicles, including spares. The additional guideway length and new vehicles was assumed to require a new Maintenance Facility, which was also incorporated into the estimate. Other costs include traffic control, the addition of three propulsion power substations, system costs, and other miscellaneous costs. The order magnitude cost for the North Extension was estimated at $760M as summarized in Table 6.

Table 6: Order of Magnitude Cost Estimate, North Extension

Item	Estimated Cost
Guideway Construction	$270,000,000
Station Construction	$82,500,000
Demolition	$14,500,000
Vehicles	$47,500,000
Other System Costs, including Maintenance Facility	$192,500,000
Sub-Total	$607,000,000
25% Contingency and Soft Costs	$151,750,000
Total	$760M

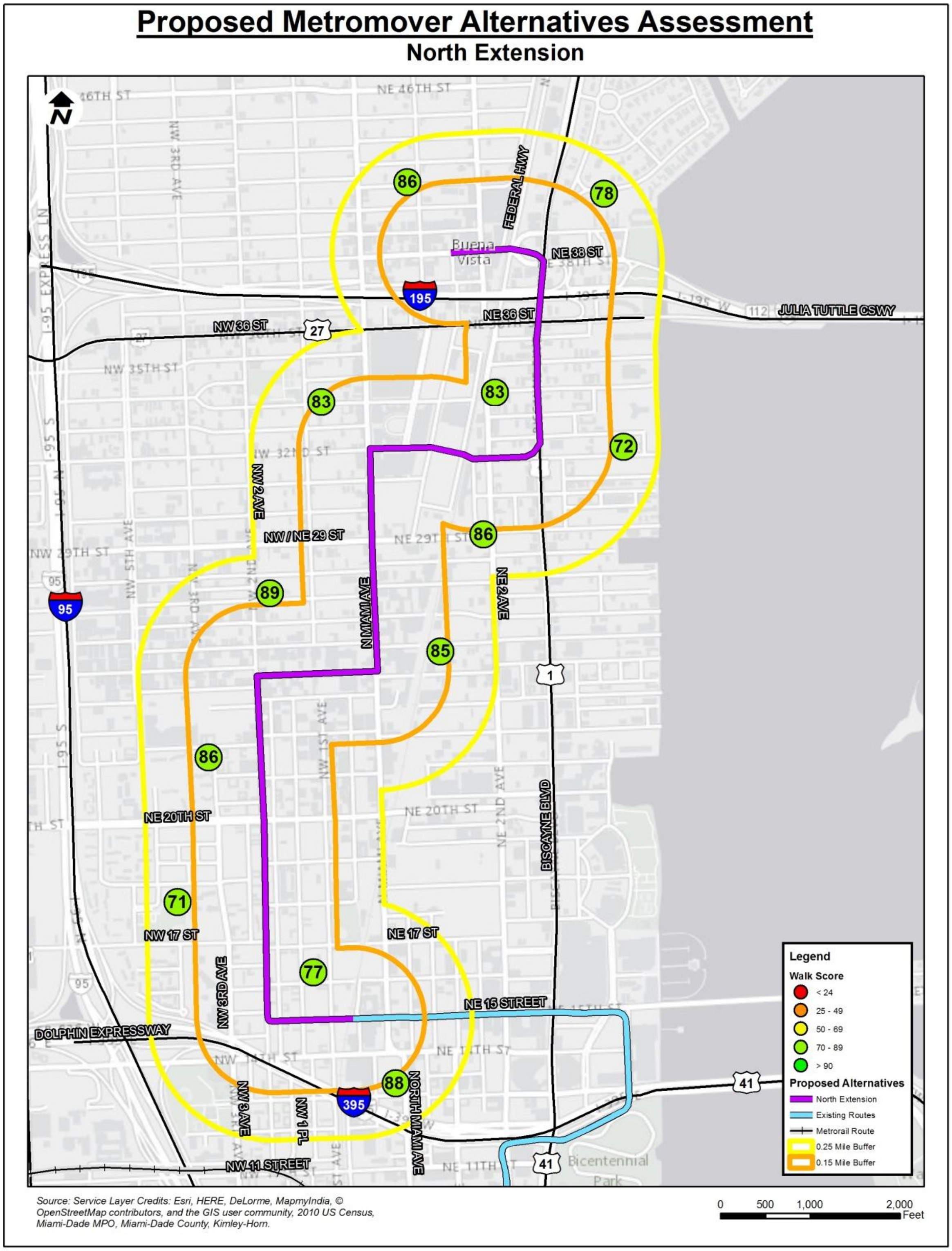

Figure 48: Walk Score® Map, North Extension

In addition to capital costs, there will be an increase in O&M costs associated with the new guideway length and vehicles. A 2011 Peer Review Study[2] provided annual O&M costs data for 2004 through 2010. Using this data, an average, annual operational cost of $4.77M per mile and an average, annual maintenance cost of $2.57M per mile was determined. This results in an average, annual O&M cost of $7.34M per mile. The additional O&M cost for the 2.6-mile proposed extension is estimated to be approximately $19.0M per year based on this O&M estimate.

5.1.2 North Loop Concept Alternative

The second concept alternative is the North Loop, shown in Figure 49. The proposed concept extends west from the existing north terminus of the Metromover, School Board Station. The route travels west along NW 15th Street until NW 2nd Avenue where it turns north. The route travels north on NW 2nd Avenue to NW 20th Street and then heads east. The route continues east along NW 20th Street while it turns into NE 20th Street. Then the route turns right to head south on NE 2nd Avenue, turns left to head east on NE 20th Street, and finally turns right onto sBiscayne Boulevard/US-1. The route travels south and terminates at Biscayne Boulevard/US-1 and NE 15th Street, rejoining with the existing Metromover alignment. An inner loop is also envisioned to provide additional circulation within the region.

Quantitative Assessment

The North Loop will not extend as far north as the North Extension, but it does provide access to Biscayne Boulevard. The North Loop extends the existing north terminus of Metromover to additional markets and can provide access to revitalized industrial areas, supporting the redevelopment potential of the area. The proposed route also provides a complementary path for planned transit along a portion of Biscayne Boulevard.

The North Loop allows for the addition of an inner loop to facilitate circulation within the area. This flexibility will facilitate the circulator trends observed in the Metromover survey.

[2] *An Analysis of Miami-Dade Transit's Operating Cost Efficiency; Volume One, Peer Review,* Center for Urban Transportation Research, November 7, 2011

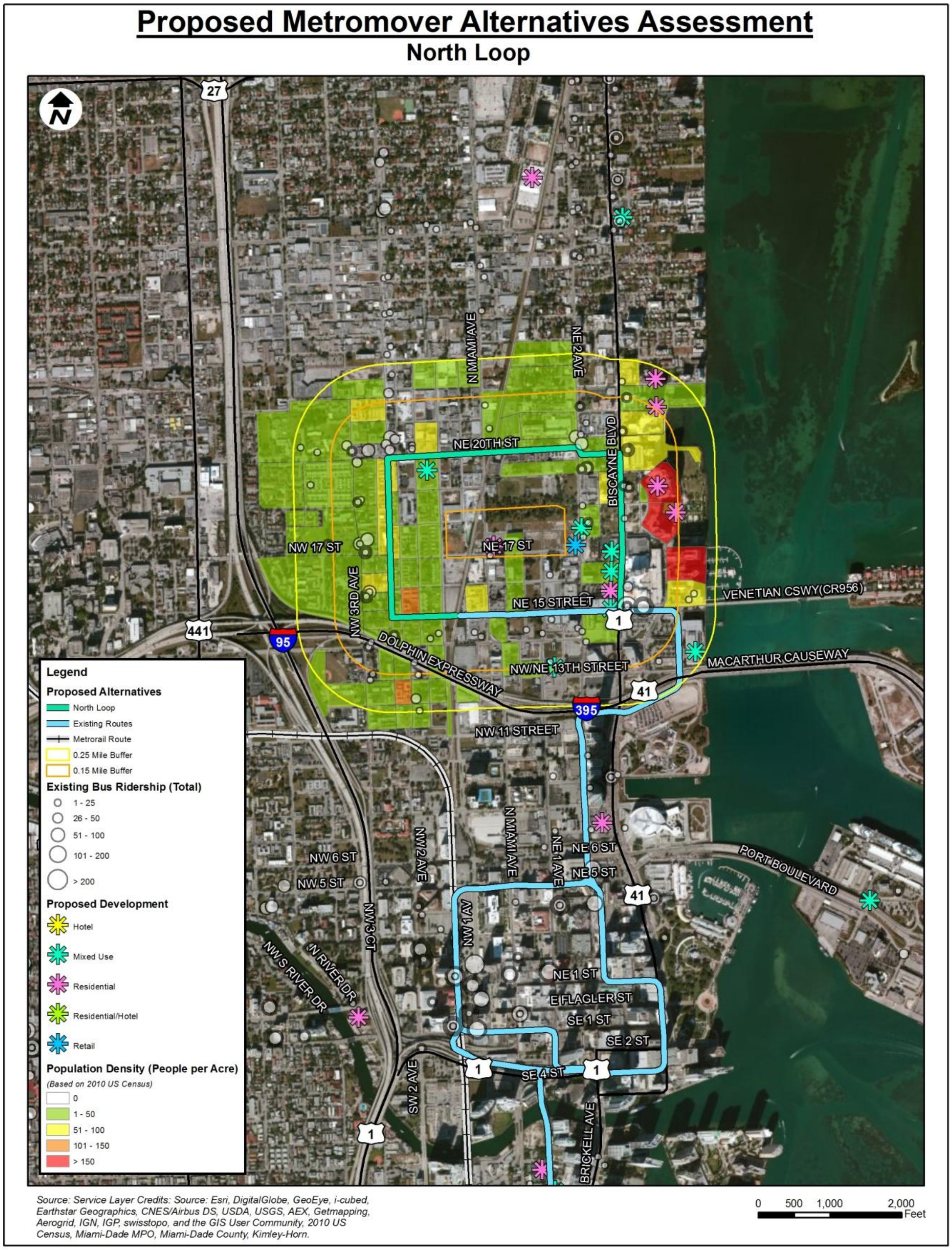

Figure 49: Metromover Concept Alternative, North Loop

Like the North Extension, there are rail crossings required for the North Loop, which will require the same 25-foot vertical clearance. Narrow streets and a high number of overhead utilities exist along certain sections and portions of the western side of the route have a questionable pedestrian environment. In addition, the “closure” of the loop immediately west of the Adrienne Arsht Center Metromover Station may be challenging.

A summary of the qualitative metrics for the North Loop is provided below:

- Infrastructure Constraints – rail crossings at locations
- Geometric Constraints – narrow street widths, overhead utilities
- Constructability – challenging MOT with rail crossings, utility relocations required
- Pedestrian Environment – varies along the route, western side of route questionable

Quantitative Assessment

GIS was used to obtain the residential population and density within 0.15 miles of either side of the proposed route. Bus ridership and proposed development within 0.25 miles of either side of the proposed route was also identified. The GIS metrics for the North Loop are summarized below.

- Residential Population
  - 8,096 people along 1.63 mile route
  - 4,967 people per mile
- Average Corridor Density
  - 20.36 people per acre
- Bus Ridership
  - 7,768 boardings/alightings along 1.63 mile route
  - 4,766 boardings/alightings per mile

Development

Along the North Loop, there are 12 major developments planned or under construction within the 0.25-mile buffer of the proposed route. These developments add over 8,000 new residential units, over 1.3 million square feet of office and retail space, and over 200 new hotel units. More than half of these developments will also be served by the existing Omni Loop Metromover route.

Pedestrian Environment

In addition to the high-level qualitative assessment, a quantitative assessment for the pedestrian environment was completed using the Walk Score® website (www.walkscore.com). The walk scores for the North Loop ranged from 71 to 92 with an average score of 85. The average score of 85 was above the Miami City average of 76. A map of the walk scores is provided in Figure 50.

Cost Estimates

Order of magnitude cost estimates were developed for the North Loop. The first component of the cost was the guideway length. This route has a length of 1.6 miles. Of the total length, approximately 800 feet are considered difficult/constrained guideway that travels over the rail crossings. A unit cost of $15K per foot was assumed for the standard guideway length, and a higher unit cost of $30K per foot was assumed for the difficult/constrained guideway construction. An additional cost for the supporting columns was also added to the guideway estimate.

In addition to the guideway costs, estimates were applied to account for the stations, systems, and vehicle costs. Based on the additional 1.6-mile guideway length, 7 new stations were assumed with a total of 13 new vehicles, including spares. The additional guideway length and new vehicles was assumed to require a new Maintenance Facility, which was also incorporated into the estimate. Other costs include traffic control, the addition of two propulsion power substations, system costs, and other miscellaneous costs. The order magnitude cost for the North Loop was estimated at $520M as summarized in Table 7.

Table 7: Order of Magnitude Cost Estimate, North Loop

Item	Estimated Cost
Guideway Construction	$188,000,000
Station Construction	$52,500,000
Demolition	$13,500,000
Vehicles	$32,500,000
Other System Costs, including Maintenance Facility	$125,000,000
Sub-Total	$411,500,000
25% Contingency and Soft Costs	$102,875,000
Total	$520M

In addition to capital costs, there will be an increase in O&M costs associated with the new guideway length and vehicles. A 2011 Peer Review Study[3] provided annual O&M costs data for 2004 through 2010. Using this data, an average, annual operational cost of $4.77M per mile and an average, annual maintenance cost of $2.57M per mile was determined. This results in an average, annual O&M cost of $7.34M per mile. The additional O&M cost for the 1.6-mile proposed extension is estimated to be approximately $12.0M per year based on this O&M estimate.

5.1.3 North Concept Comparisons

The qualitative factors are similar for both the North Extension and North Loop, with rail crossings and overhead utilities existing along both routes. However, the North Loop has a higher density than North Extension because the route accesses the higher density areas along Biscayne Boulevard. This results in approximately the same population draw for both alternatives, but with a significantly lower length (1.63 miles) for the North Loop generating a much higher population per mile for the North Loop. Also, transit ridership is approximately 50% higher for the North Loop. As such, the North Loop is the preferred north concept.

[3] *An Analysis of Miami-Dade Transit's Operating Cost Efficiency; Volume One, Peer Review,* Center for Urban Transportation Research, November 7, 2011

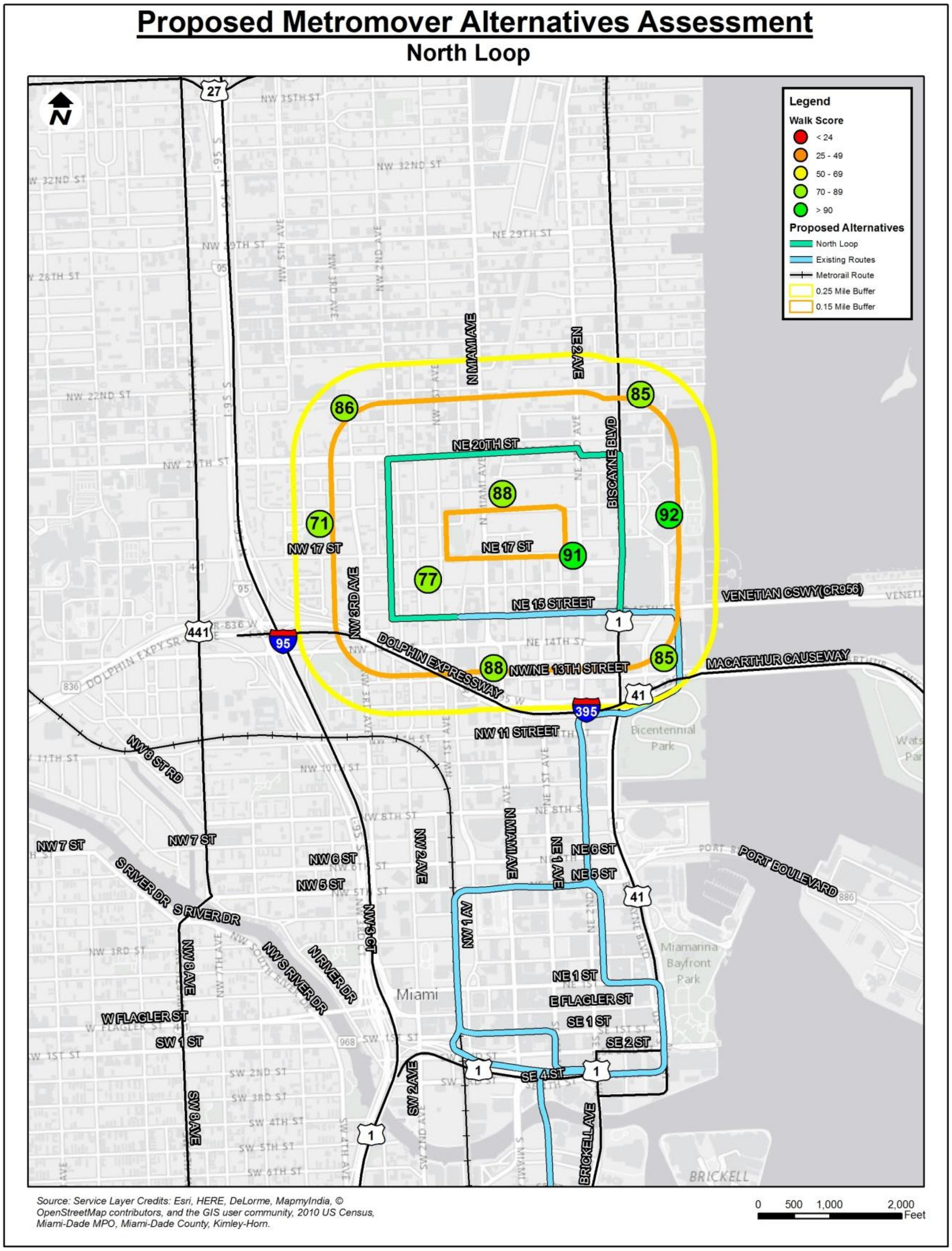

Figure 50: Walk Score® Map, North Loop

5.2 South Concept Alternatives

During the workshop nine concepts were identified for a south extension. During the initial feasibility assessment and field review, the nine concepts were refined into two south concepts: South Extension and South Loop.

5.2.1 South Extension Concept Alternative

The next concept alternative is the South Extension shown in Figure 51. The proposed concept extends east from the existing south terminus of the Metromover, the Financial District Station. The route travels east along SW 14th Street to Brickell Avenue/US-1where it turns south. The route travels south along Brickell Avenue/US-1 until it reaches its termination at Brickell Avenue/US-1 and SE 26th Road.

Qualitative Assessment

There are no major infrastructure constraints along the South Extension. Furthermore, the South Extension is primarily a linear route that appears to have sufficient right-of-way along its extent. Due to this linear alignment with minimal curves, it is anticipated to be the most constructible concept alternative.

The South Extension provides additional service for high ridership areas in the South Zone as noted in the survey and serves the dense residential areas around Brickell. The South Extension provides a potential connection to Viscaya Metrorail Station, however the route may create a duplication of planned trolley routes.

A summary of the qualitative metrics for the South Extension is provided below:

- Infrastructure Constraints – no major infrastructure constraints
- Geometric Constraints – no major geometric constraints
- Constructability – highly constructible route
- Pedestrian Environment – pedestrian friendly route

Figure 51: Metromover Concept Alternative, South Extension

Quantitative Assessment

GIS was used to obtain the residential population and density within 0.15 miles of either side of the proposed route. We Bus ridership and proposed development within 0.25 miles of either side of the proposed route was also identified. The GIS metrics for the South Extension are summarized below.

- Residential Population
    - 13,332 people along 1.01 mile route
    - 13,200 people per mile
- Average Corridor Density
    - 39.14 people per acre
- Bus Ridership
    - 363 boardings/alightings along 1.01 mile route
    - 359 boardings/alightings per mile

Development

Along the South Extension, there are six major residential and mixed-use developments in the pre-construction phase, under construction, or nearing completion within a 0.25-mile buffer of the proposed route. These developments add over 1,900 new residential units, around 10,000 square feet of retail space, and over 130 new hotel units. Five additional developments are planned or have recently been announced that propose to add over 1,700 additional residential units, over 930,000 square feet of office and retail space, and 470 additional hotel units. All of the 11 proposed, planned, or announced developments are located at the northern end of the proposed route.

Pedestrian Environment

In addition to the high-level qualitative assessment, a quantitative assessment for the pedestrian environment was completed using the Walk Score® website (www.walkscore.com). The walk scores for the South Extension ranged from 52 to 83 with an average score of 69. The average score of 69 was below the Miami City average of 76. A map of the walk scores is provided in Figure 52.

Cost Estimates

Order of magnitude cost estimates were developed for the South Extension. The first component of the cost was the guideway length. This route has a length of 1.0 miles. There are no major infrastructure constraints along this route and the alignment is generally linear, so a unit cost of $15K per foot for the standard guideway was assumed for construction. An additional cost for the supporting columns was also added to the guideway estimate.

In addition to the guideway costs, estimates were applied to account for the stations, systems, and vehicle costs. Based on the additional 1.0-mile guideway length, 4 new stations were assumed with a total of 7 new vehicles, including spares. The additional guideway length and new vehicles was assumed to require a new Maintenance Facility, which was also incorporated into the estimate. Other costs include traffic control, the addition of two propulsion power substations, system costs, and other miscellaneous costs. The order magnitude cost for the South Extension was estimated at $310M as summarized in Table 8.

Table 8: Order of Magnitude Cost Estimate, South Extension

Item	Estimated Cost
Guideway Construction	$106,000,000
Station Construction	$30,000,000
Demolition	$7,500,000
Vehicles	$17,500,000
Other System Costs, including Maintenance Facility	$80,000,000
Sub-Total	$241,000,000
25% Contingency and Soft Costs	$60,250,000
Total	$310M

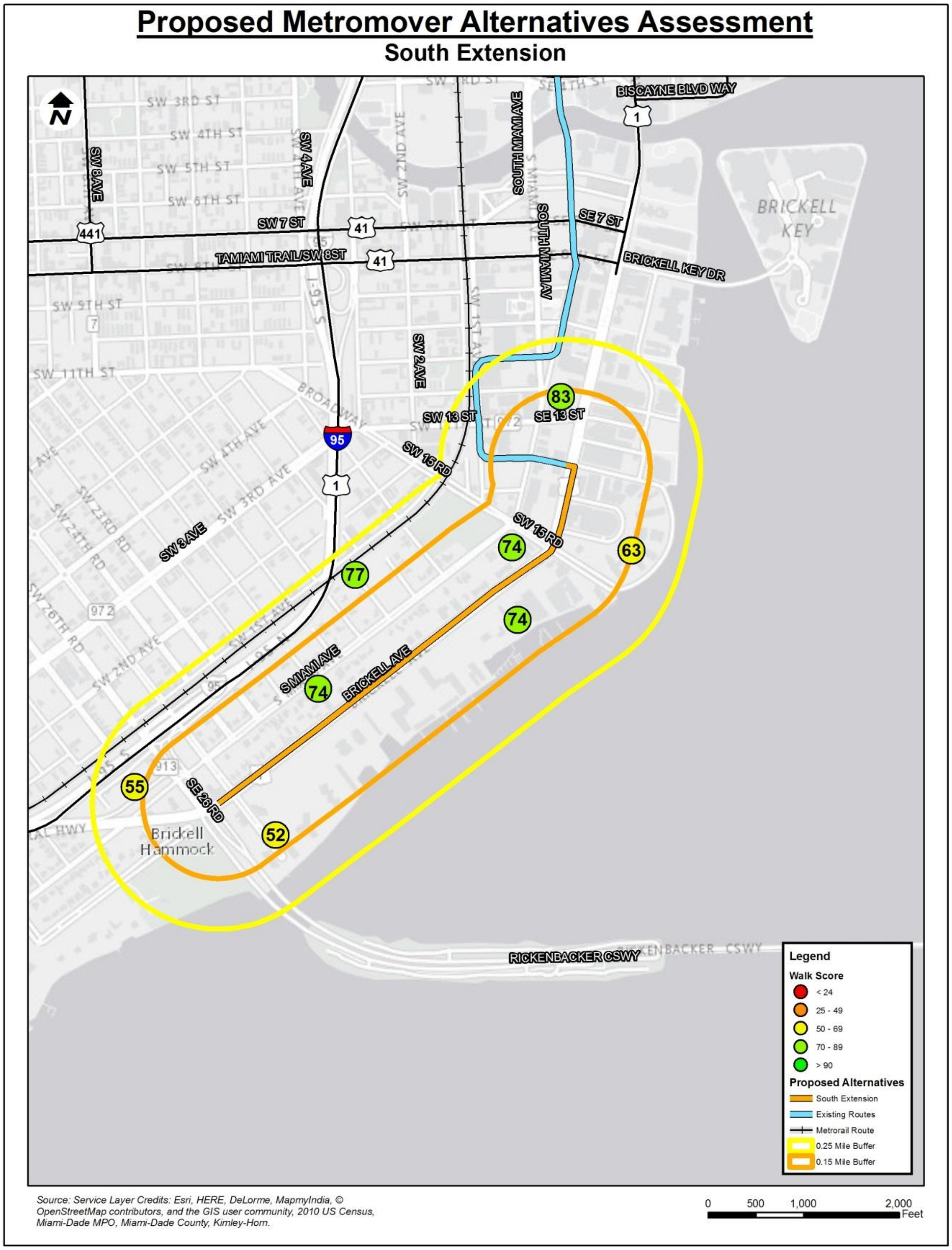

Figure 52: Walk Score® Map, South Extension

In addition to capital costs, there will be an increase in O&M costs associated with the new guideway length and vehicles. A 2011 Peer Review Study[4] provided annual O&M costs data for 2004 through 2010. Using this data, an average, annual operational cost of $4.77M per mile and an average, annual maintenance cost of $2.57M per mile was determined. This results in an average, annual O&M cost of $7.34M per mile. The additional O&M cost for the 1.0-mile proposed extension is estimated to be approximately $7.4M per year based on this O&M estimate.

5.2.2 South Loop Concept Alternative

The second south concept alternative is the South Loop shown in Figure 54. The proposed concept extends east from the existing south terminus of the Metromover, the Financial District Station. The route travels east along SW 14th Street to Brickell Bay Drive. At Brickell Bay Drive, the route travels north to SE 8th Street/Carlos Arboleya Boulevard, where it then turns west. The route then continues west along SE 8th Street/Carlos Arboleya until it reaches SE 1st Street and terminates at the Eight Street Metromover Station. The South Loop also includes an inner loop that provides additional circulation within the zone.

Qualitative Assessment

The South Loop offers a shorter extension length of 0.77 miles, but provides additional service for the denser residential areas with the high ridership noted within the survey. In particular the high "in zone" connections observed within the South Zone are facilitated. The South Loop also provides an interface with Brickell Key.

Figure 53: Brickell Bay Drive

There exist some tight radius turns, but the wider streets are anticipated to accommodate the turns. Specifically, Brickell Bay Drive provides on-street parking and a wide arterial for a potential route (Figure 53). The density of the buildings along corridor will increase the complexity of

[4] *An Analysis of Miami-Dade Transit's Operating Cost Efficiency; Volume One, Peer Review,* Center for Urban Transportation Research, November 7, 2011

Figure 54: Metromover Concept Alternative, South Loop

construction; but the shorter expansion length will reduce the costs. With the exception of the buildings, there are no major infrastructure constraints along the route.

The area is a very pedestrian friendly environment. There were a large number of pedestrians observed during the field review. Brickell offers large, decorative crosswalks and wide sidewalks in many areas.

A summary of the qualitative metrics for the South Loop is provided below:

- Infrastructure Constraints – no major infrastructure constraints
- Geometric Constraints – tight radius turns required
- Constructability –building density increases construction complexity
- Pedestrian Environment – pedestrian friendly route

Quantitative Assessment

GIS was used to obtain the residential population and density within 0.15 miles of either side of the proposed route. Bus ridership and proposed development within 0.25 miles of either side of the proposed route was also identified. The GIS metrics for the South Loop are summarized below.

- Residential Population
  - 11,572 people along 0.77 mile route
  - 15,029 people per mile
- Average Corridor Density
  - 41.54 people per acre along 0.77 mile route
- Bus Ridership
  - 2,609 boardings/alightings along 0.77 mile route
  - 3,388 boardings/alightings per mile

Development

There are over ten major residential and mixed-use developments in the pre-construction phase, under construction, or nearing completion within a 0.25-mile buffer of the proposed South Loop route. These developments add over 3,500 new residential units, over 770,000 square feet of office and retail space, and over 350 new hotel units. Six additional developments are planned or have recently been announced that propose to add over 2,400 additional residential units, over 100,000 square feet of office and retail space, and 200 additional hotel units. This results in a total of 16 developments along the 0.77 mile route.

Pedestrian Environment

In addition to the high-level qualitative assessment, a quantitative assessment for the pedestrian environment was completed using the Walk Score® website (www.walkscore.com). The walk scores for the South Loop ranged from 63 to 89 with an average of 79. The average score of 79 was above the Miami City average of 76. A map of the walk scores is provided in Figure 55.

Cost Estimates

Order of magnitude cost estimates were developed for the South Loop. The first component of the cost was the guideway length. This route has a length of 0.77 miles. There are no major infrastructure constraints along this route and a unit cost of $15K per foot for the standard guideway was applied. An additional cost for the supporting columns was also added to the guideway estimate.

In addition to the guideway costs, estimates were applied to account for the stations, systems, and vehicle costs. Based on the additional 0.77-mile guideway length, 3 new stations were assumed with a total of 5 new vehicles, including spares. Because of the limited guideway length and number of vehicles a new Maintenance Facility was not anticipated as a part of this estimate. Other costs include traffic control, the addition of one propulsion power substation, system costs, and other miscellaneous costs. The order magnitude cost for the South Loop was estimated at $260M as summarized in Table 9.

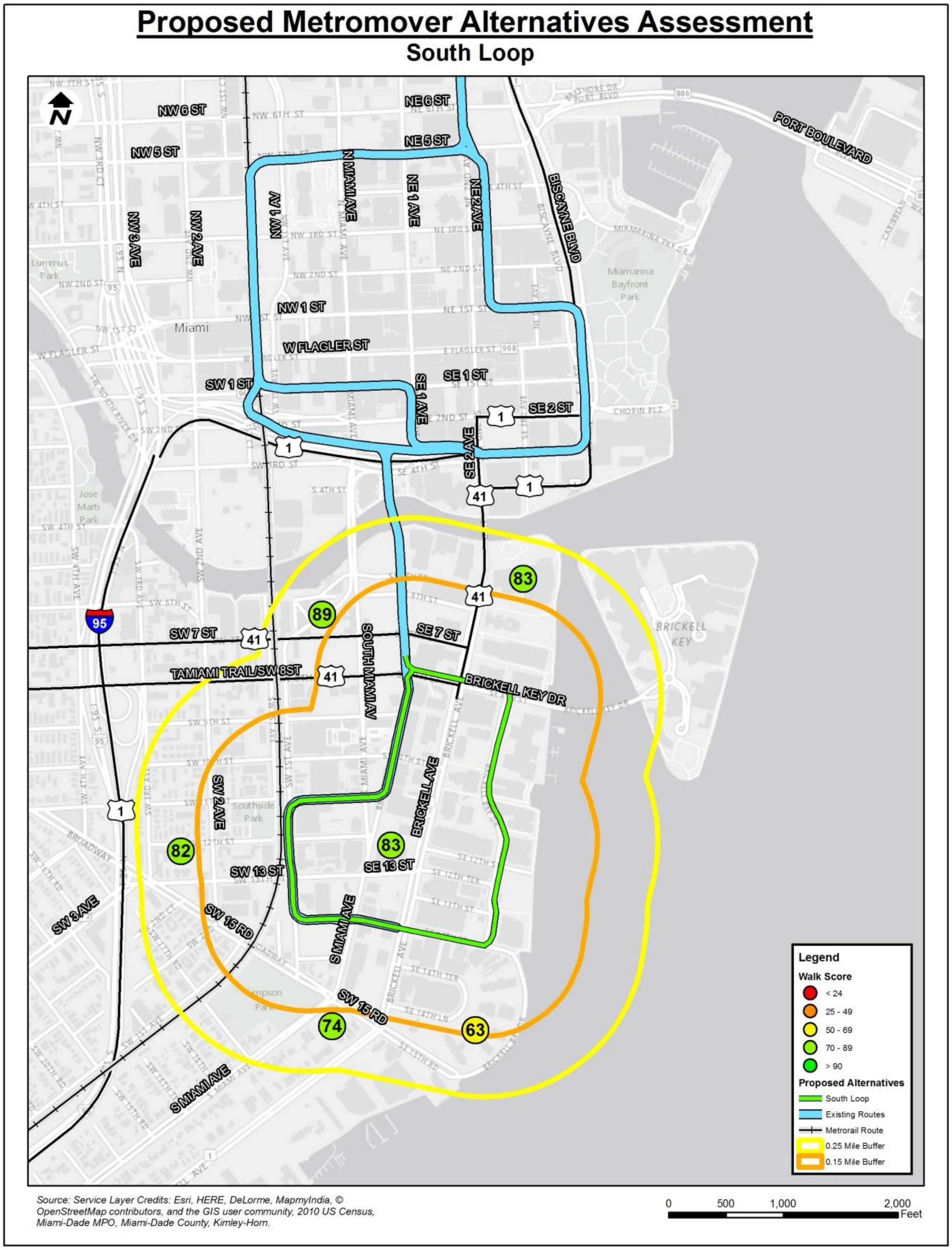

Figure 55: Walk Score® Map, South Loop

Table 9: Order of Magnitude Cost Estimate, South Loop

Item	Estimated Cost
Guideway Construction	$96,500,000
Station Construction	$22,500,000
Demolition	$9,500,000
Vehicles	$12,500,000
Other System Costs, including Maintenance Facility	$66,000,000
Sub-Total	$207,000,000
25% Contingency and Soft Costs	$51,750,000
Total	$260M

In addition to capital costs, there will be an increase in O&M costs associated with the new guideway length and vehicles. A 2011 Peer Review Study[5] provided annual O&M costs data for 2004 through 2010. Using this data, an average, annual operational cost of $4.77M per mile and an average, annual maintenance cost of $2.57M per mile was determined. This results in an average, annual O&M cost of $7.34M per mile. The additional O&M cost for the 0.77-mile proposed extension is estimated to be approximately $5.6M per year based on this O&M estimate.

5.2.3 South Concept Comparisons

The South Loop has the second highest population total, but when divided by the length has the highest population per mile of all the alternatives. In addition, the South Loop has the highest average density. The South Loop is also the shortest length extension with no major infrastructure constraints, resulting in a lower estimated cost. As such, the South Loop is the preferred south concept.

5.3 East Concept Alternative

During the workshop ten concepts were identified for an east extension. During the initial feasibility assessment and field review, the ten concepts were refined into one east concept, East Extension (Figure 56). The proposed route begins at the Metrorail Overtown Station. The route travels east along NW 6th Street until it reaches Port Boulevard. It continues east along Port Boulevard until it terminates mid-port at Panarama Way.

[5] *An Analysis of Miami-Dade Transit's Operating Cost Efficiency; Volume One, Peer Review,* Center for Urban Transportation Research, November 7, 2011

Figure 56: Metromover Concept Alternative, East Extension

5.3.1 Qualitative Assessment

The East Extension connects to the Overtown Metrorail station and provides additional distribution from Metrorail. The concept also supports PortMiami Development Plans and provides a connection for cruise passengers, employees, and future development. However, this route provides no penetration of Miami Beach.

The East Extension is a linear route that appears to have sufficient right-of-way, but there are infrastructure challenges with crossing the Intracoastal Waterway. This connection may require bridge upgrades to accommodate the Metromover system. In addition, significant, if not all, portions of the route may require high elevations to cross existing infrastructure.

Regarding the pedestrian environment, the west and central sections of the route are pedestrian friendly, with areas like Bayside and the American Airlines Arena. But the eastern portions on Port Property become less pedestrian friendly.

Because the East Extension does not connect to the existing Metromover stations or use the existing guideway, there is an option for independent technology (i.e. shuttle). Because of this independence, questions remain as to the most feasible technology option. For example, light rail vehicles may be a more feasible option for this route.

A summary of the qualitative metrics for the East Extension is provided below:

- Infrastructure Constraints – major infrastructure constraints at the Intracoastal Waterway
- Geometric Constraints – high elevations required to cross the Intracoastal Waterway
- Constructability – Intracoastal Waterway increases construction complexity
- Pedestrian Environment – pedestrian environment varies along route

5.3.2 Quantitative Assessment

GIS was used to obtain the residential population and density within 0.15 miles of either side of the proposed route. Bus ridership and proposed development within 0.25 miles of either side of the proposed route was also identified. The GIS metrics for the East Extension are summarized below.

- Residential Population

- 2,833 people along 1.73 mile route
- 1,638 people per mile

- Average Corridor Density
    - 10.60 people per acre
- Bus Ridership
    - 3,147 boardings/alightings along 1.73 mile route
    - 1,819 boardings/alightings per mile

Development

There are three new residential and mixed use developments in the pre-construction or planning phase within 0.25-mile buffer of the proposed alignment, projected to add over 2,000 new residential units. Five additional developments are planned or have recently been announced that are projected to add over 500,000 square feet of conference space, and over 1,900 additional hotel units. This results in a total of eight developments along the 1.7 mile route.

Pedestrian Environment

In addition to the high-level qualitative assessment, a quantitative assessment for the pedestrian environment was completed using the Walk Score® website (www.walkscore.com). The walk scores for the East Extension ranged from 29 to 86 with an average of 82. The average score of 82 was above the Miami City average of 76. A map of the walk scores is provided in Figure 57.

Cost Estimates

Order of magnitude cost estimates were developed for the East Extension. The first component of the cost was the guideway length. This route has a length slightly over 1.7 miles. Of the total length, approximately 3,700 feet are considered difficult/constrained guideway that travels over the infrastructure constraints such as the Intracoastal Waterway. A unit cost of $15K per foot was assumed for the standard guideway length, and a higher unit cost of $30K per foot was assumed for the difficult/constrained guideway construction. An additional cost for the supporting columns was also added to the guideway estimate.

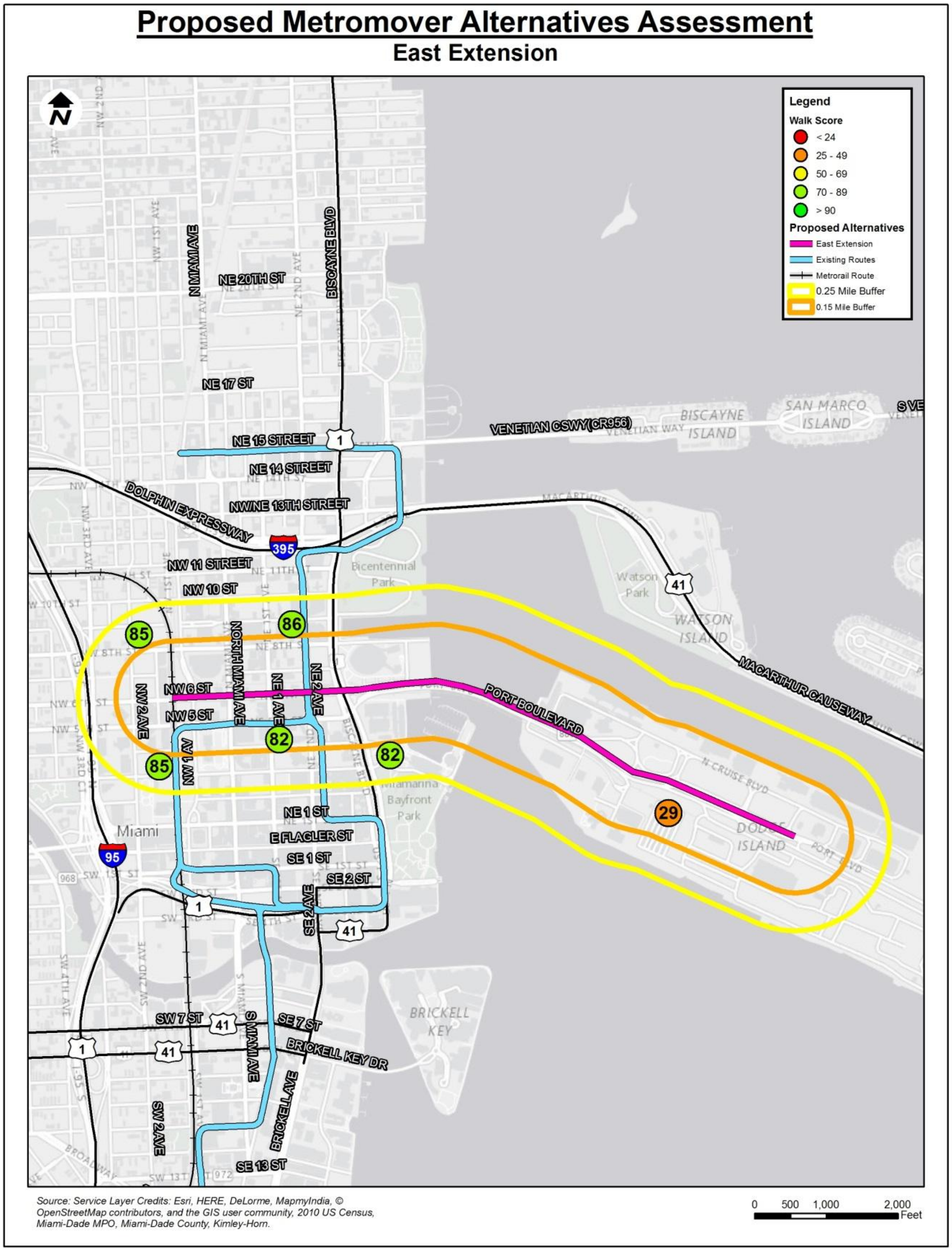

Figure 57: Walk Score® Map, East Extension

In addition to the guideway costs, estimates were applied to account for the stations, systems, and vehicle costs. Based on the additional 1.7-mile guideway length, 8 new stations were assumed with a total of 14 new vehicles, including spares. The additional guideway length and new vehicles was assumed to require a new Maintenance Facility, which was also incorporated into the estimate. Other costs include traffic control, the addition of two propulsion power substations, system costs, and other miscellaneous costs. The order magnitude cost for the East Extension was estimated at $560M as summarized in Table 10.

Table 10: Order of Magnitude Cost Estimate, East Extension

Item	Estimated Cost
Guideway Construction	$214,500,000
Station Construction	$60,000,000
Demolition	$8,000,000
Vehicles	$35,000,000
Other System Costs, including Maintenance Facility	$126,000,000
Sub-Total	$443,500,000
25% Contingency and Soft Costs	$110,875,000
Total	$560M

In addition to capital costs, there will be an increase in O&M costs associated with the new guideway length and vehicles. A 2011 Peer Review Study[6] provided annual O&M costs data for 2004 through 2010. Using this data, an average, annual operational cost of $4.77M per mile and an average, annual maintenance cost of $2.57M per mile was determined. This results in an average, annual O&M cost of $7.34M per mile. The additional O&M cost for the 1.7-mile proposed extension is estimated to be approximately $12.6M per year based on this O&M estimate.

[6] *An Analysis of Miami-Dade Transit's Operating Cost Efficiency; Volume One, Peer Review,* Center for Urban Transportation Research, November 7, 2011

5.4 West Concept Alternatives

During the workshop five concepts were identified for a west extension. During the initial feasibility assessment and field review, the five concepts were refined into one west concept, West Extension.

The proposed West Extension begins on NW 1st Street using the east/west platform at Government Center (Figure 58). The route travels west along NW 1st Street, crossing both I-95 and the Miami River. After crossing the river, the route continues onto W. Flagler Street until NW 14th Avenue. At NW 14th Avenue the route turns north and terminates at Marlins Park located at NW 14th Avenue and NW 4th Street. Figure 59 illustrates the West Extension concept.

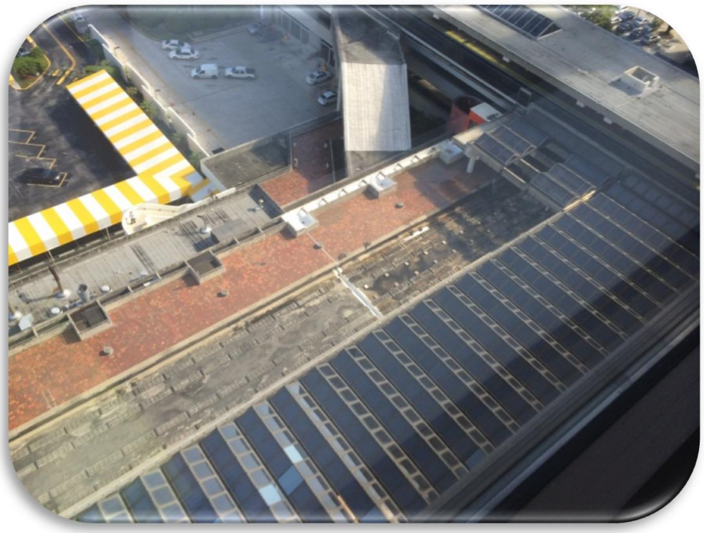

Figure 58: Government Center East/West Platform

5.4.1 Qualitative Assessment

The West Extension provides a connection to Marlins Park, although the stadium would not be the only station/connection. The route follows a heavy ridership bus route (Flagler Street), and a Metromover expansion along this route provides an alternative transit means for the corridor. The route also extends the Metromover into western areas of Miami-Dade County. In addition, the new connection over the Miami River would provide an alternative route over the river.

For the West Extension there are significant challenges with the I-95 and Miami River crossings. In particular, the Miami River crossing is narrow, but will require a high clearance to allow ships to pass. This may result in a large elevation change over a short distance – steep guideway grades that exceed design standards. In addition, the touch down point on the west side of the Miami River may have right-of-way impacts and geometric constraints exist. The alignment at the river crossing does not follow the arterial street network so right-of-way impacts are anticipated.

Figure 59: Metromover Concept Alternative, West Extension

Similar to the East Extension, the West Extension has an option for an independent line. However, this too leads to technology feasibility questions. Similar to the East Extension, light rail vehicles may be a more feasible option, especially if major sections of the route operate at-grade.

A summary of the qualitative metrics for the West Extension is provided below:

- Infrastructure Constraints –major infrastructure constraints at Miami River and I-95
- Geometric Constraints – connection west of Miami River has challenges
- Constructability – difficult due to infrastructure constraints and right-of-way
- Pedestrian Environment – pedestrian environment varies along route

5.4.2 Quantitative Assessment

GIS was used to obtain the residential population and density within 0.15 miles of either side of the proposed route. Bus ridership and proposed development within 0.25 miles of either side of the proposed route was also identified. The GIS metrics for the West Extension are summarized below.

- Residential Population
  - 10,863 people along 1.69 mile route
  - 6,428 people per mile
- Average Corridor Density
  - 27.37 people per acre
- Bus Ridership
  - 24,620 boardings/alightings along 1.7 mile route
  - 14,568 boardings/alightings per mile

Development

Along the West Extension, there is one new residential development, in the pre-construction phase within a 0.25-mile buffer of the proposed route. This residential development is projected to add 100 new residential units. Five additional developments are planned or have recently been announced that project to add over 2,000 additional residential units, over 500,000 square feet of conference space, and over 1,900 additional hotel units. This results in a total of six developments along the route.

Pedestrian Environment

In addition to the high-level qualitative assessment, a quantitative assessment for the pedestrian environment was completed using the Walk Score® website (www.walkscore.com). The walk scores for the West Extension ranged from 34 to 89 with an average of 69. The average score of 69 was below the Miami City average of 76. A map of the walk scores is provided in Figure 60.

Cost Estimates

Order of magnitude cost estimates were developed for the West Extension. The first component of the cost was the guideway length. This route has a length slightly over 1.7 miles. Of the total length, approximately 1,500 feet are considered difficult/constrained guideway that travels over the infrastructure constraints such as the Miami River and I-95. A unit cost of $15K per foot was assumed for the standard guideway length, and a higher unit cost of $30K per foot was assumed for the difficult/constrained guideway construction. An additional cost for the supporting columns was also added to the guideway estimate.

In addition to the guideway costs, estimates were applied to account for the stations, systems, and vehicle costs. Based on the additional 1.7-mile guideway length, 7 new stations were assumed with a total of 12 new vehicles, including spares. The additional guideway length and new vehicles was assumed to require a new Maintenance Facility, which was also incorporated into the estimate. Other costs include traffic control, the addition of two propulsion power substations, system costs, and other miscellaneous costs. The order magnitude cost for the West Extension was estimated at $520M as summarized in Table 11.

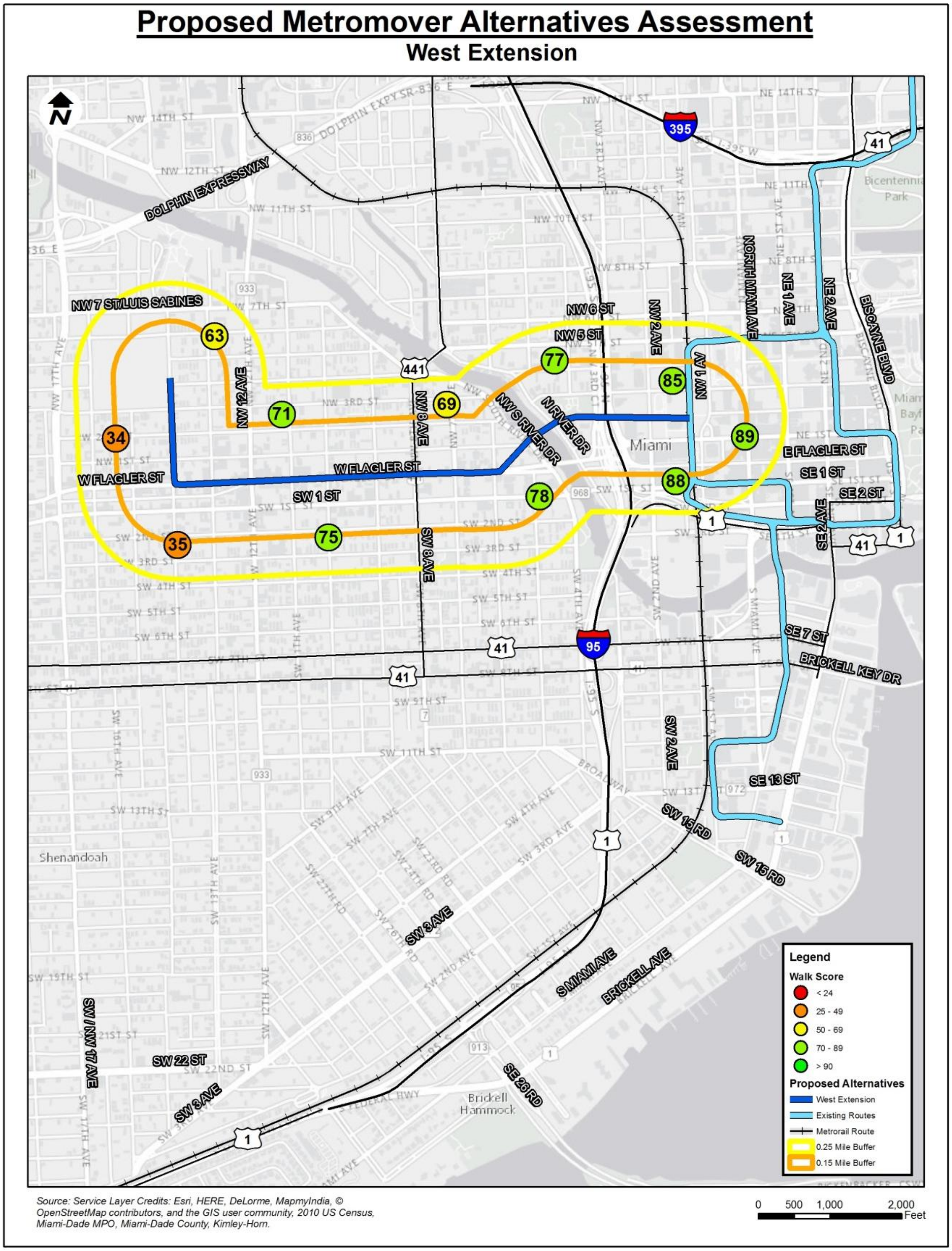

Figure 60: Walk Score® Map, West Extension

Table 11: Order of Magnitude Cost Estimate, West Extension

Item	Estimated Cost
Guideway Construction	$191,500,000
Station Construction	$52,500,000
Demolition	$10,500,000
Vehicles	$30,000,000
Other System Costs, including Maintenance Facility	$126,500,000
Sub-Total	$411,000,000
25% Contingency and Soft Costs	$102,750,000
Total	$520M

In addition to capital costs, there will be an increase in O&M costs associated with the new guideway length and vehicles. A 2011 Peer Review Study[7] provided annual O&M costs data for 2004 through 2010. Using this data, an average, annual operational cost of $4.77M per mile and an average, annual maintenance cost of $2.57M per mile was determined. This results in an average, annual O&M cost of $7.34M per mile. The additional O&M cost for the 1.7-mile proposed extension is estimated to be approximately $12.4M per year based on this O&M estimate.

5.5 Metromover Expansion Master Plan

From the initial screening of the six alternatives an overall Metromover Master Plan was developed summarizing the preferred route to the north, south, east, and west (Figure 61). The Metromover Master Plan represents the ultimate vision for the expansion of the system. The Master Plan adds 5.8 miles of guideway to the current Metromover system, resulting in a total system length 10.2 miles and making Metromover the largest urban APM system in the US. The corresponding order of magnitude cost estimate for implementing the Master Plan is estimated at $1.9B. An additional O&M estimate of $42.6M per year is estimated based on the guideway length added to the system.

[7] *An Analysis of Miami-Dade Transit's Operating Cost Efficiency; Volume One, Peer Review,* Center for Urban Transportation Research, November 7, 2011

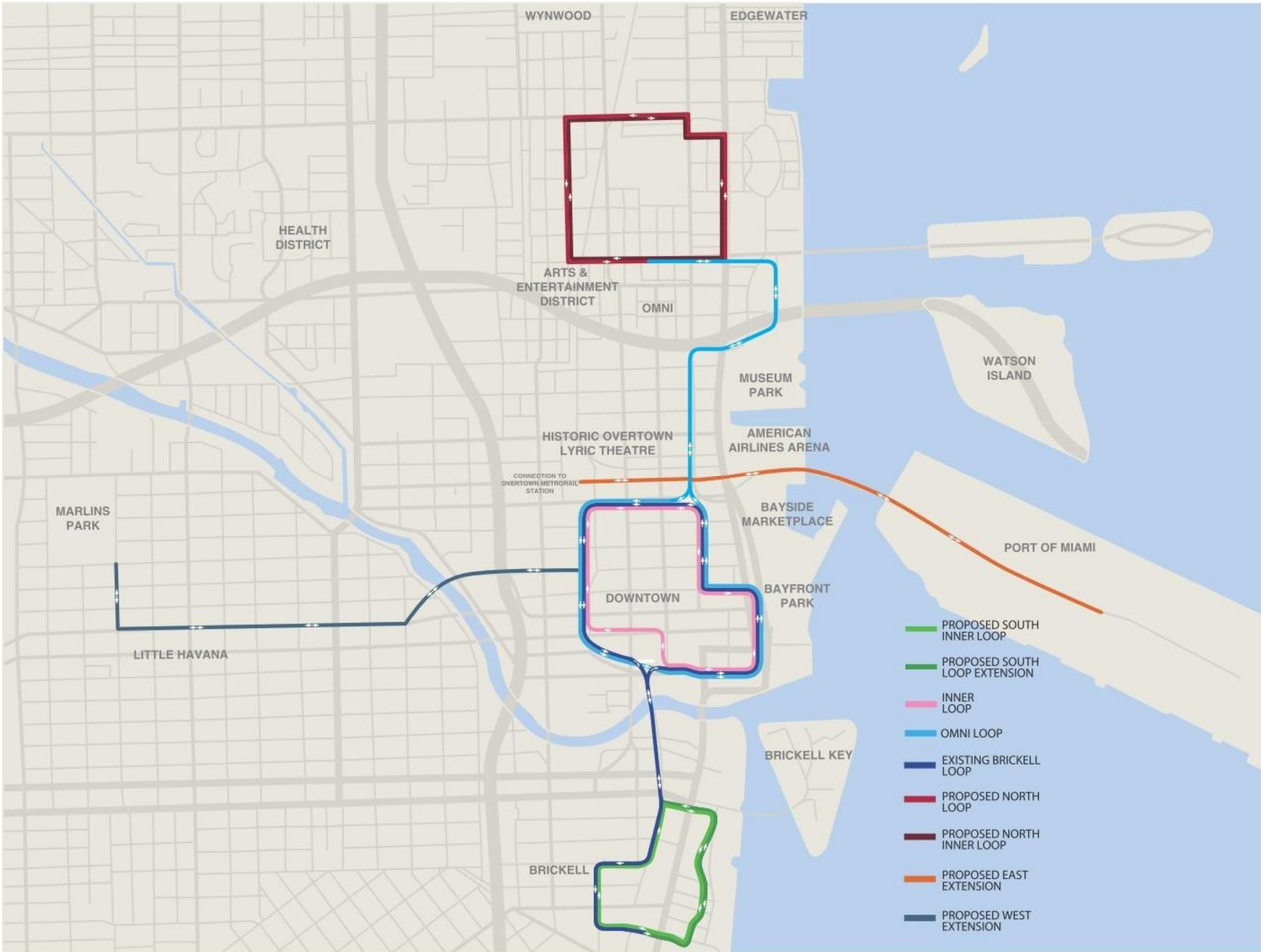

Figure 61: Metromover Expansion Master Plan

The Master Plan presents an ultimate vision, but it is not likely that all options can be built simultaneously so the concepts need to be prioritized to identify a feasible short-term expansion option. The four expansion concept alternatives were screened and prioritized taking into account the qualitative and quantitative aspects. The screening process and refined expansion plan are discussed in the following chapter, 6.0 Refined Expansion Plan.

6.0 Refined Expansion Plan

6.1 Screening Matrix

To assess the concept alternatives from the Metromover Master Plan (Figure 61) a matrix was developed taking into account both the qualitative and quantitative aspects of each concept. The evaluation ranked the concept alternatives at a high-level. The screening matrix is provided in Table 12.

The screening matrix assesses each of the metrics on a one through five scale; five being the best or most preferred ranking, and one being the lowest or least preferred ranking. The qualitative metrics were scaled and ranked by the APM design engineer that conducted the field review. The quantitative metrics were ranked in relation to the highest noted value:

- 0 – 20% of highest value was assigned one,
- 20 – 40% assigned a value of two,
- 40 – 60% assigned a value of three,
- 60 – 80% assigned a value of four, and
- 80 – 100% assigned a value of five.

Each of the values within the screening matrix offers a comparison between alternatives. In some instances there may be a wide range between values. For example, the bus ridership per mile for the West Extension was over 14,500 daily boardings and alightings per mile. The next highest route, the North Loop, had only 4,700 daily boardings and alightings per mile, or 33% of the maximum. As such, the West Extension had value of five for bus ridership and the North Loop had a value of two for bus ridership.

Two slight variations to the above assignment of scores were the relative capital costs and the walk scores. The capital costs were ranked in comparison to the highest cost (i.e. most expensive) but were assigned inverse scores, with a value of one assigned to costs within 80-100 percent of the maximum. The walk scores fell within a close range with a highest average walk score of 85 and a lowest average walk score of 69. The percentages were calculated based on where the average walk score for the individual route stood within the 16 point spread (85 – 69) to determine the assigned value.

Each metric was also assigned a weight. The metrics were broken down into two classifications. The "benefit" classification captured metrics that would benefit their respective corridors. The "constraint" classification captured challenges that exist for each concept alternative. Each metric was assigned a weight so that the benefits and constraints each accounted for approximately 50% of the total weight. The metric assignment and the individual weights are summarized in Table 12.

Table 12: Screening Matrix

Metrics	Concept Alternatives: South Loop[1]	North Loop	West Extension	East Extension	Metric Classification	Weight
Proposed Length (miles)	0.77	1.63	1.69	1.73		
Quantitative Metrics						
Relative Capital Costs[2]	3	1	1	1	Constraint	25%
Population/Mile[3]	5	2	2	1	Benefit	5%
Average Corridor Density[4]	5	2	3	1	Benefit	5%
Bus Ridership/Mile[5]	1	2	5	1	Benefit	5%
Proposed Development	5	4	2	3	Benefit	5%
Pedestrian Environment[6]	4	5	1	2	Benefit	5%
Qualitative Metrics						
Infrastructure Constraints	4	3	1	2	Constraint	7.5%
Geometric Constraints	4	2	3	5	Constraint	7.5%
Constructability	4	3	1	1	Constraint	10%
Total Weighted Points	2.75	1.68	1.30	1.28		
Ranking	**1**	**2**	**3**	**4**		

Notes:
1 - The length includes only the new loop of 0.77 miles. The total loop length is 1.47 miles.
2 - The relative costs evaluate high-level, order of magnitude costs between alternatives and assigned inverse scores.
3 - GIS analysis on population within 0.15 miles of corridor and normalized for length of proposed alternative.
4 - GIS analysis on average density along the corridor, calculated by averaging the densities within a 0.15-mile buffer of the proposed corridor.
5 - GIS analysis on the bus boarding and alighting activity within 0.25 miles of the corridor.
6 – Based on average Walk Score® along route from walkscore.com

6.2 Summary of Preferred Screening Concept

Based on the screening matrix (Table 12) the South Loop is the preferred short-term concept alternative. This concept alternative closes the south loop to form a counter-clockwise loop that connects at the 8th Street Metromover Station. This concept also adds an inner loop that travels clockwise, providing additional circulation within the area. Figure 62 illustrates the South Loop concept in relation to the existing Metromover lines.

The South Loop concept alternative provides the most benefit with the least constraints, and was thus selected for refinement. The refinement process was initiated in a meeting with MDT to discuss the system impacts. Then an analysis was completed to provide a high-level operational simulation. Finally, the concept alternative was refined to identify approximate station locations and general alignment.

6.3 System Impacts

The Metromover was initially installed in 1986. If significant extensions are implemented with a high-number of additional vehicles, system improvements will be required. First, a new maintenance facility would be required to handle the additional vehicles. In addition, the train control system may require updates with extensive guideway additions. If new equipment is added, integration costs to upgrade the old equipment would also be required.

To better understand the potential system impacts related to the Metromover expansion, a meeting was held on May 13, 2014 with an MDT operations representative. During this meeting the concept alternatives were presented and discussed. In addition, the screening of the concept alternatives was presented.

MDT anticipated that the existing Metromover

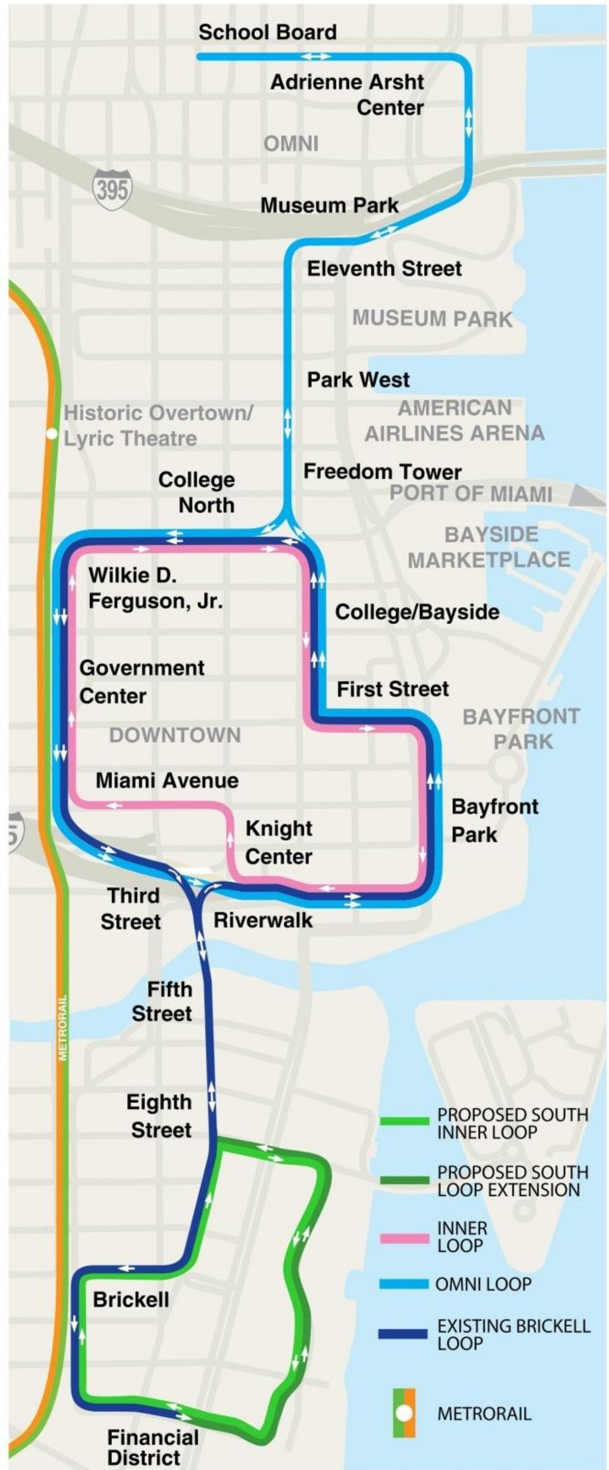

Figure 62: Preferred Concept Alternative

maintenance facility and train control system could accommodate the shorter length of additional guideway and the small number of additional vehicles associated with the South Loop. This significantly increases the viability of the South Loop for implementation in the short or medium term, as this concept alternative does not rely on large Metromover system upgrades. However, the reliance on the existing technology will make the expansion tied to the existing technology vendor (Bombardier). Longer-term there may be issues with system obsolescence.

6.4 Concept Refinement

As part of the concept refinement, potential stations were identified along the route. Three additional stations are anticipated and are illustrated in Figure 63. The approximate station location was determined based on the existing station spacing as well as communicated transportation needs within the area. Station A in close proximity to the 8th Street Metromover station will facilitate a transfer point between the inner and outer loops. Synergies may also be gained with the Brickell CitiCenter development currently under construction. Station B provides a station close to Brickell Key. The MPO has received numerous requests for additional transit options to Brickell Key, and the proposed Station B would accommodate that request. Station C provides an additional station to connect to southern Brickell destinations. Finally Station D is the existing Financial District Station. All proposed station locations are approximate and will be refined during the future design.

In addition to station placement, the turning radii were confirmed. The minimum turning radius that exists within the existing Metromover alignment is 100 feet. The graphic below illustrates the approximate alignment with a 100-foot turning radius along the new, conceptual alignment.

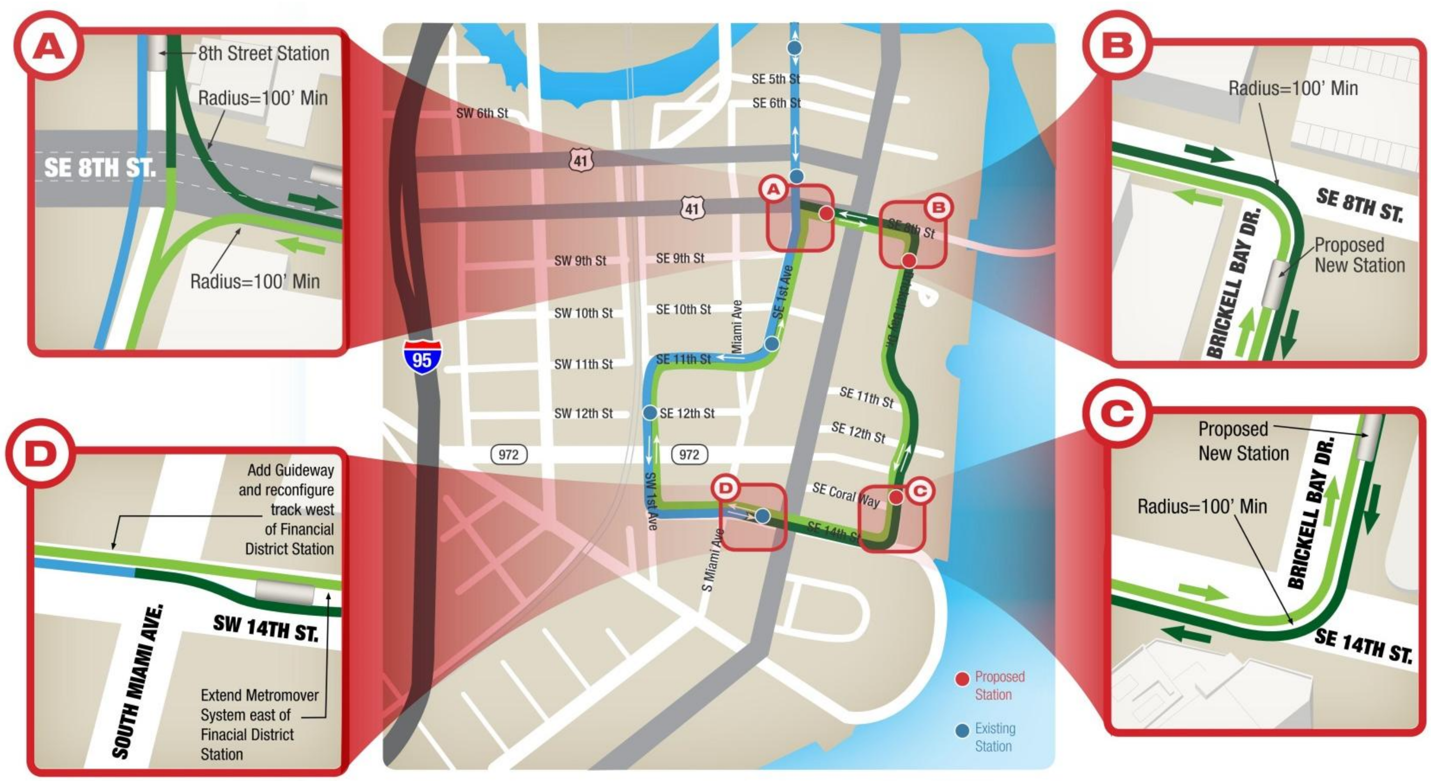

Figure 63: Refined Metromover Concept

One of the benefits of an aerial system like the Metromover is the minimal footprint required for guideway construction. Several cross sections are provided below illustrating concepts for constructing the APM guideway within the existing, public right-of-way. The level of detail within the cross sections is commensurate with this conceptual planning study and additional detail will be established during future design.

Cross Section 1 (Figure 64) shows a split pier support to accommodate the diverging guideway to the north and south. The existing street level view of Cross Section 1 is shown in Figure 65. As shown in Figure 66 there is available sidewalk that can accommodate the column supports.

Cross Section 2 is also illustrated in Figure 64 and uses a single pier support that can be implemented further east as the guideways converge. The single pier support is similar to the supports that exist along the SE 1st Avenue (Figure 67).

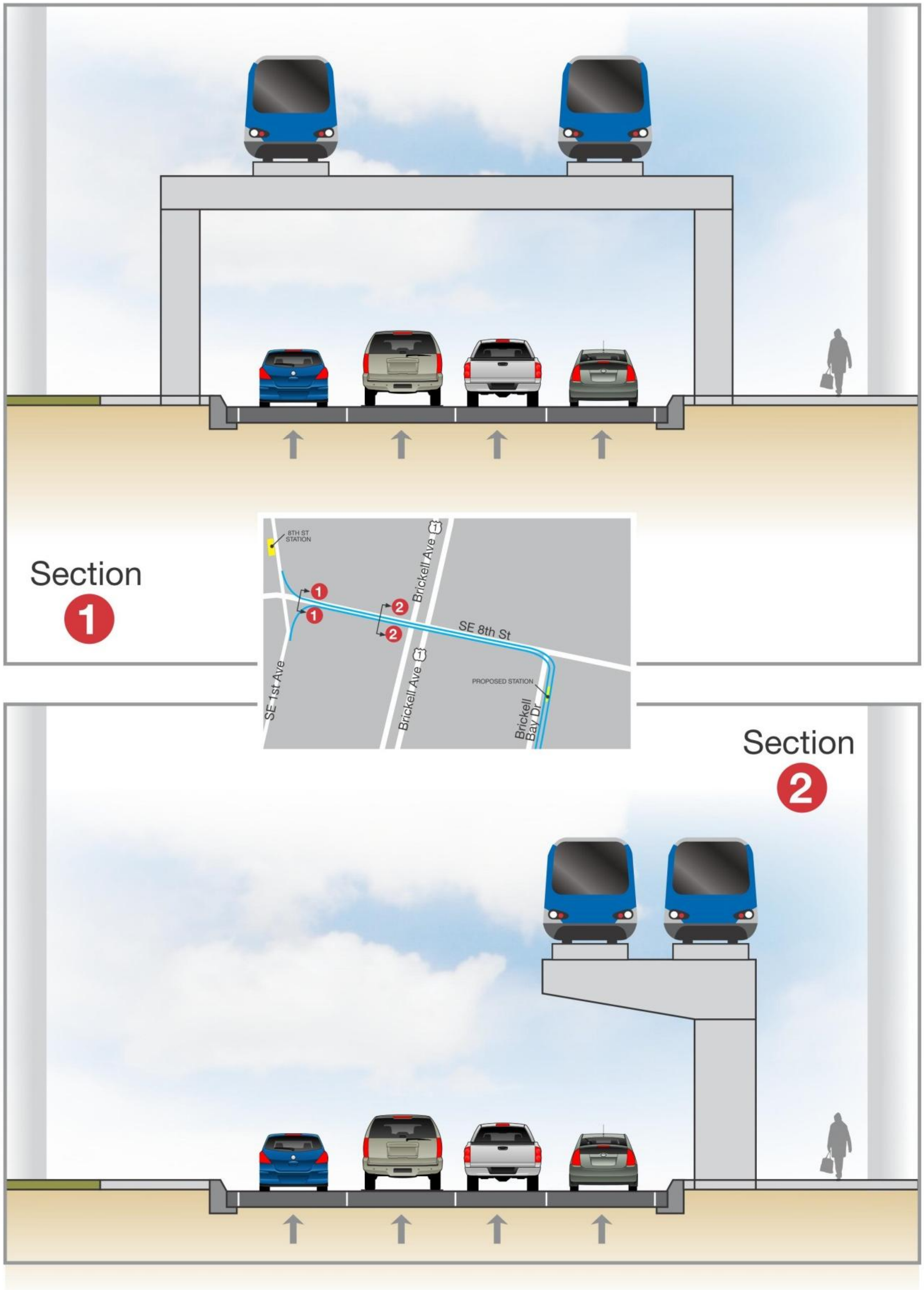

Figure 64: Cross Sections 1 and 2

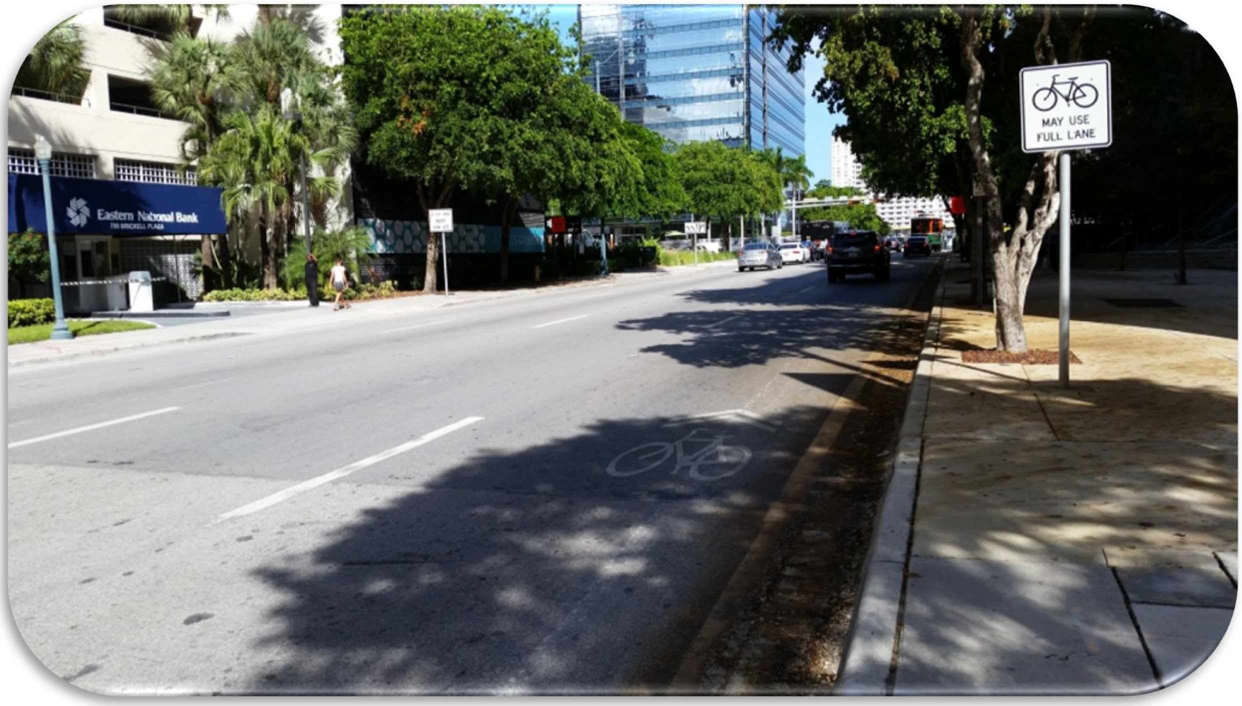

Figure 65: Existing Street View, Cross Section 1

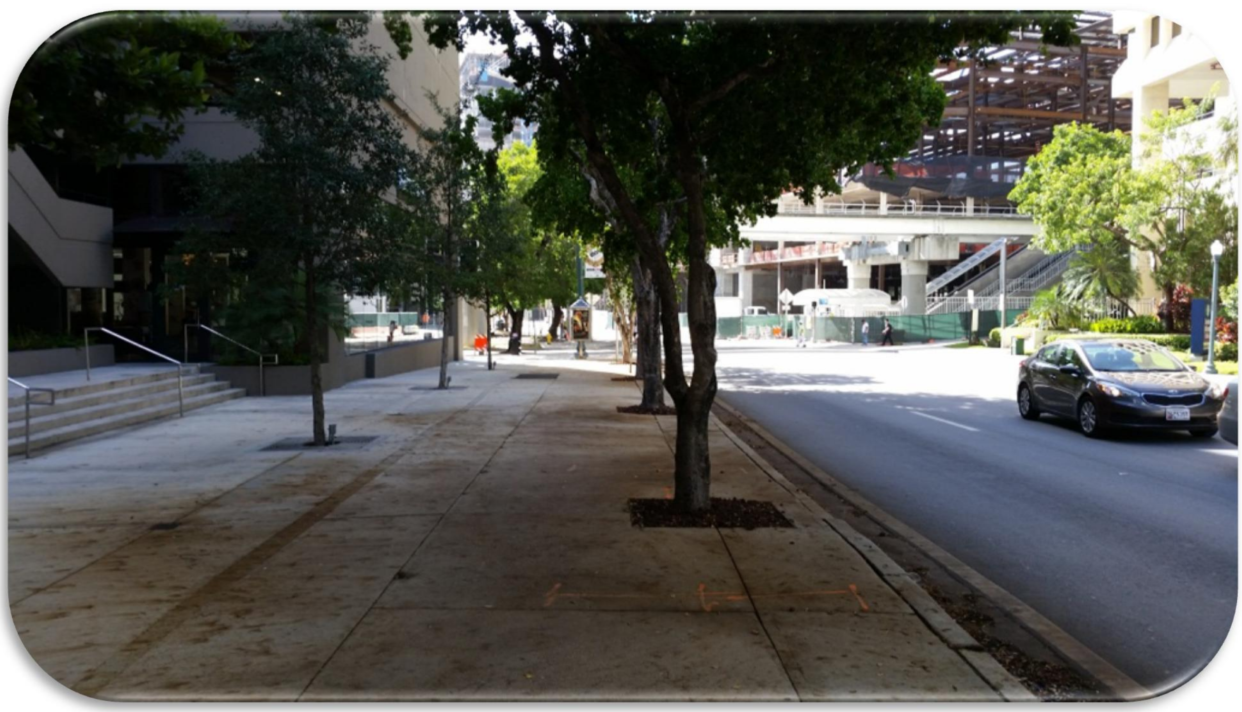

Figure 66: Available Sidewalk, SE 8th Street

Figure 67: Existing Single Pier Support, SE 1st Avenue

Along SE 8th Street east of Brickell Avenue there exists a shade canopy on an existing building (Figure 68, Figure 69) requiring a split pier support in Cross Section 3 (Figure 70). The split pier support takes advantage of the existing, raised median. Once the shade canopy is cleared, the guideway supports can transition back to single pier and use the available, expansive sidewalks (Figure 71).

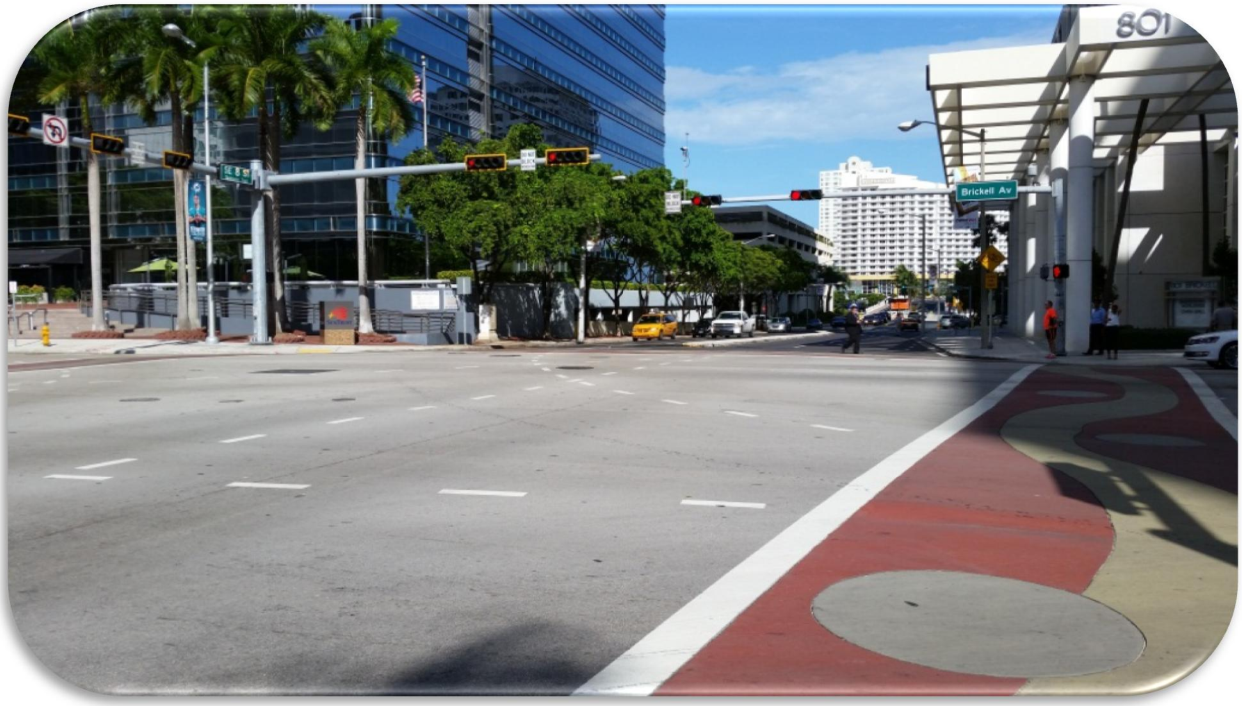

Figure 68: Existing Building Shade Canopy, SE 8th Street East of Brickell Avenue

Figure 69: Existing Shade Canopy and Available Median

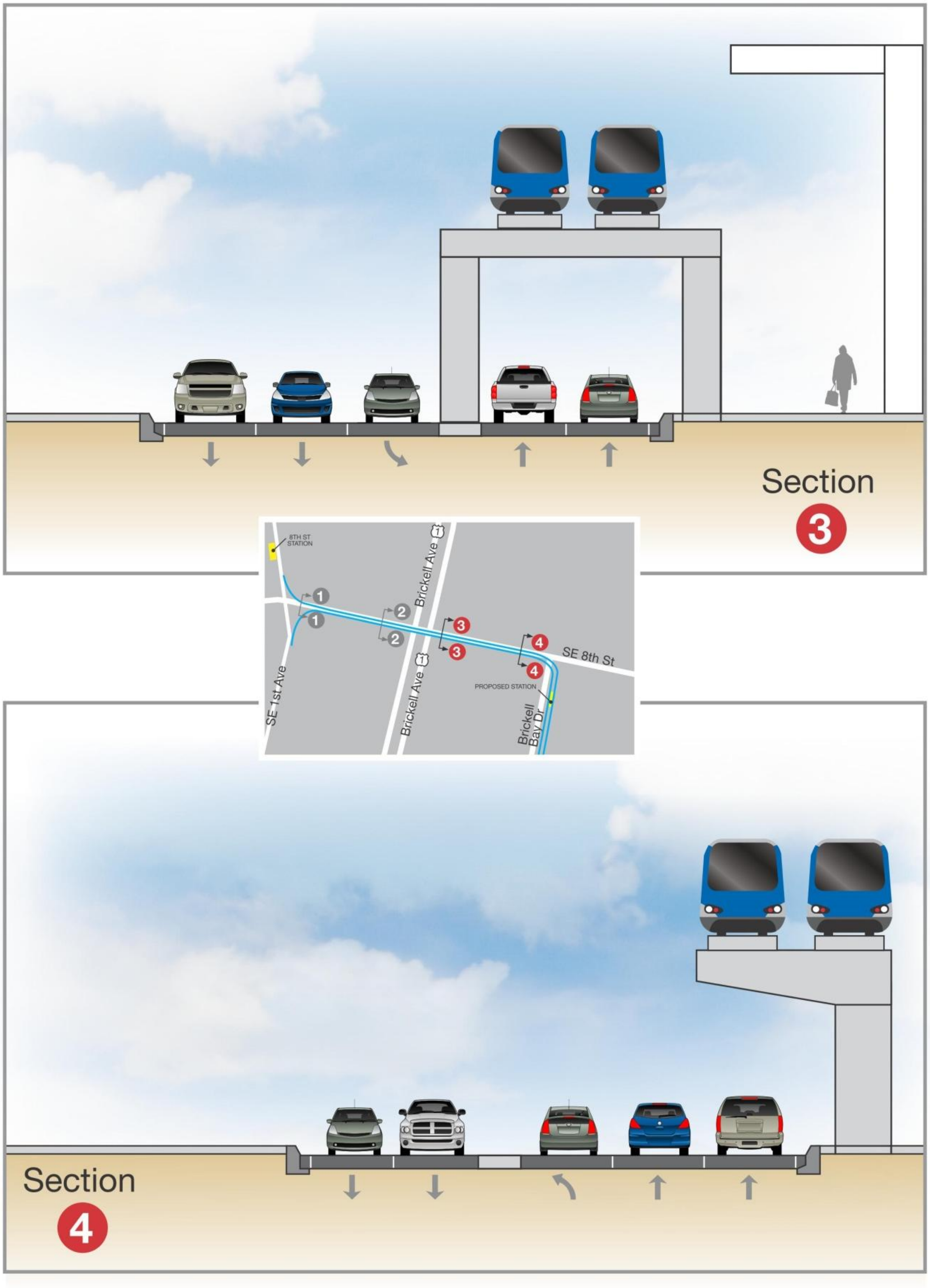

Figure 70: Cross Sections 3 and 4

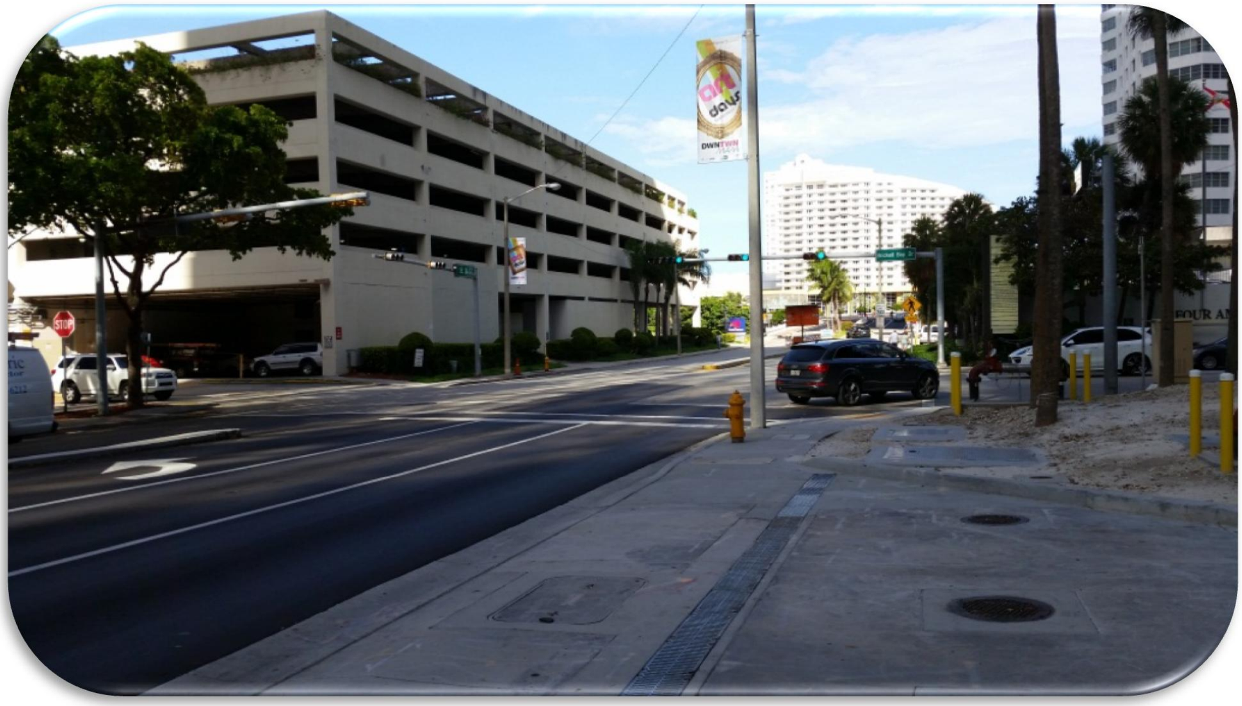

Figure 71: Sidewalk along SE 8th Street at Brickell Bay Drive

6.5 ALPS Analysis

A subsidiary of Kimley-Horn called JKH Mobility Services performed a series of Metromover simulations in the early 1990s. In late 2011 the previous work was reviewed and updated through other projects. As a part of this update, the actual simulation model data sets were converted to the current version of the simulation software, the Advanced Land-Transportation Performance Simulation™ (ALPS™). The ALPS models were also re-calibrated to reflect 2011 conditions. Additional information on ALPS is provided in Appendix F.

For this study, the ALPS model was used to conduct a planning-level operational assessment of the proposed South Loop. The ALPS model provides a means to accomplish synchronous simulations of all train operations and movements. Detailed guideway characteristics, train characteristics, and operational parameters are entered into the model to appropriately reflect the Metromover operations. The ALPS train operations simulations replicate the fundamental train propulsion and braking functions, as well as supervisory control features such as “station ahead clear” spacing of trains.

The performance data for each transit vehicle within the model is based on the Bombardier vehicle system, with two-car trains representing future conditions. The guideway and station locations are based on the refined concept (Figure 63). The operating system model for the Metromover System is shown Figure 72, as it is viewed within ALPS. The detailed area shows the individual Metromover vehicles at the realigned Financial District Station. A video of the operational simulation was also provided at the final SAC meeting and the TPC meeting.

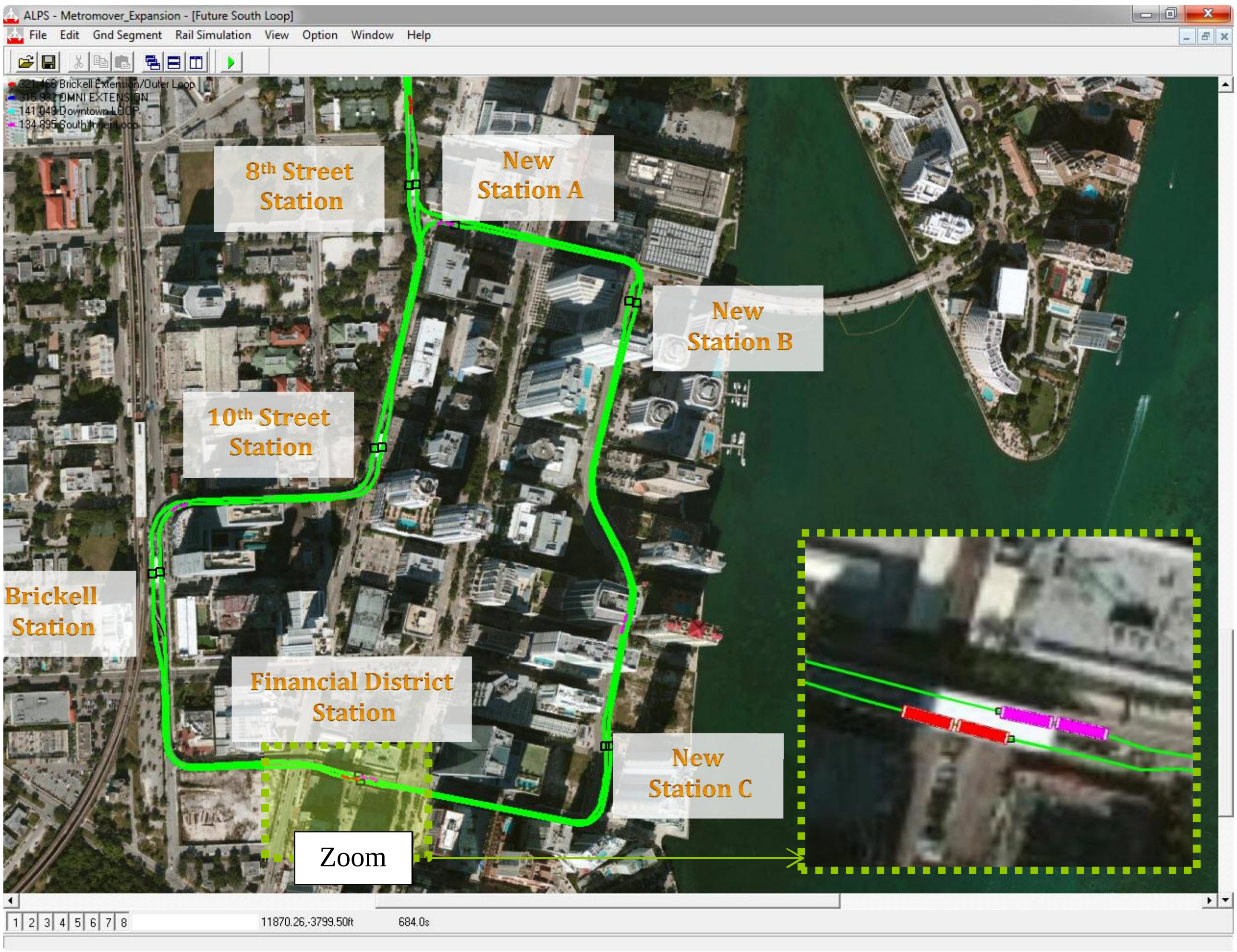

Figure 72: ALPS Model Image

Based on this high-level planning analysis, the operations remain consistent to existing conditions. The round trip time for the Brickell route will remain similar to today's operation at approximately 30 minutes with a headway of slightly over five minutes. Furthermore, with four, two-car trains in operation, the South Inner Loop is anticipated to operate at slightly over two minute headways, similar to the existing Downtown Inner Loop. The South Inner Loop has a round trip time of approximately nine minutes. The aforementioned operational measures are very preliminary based on the conceptual alignment and assumptions. With the design, more detailed estimates of the operational characteristics will be developed.

6.6 Capital Costs

Based on the refined concept, budgetary capital costs were developed and are summarized in Table 13. The construction costs summarized within this table are based on recent construction costs for APM projects with similar technologies for projects within the US and represent conceptual, high-level costs for planning purposes.

Table 13: Order of Magnitude Cost Estimate, Preferred Concept

Item	Quantity	Units	Unit Cost	Total Cost
Demolition				
Guideway and Columns Demolition at 8th Street and Financial District Stations	1,000	LF	$ 5,000	$ 5,000,000
Demolition at Column Locations	75	EA	$ 50,000	$ 3,750,000
Future Station Location Demolition	3	EA	$ 250,000	$ 750,000
Guideway				
Foundations and Columns	75	EA	$ 150,000	$ 11,250,000
Elevated Guideway - Single (1000' at 8th Street and Financial District Stations)	2,000	LF	$ 10,000	$ 20,000,000
Elevated Guideway - Double (0.77 mi)	4,100	LF	$ 15,000	$ 61,500,000
Guideway Storm Drainage	75	EA	$ 50,000	$ 3,750,000
Stations				
5,000 sf Station with Escalator, Elevator, Utilities, Communications/Security, Site Improvements	3	EA	$ 7,500,000	$ 22,500,000
Vehicles				
New Vehicles (including one spare)	5	EA	$ 2,500,000	$ 12,500,000
Other Costs				
Propulsion Power Substation	1	EA	$ 4,000,000	$ 4,000,000
Traffic Control	1	EA	$ 2,000,000	$ 2,000,000
Miscellaneous: Utility Relocations, Landscape, Power/Communication Conduits and Cable, Security, Lightning Protection, Roadway Improvements	1	EA	$ 10,000,000	$ 10,000,000
System Costs (Automatic Train Control, Running Surface, Guide Beams, Communication, Power, Switch Gear, etc.)	10,000	LF	$ 5,000	$ 50,000,000
Sub-Total				$ 207,000,000
25% Contingency and Soft Costs				$ 51,750,000
Total				$ 260M

6.6.1 Demolition Costs

The demolition costs consist of three, separate components: future station demolition, existing station demolition, and column demolition. Demolition will be required at each of the new stations. In addition, limited demolition will be required to modify the existing stations, specifically the existing 8th Street and Financial District Stations. At the 8th Street Metromover Station, modifications will be required to receive the connection of the South Loop. Modifications will also be required at the Financial District Station. Currently the Metromover accesses the Financial District Station from the north platform as shown in Figure 73. To extend the Metromover, the existing alignment will require reconfiguration to use the south platform and allow for the South Inner Loop on the north platform. Approximately 1,000 linear feet of guideway demolition was estimated to account for both the 8th Street and Financial District Station reconfigurations.

Figure 73: Financial District Station, North Platform

The final demolition cost is associated with the columns to support the elevated guideway throughout the new and replaced sections. The number of columns was estimated based on assumed 80 foot spacing between columns for the new guideway. It was assumed that one column support could support the dual guideway, but there will likely be some additional places where additional columns are required. Each column will require demolition of the footprint area to accommodate the new column.

6.6.2 Guideway Costs

New double track guideway is required for the 0.77-mile extension that closes the South Loop. In addition, there is some additional, single track guideway at the 8th Street and Financial District stations to accommodate modifications and connections mentioned in the previous section. The costs also include the individual column construction for guideway support and storm drainage at each column location to accommodate storm water run-off.

6.6.3 Station Costs

As shown in Figure 63, three new stations are proposed with the refined alternative. Consistent with the existing Metromover stations, the stations were assumed to be open-air stations sized approximately 5,000 square feet each. The station costs include estimates for elevators and escalators, as well as other general station amenities.

6.6.4 Vehicle Costs

A total of five new Metromover trains were anticipated for the proposed South Inner Loop. It is assumed that four trains will be in operation, and one spare will be provided. No new vehicles were anticipated for the South Outer Loop, as the overall distance is similar to the current travel distance with the existing operation. The estimates for vehicle costs are estimated from the recently completed MIA Mover cited in a previous MPO Study.[8]

6.6.5 Other Costs

A series of other, miscellaneous costs were also tabulated. These other costs include a new propulsion power substation. The new substation is anticipated based on the additional guideway length being added. A line item cost is also included for traffic control along city streets throughout the construction zone, often called MOT. This is a conservative estimate that accounts for the dense urban environment that exists along the corridor. Because of the busy environment, extensive MOT may be required to accommodate construction.

A line item for system costs was also added. These system costs are based on a linear foot of new guideway track being added and include automatic train control costs. The 10,000 quantity is based on dual guideways along 4,100 linear feet plus the 2,000 feet of modified single guideway at the 8th Street and Financial District Metromover Stations. Finally the miscellaneous line item accounts for additional items such as landscaping, utility relocations, security, communications, etc.

[8] *Transit Options to Port Miami Feasibility Study*, Miami-Dade MPO, June 2013

6.6.6 Allowances

A 25% allowance was added for soft costs (design, permitting, construction engineering and inspection, etc.) and contingency.

6.7 Operations and Maintenance Costs

A 2011 Peer Review Study[9] provided annual O&M costs data for 2004 through 2010. Using this data, an average, annual operational cost of $4.77M per mile and an average, annual maintenance cost of $2.57M per mile was determined. This results in an average, annual O&M cost of $7.34M per mile. The additional O&M costs for the 0.77-mile proposed extension is estimated to be approximately $5.65M per year based on this O&M estimate.

[9] *An Analysis of Miami-Dade Transit's Operating Cost Efficiency; Volume One, Peer Review,* Center for Urban Transportation Research, November 7, 2011

7.0 Implementation Strategies

The metropolitan transportation planning process establishes phases for planning and implementation of major transportation projects. Following these prescribed phases, sequentially, ensures consistency and establishes expectations amongst entities involved in the project's planning and implementation, as well as facilitates adequate public participation. Efforts to carry out the preferred alternative should follow said project phases stated herein, which meet both federal and State of Florida guidelines.

Figure 74: Metromover Vehicle

7.1 Financing

The project, from concept to construction and operations and maintenance will have to be funded on a phase by phase basis, treating each phase as a smaller project within the larger overall project. The already completed planning phase was funded by the MPO and estimates approximately $260M in construction and engineering costs (Table 13), plus an additional $8M in Project Development costs to fully implement the preferred alternative through the capital/construction phases. Funding for each phase can be provided in part, or whole, by the Federal Transit Administration (FTA), Miami-Dade MPO, Miami-Dade County, City of Miami, businesses/residents along the project's corridor, and FDOT. As the extension directly benefits the current and planned development in the Brickell area, a special assessment in the Brickell area should be considered as an additional option for funding. The original Brickell Loop was constructed using a similar special assessment.

Funding for the Final Design and Construction/Capital Phases should be a combination of:

- FTA New Starts funding 50%
- Local (Miami-Dade or City of Miami) 25%
- FDOT 25%

7.2 Conceptual Planning

Cost: $60K
Duration: 1 Year (completed)

This MPO planning study was performed to analyze, compare, and contrast existing studies and plans, and ultimately analyze various concept alternatives for expanding the Metromover system. The study concluded that connecting (or "closing") the South/Brickell Loop is a feasible alternative for implementation.

7.3 Operations and Maintenance

Cost: $6M Annually
Duration: ongoing

Prior to submitting proposals for funding to FTA and/or FDOT, O&M funding will have to be identified and committed. O&M funding should be provided by Miami-Dade County, City of Miami, and/or businesses and residents along the projects corridor. The $6M represents the incremental O&M costs associated with the additional South Loop operations.

7.4 Project Development/National Environmental Policy Act (NEPA) Review

Cost: Up to $8M
Duration: Up to 2 years

To further develop the findings of this recent MPO planning study, a project development phase will have to be initiated, in which all potential South Loop alternatives (including a no-build alternative) will be comprehensively reviewed considering costs, benefits, and project impacts. A complete environment review must also be conducted. Project development will conclude with the formal selection of an LPA, which must be shown in the LRTP as a "Cost Feasible" project.

7.5 Engineering

Cost: Up to $45M
Duration: Approximately 2 years

The project's engineering phase further refines the findings of the project development phase by producing a strong project scope, and constructible/implementable plans. All financial commitments will also be secured during the engineering phase.

7.6 Right-of-Way

Cost: Market Price
Duration: 2 to 3 years

During the conceptual planning cross sections were developed that identified the ability to construct the South Loop within the existing right-of-way. The engineering phase will determine if acquiring (purchase/easement/lease) rights of way will be a necessity to implement the LPA. If needed, right-of-way acquisition could significantly increase the project's overall budget.

7.7 Construction/Capital-Rolling Stock

Cost: $215M
Duration: 2 to 3 years

The estimated construction cost of $215M includes constructing the fixed guideway and related facilities as well as purchasing rolling stock. The planning study has found that the existing technology (Bombardier Innovia) and maintenance yard can accommodate the addition of new cars and a lengthened fixed guideway. This also includes an element of contingency.

The option of procuring engineering and construction services as one procurement via "Design-Build" methodology should also be considered. Design-Build procurements have proven to be effective at streamlining project schedules and optimizing resources by combining design and construction services into one contract. Coordination with FTA is required to ensure the design-build method properly aligns with FTA's New Starts capital funding process.

7.8 Public Participation

Cost: Included within project phases above
Duration: Throughout all project phases

The Moving Ahead for Progress in the 21st Century Act (MAP-21) pays particularly close attention to public involvement in the metropolitan transportation planning process. The bill goes as far as to require performance measures to define the success (or lack thereof) of public participation efforts. Although each phase of this project's Implementation Plan requires some form of public participation, there should be a concerted effort throughout the carrying-out of all phases to make sure that the public and stakeholders are aware of all aspects of this effort and that their issues and concerns are properly addressed.

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8.0 Summary and Conclusions

Since 1986 the Metromover has been effectively serving downtown Miami's Central Business District, Brickell, and the Arts/Entertainment neighborhoods. As evidenced by the passenger survey, the Metromover is frequently used by downtown Miami residents as an urban circulator. With the dramatic increase in Metromover ridership over the last decade and the recent development in key areas of downtown Miami, feasible options to connect future Metromover passengers to a new urban downtown lifestyle through an expanded Metromover System is clearly needed.

This study identified over 40 preliminary concept alternatives that were consolidated into six concept alternatives. The six concept alternatives were screened to identify a Metromover Master Plan (Figure 61) with proposed extensions to the north, south, east, and west. The corresponding order of magnitude cost estimate for implementing the additional 5.8 miles of guideway associated with the Master Plan is estimated at $1.9B. An additional O&M estimate of $42.6M per year is estimated based on the additional guideway length.

The concept alternatives from the Master Plan were evaluated using both qualitative and quantitative metrics to identify a preferred short-term concept, the South Loop. This concept was then refined (Figure 63) to confirm turning radii and identify three approximate station locations. The South Loop concept will provide greater connectivity and enhanced transit service to downtown Miami's increasingly pedestrian oriented residents, workers, and visitors, specifically in the growing Brickell area.

Based on feedback from MDT operations staff, it is anticipated that the 0.77-mile additional guideway extension requiring four additional operating trains can be accommodated with the existing Metromover maintenance facility and train control system. As such, this significantly improves the viability of the South Loop for implementation in the short or medium term, as this concept alternative does not rely on large Metromover system upgrades inherent to some of the other concept alternatives.

The study also identified rough order of magnitude capital and operations costs. These costs were then assigned to key implementation strategies as summarized in Table 14.

Table 14: Summary of Implementation Plan, South Loop

Implementation Task	Budget	Schedule
Project Development/NEPA	$8M	2 years
Engineering and Design	$45M	2 years
Construction/Vehicle Purchase	$215M	2-4 years
Total Project (to Operation)	$270M	**8** years
Operations and Maintenance	$6M/year	Annual

Based on the above high-level implementation plan, it is recommended that the South Loop seek inclusion in the LRTP and move forward with the project development and NEPA process.