Countywide Transit Corridors Functional Master Plan

Appendix 9
Travel Demand Forecasting Model Documentation

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Memorandum

To: Larry Cole

From: Michael Flood, Monique Ellis

Date: December 7, 2012

Subject: M-NCPPC Countywide Transit Corridors Functional Master Plan: Summary of Build Scenarios and Model Documentation for Proposed BRT Corridors

Introduction

As part of a supplemental scope of work agreement with the Montgomery County Planning Department for Maryland National Capital Park and Planning Commissions (M-NCPPC), the Parsons Brinckerhoff (PB) team analyzed various scenarios to assess the impacts of implementing bus rapid transit (BRT) runningway and intersection priority treatments on up to 17 corridors. The purpose of the analysis was to identify the minimum right-of-way needs along the proposed BRT corridors. This effort included updating the transit networks identified in the MCDOT's BRT feasibility study. The forecasts included in the draft deliverables used the model for the Purple Line and Corridor Cities Transitway AA studies. In addition to the forecasts, a microsimulation model was developed to evaluate the impacts of median busway and dedicated curb lane treatments on peak-hour traffic operation along sample BRT corridor segments.

The purpose of the travel forecast effort was to provide an overall view of estimated ridership of the proposed regional transit systems. The results of the estimated ridership were then used as a tool to identify potential right-of-way needs along selected roadways. The evaluation of the various corridor right-of-way needs was based on forecasts such as average link volume ridership by route, as well as regional statistics including district-level v/c ratios.

MDAAII Model

The transit model used for the BRT network is the Maryland Alternative Analysis II (MDAAII) model. The MDAAII model, originally developed by Maryland Transit Administration for the Purple Line and Corridor Cities Transitway (CCT) projects, uses a transit mode choice routine and complete four-step model process to develop ridership estimates for those transit modes.

An updated local bus network was developed to reflect assumed local bus service assumptions on the corridor. This network was developed after coordination with service providers in the area, including Ride On and WMATA staff. The intent of the development of this network was to reflect how service would be altered to support a fully implemented BRT network, to understand implications of this network at the level needed for decision-making.

Highway network and demographics data are based on a previous version of the the MWCOG model, which used the same 2191 zone structure as the MDAA II model. For this study, land use Round 8.1 was used for the forecasts, provided by MWCOG staff and summarized to the 2191 zone structure.

For the scenarios where the proposed BRT vehicles are running on dedicated guideway, the model's BRT mode was used and the speeds between stops/stations was adjusted to reflect actual operating conditions. For the scenarios where a route operates both on exclusive guideway for a portion on the roadway and with mixed traffic on other segments, the same BRT mode was used to maintain consistentcy in comparing the impacts of the scenario. Speeds were adjusted accordingly based on the operating characteristics of running in an exclusive guideway or mixed traffic. The local bus component of the model was re-calibrated in Summer 2012 to better reflect existing operating conditions. For each of the scenarios analyzed for this project, the background bus network was modified to provide connectivity with the proposed BRT routes as needed.

A set of model documentation has been included with this report to provide additional background on the operation of the model. Those documents include:

- Purple Line Travel Demand Forecasting Technical Report - Appendix A
- New Starts Travel Forecasting Model Calibration Report - Appendix B
- Corridor Cities Non-Included Attributes - Appendix C
- Washington Area New Starts Model Phase II Documentation Bus Speed Model (DRAFT) - Appendix D
- Washington Area New Starts Model – Transit Fares (DRAFT) – Appendix E
- MWCOG version 2.2 Relationship to MDAA II Model Structure – Appendix F
- Maryland Alternatives Analysis Phase II Model Structure – Appendix G

Non-Included Attributes

The Federal Transit Administration (FTA), in their 2007 *Proposed Guidance on New Start/Small Starts Policies and Procedures*, proposed new guidelines for calculating and reporting user benefits associated with characteristics of a transit line not included in a travel demand model. Modeled attributes include travel time, frequency and wait time, and fares and parking costs. Service attributes not part of travel demand models include "its visibility, reliability, span of service hours, comfort, protection from the weather, the chances of finding a seat, and passenger amenities." These non-included attributes are theoretically part of the mode-specific constant for *existing* transit modes being modeled. New modes are required by the FTA to use a mode-specific constant of 0, but are now allowed to take credit for any non-included attributes by using a post-processing procedure that applies user benefits (time savings) to certain riders of the proposed transit line. Those user benefits are determined by the type and nature of the attributes of the new mode.

The non-included attributes derived for the Purple Line light rail project and CCT BRT study were applied to the Montgomery County BRT project. Since the proposed BRT for both the CCT and the Montgomery County study have operating and guideway characteristics that are assumed to be identical to a light rail line, the non-included attributes developed for the Purple Line LRT were also applied to the BRT network in this effort. Refer to Appendix C for details on the non-included attributes as documented for the CCT BRT study.

BRT Modeling Scenarios

Using MWCOG's Land Use Round 8.1, the he PB team assessed five modeling scenarios for this effort; they are described as follows:

- 2040 No Build Scenario – reflects the baseline condition against which other modeling scenarios were compared
- 2040 Build Scenario with Exclusive Median Busways (Build1) – reflects one of four build scenarios in which all proposed BRT corridors were assumed to operate within exclusive median busways. This means only BRT vehicles operated within these lanes and served median stations only. Local buses continued to operate within the curb lanes of the roadways on which BRT operated.
- 2040 Build Scenario with Exclusive Median Busways (Build1A) –similar to the Build1, but with adjustments to the land use assumptions to test ridership changes along certain corridors and Countywide based on increased housing and employment in the White Oak and Glenmont planning areas.
- 2040 Build Scenario with Hybrid of Exclusive Median Busways and Repurposed Lanes (Build2) - reflects one of four build scenarios in which *most* of the proposed BRT corridors were assumed to operate within exclusive median busways. Once again, only BRT vehicles operated within these lanes and served median stations only. Highway segments along five BRT corridors had a roadway lane removed in each direction of travel to reflect BRT vehicles operating in curb lanes repurposed for transit vehicle use only. Other vehicles could use the repurposed curb lanes only in cases of making right turns.
- 2040 Build Scenario with Hybrid of Exclusive Median Busways, Repurposed Lanes, and Mixed Traffic Operations (Build2A) - reflects one of three build scenarios in which the BRT network modeled in the Build1 and Build2 scenarios were reduced to a little more than 90 miles along nine corridors. Compared to the Build1 and Build2 scenarios, the Build2A scenario reduced the number of corridors in exclusive median busways, increased the number of segments operating in repurposed lanes, and identified segments where BRT vehicles would operate in mixed traffic, based on recommended treatments proposed by M-NCPPC Planning staff. This network was developed to identify travel speeds consistent with MNCPPC recommendations for the transit network.

BRT Travel Time Assumptions

Table 1 lists the key assumptions used to develop the BRT travel times.

Table 1: Input Assumptions for BRT Travel Times

	Build 1 Build 1A	Build 2	Build 2A
Runningway Type	• Exclusive median busway	• Exclusive median busway • Dedicated curb lane	• Exclusive median busway • Dedicated curb lane • Mixed traffic
Intersection Priority	• Signal priority at all signalized intersections	• Same as Build 1/Build 1A	• Signal priority at signalized intersections with LOS C or D • Queue jumps at limited signalized intersections for BRT in curb lane or mixed traffic
Fare Collection	• Off-board (via fare vending machine)	• Same as Build 1/Build 1A	• Same as Build 1/Build 1A
Station Dwell Time	• 15 sec. for low-volume stations • 20 sec. for high-volume stations	• Same as Build 1/Build 1A	• Same as Build 1/Build 1A
Runningway Speed/ Travel Time	• Busway: Based on roadway's posted speed limit	• Busway: Based on roadway's posted speed limit • Curb lane: Reduced busway travel time at rate of 1 min/mile across same distance	• Busway: Based on roadway's posted speed limit • Curb lane: 5 MPH reduction of posted speed limit • Mixed traffic: Based on model's congested highway speed
Intersection Delays	• 45-sec. delay for non-priority signals • 30-sec. delay for signals with TSP • 15-sec. delay for signals with queue jumps • Use of synchronization factor:10 percent of delay associated with intersection priority treatments (signal priority and queue jumps)	• Same as Build 1/Build 1A	• Same as Build 1/Build 1A

Lane Repurposing Model Steps

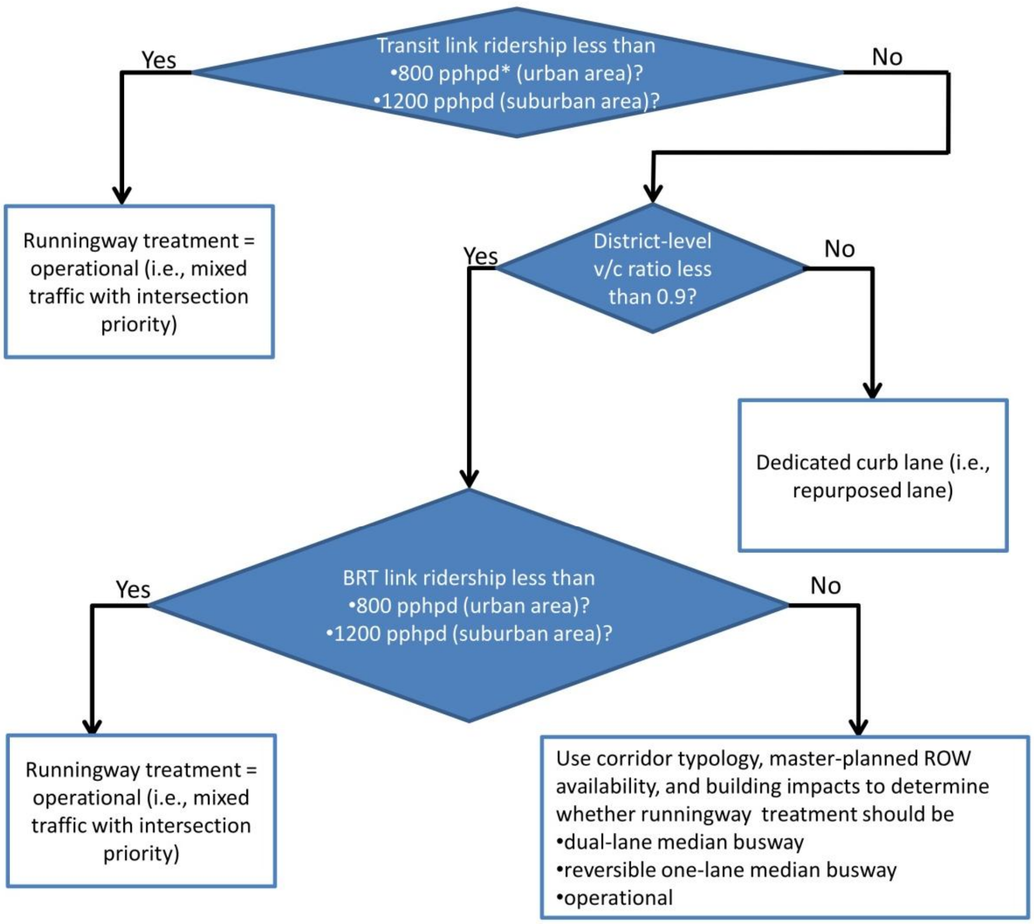
As part of this effort, a scenario assuming repurposing one travel lane from all vehicles to transit and right-turning vehicles only. Under the current MDAAII modeling application, the following steps were taken to develop the forecast for that alternative:

1. Modify the No-Build highway network to reflect the proposed changes within the "COGWithSplits" modeling framework (which was developed based on MWCOG's Version 2.2 regional travel demand model)

2. Run the "COGWithSplits" modeling procedure and generate the highway network related files to be used as part of the input files needed under the MDAAII's model run for the revised No Build scenario.
3. Run the MDAAII model for the revised No-Build scenario with the above inputs and use the resulting trip tables as the basis for the new model run.

These steps were followed for the Build2 model run. The Build2A model run was based on the trip tables resulting from the modified highway network applied to the Build2 model run.

Figure 1: Runningway Decision Flowchart



*ppdph: passengers per hour per direction of travel

Appendix A

Travel Demand Forecasting Technical Report

September 2008

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1. Introduction

The Maryland Transit Administration (MTA) is preparing an Alternatives Analysis and Draft Environmental Impact Statement (AA/DEIS) to study a range of alternatives for addressing mobility and accessibility issues in the corridor between Bethesda and New Carrollton, Maryland. The corridor is located in Montgomery and Prince George's Counties, just north of the Washington, DC boundary. The Purple Line would provide a rapid transit connection along the 16-mile corridor that lies between the Metrorail Red Line (Bethesda and Silver Spring Stations), Green Line (College Park Station), and Orange Line (New Carrollton Station). This *Travel Demand Forecasting Technical Report* describes the methodology used for the travel demand forecasting and presents the results of that analysis.

This Technical Report presents the methodology and data used in the analyses documented in the Purple Line Alternatives Analysis/Draft Environmental Impact Statement. The results presented in this report may be updated as the AA/DEIS is finalized and in subsequent study activities.

Maryland Transit Administration (MTA) developed a common travel demand forecasting model and procedures for two Alternatives Analyses in two separate corridors in the Washington DC regional modeling area. The intention was to use the same No Build forecast as the starting point for future forecasts for both the Corridor Cities Transitway (CCT) and the Purple Line (PL). Preliminary work on the CCT forecasts indicated that some enhancements to the Washington Metropolitan Council of Governments (MWCOG) travel model would be required to provide transit corridor-level alternative analysis travel forecasts information.

The enhanced model described in this document is referred to as the Maryland Alternatives Analysis Model, or the MDAA. It is based on the officially adopted MWCOG model version 2.1D#50, as modified by MWCOG for the 2007 Conformity Analysis, and referred to here as the COG Model. The COG model is a classic four step model with a static six iterations of feedback through trip generation, distribution, mode choice, and assignment. The COG mode choice model is a simple multinomial model that relies upon the path builder to distinguish choices among primary transit modes. It does not disaggregate transit trips into the various transit modes or transit access modes, nor does it accommodate transit assignment.

The COG Model was not fully developed to accommodate comprehensive transit analysis, and therefore a MWCOG model transit component post processor was developed, typically referred to as the COG Transit Component. Starting from the person trip tables that result from the sixth iteration of the full model feedback, the Transit Component applies a more sophisticated mode choice model which distinguishes between bus, bus/Metrorail, Metrorail only and commuter rail trips. Walk, Park-and-Ride, and Kiss-and-Ride trips are modeled separately and transit assignment is included. Full documentation of the Transit Component can be found in Post MWCOG - AECOM Transit *Component of Washington Regional Demand Forecasting Model Users Guide*, prepared by AECOM Consult, Inc., and dated March 2005.

The 2005 Transit Component was the starting point for modifications made for initial rounds of forecasts for the CCT. Additional modifications included edits to the networks, zones, and all files that are related to zonal-based demographics and walk percentages, to address corridor-level conditions and reporting needs. Changes were made to the Transit Component scripts in order to accommodate the new zone structure and network modifications. The resulting model, referred to here as the CCT Model, was the starting point for the MDAA.

The MDAA starts with the CCT Model and incorporates modifications to improve confidence in transit forecasts in these two corridors. The MDAA replaces the COG Model home-based work trip distribution with the CTPP. The mode choice model is a nested logit model with bus, Metrorail, commuter rail, light rail and bus rapid transit alternative transit modes. A park-and-ride station capacity restraint model was implemented to account for limited capacity at key stations.

1.1. Background and Project Location

Changing land uses in the Washington metropolitan area have resulted in more suburb-to-suburb travel, while the existing transit system is oriented toward radial travel in and out of downtown Washington, DC. The only transit service available for east-west travel is bus service, which is slow and unreliable. A need exists for efficient, rapid, and high capacity transit for east-west travel. The Purple Line would serve transit patrons whose journey is solely east-west in the corridor, as well as those who want to access the existing north-south rapid transit services, particularly Metrorail and MARC commuter rail service.

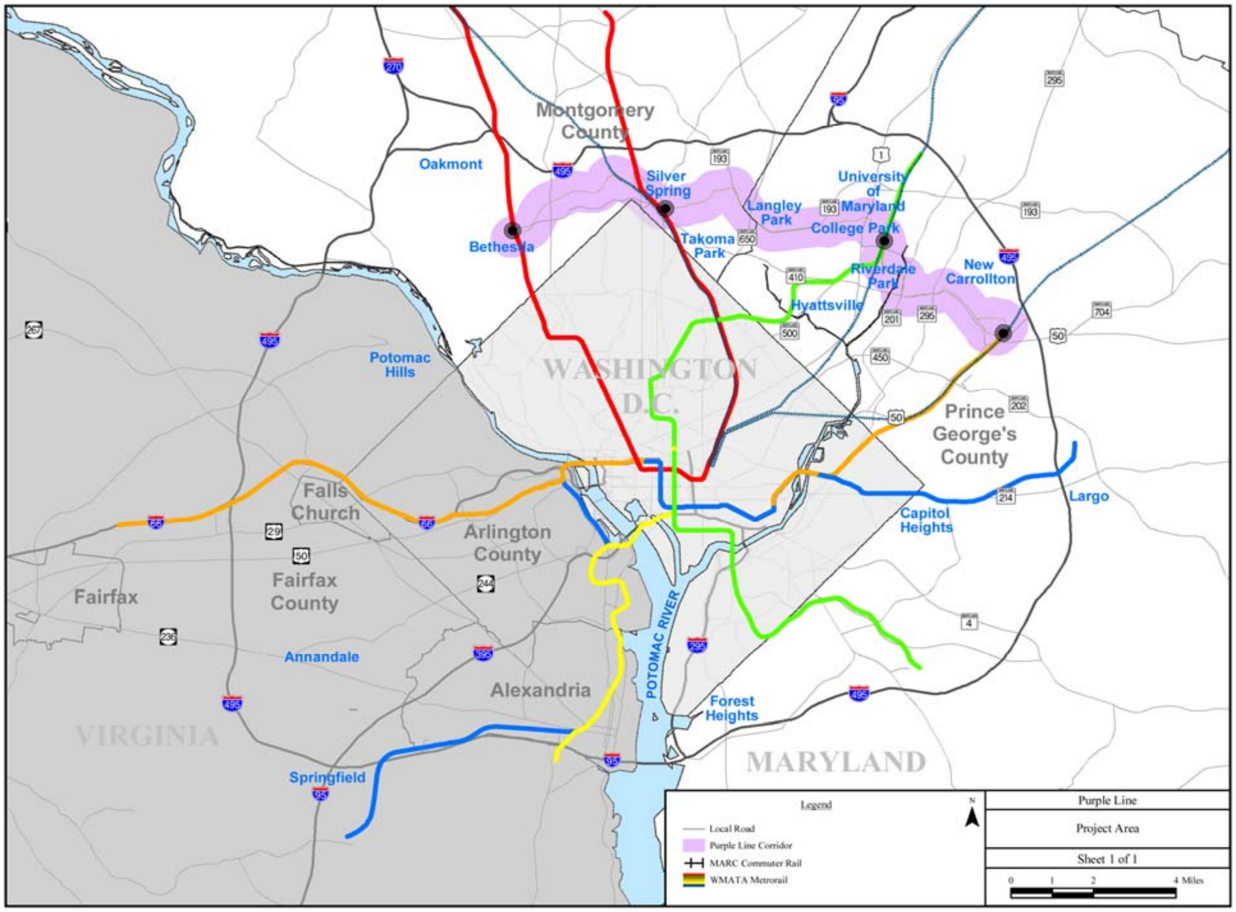
The corridor has a sizeable population that already uses transit and contains some of the busiest transit routes and transfer areas in the Washington metropolitan area. Many communities in the corridor have a high percentage of households without a vehicle, and most transit in these communities is bus service. Projections of substantial growth in population and employment in the corridor indicate a growing need for transit improvements. The increasingly congested roadway system does not have adequate capacity to accommodate the existing average daily travel demand, and congestion on these roadways is projected to worsen as traffic continues to grow through 2030.

A need exists for high quality transit service to key activity centers and to improve transit travel time in the corridor. Although north-south rapid transit serves parts of the corridor, transit users who are not within walking distance of these services must drive or use slow and unreliable buses to access them. Faster and more reliable connections along the east-west Purple Line Corridor to the existing radial rail lines (Metrorail and MARC trains) would improve mobility and accessibility. This enhanced system connectivity would also help to improve transit efficiencies. In addition, poor air quality in the region needs to be addressed, and changes to the existing transportation infrastructure would help in attaining federal air quality standards.

1.1.1. Corridor Setting

The Purple Line Corridor, as shown in Figure 1-1, is north and northeast of Washington, DC, with a majority of the alignment within one to three miles of the circumferential I-95/I-495 Capital Beltway.

Figure 1-1: Project Area



2. Travel Forecasts for Alternatives Analysis

This section provides descriptions of the alternatives for which travel forecasts were prepared for the alternatives analysis and DEIS, as well as a presentation of the results and discussion of the findings. In Chapter 3, more detailed information and forecast results are presented for each alternatives.

2.1. Alternatives Retained for Detailed Study

The Purple Line study has identified eight alternatives for detailed study, shown on Figure 2-1. The alternatives include the No Build Alternative, the Transportation System Management (TSM) Alternative, and six Build Alternatives. The Build Alternatives include three using bus rapid transit (BRT) technology and three using light rail transit (LRT) technology.

All alternatives extend the full length of the corridor between the Bethesda Metro Station in the west and the New Carrollton Metro Station in the east, with variations in alignment, type of running way (shared, dedicated, or exclusive), and amount of grade-separation options (e.g. tunnel segments or aerial). For purposes of evaluation, complete alignments need to be considered. These alternatives were used to examine the general benefits, costs, and impacts for serving major market areas within the corridor.

2.2. No Build Alternative

Existing transit service in the corridor is provided by WMATA Metrorail and Metrobus, Montgomery County Ride On local bus, Prince George's County TheBus local bus, the University of Maryland Shuttle, MARC commuter rail, and Amtrak. Table 2-1 lists the principal existing transit service within the corridor.

The transit service levels in the Constrained Long Range Plan (CLRP) are assumed for the No Build Alternative except for the Bethesda to Silver Spring segment of the Purple Line.

Figure 2-1: Alternative Alignments

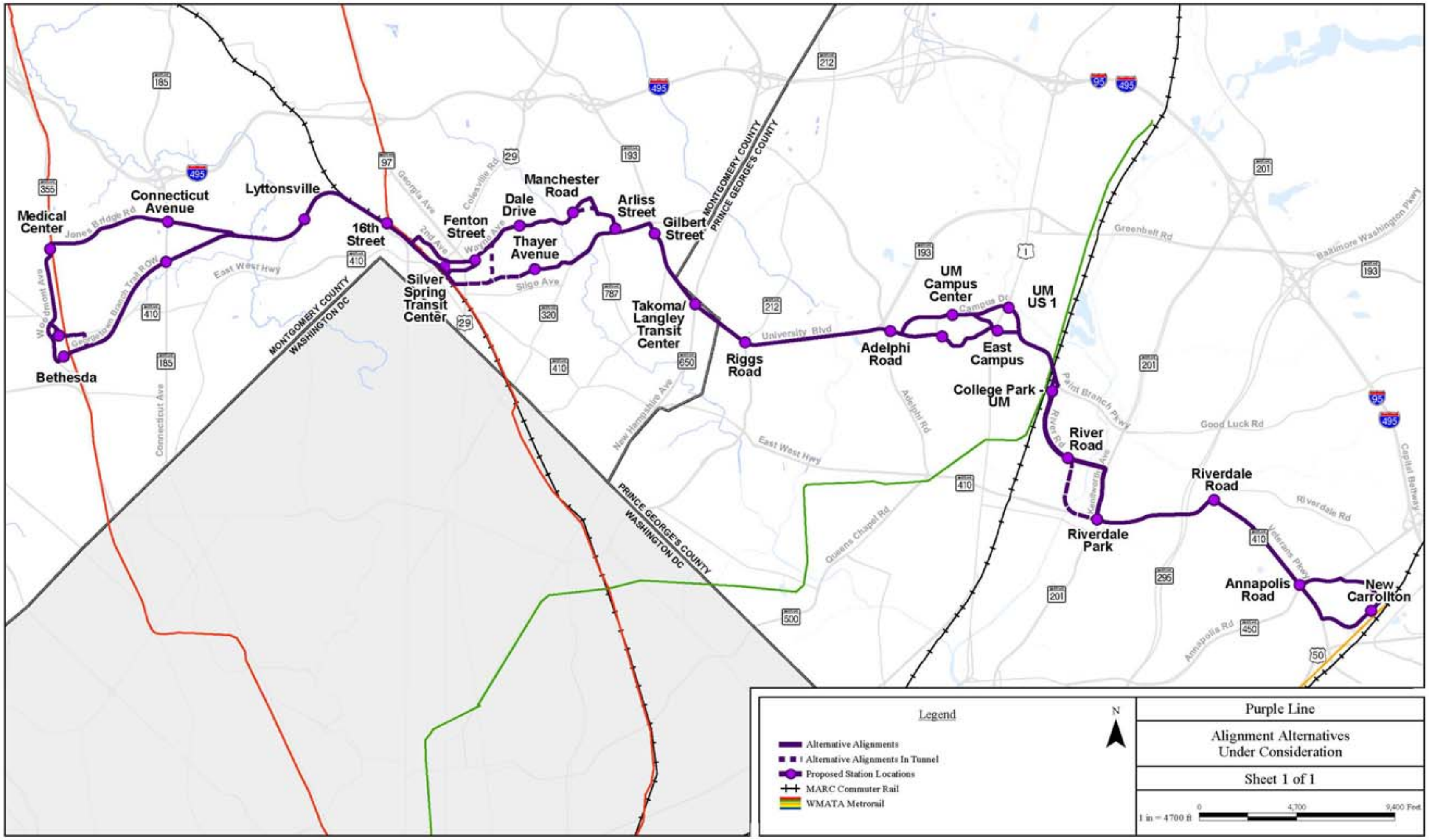


Table 2-1: Existing Transit Service

Route	Terminal & Intermediate Points
Metro Red Line	Shady Grove – Glenmont
Metro Green Line	Greenbelt – Branch Avenue
Metro Orange Line	Vienna/Fairfax/GMU – New Carrollton
J1, J2, J3	Montgomery Mall – Bethesda – Silver Spring Metro
J4	Bethesda Metro – Silver Spring – College Park Metro
C2	Wheaton Metro – Greenbelt Metro
C4	Twinbrook Metro – Prince George's Plaza Metro
F4	Silver Spring – New Carrollton
F6	Silver Spring – New Carrollton
Ride On 15	Silver Spring Metro – Langley Park
TheBus 17	Langley Park – UM – College Park Metro
UM Shuttle 111	UM – Silver Spring Metro
UM Shuttle 104	UM – College Park Metro
MARC Brunswick Line	Washington – Rockville – Gaithersburg - Brunswick
MARC Penn Line	Washington – BWI Thurgood Marshall Airport – Baltimore –Perryville
MARC Camden Line	Washington – Baltimore
Amtrak Northeast Corridor	Washington – New York and points north and south

Transit projects in the Maryland Consolidated Transportation Program (FY 2007-2012) located within the corridor, and expected to be in place by 2030, include the following:

- **Southern Entrance to Bethesda Metro Station** - A new entrance to the mezzanine of the Bethesda Metro station at the southern end of the platform. This second entrance was anticipated at the time of the initial construction of the station, but left unbuilt until ridership required it. The construction of this project is funded and design is currently underway.
- **Silver Spring Transit Center** - This project provides a fully integrated transit center at the Silver Spring Metro Station. It will serve the Metrorail Red Line and the MARC Brunswick Line. It will include bus bays for Metrobus and Ride On, an intercity bus facility, a taxi queue area, a kiss-and-ride facility, and a MARC ticketing office. Construction has begun on this facility and should be complete by 2010. Provisions have been made in the Transit Center design to accommodate a Purple Line guideway and platforms. For the Low Investment BRT Alternative, the buses would use the middle level bus facility.
- **Takoma/Langley Park Transit Center** - A new transit center will be built at the northwest corner of the University Boulevard and New Hampshire Avenue intersection. It is expected to be completed by 2010. All the Purple Line Build Alternatives would have a station at this transit center.

The Metrorail system opens at 5 AM on weekdays and 7 AM on weekends. It operates until midnight Sunday through Thursday and until 3 AM on Fridays and Saturdays.

Metrobus schedules vary by route, with most routes running every day. Ride On schedules also vary by route, with most routes running daily. TheBus buses operate Monday through Friday, with no service on weekends or holidays. Bus headways on all three systems vary by time of day. Table 2-2 lists the headways of the bus routes within the corridor. Transit service to the National Naval Medical Center/National Institutes of Health area is provided from Silver Spring and points east via the J1 route, while the Metrorail Red Line Medical Center Station connects to the entire rail-bus network.

Table 2-2: Year 2030 Bus Headways within the Corridor (minutes)

Route	Terminal and Intermediate Points	Early Morning	AM Peak	Midday	PM Peak	Evening	Saturday	Sunday
J1	Montgomery Mall-Medical Center-Silver Spring Metro	--	20	--	20	---	--	--
J2	Montgomery Mall-Bethesda-Silver Spring Metro	20	17	20	24	15	20	25
J3	Montgomery Mall-Bethesda-Silver Spring Metro	--	17	--	24	--	--	--
J4	Bethesda Metro-Silver Spring-College Park Metro	--	20	--	20	--	--	--
C2	Wheaton Metro-Greenbelt Metro	--	22	30	16	--	30	--
C4	Twinbrook Metro-Prince George's Plaza Metro	10	22	30	16	30	30	16
F4	Silver Spring – New Carrollton	12	12	40	15	--	30	60
F6	Silver Spring – New Carrollton	--	20	40	30	--	--	--
Ride On 15	Silver Spring Metro-Langley Park	15	4	12	4	30	12	15
TheBus 17	Langley Park-UM-College Park Metro	45	45	45	45	--	--	--
UM Shuttle 111	UM – Silver Spring Metro	--	35	75	45	30	--	--
UM Shuttle 104	UM – College Park Metro	8	8	12	8	20	20	20

Since no changes are anticipated to the bus network under the No Build Alternative, it is not anticipated that current service levels would change significantly, except for the impacts of growing roadway congestion, which is expected to result in lengthened bus running times and longer travel times for all vehicles.

The No Build Alternative would not include any alterations to the existing Metrobus, Ride On, or TheBus systems. It would not include addition of a new mode or new exclusive right-of-way, and would therefore not significantly increase the reliability of the existing transit system. It is expected that increasing roadway congestion will continue to decrease the reliability of the bus service, its adherence to its operational schedule, and the predictability of expected headways and transit travel times.

2.3. TSM Alternative

The TSM Alternative would include enhanced bus service in the corridor and a new through-route from Bethesda to New Carrollton replacing the existing J4 route and adding service on portions of the F4/F6 routes between College Park and New Carrollton. The TSM bus service would consist of a limited-stop bus route that would make stops consistent with those of the Build Alternatives. The core service improvements under the TSM Alternative are limited-stop bus service, selected intersection and signal preference strategies, and upgrades to bus stop amenities.

A principal difference between the TSM and the Build Alternatives is that the TSM service would operate on East West Highway between Bethesda and Silver Spring, rather than along a new guideway facility along the Georgetown Branch and Metropolitan Branch railroad rights-of-way between Bethesda and Silver Spring, as with the Build Alternatives (except under the Low Investment BRT Alternative, which runs along Jones Bridge Road.) Along East West Highway, stops would be located at Connecticut Avenue and at Grubb Road.

The TSM service would provide faster one-seat rides between major activity centers, including Medical Center Metro Station, Bethesda Metro Station, Silver Spring Metro Station, Takoma Park, Langley Park, University of Maryland, College Park Metro Station, and New Carrollton Metro Station. This route would also serve transfers to bus routes operating on radial streets, including those on Wisconsin Avenue, Connecticut Avenue, Colesville Road, Georgia Avenue, New Hampshire Avenue, Riggs Road, Adelphi Road, US 1, Kenilworth Avenue, and Annapolis Road. It would serve the long-haul trips now carried by WMATA J2/J3, Ride On 15, and, to a degree, WMATA C2/C4, and is estimated would serve nearly 80 percent of the passengers now boarding the existing routes along this corridor.

Transit service to the National Naval Medical Center/National Institutes of Health area would be provided from Silver Spring and points east through the enhanced J1 service with intersection, operational, or service modifications. The Metrorail Red Line Medical Center Station would continue to provide connectivity to the entire rail-bus network.

Because of the importance of serving the trips that interface with the Metrorail services in the Purple Line corridor, the TSM span of service would match the Metrorail span of service. The Metrorail system opens at 5 AM on weekdays and 7 AM on weekends. It operates until midnight Sunday through Thursday and until 3 AM on Fridays and Saturdays.

The fare structure for the TSM service would be the same as under the No Build Alternative, recognizing that fares would increase over time. SmartCard, or some other means of electronic fare collection, may enable an integrated fare structure and convenient transfer with other transit services in the corridors.

End-to-end, the TSM route is 16 miles long, requiring about 108 minutes of running time with an average round trip speed of 9 miles per hour. Today, the bus routes along the alignment operate in very difficult circumstances with a wide range of times in each direction and between the AM and PM. Anecdotal reports from WMATA indicate that the J4 route may require 50 percent more time than scheduled on certain runs to complete its trip. These conditions complicate schedule preparation and operations planning. It is assumed TSM measures would somewhat mitigate these conditions; however, 2030 background traffic volumes and traffic congestion levels will be far greater than they are today.

Table 2-3: Year 2030 TSM Bus Headways (minutes)

Route	Terminal and Intermediate Points	Early Morning	AM Peak	Midday	PM Peak	Evening	Weekend
TSM	Bethesda – New Carrollton	10	6	10	6	10	20
J1	Medical Center – Silver Spring	--	20	--	20	--	--
J3	Eliminate; replace with Ride On 15 service	--	--	--	--	--	--
C2	Terminate at Langley Park Langley Park – Greenbelt	30	15	20	15	30	30
C4	Twinbrook Metro – Prince George's Plaza Metro	10	8	15	8	20	20
F4	Silver Spring – New Carrollton	12	10	30	10	--	30
F6	Terminate at Prince George's Plaza Prince George's Plaza – New Carrollton	--	15	30	15	--	--
Ride On 15	Bethesda – Langley Park (extend to Bethesda)	15	15	15	15	30	15
TheBus 17	Langley Park–UM–College Park Metro	45	45	45	45	--	--

The TSM Alternative includes modifications to existing Metrobus routes intended to improve reliability, including limited-stop bus service, and intersection improvements and signal priority at certain intersections. At intersections where queue jump lanes and signal priority would be implemented, transit's reliability would increase because the effects of congestion at these locations would be reduced. In addition, the limited-stop route would provide faster connections between major origins and destinations, as well as providing one-seat rides.

However, there is only limited opportunity for improving transit service reliability using signal preference strategies in the corridor. The major radial roadways that cross the corridor, such as Connecticut Avenue, Georgia Avenue, New Hampshire Avenue, Riggs Road, Adelphi Road, US 1, Kenilworth Avenue, and Annapolis Road, are the major sources of delay and unreliability. These roadways carry very heavy arterial traffic flows into and out of Washington, DC and other major activity centers. There is very little opportunity to introduce signal preferences at these intersections without causing a major exacerbation of traffic congestion. Queue jump lanes, however, do provide a travel time reliability advantage enabling transit vehicles to get to the intersection and limit the delay to one or two traffic signal cycles.

2.4. Build Alternatives

Six Build Alternatives are under consideration. They include two transit modes, BRT and LRT. Each mode is being analyzed at three potential levels of investment: low, medium, and high. All of the Build Alternatives would extend the full length of the corridor between the Bethesda

Metro Station and the New Carrollton Metro Station with some variations in alignment location, type of running way (shared, dedicated, or exclusive), and amount of grade separation. The decision to construct dedicated lanes is dependent on the results of the operations modeling (which assumes no dedicated lanes), as well as construction costs and potential environmental benefits and impacts. Each of the Build Alternatives is described briefly below.

2.4.1. Alternative 3 - Low Investment BRT

The Low Investment BRT Alternative would primarily use existing streets to minimize capital costs. It would incorporate improvements to traffic signals (including signal priority where possible), signage, and travel lanes in appropriate areas. This alternative would mostly operate in mixed lanes, crossing all intersections at grade, and would include queue jump lanes at major intersections. Dedicated BRT lanes would be provided southbound along Kenilworth Avenue, and westbound along Annapolis Road. This is the only Build Alternative that would operate on Jones Bridge Road (directly serving the National Institutes of Health and the National Naval Medical Center) and that would use the bus portion of the new Silver Spring Transit Center.

2.4.2. Alternative 4 - Medium Investment BRT

The Medium Investment BRT Alternative is a composite of elements from the Low and High Investment BRT Alternatives. The Medium Investment BRT Alternative incorporates those lower-cost features for segments of the Low Investment BRT Alternative that perform reasonably well and those of the High Investment BRT Alternatives that provide reasonable benefits relative to the higher costs. The major incremental change for the Medium Investment BRT Alternative is that between Bethesda and Silver Spring, the transit service runs in a guideway in the Georgetown Branch right-of-way instead of along Jones Bridge Road. It would serve both the existing Bethesda bus terminal and the new south entrance to the Metro station beneath the Apex Building. At the Silver Spring Transit Center, the buses would enter on an aerial structure parallel to, but at a higher level than, the existing Metro and CSX tracks. Along University Boulevard the alternative would be in dedicated lanes and the alternative would leave Campus Drive in the University of Maryland at Regent's Drive to proceed directly through the East Campus development.

2.4.3. Alternative 5 - High Investment BRT

High Investment BRT is structured to provide the fastest travel time of the BRT alternatives. Tunnels and aerial structures are proposed at key locations to improve travel time and reduce delay. When operating within or adjacent to existing roads, this alternative would operate largely in dedicated traffic lanes. Like the Medium Investment BRT Alternative, this alternative would serve the Bethesda Station at both the bus terminal and the new south entrance. At the Silver Spring Transit Center, the buses would enter on an aerial structure parallel to, but at a higher level than, the existing Metro and CSX tracks.

2.4.4. Alternative 6 - Low Investment LRT

The terminal station for Low Investment LRT would be the Bethesda Metro Station with a connection to the southern end of the existing station platform (the LRT alternatives would only serve the south entrance of the Bethesda Station and would operate there in a stub-end platform arrangement). It would operate in shared and dedicated lanes with minimal use of vertical grade separation and horizontal traffic separation. At the Silver Spring Transit Center, the light rail transit would enter on an aerial structure parallel to, but at a higher level than, the existing tracks.

This alternative would include incorporation of signal priority or queue jump lanes at major intersections where possible, to achieve measurable time savings or reliability without overly adversely affecting traffic at the intersections.

2.4.5. Alternative 7 - Medium Investment LRT

The Medium Investment LRT Alternative is a composite of elements from the Low and High Investment LRT Investment Alternatives. This alternative incorporates those lower cost features for segments of the Low Investment LRT Alternative that perform reasonably well and those of the High Investment LRT Alternative that provide reasonable benefits relative to their higher costs. The principal incremental change for the Medium Investment LRT Alternative is the introduction of several grade separations at major roadways and more dedicated sections along roadways; however, it does not include some of the longer tunnel sections in East Silver Spring, the University of Maryland, or Riverdale Park, that are included under the High Investment BRT and LRT Alternatives.

2.4.6. Alternative 8 - High Investment LRT

The High Investment LRT Alternative is nearly identical to the High Investment BRT Alternative, except that it only serves the south entrance of the Bethesda Metro Station.

2.5. Build Alternatives Operations

The span of service for the Build Alternatives would mirror that for the Metrorail system, including extended hours on weekend nights (see Table 2-4).

The headways of the various Build Alternatives would vary by time period to reflect demand requirements. Proposed headways are shown by time period in Table 2-5. The span of services of the bus routes that feed the TSM and Build Alternatives would be adjusted to service the market needing extended service times.

Table 2-4: Year 2030 Span of Service

Day of Week	Hours
Monday - Thursday	5:00 AM – 12:00 AM
Friday	5:00 AM – 3:00 AM
Saturday	7:00 AM – 3:00 AM
Sunday	7:00 AM – 12:00 AM

Table 2-5: Year 2030 Build Alternatives Headways (minutes)

Day of Week	Early AM	Peak	Midday	PM Peak	Evening	Late PM
Weekdays	10	6	10	6	10	10
Saturdays	20	N/A	10	N/A	10	20
Sundays	20	N/A	10	N/A	10	20

The fare for all of the Build Alternatives under consideration would be consistent with the current local bus fare structure, recognizing that this would increase over time. SmartCard, or some other means of electronic fare collection, would enable an integrated fare structure and convenient transfer with the other transit services in the corridor.

The end-to-end travel times and average estimated speeds for each Build Alternative are shown in Table 2-6. As expected, the High Investment LRT Alternative, with strategic grade separation and mostly dedicated or exclusive right-of-way, would have the shortest running time and the highest average speed of all the alternatives. Average station-to-station travel time estimates for the Build Alternatives are shown in Table 2-7.

Table 2-6: Year 2030 End-to-End Travel Times

	End-to-End Running Time (minutes)	Average Speed (mph)
TSM	108	9
Low Investment BRT	96	10
Medium Investment BRT	73	13
High Investment BRT	59	16
Low Investment LRT	62	15
Medium Investment LRT	59	16
High Investment LRT	50	19

2.5.1. Reliability

The overall reliability of any of the Build Alternatives would be higher than that for the No Build or TSM alternatives because portions of the service, depending on the alternative, would operate largely in dedicated lanes or exclusive right-of-way, thus removing the vehicles from the potential delays of roadway congestion. In areas where the Purple Line would operate in shared lanes, it is anticipated that queue jump lanes and signal prioritization would be implemented where possible. The High Investment Alternatives would have the highest reliability, and the Low Investment Alternatives would have the lowest reliability. Because of the terminal configuration of the High and Medium Investment BRT Alternatives at Bethesda that involves a street running loop, those two alternatives would not be as reliable as their LRT counterparts. Similarly, the Low Investment BRT Alternative with its operations along Jones Bridge Road between Bethesda and Jones Mill Road would have lower reliability than the Low Investment LRT Alternative, which would operate in the Georgetown Branch right-of-way, which is an exclusive right-of-way.

Table 2-7: Year 2030 Average Station-to-Station Travel Times (minutes)

Segment	TSM	Low Inv. BRT	Medium Inv. BRT	High Inv. BRT	Low Inv. LRT	Medium Inv. LRT	High Inv. LRT
Bethesda Metro, North entrance to Medical Center Metro	N/A	4.7	N/A	N/A	N/A	N/A	N/A
Bethesda Metro, North entrance to Bethesda Metro, South entrance	N/A	N/A	5.2	5.2	N/A	N/A	N/A
Medical Center Metro to Connecticut Avenue	N/A	6.0	N/A	N/A	N/A	N/A	N/A
Bethesda Metro, South entrance to Connecticut Avenue	10.8	N/A	5.5	5.5	4.0	2.4	2.4
Connecticut Ave. to Grubb Road	7.3	N/A	N/A	N/A	N/A	N/A	N/A
Connecticut Avenue to Lyttonsville	N/A	5.2	3.1	3.1	2.3	2.3	2.3
Grubb Road to Silver Spring Transit Center	13.2	N/A	N/A	N/A	N/A	N/A	N/A
Lyttonsville to Woodside/16th Street	N/A	2.4	2.4	2.4	2.1	2.1	2.1
Woodside/16th Street to Silver Spring Transit Center	N/A	6.2	2.1	2.1	2.8	2.0	2.0
Silver Spring Transit Center to Fenton Street	5.1	4.6	3.1	N/A	3.1	3.1	N/A
Silver Spring Transit Center to Dale Drive	N/A	N/A	N/A	2.6	N/A	N/A	3.6
Fenton Street to Dale Drive	4.8	2.8	3.0	N/A	3.8	3.1	N/A
Dale Drive to Manchester Road	2.9	2.3	2.3	2.1	3.1	2.8	2.4
Manchester Road to Arliss Street	4.9	4.8	4.7	1.4	1.4	1.4	1.4
Arliss Street to Gilbert Street	6.6	6.6	3.4	4.0	3.8	3.8	3.8
Gilbert Street to Takoma/Langley Transit Center	4.8	4.8	2.3	2.2	2.2	2.2	2.1
Takoma/Langley Transit Center to Riggs Road	5.8	5.6	2.7	1.7	2.4	2.4	1.7
Riggs Road to Adelphi Road	6.0	5.7	5.6	3.1	3.3	3.3	3.1
Adelphi Road to UM Campus Center	4.0	3.7	2.9	2.6	2.9	2.9	2.6
UM Campus Center to UM East Campus	8.6	8.6	3.0	2.9	3.0	3.0	2.9
UM East Campus to College Park Metro	2.0	2.2	3.0	3.0	3.0	3.0	3.0
College Park Metro to River Road	2.0	1.8	1.9	1.9	1.9	1.9	1.9
River Road to Riverdale Park	5.5	5.0	4.3	3.2	4.6	4.6	3.1
Riverdale Park to Riverdale Road	4.4	4.4	4.7	2.9	4.8	4.8	2.9
Riverdale Road to Annapolis Road	4.7	4.0	3.6	3.5	3.5	3.5	3.3
Annapolis Road to New Carrollton Metro	4.6	4.4	3.8	3.5	3.9	3.9	3.6
Total Running Time (rounded up to the nearest minute)	**108**	**96**	**73**	**59**	**62**	**59**	**50**

Note: Times represent the average of morning and afternoon peak period travel times in the eastbound and westbound direction, which may vary with the specific period coding assumptions.

2.5.2. Ridership

Ridership forecasts are used to gauge the comparative attractiveness of alternatives under consideration. They are measured in terms of daily passengers and daily boardings, also called linked and unlinked trips. A passenger, or linked trip, is defined as travel from trip origin to trip destination, regardless of the number of transfers or mode changes required. A boarding, or unlinked trip, is counted as the number of times a person enters a vehicle for travel, inclusive of transfers. One linked trip from origin to destination could comprise multiple unlinked trips.

Purple Line ridership forecasts were measured in terms of total and new daily transit trips (linked), peak period boardings and alightings by station, and by peak period line volumes.

2.5.3. Total and New Transit Trips

The Build Alternatives would generate an approximately one percent increase in total regional transit ridership over the No Build Alternative. Detailed ridership forecasts are shown in Table 2-8. The results of the ridership modeling would indicate that forecast ridership on the Purple Line will not be the key determinant in selecting a preferred Build Alternative, but rather the results of the environmental, traffic, and cost-benefit analyses.

2.5.4. District–to-District Travel Patterns

The Washington metropolitan region was defined as a set of districts to enable a discussion of the current travel patterns (see Figure 2-2). A set of districts are identified around the major activity centers of Bethesda, Silver Spring, College Park/University of Maryland, and New Carrollton. Three additional districts are the “wedge” areas in between the major activity centers, Connecticut Avenue-Lyttonsville, Takoma Park-Langley Park, and Riverdale. These seven districts constitute the Purple Line corridor.

Other districts are used to define major sections of Washington, DC and travel market areas around the Metrorail lines (both branches of the Red Line, the Green Line, and the Orange Line) running to the north and northeast of the corridor. The rest of the region is defined by larger districts for the remainder of Maryland and the areas of Virginia.

The Purple Line corridor has approximately 169,000 daily transit trips that have one or both ends of the trip in the corridor. This represents some 9.5% of the transit trips for the Washington region. Some 44,000 of these transit trips have both ends of the trip within the Purple Line corridor while 60,000 transit trips are between the corridor and some part of Washington, DC. A large number of the remaining trips are associated with districts to the north or northeast of the Purple Line corridor along the Metrorail lines. The majority of the trips in the corridor are associated with the major activity centers, 134,000, while the other 35,000 are associated with the wedge districts. Of the trips associated with the major activity centers, only 9,000 are from one major activity center to another. For the wedge district trips, 8,400 are associated with the major activity centers with 15,400 associated with the Washington, DC districts.

Table 2-8: Year 2030 Total Daily Linked Transit Trips

	Type of Trip	No Build	TSM	Low Invest. BRT	Medium Invest. BRT	High Invest. BRT	Low Invest. LRT	Medium Invest. LRT	High Invest. LRT
Bus	Work	236,139	238,873	229,096	226,886	225,970	225,829	225,448	224,879
	Non-work	211,747	214,772	207,301	205,934	205,403	205,344	205,098	204,434
Metrorail	Work	561,114	560,040	558,148	558,299	557,668	558,423	558,377	558,446
	Non-work	298,451	300,917	300,909	301,583	301,852	302,331	302,523	303,011
Commuter Rail	Work and Non-Work	47,944	48,983	48,922	48,937	48,984	48,934	48,930	48,956
Purple Line	Work	NA	NA	13,827	17,896	20,759	20,444	21,377	22,953
	Non-work	NA	NA	8,570	11,169	12,423	12,307	12,849	13,488
Total Transit Trips		**1,355,395**	**1,363,585**	**1,366,773**	**1,370,704**	**1,373,059**	**1,373,612**	**1,374,602**	**1,376,167**

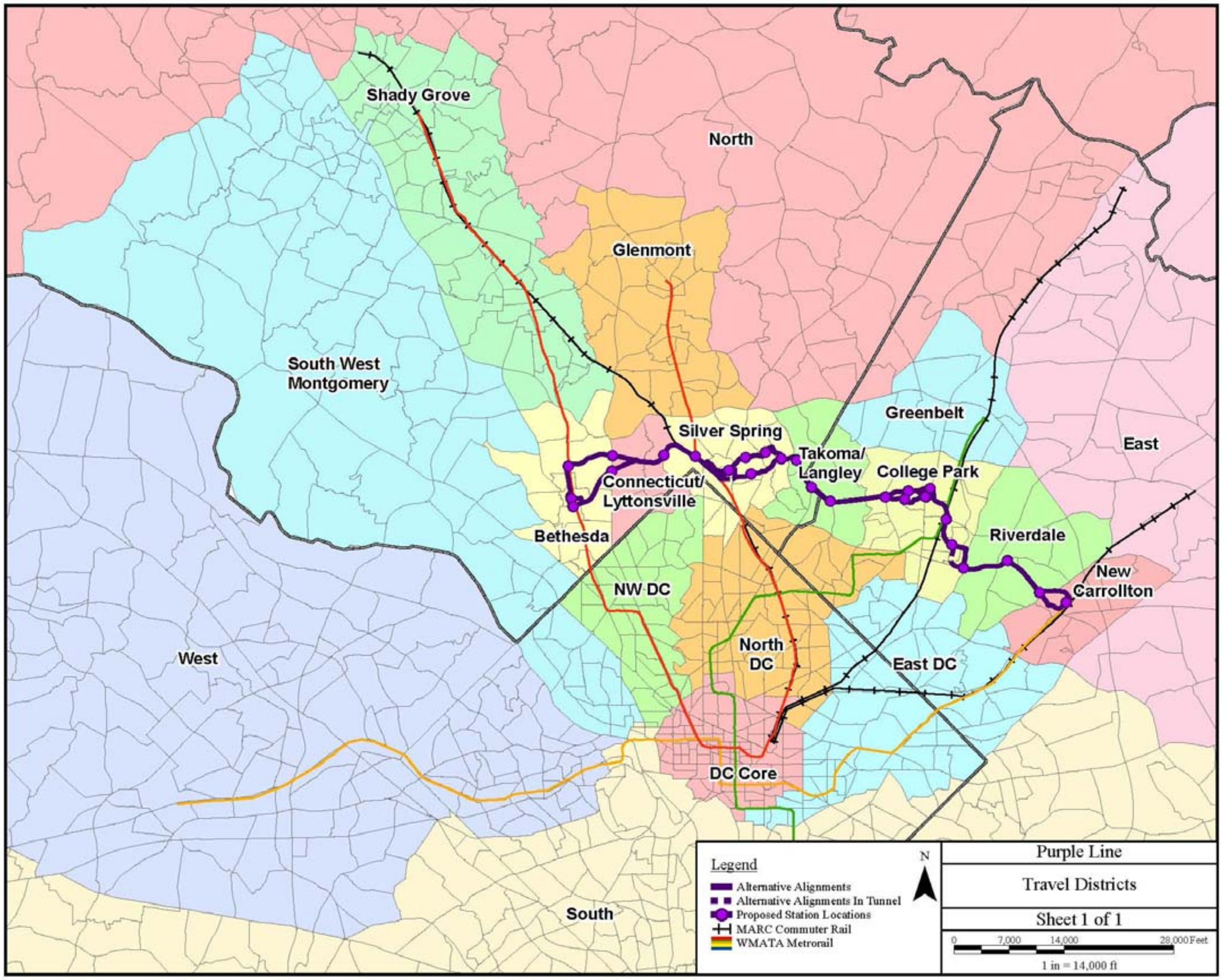


Figure 2-2: Travel Districts

What this information shows is that while there is quite a bit of existing transit travel within the Purple Line corridor, that number of corridor trips associated with areas outside the corridor is greater, i.e., corridor trips associated with Washington, DC and the area north along the Metrorail Red, Green, and Orange Lines that run through the major activity centers, especially up toward the Shady Grove-Rockville area and Glenmont area. While the major activity center districts account for the majority of the trips, a substantial number of trips are associated with the wedge districts, those areas not presently served by Metrorail and dependent on street-running bus service operating in congested mixed traffic, are linked with either one of the major activity centers or areas reachable via the Metrorail system, especially Washington, DC.

By the year 2030, daily transit trips are forecast to grow by 953,000, 52%, for a total of 2,711,000. Transit trips associated with the corridor will grow by 38%, to 234,000, while trips within the corridor will grow by 43% to 62,000 trips. While the general pattern and distribution of these transit trips would be similar to current trips, the level of growth is substantial, increasing the severity and the magnitude of the mobility needs of Purple Line corridor travelers.

The TSM Alternative would increase daily total transit trips by 16,000 over the 2030 Future No Build. Of these new transit trips, 13,200, over 80%, are between the corridor and areas outside the corridor; while the other 2,800 trips are within the corridor. The TSM alternative provides most of the benefits to corridor trips to access the transit services that connect with the rest of the region; rather than travel among districts within the corridor.

All the Build Alternatives have a similar pattern of change in the travel patterns, but because they have a similar alignment and station definitions and vary primarily by travel times, have different amount of new transit trips with High Investment LRT generating the highest number of new transit trips, and Low Investment BRT generating the lowest.

2.5.5. Daily Line Haul Boardings

Table 2-9 shows the total daily boardings for each of the alternatives. A boarding is when a person uses the transit service for all or part of trip. The boardings are shown for trips only using the Purple Line (over half the boardings), trips primarily on Metrorail and using the Purple Line for part of that trip, and trips primarily on MARC and using the Purple Line for part of that trip. High Investment LRT attracts the highest number of boardings followed by the other LRT alternatives and then the BRT alternatives.

Table 2-9: Year 2030 Daily Purple Line Ridership

Transit Ridership (daily boardings)	TSM	Low Invest. BRT	Medium Invest. BRT	High Invest. BRT	Low Invest. LRT	Medium Invest. LRT	High Invest. LRT
Purple Line	12,700	22,200	29,300	33,800	32,500	33,900	36,100
Purple Line via Metrorail	2,100	16,700	21,100	23,700	25,300	27,200	30,500
Purple Line via MARC	--	1,100	1,400	1,400	1,500	1,500	1,500
Total	**14,800**	**40,000**	**51,800**	**58,900**	**59,300**	**62,600**	**68,100**
New Transit Trips Relative to No Build	**8,200**	**11,400**	**15,300**	**17,700**	**18,200**	**19,200**	**20,500**

2.5.6. Daily Station Boardings

Daily boardings, by station, for each of the Build Alternatives are shown in Table 2-10. Not surprisingly, the highest number of riders is attracted by the High Investment LRT Alternative, followed by the Medium Investment LRT Alternative, and the Low Investment LRT and High Investment BRT, which attract approximately the same number of riders. All of the Build Alternatives, except the Low Investment BRT, have the same top three stations for daily boardings: the western terminus in Bethesda (north or south), the Silver Spring Transit Center, and the College Park Metro Station. For the Low Investment BRT Alternative, the top three stations for daily boardings are the Silver Spring Transit Center, US 1 and College Park Metro Station.

2.5.7. Station Mode of Access

At all the stations along the Purple Line alternatives, walk and feeder bus access would be the principal means of access and egress. At the Bethesda, Silver Spring, College Park, and New Carrollton Stations, transfer with Metrorail would be the major connection. With the exception of Bethesda, MARC connections would also be available at those stations. Major bus interfaces will occur at Bethesda, Silver Spring, Takoma/Langley, College Park, and New Carrollton stations. All these connections are with existing services. Some of the existing bus services will be modified to better integrate with the Purple Line stations. Some existing bus services that duplicate the Purple Line service may be cut back. While parking facilities exist at the four Metrorail stations that connect with the Purple Line, no new park-and-ride facilities would be provided at any of the Purple Line stations. Some kiss-and-ride could occur at some of stations, as occurs today at some bus stops, but additional kiss-and-ride facilities are being considered at Connecticut Avenue at the Georgetown Branch right-of-way, and at Lyttonsville.

Table 2-10: Year 2030 Build Alternatives Daily Boardings

Segment	TSM	Low Invest. BRT	Medium Invest. BRT	High Invest. BRT	Low Invest. LRT	Medium Invest. LRT	High Invest. LRT
Bethesda Metro, North Entrance	800	1,400	5,600	6,000	N/A	N/A	N/A
Medical Center Metro	N/A	3,900	N/A	N/A	N/A	N/A	N/A
Bethesda Metro, South Entrance	N/A	N/A	2,800	3,000	11,300	12,700	13,300
Montgomery Avenue	100	N/A	N/A	N/A	N/A	N/A	N/A
Connecticut Avenue	100	400	500	500	900	900	1000
Grubb Road	500	N/A	N/A	N/A	N/A	N/A	N/A
Lyttonsville	N/A	600	700	700	800	800	900
Woodside/16th Street	N/A	1,400	2,000	2,500	2,200	2,300	2,400
Silver Spring Transit Center	1200	5,100	8,700	10,400	11,100	12,200	13,600
Fenton Street	600	600	600	N/A	700	700	N/A
Dale Drive	500	1,200	1,300	1,400	1,300	1,400	1,500
Manchester Place	600	700	800	1,100	800	900	1,200
Arliss Street	600	800	900	1,700	1,300	1,500	2,200
Gilbert Street	300	300	900	1,300	1,200	1,200	1,400
Takoma/Langley Transit Center	1300	1,400	2,300	3,200	2,700	3,000	3,700
Riggs Road	300	400	600	800	700	800	900
Adelphi Road	400	500	600	700	600	700	700
UM Campus Center	600	1,500	2,100	2,200	2,100	2,200	2,200
US 1 – East Campus	700	4,400	4,400	4,700	4,500	4,500	4,700
College Park Metro	2400	8,000	8,600	9,100	8,600	8,600	8,900
River Road	500	1,500	1,500	1,500	1,500	1,500	1,500
Riverdale Park	600	1,400	1,500	1,600	1,600	1,500	1,600
Riverdale Road	500	500	500	700	600	500	700
Annapolis Road	500	900	1,100	1,200	1,000	1,000	1,200
New Carrollton Metro	1,700	3,100	3,800	4,500	3,800	3,700	4,500
Total Boardings	**14,800**	**40,000**	**51,800**	**58,800**	**59,300**	**62,600**	**68,100**

2.5.8. University of Maryland Student Travel

The travel of University of Maryland employees, faculty, and staff to and from the campus is captured within the regional travel model forecasts and these trips are included in the forecasts for the Purple Line. Many of the 36,000 students live on campus or in nearby housing within walking distance of the campus. Others live off campus and commute to school. These trips are not as concentrated in the peak periods as employee trips and are not as regular, given that the university is not in full session over the summer and various break periods.

A portion of these commuting students would use the UM shuttle, TheBus and WMATA bus services. The UM Shuttle does provide connecting services to the College Park Metrorail Station and downtown Silver Spring, including the Metrorail station.

On-campus students also use the existing bus services to access off-campus destinations, including the College Park and Silver Spring Metro Stations. Many of these trips again occur outside the normal commuting peak periods – in evenings and on weekends. The UM Shuttle provides a regular and relatively frequent service between the campus and the College Park Metrorail station throughout most of the day, carrying about 3,000 trips on a typical day. The service connecting with Silver Spring carries about 500 trips on a typical day. According to the Shuttle operator, approximately half of the users are students, or about 1,700 per day. With the Purple Line in place, these shuttle services would be discontinued or re-routed and these 1,700 would likely use the Purple Line. Some portion of these trips is likely already included in the regional model forecasts. As noted earlier, the University faculty and staff are fully accounted for by the regional forecasting model. For the purposes of the comparison of the alternatives, the analysis assumes that these trips are included in the regional forecasts and would be similar across all the alternatives.

For the travel forecast for the further development of the Locally Preferred Alternative, a separate student trip purpose forecast will be developed.

2.5.9. Special Event and Special Generators Trips

Venues such as sport stadiums and arenas and events such as major festival or holiday fireworks displays generate trips that may not be included in the regional travel forecasting process. Washington, DC is the site of many of special events and special generators that occur with enough regularity and frequency that these are included in the regional model forecasts. Within the corridor, the principal special event and special trip generator venue is the University of Maryland campus in College Park, with Byrd Stadium, Comcast Center, and Clarice Smith Performing Arts Center. Byrd Stadium seats 50,000 people and hosts five to seven home weekend football games annually. The UM Shuttle carries a total of 2,000-3,000 trips (i.e. 1,000 to 1,500 individuals) for each game. This would mean that between 2 and 3 percent of the total attendance uses the Shuttle. For basketball, soccer, lacrosse, field hockey, and events at the Clarice Smith Performing Arts Center, shuttle ridership is relatively low. While the University of Maryland does not have actual records, on an annual basis the total number of special event and special generator trips on the Shuttle is between 40,000 to 50,000. Not all these trips would be candidates for the Purple Line; however, the Purple Line could make using transit for these types of trips associated with the University of Maryland more attractive, especially if the Purple Line is centrally located on Campus Drive.

Most of these trips will be outside the normal weekday peak period, being on weekday evenings and on weekends. Averaging out over a typical weekday, these trips would represent about 170 trips, which is less than one percent of the daily usage of the Purple Line alternatives. So, while the Purple Line would provide an improved and attractive means of accessing the events at the University of Maryland and other venues, the amount will be a relatively small compared to the total usage.

2.5.10. Transportation System User Benefits

Transportation system user benefit is a measure of benefits that would accrue to users of the transportation system as a result of implementing an alternative. The users include both existing system users such as existing transit riders who might benefit from a faster trip or more convenient access to the service, as well as new transit users. These benefits include both time and monetary costs and are expressed in terms of minutes saved. The user benefit is calculated within the region's mode choice model for all alternatives and uses a measure of the traveler's value of time to convert monetary and other costs to their equivalence in time, which is added to actual time savings. Additional user benefits can accrue to users of fixed guideway transit services due to attributes of these systems not reflected strictly in terms of travel times and out-of-pocket costs. These are referred to as "mode specific attributes" and account for perceived benefits that users feel they receive for amenity, comfort, reliability, safety and other characteristics associated with the mode. The degree to which these additional benefits accrue to the users depends on the definitions of the alternatives. These would accrue to all the BRT and LRT alternative users to varying degrees depending on the specific attributes of the alternative. In this way, the measure includes a more comprehensive accounting of the total costs of travel.

Table 2-11 shows the total user benefits for the TSM and each of the Build Alternatives. As the table shows, the TSM alternative would generate more than 400,000 minutes of user benefit (about 6,700 hours) to travelers in the Washington metropolitan area each day. All of the Build Alternatives would generate higher user benefits than the TSM. The Low Investment BRT alternative would offer 75 percent more user benefits than the TSM, while the High Investment LRT Alternative would generate 271% more user benefits over the TSM alternative.

Table 2-11: Year 2030 Daily Transportation System User Benefits with Mode Specific Attributes

	Daily User Benefits (minutes)	Increase in Daily User Benefits over TSM (minutes)	Percent over TSM
TSM	401,200	--	--
Low Investment BRT	702,300	301,100	75%
Medium Investment BRT	1,022,200	621,000	155%
High Investment BRT	1,258,000	856,800	214%
Low Investment LRT	1,180,600	779,400	194%
Medium Investment LRT	1,303,800	902,600	225%
High Investment LRT	1,489,600	1,088,400	271%

2.5.11. Farebox Revenue

Farebox revenues are those that are collected from passengers using the transit services for making trips. People use a variety of means to pay fares, including cash, tokens, passes, and electronic farecards. Passes and farecards for multi-trip, or weekly and monthly periods are typically purchased at a discount. Fares revenues include both fares at the initial boarding of the trip as well any transfer costs. The Purple Line corridor has a number of transit operators including WMATA, MARC, Ride On, and TheBus. For the purposes of this analysis, the operator of the Purple Line would be the MTA.

With the increase in systemwide transit users forecasted for the alternatives, the increase in systemwide farebox revenues relative to the 2030 No Build are presented in Table 2-12.

Table 2-12: Year 2030 Annual Change in Systemwide Farebox Revenues by Alternative Relative to No Build

Alternative	Annual Change
TSM	$3,423,000
Low Investment BRT	$5,829,000
Medium Investment BRT	$7,500,000
High Investment BRT	$8,452,000
Low Investment LRT	$8,921,000
Medium Investment LRT	$9,3556,000
High Investment LRT	$10,167,000

3. Supplemental Forecast Input and Results by Alternative

The following section provides for each alternative further information and assumptions used as input to the travel forecasts, as well as more detailed forecasts results which supplement the information provided in the previous section.

3.1. No Build

3.1.1. Assumptions

The 2030 No Build network consisted of the Metropolitan Washington Council of Governments (MWCOG) officially adopted 2030 network as provided in the MWCOG model version 2.1D#50 with the following changes:

- Zone realignments and subdivisions in Montgomery County and the requisite network changes,
- Network corrections as identified by Michael Baker Corporation in conjunction with Montgomery County,
- Removal of the CCT transit network coding from the Long Range Plan
- Removal of the Anacostia LRT

Table 3-1: Year 2030 Trips (Linked) by Transit Mode – No Build

Access Mode	HBW-PK	HBW-OP	HBO-PK	HBO-OP	NHB-PK	NHB-OP	TOTAL
Bus							
Walk	149,006	63,632	83,804	49,107	42,604	26,249	414,402
Park-n-Ride	14,278	788	1,784	1,447	2,030	750	21,077
Kiss-n-Ride	7,057	1,378	1,988	998	724	262	12,407
Total	*170,341*	*65,798*	*87,576*	*51,552*	*45,358*	*27,261*	*447,886*
Metrorail							
Walk	252,173	68,182	50,200	53,765	64,583	67,272	556,175
Park-n-Ride	162,233	24,855	11,619	16,206	10,014	9,191	234,118
Kiss-n-Ride	46,628	7,043	2,890	3,161	5,593	3,957	69,272
Total	*461,034*	*100,080*	*64,709*	*73,132*	*80,190*	*80,420*	*859,565*
Commuter Rail							
Walk	5,596	322	0	0	0	0	5,918
Park-n-Ride	37,439	866	0	0	0	0	38,305
Kiss-n-Ride	3,591	130	0	0	0	0	3,721
Total	*46,626*	*1,318*	*0*	*0*	*0*	*0*	*47,944*
TOTAL	**678,001**	**167,196**	**152,285**	**124,684**	**125,548**	**107,681**	**1,355,395**

Table 3-2: Year 2030 Background Buses (Total Boardings) – No Build

Route	Boardings
C02	5,960
C04	3,952
F04	5,877
F06	3,701
GO1	85
J01	9,514
J02	6,996
J03	1,924
O1	3,244

Table 3-3: Year 2030 Metrorail (Boardings in Corridor Stations) – No Build

Station	Boardings
Bethesda	18,108
College Park	5,610
Medical Center	10,169
New Carrollton	8,105
Silver Spring	21,384

Table 3-4: Year 2030 Commuter Rail (Boardings in Corridor Stations) – No Build

Station	Boardings
College Park	225
New Carrollton	12
Silver Spring	335

3.2. TSM

Table 3-5: Coding Assumptions - TSM

Assumptions (min.) -- Headway: pk=6, op=12 Runtime: pk=71, op=66

Station	Headed to:	Anode	Bnode	Miles	Time	Speed
Bethesda North	Montgomery Ave.	3048	3079	0.36	3.4	6.4
Montgomery Ave.	Conn. Ave.	3079	3081	0.61	6.4	5.7
Conn. Ave.	Grubb Road	3081	3090	1.52	6.8	13.4
Grubb Road	Silver Spring T.C.	3093	3101	1.41	12.7	6.7
Silver Spring T.C.	Fenton St.	19028	19027	0.43	4.6	5.6
Fenton St.	Sligo Creek Parkway	3179	3109	0.87	4.8	10.9
Sligo Creek Parkway	Piney Branch & Arliss St.	3132	3080	0.74	2.9	15.3
Piney Branch & Arliss St.	Piney Branch & University	3138	3135	0.20	4.9	2.4
Piney Branch & University	University & Carroll Ave.	3135	3137	0.39	6.6	3.5
University & Carroll Ave.	Takoma/Langley T.C.	3137	3146	0.49	4.8	6.1
Takoma/Langley T.C.	Riggs Rd.	4005	4017	0.57	5.8	5.9
Riggs Rd.	Adelphi Rd.	4016	4029	1.27	6.0	12.7
Adelphi Rd.	UMD Campus Center	4049	4979	0.39	4.0	5.9
UMD Campus Center	UMD East	4979	4066	1.02	8.6	7.1
UMD East	College Park	4066	4082	1.10	2.0	33.0
College Park	River Rd.	4083	4090	0.84	2.0	25.2
River Rd.	Riverdale Park	4090	4091	0.43	5.5	4.7
Riverdale Park	Riverdale Road	4091	4103	0.96	4.4	13.1
Riverdale Road	Annapolis Rd.	4130	4129	1.47	4.7	18.8
Annapolis Rd.	New Carrollton	4135	4126	0.90	4.6	11.7

Table 3-6: Year 2030 Trips (Linked) by Transit Mode – TSM

Access Mode	HBW-PK	HBW-OP	HBO-PK	HBO-OP	NHB-PK	NHB-OP	TOTAL
Bus							
Walk	152,024	63,364	86,292	48,812	43,826	26,006	420,325
Park-n-Ride	14,469	767	1,779	1,428	1,985	723	21,151
Kiss-n-Ride	6,856	1,393	1,997	999	676	248	12,169
Total	*173,349*	*65,524*	*90,068*	*51,239*	*46,487*	*26,978*	*453,645*
Metrorail							
Walk	253,357	69,223	52,739	52,770	64,210	69,210	561,508
Park-n-Ride	158,630	25,633	11,905	16,041	10,051	8,542	230,802
Kiss-n-Ride	46,343	6,854	2,826	3,093	5,648	3,884	68,648
Total	*458,330*	*101,710*	*67,470*	*71,903*	*79,909*	*81,635*	*860,958*
Commuter Rail							
Walk	8,081	250	0	0	0	0	8,331
Park-n-Ride	36,440	707	0	0	0	0	37,147
Kiss-n-Ride	3,402	104	0	0	0	0	3,505
Total	*47,922*	*1,061*	*0*	*0*	*0*	*0*	*48,983*
TOTAL	**679,602**	**168,295**	**157,538**	**123,143**	**126,396**	**108,613**	**1,363,586**

Table 3-7: User Benefits - TSM

Description	HBW-PK	HBW-OP	HBO-PK	HBO-OP	NHB-PK	NHB-OP	TOTAL
Total User Benefits	38,444	200,665	11,940	121,813	5,122	37,040	415,024
Capped User Benefits	37,783	196,711	9,236	116,416	4,930	36,373	401,449
Percent of Total	9.4%	49.0%	2.3%	29.0%	1.2%	9.1%	100.0%
Percent Capped	1.7%	2.0%	22.6%	4.4%	3.7%	1.8%	3.3%

Table 3-8: Year 2030 Background Buses (Total Boardings) - TSM

Route	Boardings
C02	4,952
C04	3,860
F04	4,506
F06	2,837
GO17	64
J01	9,313
J02	5,765
J03	1,821

Table 3-9: Year 2030 Metrorail (Boardings in Corridor Stations) - TSM

Station	Boardings
Bethesda	18,373
College Park	5,266
Medical Center	10,200
New Carrollton	7,969
Silver Spring	20,869

Table 3-10: Year 2030 Commuter Rail (Boardings in Corridor Stations) - TSM

Station	Boardings
College Park	21
New Carrollton	12
Silver Spring	331

3.3. Low Investment BRT

Table 3-11: Coding Assumptions - Low Investment BRT

Assumptions (min.) -- Headway: pk=6, op=12 Runtime: 73

Station	Headed to:	Anode	Bnode	Miles	Time	Speed
Bethesda North	Medical Center	7681	7682	0.82	4.7	10.5
Medical Center	Connecticut Avenue North	7682	7661	1.15	6.0	11.5
Connecticut Avenue North	Lyttonsville	7661	7662	1.29	5.2	14.9
Lyttonsville	16th Street	7662	7663	0.77	2.4	19.3
16th Street	SSTC North	7663	7664	0.69	6.2	6.7
SSTC North	Fenton Street North	7664	7665	0.24	4.6	3.1
Fenton Street North	Dale Drive	7665	7666	0.55	2.8	11.8
Dale Drive	Manchester Place	7666	7683	0.53	2.3	13.8
Manchester Place	Arliss Street	7683	7667	0.43	4.8	5.4
Arliss Street	Gilbert Street	7667	7668	0.37	6.6	3.4
Gilbert Street	Takoma Langley Transit Ctr	7668	7670	0.77	4.8	9.6
Takoma Langley Transit Ctr	Riggs Road	7670	7671	0.6	5.6	6.4
Riggs Road	Adelphi Road	7671	7672	1.38	5.7	14.5
Adelphi Road	U of MD Campus Center	7672	7673	0.59	3.7	9.6
U of MD Campus Center	U of MD Route 1	7673	7674	0.55	8.6	3.8
U of MD Route 1	College Park - U of MD [East]	7674	7675	0.87	2.2	23.7
College Park - U of MD [East]	River Road	7675	7676	0.72	1.8	24.0
River Road	Riverdale Park	7676	7677	0.58	5.4	6.4
Riverdale Park	Riverdale Road	7677	7678	1.12	4.0	16.8
Riverdale Road	Annapolis Road	7678	7679	1.14	4.0	17.1
Annapolis Road	New Carrollton	7679	7680	0.81	4.4	11.0

Table 3-12: Year 2030 Trips (Linked) by Transit Mode - Low Investment BRT

Access Mode	HBW-PK	HBW-OP	HBO-PK	HBO-OP	NHB-PK	NHB-OP	TOTAL
Bus							
Walk	147,059	58,781	84,118	45,717	42,889	24,871	403,435
Park-n-Ride	14,312	767	1,768	1,386	1,968	711	20,911
Kiss-n-Ride	6,785	1,393	1,985	973	670	244	12,050
Total	*168,155*	*60,941*	*87,872*	*48,076*	*45,527*	*25,826*	*436,396*
Metrorail							
Walk	254,149	67,605	52,936	52,809	64,817	69,288	561,603
Park-n-Ride	157,653	25,666	11,534	15,697	9,984	8,428	228,962
Kiss-n-Ride	46,226	6,849	2,788	3,077	5,661	3,891	68,492
Total	*458,028*	*100,120*	*67,257*	*71,583*	*80,463*	*81,606*	*859,057*
Commuter Rail							
Walk	6,713	3,760	3,261	1,917	1,148	831	17,630
Park-n-Ride	2,382	739	662	462	133	105	4,482
Kiss-n-Ride	185	47	26	5	16	5	285
Total	*9,280*	*4,547*	*3,949*	*2,383*	*1,297*	*941*	*22,397*
BRT							
Walk	6,713	3,760	3,261	1,917	1,148	831	17,630
Park-n-Ride	2,382	739	662	462	133	105	4,482
Kiss-n-Ride	185	47	26	5	16	5	285
Total	*9,280*	*4,547*	*3,949*	*2,383*	*1,297*	*941*	*22,397*
Total	**683,393**	**166,599**	**159,078**	**122,043**	**127,287**	**108,373**	**1,366,773**

Table 3-13: Year 2030 Boardings (Station to Station) - Low Investment BRT

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Total
1: Bethesda No	0	283	88	42	102	568	9	68	48	124	21	60	10	5	3	4	0	0	0	0	0	0	**1,435**
2: Medical CTR	283	0	214	153	455	1,710	44	237	162	350	61	185	23	11	11	3	0	1	1	0	0	0	**3,904**
3: Conn Ave	88	214	0	5	25	86	1	6	3	6	1	3	0	0	0	0	0	0	0	0	0	0	**438**
4: Lyttonsville	42	153	5	0	10	294	4	12	9	23	4	10	2	1	2	4	0	1	2	0	1	1	**580**
5: 16th Street	102	455	25	10	0	654	4	41	24	44	7	29	4	4	10	12	0	2	4	1	2	3	**1,437**
6: SSTC No	568	1,710	86	294	654	0	384	706	302	175	13	84	3	8	10	0	0	0	0	0	0	0	**4,997**
7: Fenton St	9	44	1	4	4	384	0	11	53	27	8	68	1	9	7	3	0	0	0	0	0	0	**633**
8: Dale Drive	68	237	6	12	41	706	11	0	0	6	2	20	4	3	10	18	1	2	2	0	0	5	**1,154**
9: Manchester Pl	48	162	3	9	24	302	53	0	0	0	0	24	4	4	11	18	2	1	1	0	0	6	**672**
10: Arliss Street	124	350	6	23	44	175	27	6	0	0	0	16	7	4	15	21	4	3	3	1	1	9	**839**
11: Gilbert St	21	61	1	4	7	13	8	2	0	0	0	26	5	7	25	37	20	7	5	1	2	24	**276**
12: Takoma/Langley	60	185	3	10	29	84	68	20	24	16	26	0	17	61	119	201	239	34	28	10	18	121	**1,373**
13: Riggs Rd	10	23	0	2	4	3	1	4	4	7	5	17	0	24	46	93	23	15	10	2	6	49	**348**
14: Adelphi Rd	5	11	0	1	4	8	9	3	4	4	7	61	24	0	0	32	280	8	12	4	7	37	**521**
15: UMD Center	3	11	0	2	10	10	7	10	11	15	25	119	46	0	0	79	875	24	46	9	26	160	**1,488**
16: UMD US 1	4	3	0	4	12	0	3	18	18	21	37	201	93	32	79	0	2,953	109	138	40	88	539	**4,392**
17: College Park	0	0	0	0	0	0	0	1	2	4	20	239	23	280	875	2,953	0	983	858	250	324	1,104	**7,916**
18: River Rd	0	1	0	1	2	0	0	2	1	3	7	34	15	8	24	109	983	0	12	15	27	203	**1,447**
19: Riverdale Park	0	1	0	2	4	0	0	2	1	3	5	28	10	12	46	138	858	12	0	17	22	279	**1,440**
20: Riverdale Rd	0	0	0	0	1	0	0	0	0	1	1	10	2	4	9	40	250	15	17	0	6	149	**505**
21: Annapolis Rd	0	0	0	1	2	0	0	0	0	1	2	18	6	7	26	88	324	27	22	6	0	407	**937**
22: New Carrollton	0	0	0	1	3	0	0	5	6	9	24	121	49	37	160	539	1,104	203	279	149	407	0	**3,096**
Total	**1,435**	**3,904**	**438**	**580**	**1,437**	**4,997**	**633**	**1,154**	**672**	**839**	**276**	**1,373**	**348**	**521**	**1,488**	**4,392**	**7,916**	**1,447**	**1,440**	**505**	**937**	**3,096**	**39,828**

Table 3-14: Year 2030 User Benefits - Low Investment BRT

Description	HBW-PK	HBW-OP	HBO-PK	HBO-OP	NHB-PK	NHB-OP	TOTAL
Total User Benefits	268,103	(76,643)	80,937	(45,684)	37,204	(8,105)	255,812
Capped User Benefits	261,168	(81,125)	71,934	(55,489)	35,235	(9,237)	222,486
Percent of Total	117.4%	-36.5%	32.3%	-24.9%	15.8%	-4.2%	100.0%
Percent Capped	2.6%	0.0%	11.1%	0.0%	5.3%	0.0%	13.0%

Table 3-15: Year 2030 Background Buses (Total Boardings) – Low Investment BRT

Route	Boardings
C02	5,058
C04	3,805
F04	3,375
F06	1,871
GO17	33
J01	8,820
J02	6,062
J03	1,773

Table 3-16: Year 2030 Metrorail (Boardings in Corridor Stations) – Low Investment BRT

Station	Boardings
Bethesda	17,313
College Park	9,938
Medical Center	12,431
New Carrollton	8,359
Silver Spring	20,779

Table 3-17: Year 2030 Commuter Rail (Boardings in Corridor Stations) – Low Investment BRT

Station	Boardings
College Park	65
New Carrollton	14
Silver Spring	315

3.4. Medium Investment BRT

Table 3-18: Coding Assumptions - Medium Investment BRT

Assumptions (min.) -- Headway: pk=6, op=12 Runtime: 64

Station	Headed to:	Anode	Bnode	Miles	Time	Speed
Bethesda North	Bethesda South	7681	7660	0.21	5.2	2.4
Bethesda South	Connecticut Avenue South	7660	7685	1.31	5.5	14.3
Connecticut Avenue South	Lyttonsville	7685	7662	1.37	3.1	26.5
Lyttonsville	16th Street	7662	7663	0.77	2.4	19.3
16th Street	SSTC South	7663	7686	0.65	2.1	18.6
SSTC South	Fenton Street North	7686	7665	0.33	3.1	6.4
Fenton Street North	Dale Drive	7665	7666	0.55	3.0	11.0
Dale Drive	Manchester Place	7666	7683	0.53	2.3	13.8
Manchester Place	Arliss Street	7683	7667	0.43	4.7	5.5
Arliss Street	Gilbert Street	7667	7668	0.37	3.4	6.5
Gilbert Street	Takoma Langley Transit Ctr	7668	7670	0.77	2.3	20.1
Takoma Langley Transit Ctr	Riggs Road	7670	7671	0.6	2.7	13.3
Riggs Road	Adelphi Road	7671	7672	1.38	5.6	14.8
Adelphi Road	U of MD Campus Center	7672	7673	0.59	2.9	12.2
U of MD Campus Center	East Campus	7673	7689	0.53	3.0	10.6
East Campus	College Park - U of MD [West]	7689	7690	0.76	3.0	15.2
College Park - U of MD [West]	River Road	7690	7676	0.7	1.9	22.1
River Road	Riverdale Park	7676	7677	0.58	4.3	8.1
Riverdale Park	Riverdale Road	7677	7678	1.12	4.7	14.3
Riverdale Road	Annapolis Road	7678	7679	1.14	3.6	19.0
Annapolis Road	New Carrollton	7679	7680	0.81	3.8	12.8

Table 3-19: Year 2030 Trips (Linked) by Transit Mode - Medium Investment BRT

Access Mode	HBW-PK	HBW-OP	HBO-PK	HBO-OP	NHB-PK	NHB-OP	TOTAL
Bus							
Walk	145,548	58,229	83,603	45,440	42,530	24,699	400,049
Park-n-Ride	14,213	765	1,766	1,384	1,942	710	20,779
Kiss-n-Ride	6,741	1,390	1,982	972	663	244	11,992
Total	*166,502*	*60,384*	*87,350*	*47,795*	*45,135*	*25,654*	*432,820*
Metrorail							
Walk	254,633	67,588	52,976	52,888	65,358	69,563	563,005
Park-n-Ride	157,432	25,594	11,433	15,514	10,031	8,366	228,371
Kiss-n-Ride	46,209	6,844	2,789	3,090	5,670	3,905	68,506
Total	*458,274*	*100,025*	*67,197*	*71,493*	*81,058*	*81,835*	*859,882*
Commuter Rail							
Walk	8,128	205	0	0	0	0	8,333
Park-n-Ride	36,411	684	0	0	0	0	37,095
Kiss-n-Ride	3,408	101	0	0	0	0	3,510
Total	*47,947*	*990*	*0*	*0*	*0*	*0*	*48,937*
BRT							
Walk	8,965	4,796	4,299	2,570	1,381	1,109	23,120
Park-n-Ride	3,011	834	781	574	257	140	5,596
Kiss-n-Ride	236	54	31	6	15	6	349
Total	*12,212*	*5,684*	*5,111*	*3,150*	*1,653*	*1,255*	*29,064*
TOTAL	**684,935**	**167,083**	**159,659**	**122,438**	**127,846**	**108,743**	**1,370,703**

Table 3-20: Year 2030 Boardings (Station to Station) - Medium Investment BRT

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Total
1: Bethesda No	0	121	56	72	363	3,175	58	302	238	426	182	327	94	21	19	41	2	8	15	4	8	0	**5,532**
2: Bethesda So	121	0	102	112	186	1,605	20	55	18	35	9	43	5	5	36	33	0	2	0	0	0	1	**2,388**
3: Conn Ave	56	102	0	11	29	287	3	34	23	27	26	37	10	4	7	15	0	1	1	0	0	1	**674**
4: Lyttonsville	72	112	11	0	9	377	6	17	11	19	12	16	4	2	4	7	0	1	2	0	2	4	**688**
5: 16th St	363	186	29	9	0	987	11	61	29	41	31	46	11	6	19	31	1	3	5	2	2	12	**1,885**
6: SSTC So	3,175	1,605	287	377	987	126	390	719	345	143	114	226	30	32	51	46	0	2	3	1	2	10	**8,671**
7: Fenton St	58	20	3	6	11	390	0	11	23	5	14	36	6	4	3	13	0	2	1	0	1	3	**610**
8: Dale Drive	302	55	34	17	61	719	11	0	0	5	5	26	6	5	12	25	5	2	3	0	1	10	**1,304**
9: Manchester Pl	238	18	23	11	29	345	23	0	0	0	3	30	7	5	14	28	9	2	2	0	1	11	**799**
10: Arliss St	426	35	27	19	41	143	5	5	0	0	0	41	13	8	23	43	25	5	5	1	2	20	**887**
11: Gilbert St	182	9	26	12	31	114	14	5	3	0	0	41	9	12	49	143	88	20	15	4	9	81	**867**
12: Takoma/Langley	327	43	37	16	46	226	36	26	30	41	41	0	44	64	148	322	582	43	41	13	25	174	**2,325**
13: Riggs Rd	94	5	10	4	11	30	6	6	7	13	9	44	0	22	60	98	65	14	12	3	7	54	**574**
14: Adelphi Rd	21	5	4	2	6	32	4	5	5	8	12	64	22	0	0	55	305	9	14	4	8	47	**632**
15: UMD	19	36	7	4	19	51	3	12	14	23	49	148	60	0	0	123	1,157	28	58	14	32	205	**2,062**
16: East Campus	41	33	15	7	31	46	13	25	28	43	143	322	98	55	123	0	2,492	99	129	39	89	552	**4,423**
17: College Park	2	0	0	0	1	0	0	5	9	25	88	582	65	305	1,157	2,492	25	950	861	252	344	1,370	**8,533**
18: River Rd	8	2	1	1	3	2	2	2	2	5	20	43	14	9	28	99	950	12	13	15	28	218	**1,477**
19: Riverdale Park	15	0	1	2	5	3	1	3	2	5	15	41	12	14	58	129	861	13	0	16	22	298	**1,516**
20: Riverdale Rd	4	0	0	0	2	1	0	0	0	1	4	13	3	4	14	39	252	15	16	0	6	153	**527**
21: Annapolis Rd	8	0	0	2	2	2	1	1	1	2	9	25	7	8	32	89	344	28	22	6	0	391	**980**
22: New Carrollton	0	1	1	4	12	10	3	10	11	20	81	174	54	47	205	552	1,370	218	298	153	391	135	**3,750**
Total	**5,532**	**2,388**	**674**	**688**	**1,885**	**8,671**	**610**	**1,304**	**799**	**887**	**867**	**2,325**	**574**	**632**	**2,062**	**4,423**	**8,533**	**1,477**	**1,516**	**527**	**980**	**3,750**	**51,104**

Table 3-21: Year 2030 User Benefits - Medium Investment BRT

Description	HBW-PK	HBW-OP	HBO-PK	HBO-OP	NHB-PK	NHB-OP	TOTAL
Total User Benefits	383,142	(41,805)	112,277	(26,406)	62,354	6,416	495,978
Capped User Benefits	373,866	(47,668)	98,315	(39,128)	59,703	4,985	450,073
Percent of Total	83.1%	-10.6%	21.8%	-8.7%	13.3%	1.1%	100.0%
Percent Capped	2.4%	0.0%	12.4%	0.0%	4.3%	22.3%	9.3%

Table 3-22: Year 2030 Background Buses (Total Boardings) – Medium Investment BRT

Route	Boardings
C02	4,857
C04	3,716
F04	3,133
F06	1,838
GO17	33
J01	8,295
J02	5,147
J03	1,574

Table 3-23: Year 2030 Metrorail (Boardings in Corridor Stations) – Medium Investment BRT

Station	Boardings
Bethesda	20,920
College Park	10,271
Medical Center	10,577
New Carrollton	8,248
Silver Spring	20,890

Table 3-24: Year 2030 Commuter Rail (Boardings in Corridor Stations) - Medium Investment BRT

Station	Boardings
College Park	77
New Carrollton	16
Silver Spring	299

3.5. High Investment BRT

Table 3-25: Coding Assumptions - High Investment BRT

Assumptions (min.) -- Headway: pk=6, op=12 Runtime: 57

Station	Headed to:	Anode	Bnode	Miles	Time	Speed
Bethesda North	Bethesda South	7681	7660	0.21	5.2	2.4
Bethesda South	Connecticut Avenue South	7660	7685	1.31	5.5	14.3
Connecticut Avenue South	Lyttonsville	7685	7662	1.37	3.1	26.5
Lyttonsville	16th Street	7662	7663	0.77	2.4	19.3
16th Street	SSTC South	7663	7686	0.65	2.1	18.6
SSTC South	Dale Drive	7686	7666	0.88	3.6	14.7
Dale Drive	Manchester Place	7666	7683	0.53	2.1	15.1
Manchester Place	Arliss Street	7683	7667	0.43	1.4	18.4
Arliss Street	Gilbert Street	7667	7668	0.37	4.0	5.6
Gilbert Street	Takoma Langley Transit Ctr	7668	7670	0.77	2.2	21.0
Takoma Langley Transit Ctr	Riggs Road	7670	7671	0.6	1.7	21.2
Riggs Road	Adelphi Road	7671	7672	1.38	3.1	26.7
Adelphi Road	U of MD Campus Center	7672	7673	0.59	2.6	13.6
U of MD Campus Center	East Campus	7673	7689	0.53	2.9	11.0
East Campus	College Park - U of MD [West]	7689	7690	0.76	3.0	15.2
College Park - U of MD [West]	River Road	7690	7676	0.7	1.9	22.1
River Road	Riverdale Park	7676	7677	0.58	3.2	10.9
Riverdale Park	Riverdale Road	7677	7678	1.12	2.9	23.2
Riverdale Road	Annapolis Road	7678	7679	1.14	3.5	19.5
Annapolis Road	New Carrollton	7679	7680	0.81	3.5	13.9

Table 3-26: Year 2030 Trips (Linked) - High Investment BRT

Access Mode	HBW-PK	HBW-OP	HBO-PK	HBO-OP	NHB-PK	NHB-OP	TOTAL
Bus							
Walk	44,941	57,950	83,323	45,304	42,456	24,668	398,641
Park-n-Ride	14,194	764	1,763	1,383	1,940	710	20,754
Kiss-n-Ride	6,733	1,388	1,979	9711	662	244	11,978
Total	*165,868*	*60,102*	*87,065*	*47,658*	*45,058*	*25,622*	*431,373*
Metrorail							
Walk	254,448	67,399	52,979	52,985	65,394	69,595	562,800
Park-n-Ride	157,256	25,547	11,451	15,579	10,039	8,371	228,243
Kiss-n-Ride	46,182	6,836	2,789	3,091	5,672	3,907	68,477
Total	*457,886*	*99,782*	*67,220*	*71,654*	*81,105*	*81,873*	*859,520*
Commuter Rail							
Walk	8,158	206	0	0	0	0	8,364
Park-n-Ride	36,424	685	0	0	0	0	37,109
Kiss-n-Ride	3,410	102	0	0	0	0	3,512
Total	*47,992*	*992*	*0*	*0*	*0*	*0*	*48,984*
BRT							
Walk	10,705	5,718	4,928	2,902	1,557	1,214	27,023
Park-n-Ride	3,154	870	790	550	282	139	5,785
Kiss-n-Ride	254	58	33	6	16	6	374
Total	*14,112*	*6,647*	*5,750*	*3,458*	*1,856*	*1,359*	*33,182*
TOTAL	**685,859**	**167,523**	**160,035**	**122,770**	**128,018**	**108,855**	**1,373,060**

Table 3-27: Year 2030 Boardings (Station to Station) - High Investment BRT

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Total
1: Bethesda No	0	121	56	72	362	3,043	315	251	739	214	389	126	33	37	91	11	20	42	15	24	20	**5,981**
2: Bethesda So	121	0	102	112	186	1,612	57	13	65	10	51	8	10	82	70	3	6	1	0	1	5	**2,515**
3: Conn Ave So	56	102	0	11	29	282	37	25	51	33	46	13	5	12	26	2	3	8	3	4	4	**752**
4: Lyttonsville	72	112	11	0	9	372	18	12	29	14	18	6	2	5	11	2	2	3	1	2	8	**709**
5: 16th St	362	186	29	9	0	978	65	30	65	37	55	16	8	25	48	7	5	7	2	4	23	**1,961**
6: SSTC So	3,043	1,612	282	372	978	510	769	620	542	346	514	120	80	193	240	4	21	26	9	16	90	**10,387**
8: Dale Drive	315	57	37	18	65	769	0	0	15	16	29	8	6	14	29	12	3	4	1	2	17	**1,417**
9: Manchester Road	251	13	25	12	30	620	0	0	0	12	33	9	6	15	32	22	3	3	1	1	16	**1,104**
10: Arliss St	739	65	51	29	65	542	15	0	0	0	40	13	10	25	56	38	6	5	1	3	26	**1,729**
11: Gilbert St	214	10	33	14	37	346	16	12	0	0	41	13	17	75	169	130	23	19	6	12	108	**1,295**
12: Takoma/Langley	389	51	46	18	55	514	29	33	40	41	0	57	76	165	365	943	50	49	18	31	242	**3,212**
13: Riggs Rd	126	8	13	6	16	120	8	9	13	13	57	0	31	60	111	120	18	19	5	12	79	**844**
14: Adelphi Rd	33	10	5	2	8	80	6	6	10	17	76	31	0	0	55	264	9	14	5	9	55	**695**
15: UM	37	82	12	5	25	193	14	15	25	75	165	60	0	0	122	986	27	56	19	35	244	**2,197**
16: East Campus	91	70	26	11	48	240	29	32	56	169	365	111	55	122	0	2,227	96	121	51	95	639	**4,654**
17: College Park	11	3	2	2	7	4	12	22	38	130	943	120	264	986	2,227	24	884	825	355	494	1,672	**9,025**
18: River Rd	20	6	3	2	5	21	3	3	6	23	50	18	9	27	96	884	12	21	16	30	272	**1,527**
19: Riverdale Park	42	1	8	3	7	26	4	3	5	19	49	19	14	56	121	825	21	0	18	24	333	**1,598**
20: Riverdale Rd	15	0	3	1	2	9	1	1	1	6	18	5	5	19	51	355	16	18	0	6	146	**678**
21: Annapolis Rd	24	1	4	2	4	16	2	1	3	12	31	12	9	35	95	494	30	24	6	0	317	**1,122**
22: New Carrollton	20	5	4	8	23	90	17	16	26	108	242	79	55	244	639	1,672	272	333	146	317	136	**4,452**
Total	**5,981**	**2,515**	**752**	**709**	**1,961**	**10,387**	**1,417**	**1,104**	**1,729**	**1,295**	**3,212**	**844**	**695**	**2,197**	**4,654**	**9,025**	**1,527**	**1,598**	**678**	**1,122**	**4,452**	57,854

Table 3-28: Year 2030 User Benefits - High Investment BRT

Description	HBW-PK	HBW-OP	HBO-PK	HBO-OP	NHB-PK	NHB-OP	TOTAL
Total User Benefits	452,969	(9,264)	132,337	(10,503)	69,041	10,483	645,063
Capped User Benefits	442,243	(15,948)	116,728	(24,370)	65,588	8,802	593,043
Percent of Total	74.6%	-2.7%	19.7%	-4.1%	11.1%	1.5%	100.0%
Percent Capped	2.4%	0.0%	11.8%	0.0%	5.0%	16.0%	8.1%

Table 3-29: Year 2030 Background Buses (Total Boardings) – High Investment BRT

Route	Boardings
C02	4,763
C04	3,589
F04	2,908
F06	1,766
GO17	32
J01	8,269
J02	5,120
J03	1,562

Table 3-30: Year 2030 Metrorail (Boardings in Corridor Stations) – High Investment BRT

Station	Boardings
Bethesda	21,288
College Park	10,468
Medical Center	10,583
New Carrollton	8,223
Silver Spring	21,262

Table 3-31: Year 2030 Commuter Rail (Boardings in Corridor Stations) - High Investment BRT

Station	Boardings
College Park	87
New Carrollton	16
Silver Spring	295

3.6. Low Investment LRT

Table 3-32: Coding Assumptions - Low Investment LRT

Assumptions (min.) -- Headway: pk=6, op=12 Runtime: 59

Station	Headed to:	Anode	Bnode	Miles	Time	Speed
Bethesda South	Connecticut Avenue South	7660	7685	1.31	4.0	19.7
Connecticut Avenue South	Lyttonsville	7685	7662	1.37	2.3	35.7
Lyttonsville	16th Street	7662	7663	0.77	2.1	22.0
16th Street	SSTC South	7663	7686	0.65	2.8	13.9
SSTC South	Fenton Street South	7686	7687	0.38	3.1	7.4
Fenton Street South	Dale Drive	7687	7666	0.51	3.8	8.1
Dale Drive	Manchester Place	7666	7683	0.53	3.1	10.3
Manchester Place	Arliss Street	7683	7667	0.43	1.4	18.4
Arliss Street	Gilbert Street	7667	7668	0.37	3.8	5.8
Gilbert Street	Takoma Langley Transit Ctr	7668	7670	0.77	2.2	21.0
Takoma Langley Transit Ctr	Riggs Road	7670	7671	0.6	2.4	15.0
Riggs Road	Adelphi Road	7671	7672	1.38	3.3	25.1
Adelphi Road	U of MD Campus Center	7672	7673	0.59	2.9	12.2
U of MD Campus Center	East Campus	7673	7689	0.53	3.0	10.6
East Campus	College Park - U of MD [West]	7689	7690	0.76	3.0	15.2
College Park - U of MD [West]	River Road	7690	7676	0.7	1.9	22.1
River Road	Riverdale Park	7676	7677	0.58	4.6	7.6
Riverdale Park	Riverdale Road	7677	7678	1.12	4.8	14.0
Riverdale Road	Annapolis Road	7678	7679	1.14	3.5	19.5
Annapolis Road	New Carrollton	7679	7680	0.81	3.9	12.5

Table 3-33: Year 2030 Trips (Linked) by Transit Mode - Low Investment LRT

Access Mode	HBW-PK	HBW-OP	HBO-PK	HBO-OP	NHB-PK	NHB-OP	TOTAL
Bus							
Walk	144,810	57,942	83,317	45,316	42,414	24,637	398,437
Park-n-Ride	14,191	765	1,765	1,384	1,942	710	20,757
Kiss-n-Ride	6,731	1,389	1,981	972	663	244	11,980
Total	*165,733*	*60,096*	*87,063*	*47,672*	*45,018*	*25,591*	*431,174*
Metrorail							
Walk	254,929	67,387	53,028	53,014	65,525	69,769	563,653
Park-n-Ride	157,506	25,576	11,487	15,586	10,064	8,398	228,617
Kiss-n-Ride	46,185	6,838	2,792	3,087	5,674	3,908	68,485
Total	*458,621*	*99,802*	*67,307*	*71,686*	*81,263*	*82,075*	*860,755*
Commuter Rail							
Walk	8,123	204	0	0	0	0	8,327
Park-n-Ride	36,413	684	0	0	0	0	37,098
Kiss-n-Ride	3,408	101	0	0	0	0	3,510
Total	*47,945*	*989*	*0*	*0*	*0*	*0*	*48,935*
LRT							
Walk	10,347	5,702	4,885	2,881	1,593	1,244	26,651
Park-n-Ride	3,186	869	730	525	263	121	5,694
Kiss-n-Ride	277	63	35	7	18	6	405
Total	*13,810*	*6,634*	*5,650*	*3,412*	*1,874*	*1,371*	*32,751*
TOTAL	**686,109**	**167,521**	**160,020**	**122,770**	**128,155**	**109,038**	**1,373,614**

Table 3-34: Year 2030 Boardings (Station to Station) - Low Investment LRT

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Total
2: Bethesda So	0	304	305	953	6,937	134	407	283	681	329	474	131	44	80	131	7	20	33	10	21	19	11,303
3: Conn Ave So	304	0	12	39	284	3	35	23	38	32	46	12	4	10	19	1	2	6	1	2	1	874
4: Lyttonsville	305	12	0	9	353	6	14	11	24	13	17	4	2	4	8	1	1	3	0	2	5	794
5: 16th St	953	39	9	0	855	11	54	27	49	33	50	12	6	20	38	2	4	6	1	3	14	2,186
6: SSTC So	6,937	284	353	855	0	407	679	309	255	270	426	55	42	86	88	0	6	6	1	3	20	11,082
7: Fenton St So	134	3	6	11	407	0	11	22	21	27	40	9	5	4	15	0	2	2	0	1	4	724
8: Dale Drive	407	35	14	54	679	11	0	0	15	13	29	8	6	13	27	10	3	3	0	1	13	1,341
9: Manchester Pl	283	23	11	27	309	22	0	0	0	12	35	9	6	15	30	21	3	3	0	1	14	824
10: Arliss St	681	38	24	49	255	21	15	0	0	0	49	12	9	23	47	25	5	5	1	2	20	1,281
11: Gilbert St	329	32	13	33	270	27	13	12	0	0	42	8	13	50	145	86	21	15	4	9	85	1,207
12: Tak/Lang	474	46	17	50	426	40	29	35	49	42	0	35	65	148	323	567	43	42	13	26	181	2,651
13: Riggs Rd	131	12	4	12	55	9	8	9	12	8	35	0	25	62	103	78	16	14	3	7	61	664
14: Adelphi Rd	44	4	2	6	42	5	6	6	9	13	65	25	0	0	54	282	9	14	4	8	47	645
15: UMD	80	10	4	20	86	4	13	15	23	50	148	62	0	0	123	1,102	28	59	14	33	216	2,090
16: East Campus	131	19	8	38	88	15	27	30	47	145	323	103	54	123	0	2,429	100	130	40	91	575	4,516
17: College Park	7	1	1	2	0	0	10	21	25	86	567	78	282	1,102	2,429	0	932	848	258	399	1,455	8,503
18: River Rd	20	2	1	4	6	2	3	3	5	21	43	16	9	28	100	932	0	19	15	28	226	1,483
19: Riverdale Park	33	6	3	6	6	2	3	3	5	15	42	14	14	59	130	848	19	0	17	23	309	1,557
20: Riverdale Rd	10	1	0	1	1	0	0	0	1	4	13	3	4	14	40	258	15	17	0	6	157	545
21: Annapolis Rd	21	2	2	3	3	1	1	1	2	9	26	7	8	33	91	399	28	23	6	0	376	1,042
22: New Carroll	19	1	5	14	20	4	13	14	20	85	181	61	47	216	575	1,455	226	309	157	376	0	3,798
Total	**11,303**	**874**	**794**	**2,186**	**11,082**	**724**	**1,341**	**824**	**1,281**	**1,207**	**2,651**	**664**	**645**	**2,090**	**4,516**	**8,503**	**1,483**	**1,557**	**545**	**1,042**	**3,798**	**59,110**

Table 3-35: Year 2030 User Benefits - Low Investment LRT

Description	HBW-PK	HBW-OP	HBO-PK	HBO-OP	NHB-PK	NHB-OP	TOTAL
Total User Benefits	478,705	(8,484)	131,866	(10,328)	75,702	18,057	685,518
Capped User Benefits	467,783	(14,723)	116,088	(24,464)	71,753	16,114	632,551
Percent of Total	74.0%	-2.3%	18.4%	-3.9%	11.3%	2.5%	100.0%
Percent Capped	2.3%	0.0%	12.0%	0.0%	5.2%	10.8%	7.7%

Table 3-36: Year 2030 Background Buses (Total Boardings) - Low Investment LRT

Route	Boardings
C02	4,846
C04	3,666
F04	3,099
F06	1,835
GO1	32
J01	7,979
J02	4,892
J03	1,453

Table 3-37: Year 2030 Metrorail (Boardings in Corridor Stations) - Low Investment LRT

Station	Boardings
Bethesda	22,120
College Park	10,211
Medical Center	10,822
New Carrollton	8,244
Silver Spring	21,807

Table 3-38: Year 2030 Commuter Rail (Boardings in Corridor Stations) - Low Investment LRT

Station	Boardings
College Park	79
New Carrollton	16
Silver Spring	293

3.7. Medium Investment LRT

Table 3-39: Coding Assumptions - Medium Investment LRT

Assumptions (min.) -- Headway: pk=6, op=12 Runtime: 52

Station	Headed to:	Anode	Bnode	Miles	Time	Speed
Bethesda South	Connecticut Avenue South	7660	7685	1.31	2.4	32.8
Connecticut Avenue South	Lyttonsville	7685	7662	1.37	2.3	35.7
Lyttonsville	16th Street	7662	7663	0.77	2.1	22.0
16th Street	SSTC South	7663	7686	0.65	2.0	19.5
SSTC South	Fenton Street South	7686	7687	0.38	3.1	7.4
Fenton Street South	Dale Drive	7687	7666	0.51	3.1	9.9
Dale Drive	Manchester Place	7666	7683	0.53	2.8	11.4
Manchester Place	Arliss Street	7683	7667	0.43	1.4	18.4
Arliss Street	Gilbert Street	7667	7668	0.37	3.8	5.8
Gilbert Street	Takoma Langley Transit Ctr	7668	7670	0.77	2.2	21.0
Takoma Langley Transit Ctr	Riggs Road	7670	7671	0.6	2.4	15.0
Riggs Road	Adelphi Road	7671	7672	1.38	3.3	25.1
Adelphi Road	U of MD Campus Center	7672	7673	0.59	2.9	12.2
U of MD Campus Center	East Campus	7673	7689	0.53	3.0	10.6
East Campus	College Park - U of MD [West]	7689	7690	0.76	3.0	15.2
College Park - U of MD [West]	River Road	7690	7676	0.7	1.9	22.1
River Road	Riverdale Park	7676	7677	0.58	4.6	7.6
Riverdale Park	Riverdale Road	7677	7678	1.12	4.8	14.0
Riverdale Road	Annapolis Road	7678	7679	1.14	3.5	19.5
Annapolis Road	New Carrollton	7679	7680	0.81	3.9	12.5

Table 3-40: Year 2030 Trips (Linked) by Transit Mode - Medium Investment LRT

Access Mode	HBW-PK	HBW-OP	HBO-PK	HBO-OP	NHB-PK	NHB-OP	TOTAL
Bus							
Walk	144,551	57,837	83,202	45,262	42,362	24,613	397,828
Park-n-Ride	14,180	764	1,765	1,384	1,941	710	20,743
Kiss-n-Ride	6,727	1,388	1,981	972	662	244	11,974
Total	*165,458*	*59,990*	*86,947*	*47,618*	*44,966*	*25,567*	*430,546*
Metrorail							
Walk	254,998	67,403	53,036	53,085	65,607	69,853	563,982
Park-n-Ride	157,413	25,556	11,464	15,556	10,062	8,393	228,444
Kiss-n-Ride	46,171	6,836	2,793	3,089	5,676	3,910	68,475
Total	*458,582*	*99,795*	*67,293*	*71,730*	*81,345*	*82,155*	*860,901*
Commuter Rail							
Walk	8,111	203	0	0	0	0	8,314
Park-n-Ride	36,422	684	0	0	0	0	37,106
Kiss-n-Ride	3,408	101	0	0	0	0	3,510
Total	*47,942*	*988*	*0*	*0*	*0*	*0*	*48,929*
LRT							
Walk	10,889	5,931	5,120	2,982	1,678	1,302	27,901
Park-n-Ride	3,306	895	761	543	268	127	5,901
Kiss-n-Ride	291	65	36	7	19	6	424
Total	*14,486*	*6,891*	*5,917*	*3,532*	*1,964*	*1,436*	*34,225*
TOTAL	**686,467**	**167,663**	**160,157**	**122,880**	**128,275**	**109,158**	**1,374,601**

Table 3-41: Year 2030 Boardings (Station to Station) - Medium Investment LRT

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Total
2: Bethesda So	0	352	328	1,029	7,843	135	453	304	836	249	505	149	50	133	177	13	28	48	13	26	21	**12,692**
3: Conn Ave	352	0	10	35	283	3	35	24	44	32	46	13	4	9	20	1	3	6	1	3	2	**926**
4: Lyttonsville	328	10	0	9	354	5	17	11	25	14	17	5	2	4	10	1	1	3	1	2	6	**825**
5: 16th St	1,029	35	9	0	909	11	59	28	52	34	51	13	7	22	42	4	4	7	1	3	16	**2,336**
6: SSTC	7,843	283	354	909	0	401	660	305	331	194	399	69	58	144	128	0	8	7	2	4	27	**12,126**
7: Fenton St	135	3	5	11	401	0	11	23	21	27	40	10	5	4	22	1	3	5	1	2	9	**739**
8: Dale Dr	453	35	17	59	660	11	0	0	15	13	29	8	6	14	28	11	3	3	1	1	14	**1,381**
9: Manchester Pl	304	24	11	28	305	23	0	0	0	12	34	9	6	15	31	26	3	3	0	1	15	**850**
10: Arliss St	836	44	25	52	331	21	15	0	0	0	49	13	10	25	54	37	5	5	1	2	21	**1,546**
11: Gilbert St	249	32	14	34	194	27	13	12	0	0	41	9	17	73	158	126	22	17	4	10	90	**1,142**
12: Tak/Lang	505	46	17	51	399	40	29	34	49	41	0	44	74	160	348	867	48	44	14	27	194	**3,031**
13: Riggs Rd	149	13	5	13	69	10	8	9	13	9	44	0	26	65	107	97	18	18	4	10	69	**756**
14: Adelphi Rd	50	4	2	7	58	5	6	6	10	17	74	26	0	0	55	273	9	14	4	8	46	**674**
15: UMD	133	9	4	22	144	4	14	15	25	73	160	65	0	0	122	1,023	27	57	13	32	202	**2,144**
16: East Campus	177	20	10	42	128	22	28	31	54	158	348	107	55	122	0	2,344	97	125	38	86	542	**4,534**
17: College Park	13	1	1	4	0	1	11	26	37	126	867	97	273	1,023	2,344	0	922	828	244	333	1,362	**8,513**
18: River Rd	28	3	1	4	8	3	3	3	5	22	48	18	9	27	97	922	0	19	15	28	218	**1,481**
19: Riverdale Park	48	6	3	7	7	5	3	3	5	17	44	18	14	57	125	828	19	0	16	22	298	**1,545**
20: Riverdale Rd	13	1	1	1	2	1	1	0	1	4	14	4	4	13	38	244	15	16	0	6	155	**534**
21: Annapolis Rd	26	3	2	3	4	2	1	1	2	10	27	10	8	32	86	333	28	22	6	0	400	**1,006**
22: New Carroll	21	2	6	16	27	9	14	15	21	90	194	69	46	202	542	1,362	218	298	155	400	0	**3,707**
Total	**12,692**	**926**	**825**	**2,336**	**12,126**	**739**	**1,381**	**850**	**1,546**	**1,142**	**3,031**	**756**	**674**	**2,144**	**4,534**	**8,513**	**1,481**	**1,545**	**534**	**1,006**	**3,707**	**62,488**

Table 3-42: Year 2030 User Benefits - Medium Investment LRT

Description	HBW-PK	HBW-OP	HBO-PK	HBO-OP	NHB-PK	NHB-OP	TOTAL
Total User Benefits	509,171	2,544	139,494	(4,831)	81,341	22,949	750,668
Capped User Benefits	498,269	(3,697)	123,509	(19,078)	77,133	20,857	696,993
Percent of Total	71.5%	-0.5%	17.7%	-2.7%	11.1%	3.0%	100.0%
Percent Capped	2.1%	0.0%	11.5%	0.0%	5.2%	9.1%	7.2%

Table 3-43: Year 2030 Background Buses (Total Boardings) - Medium Investment LRT

Route	Boardings
C02	4,799
C04	3,630
F04	3,123
F06	1,836
GO17	32
J01	7,785
J02	4,815
J03	1,434

Table 3-44: Year 2030 Metrorail (Boardings in Corridor Stations) - Medium Investment LRT

Station	Boardings
Bethesda	22,757
College Park	10,180
Medical Center	10,846
New Carrollton	8,246
Silver Spring	21,909

Table 3-45: Year 2030 Commuter Rail (Boardings in Corridor Stations) - Medium Investment LRT

Station	Boardings
College Park	79
New Carrollton	16
Silver Spring	290

3.8. High Investment LRT

Table 3-46: Coding Assumptions – High Investment LRT

Assumptions (min.) -- Headway: pk=6, op=12 Runtime: 46

Station	Headed to:	Anode	Bnode	Miles	Time	Speed
Bethesda South	Connecticut Avenue South	7660	7685	1.31	2.4	32.8
Connecticut Avenue South	Lyttonsville	7685	7662	1.37	2.3	35.7
Lyttonsville	16th Street	7662	7663	0.77	2.1	22.0
16th Street	SSTC South	7663	7686	0.65	2.0	19.5
SSTC South	Dale Drive	7686	7666	0.88	3.6	14.7
Dale Drive	Manchester Place	7666	7683	0.53	2.5	12.7
Manchester Place	Arliss Street	7683	7667	0.43	1.4	18.4
Arliss Street	Gilbert Street	7667	7668	0.37	3.8	5.8
Gilbert Street	Takoma Langley Transit Ctr	7668	7670	0.77	2.1	22.0
Takoma Langley Transit Ctr	Riggs Road	7670	7671	0.6	1.7	21.2
Riggs Road	Adelphi Road	7671	7672	1.38	3.1	26.7
Adelphi Road	U of MD Campus Center	7672	7673	0.59	2.6	13.6
U of MD Campus Center	East Campus	7673	7689	0.53	2.9	11.0
East Campus	College Park - U of MD [West]	7689	7690	0.76	3.0	15.2
College Park - U of MD [West]	River Road	7690	7676	0.7	1.9	22.1
River Road	Riverdale Park	7676	7677	0.58	3.1	11.2
Riverdale Park	Riverdale Road	7677	7678	1.12	2.9	23.2
Riverdale Road	Annapolis Road	7678	7679	1.14	3.3	20.7
Annapolis Road	New Carrollton	7679	7680	0.81	3.6	13.5

Table 3-47: Year 2030 Trips (Linked) by Transit Mode - High Investment LRT

Access Mode	HBW-PK	HBW-OP	HBO-PK	HBO-OP	NHB-PK	NHB-OP	TOTAL
Bus							
Walk	144,166	57,676	83,015	45,168	42,308	24,592	396,925
Park-n-Ride	14,165	765	1,764	1,385	1,939	710	20,728
Kiss-n-Ride	6,721	1,387	1,979	971	662	244	11,964
Total	*165,052*	*59,827*	*86,757*	*47,525*	*44,909*	*25,546*	*429,617*
Metrorail							
Walk	255,110	67,494	53,089	53,237	65,666	69,902	564,498
Park-n-Ride	157,301	25,526	11,500	15,624	10,076	8,398	228,425
Kiss-n-Ride	46,175	6,840	2,813	3,104	5,684	3,917	68,533
Total	*458,586*	*99,860*	*67,403*	*71,964*	*81,427*	*82,217*	*861,456*
Commuter Rail							
Walk	8,134	204	0	0	0	0	8,337
Park-n-Ride	36,424	685	0	0	0	0	37,109
Kiss-n-Ride	3,408	102	0	0	0	0	3,509
Total	*47,966*	*990*	*0*	*0*	*0*	*0*	*48,956*
LRT							
Walk	11,974	6,326	5,523	3,180	1,805	1,379	30,186
Park-n-Ride	3,371	905	672	465	279	114	5,807
Kiss-n-Ride	308	69	38	7	19	7	448
Total	*15,653*	*7,300*	*6,233*	*3,652*	*2,103*	*1,500*	*36,441*
TOTAL	687,257	167,978	160,393	123,141	128,439	109,263	1,376,470

Table 3-48: Year 2030Boardings (Station to Station) - High Investment LRT

	2	3	4	5	6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Total
2: Bethesda So	0	352	329	1,033	7,922	479	350	1,095	271	589	180	57	161	275	32	37	61	25	43	62	**13,353**
3: Conn Ave	352	0	10	35	283	39	27	61	36	51	15	5	11	26	2	4	8	3	5	10	**983**
4: Lyttonsville	329	10	0	9	366	19	13	32	15	19	6	2	5	11	2	2	3	1	2	8	**854**
5: 16th Street	1,033	35	9	0	913	65	31	69	38	57	16	8	24	49	8	5	8	2	4	25	**2,399**
6: SSTC	7,922	283	366	913	0	764	593	679	345	859	125	81	199	247	4	23	31	9	18	113	**13,574**
8: Dale Dr	479	39	19	65	764	0	0	15	16	30	8	6	14	30	12	3	4	1	2	17	**1,524**
9: Manchester Pl	350	27	13	31	593	0	0	0	12	34	9	6	15	32	22	3	3	1	1	16	**1,168**
10: Arliss Street	1,095	61	32	69	679	15	0	0	0	49	13	10	26	57	39	6	5	1	3	27	**2,187**
11: Gilbert Street	271	36	15	38	345	16	12	0	0	42	13	17	75	170	131	23	20	6	12	112	**1,354**
12: Tak/Langley	589	51	19	57	859	30	34	49	42	0	55	76	165	366	896	50	50	18	32	245	**3,683**
13: Riggs Rd	180	15	6	16	125	8	9	13	13	55	0	32	60	111	113	18	19	5	12	81	**891**
14: Adelphi Rd	57	5	2	8	81	6	6	10	17	76	32	0	0	55	262	9	14	5	9	56	**710**
15: UMD	161	11	5	24	199	14	15	26	75	165	60	0	0	122	966	27	56	19	35	247	**2,227**
16: East Campus	275	26	11	49	247	30	32	57	170	366	111	55	122	0	2,160	96	121	51	96	650	**4,725**
17: College Park	32	2	2	8	4	12	22	39	131	896	113	262	966	2,160	0	874	819	351	501	1,703	**8,897**
18: River Rd	37	4	2	5	23	3	3	6	23	50	18	9	27	96	874	0	26	17	31	276	**1,530**
19: Riverdale Park	61	8	3	8	31	4	3	5	20	50	19	14	56	121	819	26	0	18	24	338	**1,628**
20: Riverdale Rd	25	3	1	2	9	1	1	1	6	18	5	5	19	51	351	17	18	0	6	147	**686**
21: Annapolis Rd	43	5	2	4	18	2	1	3	12	32	12	9	35	96	501	31	24	6	0	326	**1,162**
22: New Carroll	62	10	8	25	113	17	16	27	112	245	81	56	247	650	1,703	276	338	147	326	0	**4,459**
Total	**13,353**	**983**	**854**	**2,399**	**13,574**	**1,524**	**1,168**	**2,187**	**1,354**	**3,683**	**891**	**710**	**2,227**	**4,725**	**8,897**	**1,530**	**1,628**	**686**	**1,162**	**4,459**	**67,994**

Table 3-49: Year 2030 User Benefits - High Investment LRT

Description	HBW-PK	HBW-OP	HBO-PK	HBO-OP	NHB-PK	NHB-OP	TOTAL
Total User Benefits	569,199	25,565	152,528	7,830	87,845	26,828	869,795
Capped User Benefits	556,873	18,466	135,850	(7,593)	82,616	24,427	810,639
Percent of Total	68.7%	2.3%	16.8%	-0.9%	10.2%	3.0%	100.0%
Percent Capped	2.2%	27.8%	10.9%	0.0%	6.0%	8.9%	6.8%

Table 3-50: Year 2030 Background Buses (Total Boardings) - High Investment LRT

Route	Boardings
C02	4,764
C04	3,566
F04	2,922
F06	1,782
GO1	30
J01	7,786
J02	4,805
J03	1,431

Table 3-51: Year 2030 Metrorail (Boardings in Corridor Stations) - High Investment LRT

Station	Boardings
Bethesda	23,256
College Park	10,325
Medical Center	10,860
New Carrollton	8,238
Silver Spring	22,715

Table 3-52: Year 2030 Commuter Rail (Boardings in Corridor Stations) - High Investment LRT

Station	Boardings
College Park	87
New Carrollton	17
Silver Spring	292

3.9. Comparative Summary

Information is provided below on the background bus system as well as additional information formatted to show comparisons across alternatives.

3.10. Background Bus Assumptions

Bus routes listed in the following table were diverted to connect to the given stations by alternative in order to provide feeder service to the Purple Line For the 2030 networks.

Table 3-53: Background Bus

Stations	TSM	Low Inv. BRT	All Others
Connecticut Avenue			J1, J2, J3
Lyttonsville Place		RO1, RO4	RO1, RO4
Grubb Road	RO2 (AM)		
Arliss/Piney Branch	RO 12, RO 13	RO 12, RO 13	RO 12, RO 13

The J4 bus route, present in the 2000 base year has been discontinued and removed from all future year forecast networks. In addition, route RO15 has been removed. For the Low BRT, route J1 has also been removed to eliminate redundant service.

Table 3-54: Year 2030 Trips, Boardings and User Benefits

Version 3	TSM	Low Inv. BRT	Med. Inv. BRT	High Inv. BRT	Low Inv. LRT	Med. Inv. LRT	High Inv. LRT
Total User Benefits (daily minutes)	414,741	255,812	495,978	645,063	685,518	750,668	869,795
Capped User Benefits (daily minutes)	401,166	222,486	450,073	593,043	632,551	696,993	810,639
Percent Capped	3.3%	13.0%	9.3%	8.1%	7.7%	7.2%	6.8%
Baseline Linked Transit Trips	1,366,361	1,363,580	1,363,580	1,363,580	1,363,580	1,363,580	1,363,580
Build Linked Transit Trips	1,363,580	1,366,773	1,370,703	1,373,060	1,373,614	1,374,601	1,376,470
LRT/BRT Linked Trips	0	22,397	29,064	33,182	32,751	34,225	36,441
Boardings							
Purple Line Boardings		22,201	29,329	33,795	32,459	33,922	36,114
Purple Line Boardings in MR Paths		16,689	21,075	23,750	25,307	27,165	30,494
Purple Line Boardings in CR Paths		1,085	1,350	1,292	1,495	1,536	1,465

Table 3-55: Year 2030 Background Bus Boardings (Total Daily)

Route	NB	TSM	Low Inv. BRT	Med. Inv. BRT	High Inv. BRT	Low Inv. LRT	Med. Inv. LRT	High Inv. LRT
C02	5,960	4,952	5,058	4,857	4,763	4,846	4,799	4,764
C04	3,952	3,860	3,805	3,716	3,589	3,666	3,630	3,566
F04	5,877	4,506	3,375	3,133	2,908	3,099	3,123	2,922
F06	3,701	2,837	1,871	1,838	1,766	1,835	1,836	1,782
GO17	85	64	33	33	32	32	32	30
J01	9,514	9,313	8,820	8,295	8,269	7,979	7,785	7,786
J02	6,996	5,765	6,062	5,147	5,120	4,892	4,815	4,805
J03	1,924	1,821	1,773	1,574	1,562	1,453	1,434	1,431
RO15	3,244							

Table 3-56: Year 2030 Metrorail Station Boardings (Total Daily)

Station	NB	TSM	Low Inv. BRT	Med. Inv. BRT	High Inv. BRT	Low Inv. LRT	Med. Inv. LRT	High Inv. LRT
Bethesda	18,108	18,373	17,313	20,920	21,288	22,120	22,757	23,256
College Park	5,610	5,266	9,938	10,271	10,468	10,211	10,180	10,325
Medical Center	10,169	10,200	12,431	10,577	10,583	10,822	10,846	10,860
New Carrollton	8,105	7,969	8,359	8,248	8,223	8,244	8,246	8,238
Silver Spring	21,384	20,869	20,779	20,890	21,262	21,807	21,909	22,715

Table 3-57: Year 2030 Commuter Rail Station Boardings (Total Daily)

Station	NB	TSM	Low Inv. BRT	Med. Inv. BRT	High Inv. BRT	Low Inv. LRT	Med. Inv. LRT	High Inv. LRT
College Park	225	21	65	77	87	79	79	87
New Carrollton	12	12	14	16	16	16	16	17
Silver Spring	335	331	315	299	295	293	290	292

3.11. Non-Included (Mode Specific) Attributes

Table 3-58: Non-Included Attributes

Non-included attribute	Prem. only	Prem. + local	Prem. only	Prem. + local	Prem. only	Prem. + local	Prem. only	Prem. + local	Prem. only	Prem. + local	Prem. only	Prem. + local
Guideway-like characteristics	**1.0**	**0.3**	**3.3**	**1.2**	**5.4**	**2.0**	**3.0**	**1.1**	**3.9**	**1.4**	**5.4**	**2.0**
- reliability of vehicle arrival	0.0	0.0	1.3	0.7	2.4	1.2	1.6	0.8	1.7	0.9	2.4	1.2
- branding/visibility/learnability	0.5	0.3	1.0	0.5	1.5	0.8	0.5	0.3	1.0	0.5	1.5	0.8
- schedule-free service	0.5	0.0	1.0	0.0	1.5	0.0	0.9	0.0	1.2	0.0	1.5	0.0
Span of good service	**1.0**	**0.0**	**1.5**	**0.0**	**2.0**	**0.0**	**1.0**	**0.0**	**1.5**	**0.0**	**2.0**	**0.0**
Passenger amenities	**2.0**	**1.5**	**2.5**	**2.0**	**3.0**	**2.5**	**2.0**	**1.5**	**2.5**	**2.0**	**3.0**	**2.5**
- stations/stops	1.0	0.5	1.5	1.0	2.0	1.5	1.0	0.5	1.5	1.0	2.0	1.5
- dynamic schedule information	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
TOTAL	**4.0**	**1.8**	**7.3**	**3.2**	**10.4**	**4.5**	**6.0**	**2.6**	**7.9**	**3.4**	**10.4**	**4.5**
IVT coefficient	0.95	0.98	0.92	0.97	0.90	0.96	0.95	0.98	0.92	0.97	0.90	0.96

Table 3-59: Year 2030 User Benefits Effects of Non-included Attributes

	TSM	Low Inv. BRT	Med. Inv. BRT	High Inv. BRT	Low Inv. LRT	Med. Inv. LRT	High Inv. LRT
Capped User Benefits (minutes)	401,166	222,486	450,073	593,043	632,551	696,993	810,639
Capped User w/ Non-Included Effects		301,140	621,000	856,800	779,400	902,640	1,088,460
Percent Increase		35%	38%	44%	23%	30%	34%

Appendix B

New Starts Travel Forecasting Model Calibration Report

For Evaluating the Purple Line and the Corridor Cities Transitway Projects

November 2010

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Tables

Figures

1. Introduction

A. Project Overview

The Maryland Transit Administration (MTA) has been analyzing two corridors for potential new transit service: 1) the Purple Line (PL) in the near northern suburbs of Washington, DC; and 2) the Corridor Cities Transitway (CCT) also in the Washington, DC suburbs and in the heart of Montgomery County, Maryland. To support the Alternatives Analyses/Draft Environmental Impact Statements (AA/DEIS) for these two projects, the MTA enhanced the Metropolitan Washington Council of Governments (MWCOG) regional travel model to generate transit forecasts for each of these New Starts projects. That enhanced model is referred to as the MDAA Phase I model (MDAAI).

The FTA requires that travel forecasts for inclusion in the application to enter Preliminary Engineering (PE) be developed based on "current" observed transit survey data. As such, a Phase II model (MDAAII) development effort was undertaken, which included surveying Metrorail riders and incorporating the MWCOG 2007 regional bus survey. Additional issues identified in MDAAI were also addressed in MDAAII, including; inconsistency between bus speeds and highway congestion, inflexible fare model, partial (rather than full) implementation of the parking capacity restraint mechanism, imprecise coding of station access times and an incorrectly defined hierarchy of modes.

This report documents the mode choice model calibration of MDAAII.

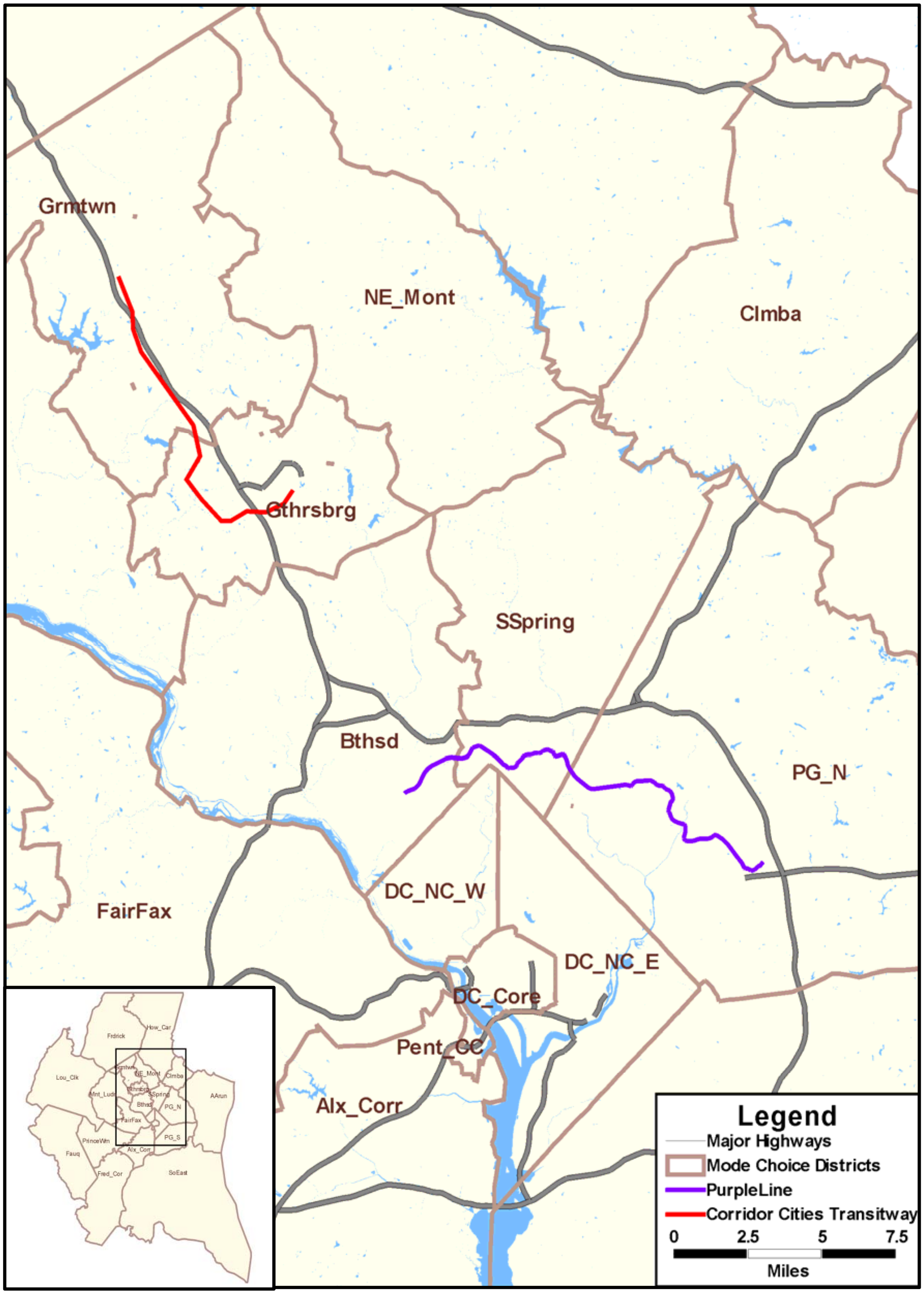
B. Relationship of the MWCOG and MDAAII Models

MDAAI, and therefore MDAAII, originated as transit component add-ons to the MWCOG regional travel model version 2.1D#50. The transit component evolved over several years through use by many different project sponsors. A description of the lineage of MDAAI can be found in *Technical Memorandum: Travel Demand Forecasting Model Enhancements*.

MTA's modeling efforts have focused on transit mode choice and ridership. Every effort was made during the development of MDAAI and MDAAII to maintain the integrity of the MWCOG forecasting elements regarding highway components. The MWCOG model person trip tables and other key outputs that resulted from a full run through six iterations of model feedback were carried forward to MDAAII and serve as the starting point for MDAAII.

The two project alignments (PL and CCT) are shown in Figure 1. The district system shown reflects MDAAII redistricting, which resulted to assure that districts used for calibration represented unique and cohesive areas of density and development rather than political jurisdictions.

Figure 1: Corridor Locations



C. Major Changes in MDAAII

The following lists the major changes in MDAAII:

1. Transit Calibration Target Values (CTV) based on current survey data.
2. Based on MWCOG model version 2.2 (referred to hereafter as COG). MDAAI was based on MWCOG version 2.1D #50.
3. Adjustment to a 2005 base year rather than 2000. Costs are in year 2000 dollars.
4. Realignment of zones in the CCT Corridor, and zone splitting in the PL Corridor.
5. Zone splits and related network changes coded in the MWCOG inputs, and results after splits validated against MWCOG results for both 2005 and 2030. (In MDAAI, the effects of zone splits on MWCOG outputs were approximated.)
6. Transit Fare Model added.
7. Bus Speed Model added.
8. Path Building modifications
9. Modifications to mode choice model in-vehicle time and cost coefficients.

Section 2 of this report describes the survey data and its use in tabulation of calibration targets. As in Phase I, the HBW person trip table distribution from COG version 2.2 does not match well the distribution of the Census Bureau's 2000 Census Transportation Planning Package (CTPP). Section 3 discusses adjustments made to the COG HBW person trip table to bring it into closer alignment with the CTPP observed distribution. Changes to the model structure and pathbuilding parameters are discussed in Section 4. The calibration and validation are described in Sections 5 and 6.

2. Transit Survey Data and Calibration Targets

A. Transit Survey Data

Table 1 lists the transit survey data from four different surveys. Because of the variance in formats, survey instruments, distribution methodology, and expansion methodology, the surveys were not combined into one comprehensive observed database.

The survey data was used to evaluate transit travel behavior in the region and the model's path building assumptions, and to develop calibration target values. Tabulations of key variables from the transit surveys provide information about transit travel behavior and are provided in Appendix D. Evaluation of path building assumptions is discussed in Section 4.

Data by mode from the four surveys were recombined (Figure 2) to create the final CTVs (Table 2).

Table 1: Transit Surveys

Survey	Brief Description
Washington Metropolitan Area Transit Authority (WMATA) 2008 Mezzanine Survey.	Conducted by WB&A Associates in the fall of 2008. Distributed on Mezzanines and expanded to September 2008 automated fare collection boardings and alightings.
Metropolitan Washington Council of Governments Regional Bus Survey (2007/2008).	On-board survey conducted by NuStats LLP in 2007, expanded by PB. Note that this survey was provided by MWCOG in draft form and may not include any subsequent MWCOG edits.
Baltimore Metropolitan Council (BMC) 2007 Survey.	Conducted and expanded by NuStats LLP in the spring and fall of 2007. An on-board survey on all transit modes in the Baltimore region, including those transit services operating in the Washington, DC region.
Virginia Railway Express (VRE) boarding survey from 2005.	Conducted by VRE annually.

Figure 2: Survey Sources

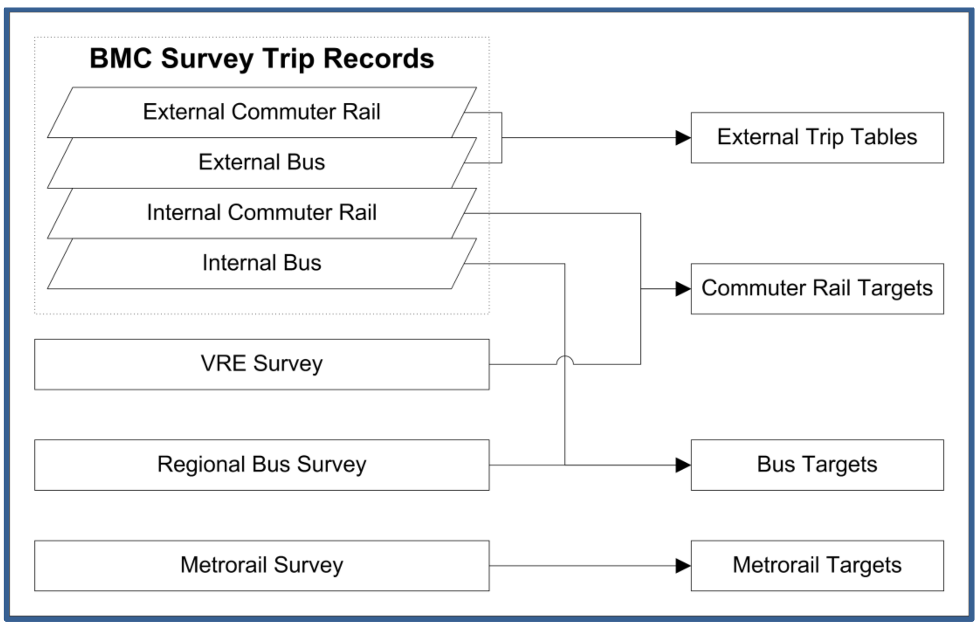


Table 2: Calibration Target Values

				HBO				HBW				NHB	TOTAL CTV FOR MODE CHOICE	NHB DD TARGETS	AIR PASSENGERS AND VISITORS	TOTAL OBSERVED TRANSIT TRIPS
AUTO/TRANSIT	PERIOD	MODE	ACCESS	INCOME 1	INCOME 2	INCOME 3	TOTAL	INCOME 1	INCOME 2	INCOME 3	TOTAL					
Auto	PK	Drive Alone		896,026	1,072,387	1,205,671	3,174,084	592,630	579,247	694,315	1,866,192	1,250,679	6,290,955			6,290,955
		Shared Ride 2		320,203	383,226	430,857	1,134,286	102,169	99,862	119,699	321,730	413,195	1,869,210			1,869,210
		Share Ride 3+		235,724	282,121	317,185	835,030	37,973	37,115	44,488	119,576	288,690	1,243,296			1,243,296
	PK Total			1,451,953	1,737,734	1,953,713	5,143,400	732,771	716,224	858,502	2,307,498	1,952,563	9,403,461			9,403,461
	OP	Drive Alone		1,370,673	1,640,456	1,844,345	4,855,474	272,271	266,122	318,988	857,380	2,277,329	7,990,183			7,990,183
		Shared Ride 2		489,822	586,231	659,092	1,735,144	46,939	45,879	54,993	147,812	752,375	2,635,332			2,635,332
		Share Ride 3+		360,593	431,567	485,206	1,277,366	17,446	17,052	20,439	54,937	525,667	1,857,970			1,857,970
	OP Total			2,221,088	2,658,254	2,988,642	7,867,984	336,656	329,053	394,420	1,060,129	3,555,372	12,483,485			12,483,485
Auto Total				3,673,041	4,395,987	4,942,356	13,011,384	1,069,427	1,045,278	1,252,922	3,367,627	5,507,935	21,886,946			21,886,946
Transit	PK	Commuter Rail	KNR					264	399	599	1,261		1,261		52	1,314
			PNR					2,868	3,763	9,243	15,874		15,874		762	16,637
			WLK					401	384	501	1,285		1,285		98	1,384
		Bus	KNR	518	2	23	542	1,057	386	188	1,631	379	2,552		108	2,660
			PNR	235	118		354	3,540	3,773	2,382	9,695	118	10,167		574	10,741
			WLK	26,380	2,193	920	29,493	76,210	17,784	8,894	102,889	11,687	144,069		402	144,471
		Metrorail	KNR	774	406	669	1,849	10,491	8,527	16,835	35,853		37,702	3,994	1,270	42,966
			PNR	1,536	1,045	2,006	4,588	20,068	27,691	71,948	119,708		124,296	6,169	1,853	132,318
			WLK	13,755	4,001	4,964	22,720	76,129	48,784	83,006	207,919		230,639	36,278	8,874	275,791
	PK Total			43,198	7,766	8,582	59,546	191,028	111,492	193,596	496,116	12,184	567,846	46,441	13,995	628,282
	OP	Commuter Rail	KNR					104	31	19	154		154		184	338
			PNR					210	402	271	883		883		96	979
			WLK					98	59	46	203		203		343	546
		Bus	KNR	426		199	625	831	216	89	1,136	674	2,435			2,435
			PNR	213		16	229	1,250	1,307	613	3,171	204	3,604		58	3,661
			WLK	49,018	4,044	2,335	55,397	60,348	9,693	3,558	73,599	23,426	152,422		281	152,703
		Metrorail	KNR	1,447	493	922	2,862	2,554	2,006	3,472	8,031		10,893	3,105	1,506	15,504
			PNR	2,287	1,599	3,861	7,748	4,562	5,466	14,497	24,525		32,273	4,007	1,344	37,624
			WLK	22,976	7,733	9,608	40,317	31,372	15,546	25,800	72,718		113,036	42,498	10,027	165,561
	OP Total			76,368	13,869	16,941	107,178	101,330	34,726	48,365	184,421	24,304	315,903	49,610	13,839	379,351
Transit Total				119,566	21,636	25,523	166,725	292,358	146,218	241,961	680,537	36,488	883,749	96,050	27,834	1,007,633
Grand Total				3,792,607	4,417,623	4,967,879	13,178,109	1,361,785	1,191,496	1,494,883	4,048,164	5,544,423	22,770,695	96,050	27,834	22,894,579
TRANSIT TOTAL BY MODE																
	PK	Commuter Rail						3,533	4,545	10,343	18,421		18,421		913	19,334
		Bus		27,133	2,313	942	30,389	80,808	21,944	11,464	114,215	12,184	156,788		1,085	157,872
		Metrorail		16,065	5,453	7,640	29,158	106,687	85,003	171,789	363,480		392,637	46,441	11,998	451,076
	PK Total			43,198	7,766	8,582	59,546	191,028	111,492	193,596	496,116	12,184	567,846	46,441	13,995	628,282
	OP	Commuter Rail						412	492	335	1,240		1,240		624	1,864
		Bus		49,657	4,044	2,550	56,251	62,429	11,217	4,260	77,906	24,304	158,461		338	158,799
		Metrorail		26,710	9,826	14,391	50,927	38,488	23,017	43,769	105,275		156,202	49,610	12,877	218,689
	OP Total			76,368	13,869	16,941	107,178	101,330	34,726	48,365	184,421	24,304	315,903	49,610	13,839	379,351
TRANSIT TOTAL BY MODE				119,566	21,636	25,523	166,725	292,358	146,218	241,961	680,537	36,488	883,749	96,050	27,834	1,007,633
TRANSIT TOTAL BY ACCESS																
	PK	KNR		1,292	408	692	2,392	11,812	9,312	17,621	38,746	379	41,516	3,994	1,431	46,941
		PNR		1,771	1,164	2,006	4,942	26,476	35,228	83,573	145,277	118	150,337	6,169	3,190	159,695
		WLK		40,135	6,194	5,884	52,213	152,740	66,952	92,401	312,094	11,687	375,993	36,278	9,374	421,646
	PK Total			43,198	7,766	8,582	59,546	191,028	111,492	193,596	496,116	12,184	567,846	46,441	13,995	628,282
	OP	KNR		1,873	493	1,121	3,487	3,489	2,253	3,579	9,321	674	13,482	3,105	1,690	18,277
		PNR		2,501	1,599	3,877	7,977	6,023	7,175	15,381	28,579	204	36,760	4,007	1,498	42,265
		WLK		71,994	11,777	11,943	95,714	91,818	25,298	29,404	146,521	23,426	265,661	42,498	10,651	318,810
	OP Total			76,368	13,869	16,941	107,178	101,330	34,726	48,365	184,421	24,304	315,903	49,610	13,839	379,351
TRANSIT TOTAL BY ACCESS				119,566	21,636	25,523	166,725	292,358	146,218	241,961	680,537	36,488	883,749	96,050	27,834	1,007,633

It was assumed that commuter rail trips are entirely HBW trips. The Virginia Railway Express (VRE) operates only in the peak periods and therefore the assumption that these are primarily work trips is reasonable. Maryland Area Regional Commuter (MARC) train service serves passengers throughout the day, and serves a few passengers destined to Baltimore-Washington International Airport (BWI). Air passengers and visitors were not included in the mode choice calibration. Commuter rail home-based other (HBO) trips in the BMC survey that had one end in the Washington region's model area (the Region) were negligible and omitted. Non-home-based (NHB) targets were separated into Metrorail and bus categories. Metrorail trips were used to estimate the NHB direct demand model (NHBDD). The NHB observed trips were used as targets for the mode choice model to estimate the choice between bus and auto.

Observed transit air passengers and visitors were not included in the mode choice, but were added to the transit trip tables after mode choice. It was assumed that these trips would not grow substantially between 2005 and 2030. They are not expected to have a substantial effect on the PL or CCT projects.

Trips in the BMC survey that were neither produced nor attracted in the Region were eliminated. Those that were produced and attracted in the Region were added to the commuter rail and bus calibration targets. BMC trips that had either a production or attraction end in the Region with the opposing end outside the Region were added to the external trip tables for commuter rail and bus.

Auto calibration targets were taken from the final auto trip tables from COG after the sixth iteration of model feedback[1].

B. Person Trip Adjustments

The MDAAII survey data included transit data but no additional household travel survey data. COG has been validated for highway performance and for Metrorail ridership and therefore it is desirable to maintain the number of auto person trips in MDAAII as in COG, which estimated transit trips of 1,040,804 in 2005 while the MDAAII surveys indicate 979,799 transit trips (excluding 4,562 air passenger and 23,272 visitor transit trips) in 2005; therefore, when adding the transit targets to the auto targets (from COG), the targeted person trips are greater (by 157,055) than COG's person trips. Differences vary by time of day, income, and purpose. Person trip table adjustment factors are shown in Table 3. COG person trips were reduced by 0.68% (or 157,055 trips), from 22,927,750 to 22,770,695.

Figure 3 illustrates the adjustments made to the person trip tables to accommodate the difference in MDAAII transit calibration targets and COG's transit trips as well as adjustments in HBW person trips required to more closely match the CTPP trip distribution.

[1] *TPB Travel Forecasting Model, Version 2.2; Specification, Validation, and User's Guide,* National Capital Regional Transportation Planning Board, March 1, 2008.

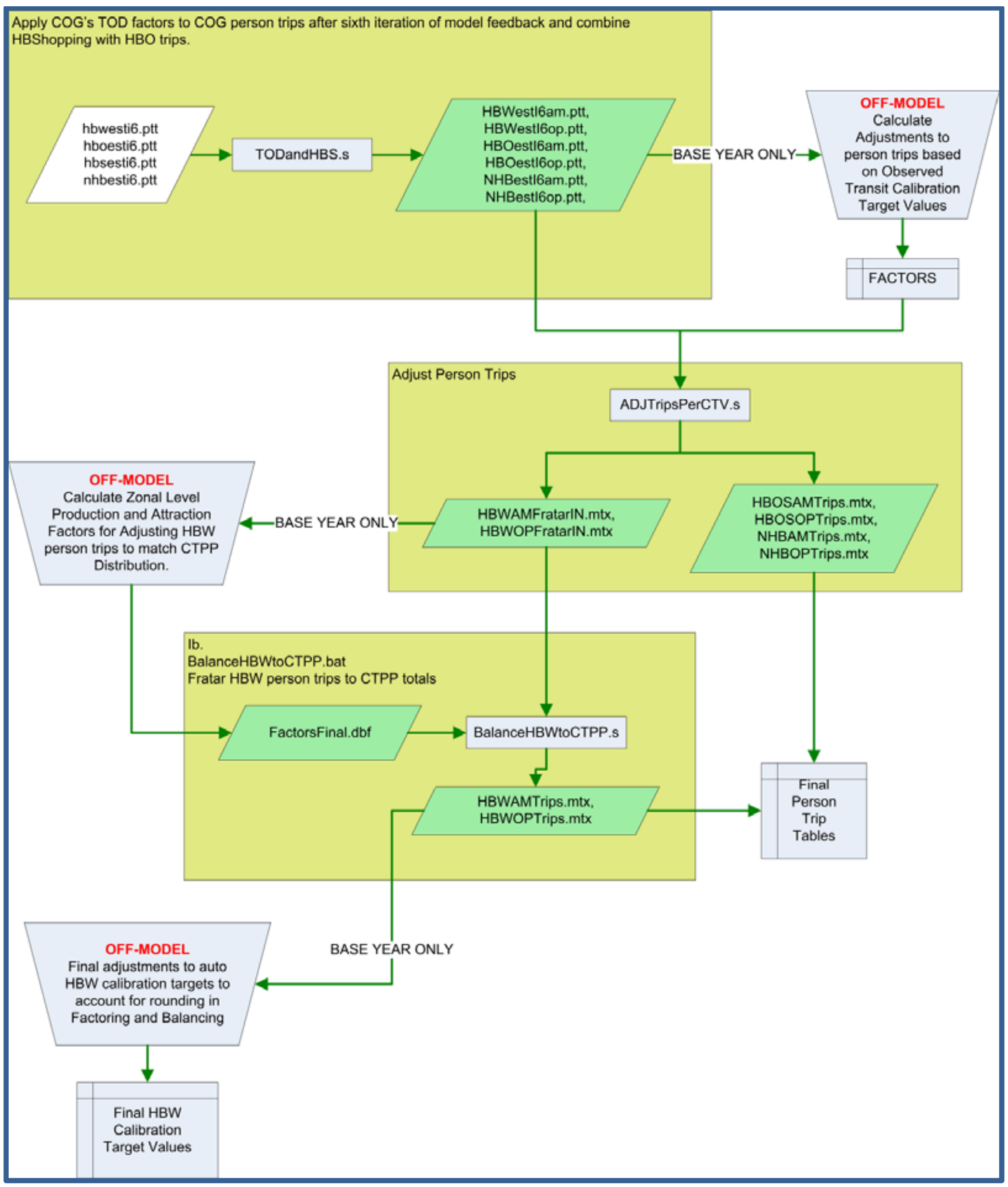
Table 3: Person Trip Table Adjustment Factors

	HBW		HBO		NHB	
	Peak	**Off-Peak**	**Peak**	**Off-Peak**	**Peak**	**Off-Peak**
Income Group 1	1.10	1.24	1.03	1.03	.98	.98
Income Group 2	1.05	.99	.99	.99		
Income Group 3	.98	.94	.98	.98		
Income Group 4	1.04	.96	.98	.98		

Notes:

1. Factors are rounded to two digits for ease of reading.
2. Income Groups 1 and 2 were subsequently combined into one income group.

Figure 3: Person Trip and Calibration Target Values Adjustments



C. Implied Transit Shares

District-to-district tabulations of the implied transit share (person trips divided by observed transit trips) by purpose and income group were prepared. The district-to-district trip tables are in Appendix C.

There are two purposes for calculating the implied transit shares. The first purpose is to determine if there are enough person trips in each market to allow the mode choice model to allocate trips to transit. If the implied transit share for a given district-to-district interchange is extremely high then it would be difficult for the mode choice model to achieve convergence with explainable constants. Reasons for the unacceptably high, implied shares must be identified and addressed.

The second purpose is to validate the changes made to the HBW person trip table. If the result of changes to the HBW distribution is districts with unacceptably high, implied transit shares then the re-distribution methodology must be reviewed.

The MDAAII implied transit shares were all within reason.

3. Home-based Work Trip Distribution

Home-Based Work (HBW) trips are considered an important market for transit ridership, and as the Census Bureau's Journey to Work (JTW) data from the Census Transportation Planning Package (CTPP) provides a good source for verifying the HBW trip distribution patterns, the first step in the calibration effort was to verify the HBW person trip distribution from COG against the JTW distribution. Adjustments were made as described below.

A. Methodology

The CTPP survey data was collected in 1999 and adjusted by MWCOG to account for major employers that were incorrectly geocoded. In addition, MWCOG converted the CTPP observed trips to translate into average weekday work attractions. The CTPP data was normalized to COG's 2005 total HBW trips and compared to COG's HBW trips at the district level. COG's HBW trips used for this comparison resulted from a full run of COG through six iterations of model feedback—after the zone splitting that is described in Appendix E and after adjustments required to accommodate the development of calibration target.

The comparison is shown in Table 4. Substantial differences resulted in some of the key geographic areas for the MTA projects. Intra-district trips are over-estimated, particularly in the far suburban districts, but also in the DC-Core East and in the CCT districts. HBW trips to the DC-Core are underestimated by 15% and many other districts vary from the CTPP by more than ±15%. Attempts to adjust the distribution by iterative proportional fitting (IPF) did not address the intra-district anomalies, and resulted in unacceptably high levels of implied transit shares (or trips available to transit) in many district-to-district pairs.

Table 4: Comparison of COG HBW Person Trip Table with CTPP

COG version 2.2 Person Trips -- After Zone Splitting and Six Iterations of Model Feedback

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOTAL
1	DC_Core	21,831	3,316	4,903	1,662	528	1,070	285	24	1	8	1	67	100	354	1,685	2,319	5,026	313	152	5	-	2	17	43,669
2	DC_NC_W	64,530	16,032	8,680	10,484	2,896	2,793	1,487	205	27	35	6	237	176	437	3,884	4,153	11,082	614	218	5	4	-	19	128,004
3	DC-NC-E	75,246	8,598	27,970	6,703	3,763	11,428	1,270	186	25	61	15	650	1,114	4,681	3,793	5,311	9,841	548	281	13	2	-	219	161,718
4	Bethesda	43,323	8,680	5,499	61,454	9,691	5,078	18,147	2,048	331	377	50	817	417	524	2,446	2,885	15,133	1,476	401	8	6	2	15	178,808
5	SilverSpring	41,561	6,036	9,744	34,631	27,156	17,324	10,563	1,480	181	1,254	225	4,257	1,849	1,286	1,624	1,698	6,442	545	148	-	-	-	37	168,041
6	PG_north	63,192	9,254	36,655	18,721	15,089	96,060	4,366	614	82	507	193	11,369	20,534	16,025	5,137	5,876	11,073	539	243	14	-	1	904	316,448
7	Gaithersburg	7,979	2,080	1,260	20,840	2,927	1,687	36,403	7,097	1,138	369	110	485	152	132	595	673	4,777	670	113	1	21	-	1	89,510
8	Germantown	5,597	1,790	973	19,798	2,900	1,508	36,306	25,387	5,148	1,013	407	1,002	220	90	395	429	3,891	889	60	1	84	-	-	107,888
9	Frederick	250	233	92	3,111	505	425	9,700	8,551	104,285	717	5,620	3,895	551	15	25	20	303	2,599	62	-	2,260	5	-	143,224
10	NE_Mont	5,258	924	1,150	10,438	4,399	2,803	11,266	5,492	1,792	3,296	545	2,539	655	156	189	154	1,014	188	13	-	20	-	1	52,292
11	How_Carroll	512	188	342	1,780	1,377	1,863	3,231	3,020	18,919	922	65,796	11,352	2,151	75	26	24	130	175	4	-	152	-	-	112,039
12	Columbia	4,244	1,109	2,853	5,428	5,773	14,128	2,673	931	2,299	697	2,179	56,706	18,130	765	250	202	918	76	12	-	27	-	7	119,407
13	AnneArundel	12,038	1,162	8,571	2,946	3,173	28,003	723	141	115	174	244	20,858	196,926	9,174	780	818	1,308	30	16	-	-	-	2,195	289,395
14	PG_South	65,724	5,351	40,378	4,645	2,985	26,931	877	98	2	49	9	961	5,079	56,816	6,612	12,347	11,563	343	428	26	-	-	6,578	247,802
15	Pent_CC	4,056	296	507	220	37	97	63	6	2	1	-	3	7	37	1,803	1,359	1,753	104	57	3	-	-	1	10,412
16	Alx_Corridor	89,998	6,116	13,004	4,448	723	2,200	1,049	120	6	10	-	56	134	3,177	22,688	148,197	68,874	6,207	11,527	2,366	63	36	214	381,213
17	Fairfax	65,815	7,366	7,218	8,607	1,181	1,206	2,168	285	58	14	1	91	63	680	10,637	30,254	127,637	28,836	14,834	214	204	68	31	307,468
18	Mont_Loud	10,414	1,927	1,153	5,782	639	325	4,915	1,541	1,742	43	28	44	16	80	1,656	5,119	45,935	142,829	16,227	82	1,797	128	1	242,423
19	PrinceWm	17,400	1,778	2,313	2,591	318	312	525	48	66	2	1	7	8	570	3,987	33,223	64,656	39,801	113,998	4,437	2,286	4,500	28	292,855
20	Fred_Corridor	13,435	322	826	349	46	127	63	5	2	-	-	-	3	349	2,932	53,945	12,935	2,853	28,160	194,045	242	2,787	2,417	315,843
21	Lou_Clk	213	106	43	672	50	26	1,821	1,358	10,330	30	117	87	12	4	52	383	3,770	27,653	7,137	41	33,747	862	-	88,514
22	Fauquier	-	3	-	5	-	-	3	-	23	-	-	-	-	-	-	173	922	1,792	11,002	4,338	913	19,830	40	39,044
23	SouthEast	12,869	706	10,837	510	499	6,800	80	3	-	2	1	113	4,774	24,944	1,175	2,643	1,627	26	80	1,837	-	11	171,176	240,713
	Total	625,485	83,373	184,971	225,825	86,655	222,194	147,984	58,640	146,574	9,581	75,548	115,596	253,071	120,371	72,371	312,205	410,610	259,106	205,173	207,436	41,828	28,232	183,901	4,076,730

CTPP Adjusted by COG and Normalized to COG Total Person Trips

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOTAL
1	DC_Core	21,269	3,788	4,102	2,492	711	1,358	426	118	-	9	14	40	262	415	1,256	1,994	3,622	588	471	63	16	15	37	43,066
2	DC_NC_W	61,294	11,882	7,144	6,727	1,414	2,117	1,378	322	73	38	-	182	346	462	1,265	3,141	6,993	1,294	760	88	-	17	137	107,074
3	DC-NC-E	97,653	14,582	42,606	9,035	4,461	10,433	2,781	619	81	227	14	516	641	5,420	5,455	7,395	9,677	1,964	1,818	453	55	55	668	216,609
4	Bethesda	47,902	10,672	6,271	54,548	8,881	7,477	16,847	4,827	745	1,086	72	1,223	799	1,085	1,281	2,950	10,237	3,453	1,641	284	24	22	243	182,570
5	SilverSpring	43,406	8,380	13,291	37,120	31,596	18,791	13,625	3,345	501	1,873	275	3,795	2,048	2,731	2,022	3,017	7,770	2,470	1,214	362	42	32	644	198,350
6	PG_north	67,660	8,906	30,943	21,533	16,012	103,371	8,243	2,411	413	858	501	8,638	10,931	22,767	5,146	8,616	11,871	2,667	2,037	656	65	124	2,118	336,487
7	Gaithersburg	10,465	2,342	1,889	21,431	3,358	2,596	24,524	8,009	1,206	858	72	578	227	461	796	1,272	4,247	1,764	732	109	9	27	72	87,044
8	Germantown	10,613	1,967	1,850	24,931	4,550	2,664	28,898	19,390	2,533	1,527	313	867	500	537	968	1,410	5,077	2,230	815	176	16	10	238	112,080
9	Frederick	3,734	665	665	9,036	2,226	1,469	12,060	9,203	80,409	1,270	3,493	1,990	1,194	245	359	650	1,654	3,149	598	132	652	22	166	135,041
10	NE_Mont	4,506	598	1,032	9,293	3,642	2,269	7,983	3,852	717	4,817	264	1,069	355	285	205	546	1,455	634	172	105	-	-	109	43,908
11	How_Carroll	1,831	239	403	2,470	1,498	3,478	2,439	1,845	4,049	812	50,010	13,200	7,133	328	130	208	501	232	153	23	50	-	159	91,191
12	Columbia	9,527	802	2,658	6,034	5,663	18,215	3,093	809	772	555	3,762	55,227	19,346	1,969	755	1,141	2,455	788	450	166	-	-	241	134,428
13	AnneArundel	19,624	1,143	5,819	4,483	2,367	30,530	2,085	529	311	174	1,098	20,925	194,098	8,949	1,826	2,693	3,474	945	507	256	10	-	3,139	304,985
14	PG_South	66,175	5,444	26,786	5,768	3,355	29,379	2,098	424	116	156	46	1,420	2,117	45,020	6,483	13,736	12,055	2,675	2,021	461	73	18	5,225	231,051
15	Pent_CC	6,533	439	515	287	71	114	34	30	-	-	-	24	-	39	659	850	1,572	326	108	49	-	-	37	11,687
16	Alx_Corridor	93,694	7,361	16,898	7,111	2,006	5,720	2,302	894	125	140	33	486	1,200	5,612	27,641	129,678	76,747	17,445	26,845	5,642	428	189	1,241	429,438
17	Fairfax	78,308	8,201	7,256	8,447	1,263	3,003	3,205	826	212	101	-	429	451	1,243	8,731	28,076	106,737	26,741	22,422	1,403	415	342	319	308,131
18	Mont_Loud	16,124	1,561	2,372	6,578	1,150	1,641	3,811	1,860	638	161	18	261	294	412	2,755	9,136	45,441	92,972	18,069	801	1,945	319	207	208,526
19	PrinceWm	29,282	2,019	4,752	3,805	709	2,454	1,503	612	122	39	22	98	358	1,521	8,586	31,168	68,587	34,184	88,259	8,429	862	1,571	424	289,366
20	Fred_Corridor	23,165	1,259	5,152	1,408	499	1,708	621	178	32	46	15	88	212	1,362	10,245	42,405	24,195	9,010	23,602	130,983	137	685	4,946	281,953
21	Lou_Clk	2,606	229	359	1,057	373	230	818	535	2,722	48	77	137	76	192	355	1,337	4,645	17,567	3,729	211	20,753	511	21	58,588
22	Fauquier	1,365	145	295	303	26	102	64	14	23	-	-	11	-	79	415	1,344	4,183	3,415	8,586	1,670	596	14,323	48	37,007
23	SouthEast	20,893	1,227	8,465	1,837	1,023	14,643	1,035	315	79	51	108	823	3,507	24,388	3,090	6,192	4,531	1,471	1,214	3,400	80	125	129,655	228,152
	Total	737,629	93,851	191,523	245,734	96,854	263,762	139,873	60,967	95,879	14,846	60,207	112,027	246,095	125,522	90,424	298,955	417,726	227,984	206,223	155,922	26,228	18,407	150,094	4,076,732

Table 4: Comparison of COG HBW Person Trip Table with CTPP (continued)

Absolute Difference (COG - CTPP)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOTAL
1	DC_Core	562	472	802	830	183	288	141	94	1	1	13	27	162	61	429	324	1,404	275	319	58	16	13	19	604
2	DC_NC_W	3,235	4,150	1,536	3,757	1,482	676	110	116	46	2	6	55	170	25	2,619	1,012	4,089	680	542	83	4	17	119	20,931
3	DC-NC-E	22,406	5,984	14,636	2,332	698	995	1,512	433	57	165	2	134	473	739	1,662	2,083	164	1,417	1,537	440	53	55	449	54,889
4	Bethesda	4,579	1,992	772	6,907	810	2,398	1,299	2,779	414	709	22	406	381	560	1,165	65	4,896	1,977	1,239	276	18	20	227	3,758
5	SilverSpring	1,845	2,344	3,547	2,489	4,441	1,467	3,063	1,865	320	619	50	462	199	1,445	398	1,319	1,328	1,925	1,066	362	42	32	607	30,310
6	PG_north	4,468	348	5,712	2,811	923	7,311	3,878	1,796	331	351	309	2,731	9,603	6,742	9	2,741	798	2,128	1,793	641	65	122	1,213	20,040
7	Gaithersburg	2,486	262	629	591	431	909	11,879	912	68	490	38	92	75	329	202	600	530	1,094	619	108	12	27	71	2,464
8	Germantown	5,016	177	877	5,133	1,650	1,155	7,407	5,997	2,615	515	94	135	280	447	573	980	1,186	1,341	755	175	68	10	238	4,193
9	Frederick	3,485	432	573	5,925	1,722	1,044	2,361	652	23,875	553	2,127	1,906	644	229	334	630	1,352	550	536	132	1,607	17	166	8,180
10	NE_Mont	753	325	118	1,146	758	535	3,284	1,639	1,074	1,521	280	1,471	301	129	15	392	441	446	158	105	20		108	8,388
11	How_Carroll	1,318	51	60	690	121	1,615	792	1,175	14,870	109	15,786	1,847	4,981	254	105	185	371	58	149	23	102		159	20,846
12	Columbia	5,283	307	196	606	109	4,087	420	122	1,527	142	1,583	1,479	1,216	1,204	505	938	1,538	712	437	166	27		234	15,021
13	AnneArundel	7,586	19	2,752	1,537	806	2,527	1,362	388	196	-	854	67	2,828	225	1,046	1,875	2,165	915	491	256	10		945	15,592
14	PG_South	451	93	13,592	1,123	369	2,448	1,221	327	114	107	37	459	2,962	11,795	129	1,390	491	2,332	1,592	436	73	18	1,353	16,751
15	Pent_CC	2,477	143	8	68	34	17	28	24	2	1		21	7	2	1,144	509	181	222	51	46			35	1,276
16	Alx_Corridor	3,696	1,246	3,894	2,662	1,282	3,520	1,253	773	119	130	33	430	1,067	2,435	4,953	18,519	7,873	11,237	15,318	3,276	365	153	1,028	48,222
17	Fairfax	12,492	835	38	160	82	1,798	1,037	541	154	87	1	338	388	563	1,907	2,178	20,900	2,095	7,587	1,189	211	274	289	661
18	Mont_Loud	5,711	367	1,219	796	511	1,316	1,104	319	1,104	118	9	217	278	332	1,099	4,016	493	49,857	1,842	719	148	192	206	33,896
19	PrinceWm	11,882	241	2,439	1,214	391	2,142	978	564	57	37	21	91	350	950	4,599	2,055	3,931	5,617	25,738	3,992	1,425	2,929	397	3,489
20	Fred_Corridor	9,731	936	4,326	1,060	453	1,581	559	173	30	46	15	88	208	1,012	7,313	11,540	11,260	6,157	4,558	63,062	104	2,101	2,529	33,889
21	Lou_Clk	2,393	123	316	386	323	204	1,003	823	7,608	18	40	51	64	188	302	955	875	10,086	3,408	169	12,994	350	21	29,927
22	Fauquier	1,365	142	295	298	26	102	61	14	1			11		79	415	1,172	3,261	1,623	2,416	2,668	317	5,507	9	2,034
23	SouthEast	8,024	520	2,371	1,327	524	7,842	956	311	79	49	106	710	1,267	556	1,915	3,549	2,904	1,445	1,134	1,563	80	113	41,521	12,563
	Total	112,143	10,478	6,552	19,910	10,198	41,565	8,108	2,325	50,694	5,267	15,342	3,571	6,978	5,149	18,053	13,247	7,116	31,121	1,047	51,516	15,598	9,824	33,806	-

NOTE: CTPP table was modified by MWCOG to convert trips to Ps and As and to correct the location of some major employers. It was then normalized to the COG totals by PB.

Percent Difference

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOTAL
1	DC_Core	3%		20%																					1%
2	DC_NC_W	5%	35%	22%	56%													58%							20%
3	DC-NC-E	23%	41%	34%	26%	16%	10%								14%	30%	28%	2%							25%
4	Bethesda	10%	19%	12%	13%	9%	32%	8%	58%									48%							2%
5	SilverSpring	4%	28%	27%	7%	14%	8%	22%										17%							15%
6	PG_north	7%	4%	18%	13%	6%	7%	47%					32%	88%	30%	0%	32%	7%							6%
7	Gaithersburg	24%			3%			48%	11%									12%							3%
8	Germantown	47%			21%	36%		26%	31%									23%							4%
9	Frederick				66%			20%	7%	30%															6%
10	NE_Mont	17%			12%			41%			32%														19%
11	How_Carroll									367%		32%	14%	70%											23%
12	Columbia	55%			10%	2%	22%						3%	6%											11%
13	AnneArundel	39%		47%	34%		8%						0%	1%	3%										5%
14	PG_South	1%	2%	51%	19%		8%								26%	2%	10%	4%						26%	7%
15	Pent_CC	38%																							11%
16	Alx_Corridor	4%	17%	23%	37%		62%								43%	18%	14%	10%	64%	57%	58%				11%
17	Fairfax	16%	10%	1%	2%											22%	8%	20%	8%	34%					0%
18	Mont_Loud	35%			12%												44%	1%	54%	10%					16%
19	PrinceWm	41%		51%												54%	7%	6%	16%	29%	47%				1%
20	Fred_Corridor	42%		84%												71%	27%	47%	68%	19%	48%			51%	12%
21	Lou_Clk																	19%	57%			63%			51%
22	Fauquier																	78%		28%			38%		6%
23	SouthEast	38%		28%			54%								2%		57%	64%						32%	6%
	Total	15%	11%	3%	8%	11%	16%	6%	4%	53%	35%	25%	3%	3%	4%	20%	4%	2%	14%	1%	33%	59%	53%	23%	0%

Combinations of approaches to adjustment were tested and a final approach adopted involved the following steps:

1. Aggregate COG's HBW person trip tables by time of day and income level into one total COG HBW person trip table, and calculate the time of day and income level shares at the i-j pair level for later use.
2. Adjust COG's HBW total person trip table intra-district trips to target the total number of intra-district trips in the CTPP. This resulted in a net loss of 480,000 HBW trips (12%), reflecting the regionwide over-estimation of intra-district trips.
3. Use an IPF procedure to adjust COG's HBW total person trip productions and attractions at the district level to match the CTPP productions and attractions district totals.
4. At the zonal level, calculate production and attraction adjustment factors by dividing the adjusted zonal marginal totals (#2 above) by the original COG zonal marginal totals to derive a set of zonal level marginal targets.
5. Apply the zonal level marginal production and attraction targets from #3 above to COG's 2005 and 2030 HBW person trip tables to derive MDAAII HBW person trip tables.
6. Disaggregate MDAAII HBW person trip tables into income and time-of-day tables using shares at the zonal i-j pair level (#1 above).

Table 5 shows the intrazonal factors and marginal targets as well as the district-level totals for the CTPP, the original COG trip table, and the final MDAAII HBW trip table.

Table 6 shows the comparison of the final 2005 MDAAII HBW total person trip table to the CTPP person trip table normalized to COG's total HBW person trips. The final IPF to match the district marginal totals causes the intra-district totals to not match exactly, and some intra-district totals are still over estimated, but the intra-district trip tables are substantially improved (see Table 4), and MDAAII marginal totals match CTPP marginal totals at the district level.

B. Evaluating HBW Person Trip Distribution Changes

To further evaluate the adequacy of the person trip tables, the implied transit share was calculated by dividing the observed transit trips by the person trips at the district level. This was done for all purposes and times of day. However, the implied transit shares for the HBW purposes suggest the distribution changes made to the HBW trip table have eliminated potential problems in calibration.

Table 5: HBW Intrazonal Factors and Marginal Targets

District	District Name	COG		CTPP		Intra-Dist Factors	After Intra-Dist Factoring		Marginal Targets		Final Adjusted MDAAII Marginal Totals	
		Prod	Attr	Prod	Attr	Factors	Prod	Attr	Prod	Attr	Prod	Attr
1	DC_Core	43,670	625,488	43,066	737,631	0.852	40,429	622,247	1.065	1.185	43,066	737,631
2	DC_NC_W	128,004	83,373	107,073	93,851	0.648	122,357	77,725	0.875	1.207	107,074	93,851
3	DC-NC-E	161,720	184,971	216,609	191,523	1.331	170,989	194,239	1.267	0.986	216,609	191,523
4	Bethesda	178,809	225,824	182,568	245,734	0.776	165,031	212,046	1.106	1.159	182,568	245,734
5	SilverSpring	168,041	86,656	198,351	96,854	1.017	168,501	87,116	1.177	1.112	198,351	96,854
6	PG_north	316,448	222,196	336,487	263,761	0.941	310,737	216,484	1.083	1.218	336,487	263,761
7	Gaithersburg	89,510	147,983	87,045	139,876	0.589	74,542	133,015	1.168	1.052	87,045	139,876
8	Germantown	107,886	58,642	112,079	60,967	0.668	99,446	50,202	1.127	1.214	112,079	60,967
9	Frederick	143,223	146,574	135,043	95,880	0.674	109,218	112,569	1.236	0.852	135,042	95,880
10	NE_Mont	52,294	9,578	43,906	14,845	1.277	53,209	10,493	0.825	1.415	43,906	14,845
11	How_Carroll	112,039	75,548	91,193	60,206	0.664	89,953	53,462	1.014	1.126	91,192	60,206
12	Columbia	119,408	115,598	134,428	112,027	0.851	110,972	107,163	1.211	1.045	134,428	112,027
13	AnneArundel	289,394	253,070	304,986	246,092	0.861	262,115	225,792	1.164	1.090	304,985	246,092
14	PG_South	247,801	120,372	231,050	125,521	0.693	230,335	102,906	1.003	1.220	231,050	125,521
15	Pent_CC	10,411	72,372	11,687	90,425	0.320	9,184	71,146	1.273	1.271	11,687	90,425
16	Alx_Corridor	381,213	312,202	429,435	298,955	0.765	346,358	277,347	1.240	1.078	429,437	298,955
17	Fairfax	307,468	410,610	308,129	417,726	0.731	273,122	376,265	1.128	1.110	308,130	417,726
18	Mont_Loud	242,422	259,105	208,527	227,985	0.569	180,854	197,537	1.153	1.154	208,528	227,985
19	PrinceWm	292,857	205,173	289,368	206,220	0.677	256,000	168,316	1.130	1.225	289,370	206,220
20	Fred_Corridor	315,843	207,437	281,954	155,921	0.590	236,281	127,875	1.193	1.219	281,958	155,921
21	Lou_Clk	88,515	41,828	58,589	26,230	0.537	72,907	26,219	0.804	1.000	58,589	26,230
22	Fauquier	39,043	28,232	37,009	18,408	0.631	31,732	20,921	1.166	0.880	37,010	18,408
23	SouthEast	240,715	183,901	228,152	150,095	0.662	182,861	126,046	1.248	1.191	228,144	150,095
		4,076,734	4,076,734	4,076,734	4,076,734		3,597,131	3,597,131			4,076,734	4,076,734

Table 6: Comparison of MDAA Adjusted HBW Person Trips with CTPP

COG Model Version 2.2 After Adjustments

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOTAL
1	DC_Core	22,685	3,404	4,433	1,586	503	1,093	221	18	-	10	1	48	75	328	1,824	1,849	4,568	270	136	3	-	1	11	43,067
2	DC_NC_W	56,440	13,762	6,589	8,406	2,327	2,388	968	134	8	38	3	142	110	340	3,536	2,790	8,468	444	164	2	3	-	10	107,072
3	DC-NC-E	106,501	11,981	34,474	8,686	4,875	15,923	1,340	197	12	106	14	636	1,137	5,947	5,609	5,775	12,193	645	344	11	2	-	201	216,609
4	Bethesda	48,457	9,549	5,329	62,543	9,912	5,529	15,373	1,741	126	519	34	623	335	524	2,854	2,489	14,855	1,366	389	5	4	1	11	182,568
5	SilverSpring	53,274	7,626	10,825	40,607	31,657	21,568	10,270	1,457	81	1,989	177	3,761	1,715	1,478	2,168	1,674	7,250	580	164	-	-	-	31	198,352
6	PG_north	72,750	10,522	36,604	19,807	15,910	108,403	3,797	542	33	726	140	9,317	17,374	16,604	6,166	5,186	11,166	516	242	9	-	1	673	336,488
7	Gaithersburg	9,412	2,418	1,289	22,219	3,145	1,929	31,529	6,338	454	531	75	387	130	140	731	614	4,941	633	115	1	13	-	1	87,045
8	Germantown	7,397	2,330	1,113	23,670	3,480	1,926	35,208	24,956	2,344	1,623	304	884	208	106	543	440	4,508	910	67	1	60	-	-	112,078
9	Frederick	495	456	158	5,747	922	823	14,786	13,322	76,144	1,786	6,459	5,307	806	28	52	31	529	4,431	116	-	2,638	6	-	135,042
10	NE_Mont	5,042	880	960	9,251	3,870	2,613	8,395	4,296	647	4,014	322	1,685	459	135	189	114	864	147	11	-	11	-	1	43,906
11	How_Carroll	677	255	401	2,325	1,766	2,506	3,643	3,551	10,160	1,706	50,365	10,972	2,213	92	35	25	152	213	5	-	129	-	-	91,191
12	Columbia	6,290	1,626	3,670	7,373	7,798	19,996	3,006	1,085	1,220	1,283	2,005	56,870	19,245	1,015	386	230	1,191	93	16	-	23	-	7	134,428
13	AnneArundel	16,425	1,573	10,142	3,721	3,985	37,397	754	151	56	298	210	20,372	193,368	11,147	1,112	852	1,568	34	19	-	-	-	1,801	304,985
14	PG_South	67,270	5,415	35,763	4,351	2,782	27,064	672	76	1	62	6	683	3,736	51,172	7,063	9,622	10,360	294	377	15	-	-	4,268	231,052
15	Pent_CC	4,844	349	525	240	40	114	56	6	1	2	-	3	6	39	2,225	1,246	1,830	104	58	2	-	-	1	11,691
16	Alx_Corridor	116,847	7,844	14,609	5,294	861	2,803	1,019	118	3	15	-	50	125	3,642	30,649	145,751	78,071	6,790	12,928	1,761	63	21	174	429,438
17	Fairfax	73,450	8,111	6,977	8,784	1,208	1,316	1,802	240	23	19	1	69	51	674	12,383	26,101	124,485	27,481	14,593	136	172	34	21	308,131
18	Mont_Loud	11,324	2,104	1,085	6,476	714	375	4,887	1,553	664	71	20	39	14	77	1,821	4,090	41,564	115,885	14,490	48	1,168	57	1	208,527
19	PrinceWm	21,148	2,113	2,445	2,846	352	375	473	44	26	3	1	6	7	617	5,068	30,567	67,096	39,069	109,892	2,898	1,981	2,324	20	289,371
20	Fred_Corridor	18,757	442	994	444	59	175	66	5	1	-	-	-	3	431	4,253	56,233	15,696	3,381	32,174	145,127	253	1,663	1,801	281,958
21	Lou_Clk	219	114	40	699	51	28	1,527	1,134	3,865	41	70	62	9	3	53	270	3,137	22,322	5,763	21	18,781	381	-	58,590
22	Fauquier	-	5	-	7	-	-	3	-	12	-	-	-	-	-	-	209	1,254	2,347	14,061	4,234	928	13,910	39	37,009
23	SouthEast	17,925	973	13,099	653	636	9,417	83	3	-	4	1	111	4,965	30,984	1,706	2,798	1,982	31	96	1,647	-	8	141,022	228,144
	Total	737,629	93,852	191,524	245,735	96,853	263,761	139,878	60,967	95,881	14,846	60,208	112,027	246,091	125,523	90,426	298,956	417,728	227,986	206,220	155,921	26,229	18,407	150,094	4,076,742

CTPP After MWCOG Adjustments, Normalized to COG Total Person Trips

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOTAL
1	DC_Core	21,269	3,788	4,102	2,492	711	1,358	426	118	-	9	14	40	262	415	1,256	1,994	3,622	588	471	63	16	15	37	43,066
2	DC_NC_W	61,294	11,882	7,144	6,727	1,414	2,117	1,378	322	73	38	-	182	346	462	1,265	3,141	6,993	1,294	760	88	-	17	137	107,074
3	DC-NC-E	97,653	14,582	42,606	9,035	4,461	10,433	2,781	619	81	227	14	516	641	5,420	5,455	7,395	9,677	1,964	1,818	453	55	55	668	216,609
4	Bethesda	47,902	10,672	6,271	54,548	8,881	7,477	16,847	4,827	745	1,086	72	1,223	799	1,085	1,281	2,950	10,237	3,453	1,641	284	24	22	243	182,570
5	SilverSpring	43,406	8,380	13,291	37,120	31,596	18,791	13,625	3,345	501	1,873	275	3,795	2,048	2,731	2,022	3,017	7,770	2,470	1,214	362	42	32	644	198,350
6	PG_north	67,660	8,906	30,943	21,533	16,012	103,371	8,243	2,411	413	858	501	8,638	10,931	22,767	5,146	8,616	11,871	2,667	2,037	656	65	124	2,118	336,487
7	Gaithersburg	10,465	2,342	1,889	21,431	3,358	2,596	24,524	8,009	1,206	858	72	578	227	461	796	1,272	4,247	1,764	732	109	9	27	72	87,044
8	Germantown	10,613	1,967	1,850	24,931	4,550	2,664	28,898	19,390	2,533	1,527	313	867	500	537	968	1,410	5,077	2,230	815	176	16	10	238	112,080
9	Frederick	3,734	665	665	9,036	2,226	1,469	12,060	9,203	80,409	1,270	3,493	1,990	1,194	245	359	650	1,654	3,149	598	132	652	22	166	135,041
10	NE_Mont	4,506	598	1,032	9,293	3,642	2,269	7,983	3,852	717	4,817	264	1,069	355	285	205	546	1,455	634	172	105	-	-	109	43,908
11	How_Carroll	1,831	239	403	2,470	1,498	3,478	2,439	1,845	4,049	812	50,010	13,200	7,133	328	130	208	501	232	153	23	50	-	159	91,191
12	Columbia	9,527	802	2,658	6,034	5,663	18,215	3,093	809	772	555	3,762	55,227	19,346	1,969	755	1,141	2,455	788	450	166	-	-	241	134,428
13	AnneArundel	19,624	1,143	5,819	4,483	2,367	30,530	2,085	529	311	174	1,098	20,925	194,098	8,949	1,826	2,693	3,474	945	507	256	10	-	3,139	304,985
14	PG_South	66,175	5,444	26,786	5,768	3,355	29,379	2,098	424	116	156	46	1,420	2,117	45,020	6,483	13,736	12,055	2,675	2,021	461	73	18	5,225	231,051
15	Pent_CC	6,533	439	515	287	71	114	34	30	-	-	-	24	-	39	659	850	1,572	326	108	49	-	-	37	11,687
16	Alx_Corridor	93,694	7,361	16,898	7,111	2,006	5,720	2,302	894	125	140	33	486	1,200	5,612	27,641	129,678	76,747	17,445	26,845	5,642	428	189	1,241	429,438
17	Fairfax	78,308	8,201	7,256	8,447	1,263	3,003	3,205	826	212	101	-	429	451	1,243	8,731	28,076	106,737	26,741	22,422	1,403	415	342	319	308,131
18	Mont_Loud	16,124	1,561	2,372	6,578	1,150	1,641	3,811	1,860	638	161	18	261	294	412	2,755	9,136	45,441	92,972	18,069	801	1,945	319	207	208,526
19	PrinceWm	29,282	2,019	4,752	3,805	709	2,454	1,503	612	122	39	22	98	358	1,521	8,586	31,168	68,587	34,184	88,259	8,429	862	1,571	424	289,366
20	Fred_Corridor	23,165	1,259	5,152	1,408	499	1,708	621	178	32	46	15	88	212	1,362	10,245	42,405	24,195	9,010	23,602	130,983	137	685	4,946	281,953
21	Lou_Clk	2,606	229	359	1,057	373	230	818	535	2,722	48	77	137	76	192	355	1,337	4,645	17,567	3,729	211	20,753	511	21	58,588
22	Fauquier	1,365	145	295	303	26	102	64	14	23	-	-	11	-	79	415	1,344	4,183	3,415	8,586	1,670	596	14,323	48	37,007
23	SouthEast	20,893	1,227	8,465	1,837	1,023	14,643	1,035	315	79	51	108	823	3,507	24,388	3,090	6,192	4,531	1,471	1,214	3,400	80	125	129,655	228,152
	Total	737,629	93,851	191,523	245,734	96,854	263,762	139,873	60,967	95,879	14,846	60,207	112,027	246,095	125,522	90,424	298,955	417,726	227,984	206,223	155,922	26,228	18,407	150,094	4,076,732

Table :6 Comparison of MDAA Adjusted HBW Person Trips with CTPP (continued)

Absolute Difference (COG - CTPP)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOTAL
1	DC_Core	1,416	384	331	906	208	265	205	100	-	1	13	8	187	87	568	145	946	318	335	60	16	14	26	1
2	DC_NC_W	4,854	1,880	555	1,679	913	271	410	188	65	-	3	40	236	122	2,271	351	1,475	850	596	86	3	17	127	2
3	DC-NC-E	8,848	2,601	8,132	349	414	5,490	1,441	422	69	121	-	120	496	527	154	1,620	2,516	1,319	1,474	442	53	55	467	-
4	Bethesda	555	1,123	942	7,995	1,031	1,948	1,474	3,086	619	567	38	600	464	561	1,573	461	4,618	2,087	1,252	279	20	21	232	2
5	SilverSpring	9,868	754	2,466	3,487	61	2,777	3,355	1,888	420	116	98	34	333	1,253	146	1,343	520	1,890	1,050	362	42	32	613	2
6	PG_north	5,090	1,616	5,661	1,726	102	5,032	4,446	1,869	380	132	361	679	6,443	6,163	1,020	3,430	705	2,151	1,795	647	65	123	1,445	1
7	Gaithersburg	1,053	76	600	788	213	667	7,005	1,671	752	327	3	191	97	321	65	658	694	1,131	617	108	4	27	71	1
8	Germantown	3,216	363	737	1,261	1,070	738	6,310	5,566	189	96	9	17	292	431	425	970	569	1,320	748	175	44	10	238	2
9	Frederick	3,239	209	507	3,289	1,304	646	2,726	4,119	4,265	516	2,966	3,317	388	217	307	619	1,125	1,282	482	132	1,986	16	166	1
10	NE_Mont	536	282	72	42	228	344	412	444	70	803	58	616	104	150	16	432	591	487	161	105	11	-	108	2
11	How_Carroll	1,154	16	2	145	268	972	1,204	1,706	6,111	894	355	2,228	4,920	236	95	183	349	19	148	23	79	-	159	-
12	Columbia	3,237	824	1,012	1,339	2,135	1,781	87	276	448	728	1,757	1,643	101	954	369	911	1,264	695	434	166	23	-	234	-
13	AnneArundel	3,199	430	4,323	762	1,618	6,867	1,331	378	255	124	888	553	730	2,198	714	1,841	1,906	911	488	256	10	-	1,338	-
14	PG_South	1,095	29	8,977	1,417	573	2,315	1,426	348	115	94	40	737	1,619	6,152	580	4,114	1,695	2,381	1,644	446	73	18	957	1
15	Pent_CC	1,689	90	10	47	31	-	22	24	1	2	-	21	6	-	1,566	396	258	222	50	47	-	-	36	4
16	Alx_Corridor	23,153	483	2,289	1,817	1,145	2,917	1,283	776	122	125	33	436	1,075	1,970	3,008	16,073	1,324	10,655	13,917	3,881	365	168	1,067	-
17	Fairfax	4,858	90	279	337	55	1,687	1,403	586	189	82	1	360	400	569	3,652	1,975	17,748	740	7,829	1,267	243	308	298	-
18	Mont_Loud	4,800	543	1,287	102	436	1,266	1,076	307	26	90	2	222	280	335	934	5,046	3,877	22,913	3,579	753	777	262	206	1
19	PrinceWm	8,134	94	2,307	959	357	2,079	1,030	568	96	36	21	92	351	904	3,518	601	1,491	4,885	21,633	5,531	1,119	753	404	5
20	Fred_Corridor	4,408	817	4,158	964	440	1,533	555	173	31	46	15	88	209	931	5,992	13,828	8,499	5,629	8,572	14,144	116	978	3,145	5
21	Lou_Clk	2,387	115	319	358	322	202	709	599	1,143	7	7	75	67	189	302	1,067	1,508	4,755	2,034	190	1,972	130	21	2
22	Fauquier	1,365	140	295	296	26	102	61	14	11	-	-	11	-	79	415	1,135	2,929	1,068	5,475	2,564	332	413	9	2
23	SouthEast	2,968	254	4,634	1,184	387	5,226	952	312	79	47	107	712	1,458	6,596	1,384	3,394	2,549	1,440	1,118	1,753	80	117	11,367	8
	Total	-	1	1	1	1	1	5	-	2	-	1	-	4	1	2	1	2	2	3	1	1	-	-	10

NOTE: CTPP table was modified by MWCOG to convert trips to Ps and As and to correct the location of some major employers. It was then normalized to the COG totals by PB.

Percent Difference

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOTAL
1	DC_Core	7%		8%																					0%
2	DC_NC_W	8%	16%	8%	25%													21%							0%
3	DC-NC-E	9%	18%	19%	4%	9%	53%								10%	3%	22%	26%							0%
4	Bethesda	1%	11%	15%	15%	12%	26%	9%	64%									45%							0%
5	SilverSpring	23%	9%	19%	9%	0%	15%	25%										7%							0%
6	PG_north	8%	18%	18%	8%	1%	5%	54%					8%	59%	27%	20%	40%	6%							0%
7	Gaithersburg	10%			4%			29%	21%									16%							0%
8	Germantown	30%			5%	24%		22%	29%									11%							0%
9	Frederick				36%			23%	45%	5%															0%
10	NE_Mont	12%			0%			5%			17%														0%
11	How_Carroll									151%		1%	17%	69%											0%
12	Columbia	34%			22%	38%	10%						3%	1%											0%
13	AnneArundel	16%		74%	17%		22%						3%	0%	25%										0%
14	PG_South	2%	1%	34%	25%		8%								14%	9%	30%	14%						18%	0%
15	Pent_CC	26%																							0%
16	Alx_Corridor	25%	7%	14%	26%		51%								35%	11%	12%	2%	61%	52%	69%				0%
17	Fairfax	6%	1%	4%	4%											42%	7%	17%	3%	35%					0%
18	Mont_Loud	30%			2%												55%	9%	25%	20%					0%
19	PrinceWm	28%		49%												41%	2%	2%	14%	25%	66%				0%
20	Fred_Corridor	19%		81%												58%	33%	35%	62%	36%	11%			64%	0%
21	Lou_Clk																	32%	27%			10%			0%
22	Fauquier																	70%		64%			3%		0%
23	SouthEast	14%		55%			36%								27%		55%	56%						9%	0%
	Total	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

4. Model and Pathbuilding Modifications

Substantial changes have been made to MDAAII since MDAAI was completed: some are a direct result of information made available from the new survey data and field-collected data, some corrections were identified in MDAAI, and some were structural changes required to accurately reflect transit travel behavior and/or level-of-service attributes (i.e., the inclusion of a fare model and a bus speed model).

A. Access Impedances

Figure 4 illustrates the types of transit access available in the model. Walk access must be either directly from a TAZ to a station (if it is within the maximum walk distance) or along the sidewalk network. The sidewalk network is constructed from the highway network excepting the freeways. Access to the sidewalk network must be at an existing bus node. Walk speeds are assumed to be 3 mph. Walk access times were modified to reflect "faithful station coding" paradigms. These changes are described in the following sections.

1. Walk from Park-n-Ride Lots

Average walk time from park-and-ride (PNR) lots to the stations were assigned to the PNR access links based on PNR lot sizes; the underlying theory being that the size of the lot is related to the average time it takes to walk across the lot to the station. The lot sizes were allocated to ranges as shown in Table 7. These average walk times were validated by scaling distances from the visually identified geographic centroids of parking lots as shown on aerial photographs (Google Maps), applying a 3 mph speed, and comparing the resulting times to documented parking lot sizes.

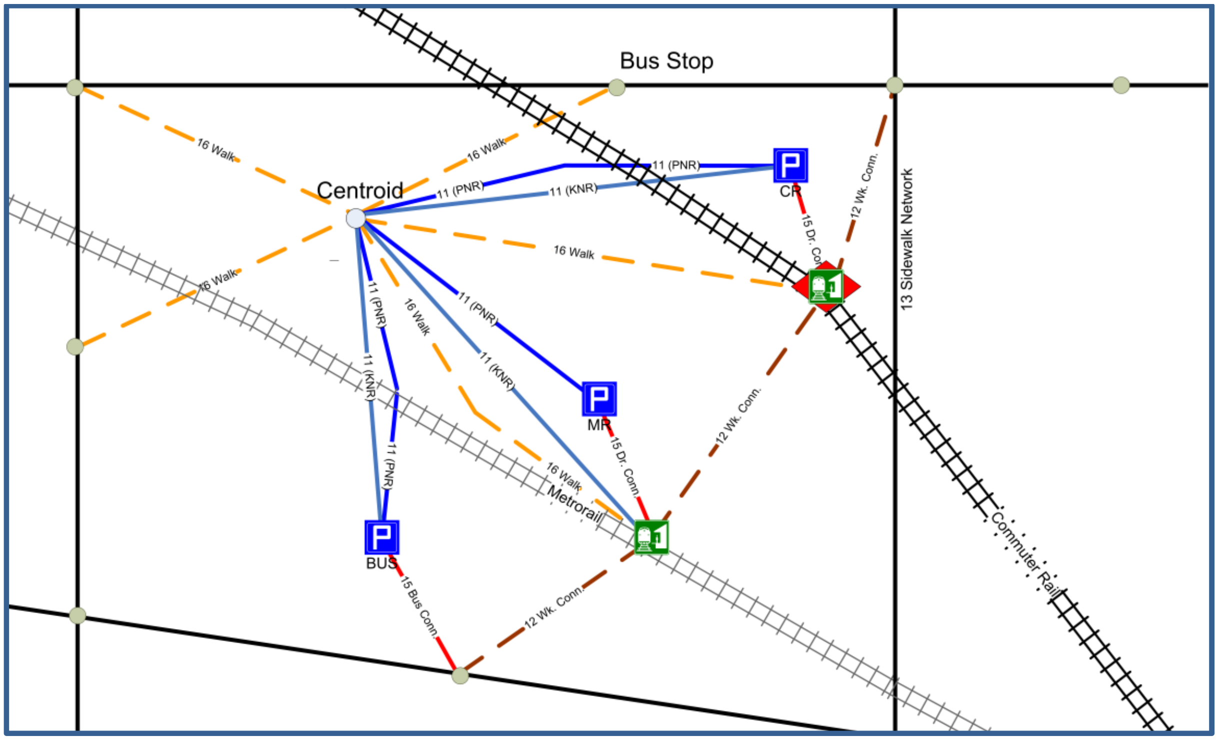
Table 7: Park-and-Ride Lot Sizes and Assigned Average Walk Times to Stations

Parking Lot Capacity up to:	Assigned Average Minutes of Access Time from Auto to Station
350	2.0
1,269	3.0
4,000	3.5
5,800	4.5
99,999	7.0

2. Access to Platform Time

The estimated time required to reach the platform from the station entrance is sometimes called "faithful station coding." Because some of the Metrorail stations are very deep, and access can require a substantial amount of time on escalators or walking on long platforms, the more accurate assessment of actual walk access time from the station entrance to the platform was considered to be important. Field data collection approximated an average walking time during a typical rush hour, and in some cases, multiple samples from the same station were collected and averaged. Table 8 shows the minutes of impedance added to each Metrorail station path.

Figure 4: Access Coding



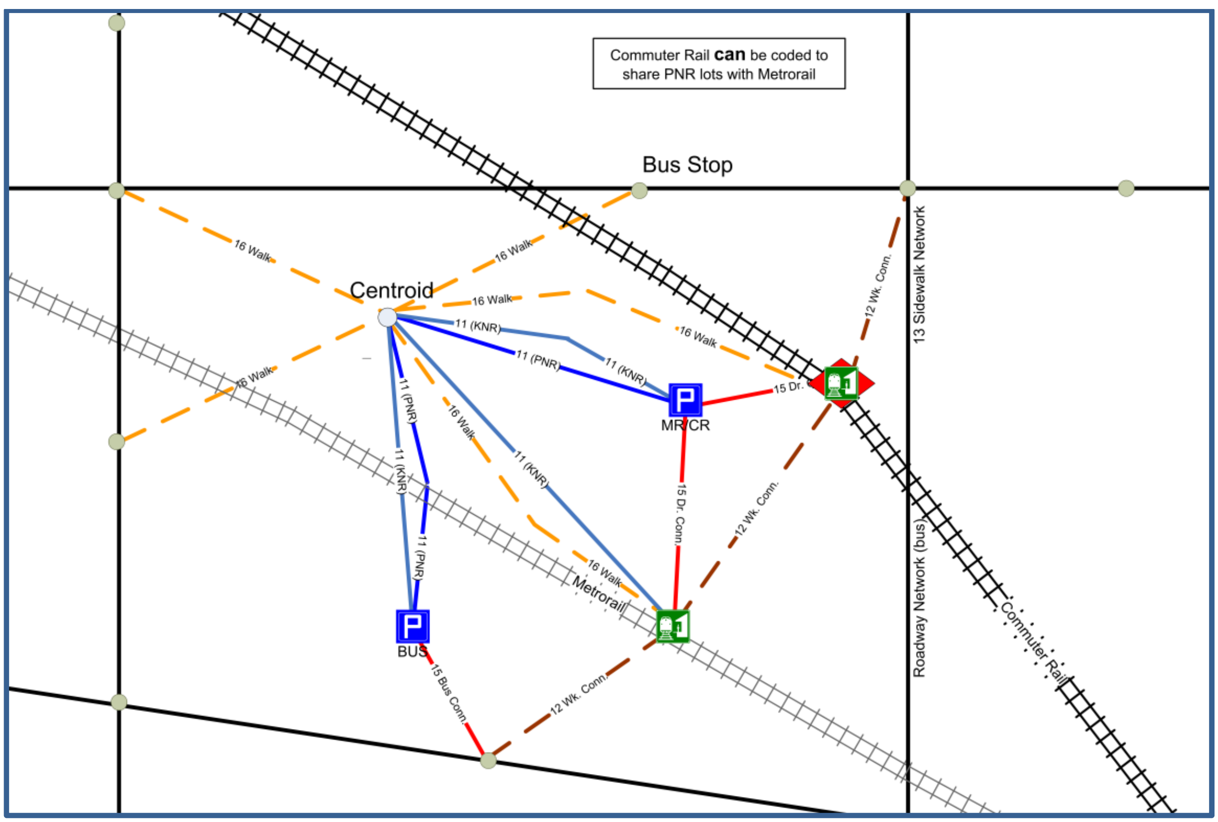


Table 8: Walk Times to Metrorail Platforms

Metrorail Station	Added Walk to Platform (Minutes)	Metrorail Station	Added Walk to Platform (Minutes)
Addison Road	1.0	Eisenhower Avenue	1.5
Anacostia	2.0	Farragut North	2.0
Archives	2.0	Farragut West	2.0
Arlington Cemetery	2.0	Federal Center SW	2.5
Ballston	3.0	Federal Triangle	2.5
Benning Road	2.0	Foggy Bottom-GWU	2.0
Bethesda	4.0	Forest Glen	2.5
Braddock Road	1.5	Fort Totten	2.0
Branch Avenue	1.5	Franconia-Springfield	2.5
Brookland-CUA	1.5	Friendship Heights	4.5
Capitol Heights	2.0	Gallery Place	3.5
Capitol South	2.5	Georgia Ave	3.0
Cheverly	1.5	Glenmont	2.5
Clarendon	2.5	Greenbelt	1.0
Cleveland Park	3.0	Grosvenor	2.0
College Park	2.0	Herndon/Monroe	1.5
Columbia Heights	3.0	Huntington	2.0
Congress Heights	2.5	King Street	1.0
Court House	5.0	Landover	1.0
Crystal City	3.0	Largo Town Center	2.0
Deanwood	1.0	L'Enfant Plaza	4.0
Dulles Airport	1.5	McPherson Square	2.5
Dulles North	1.5	Medical Center	4.0
Dunn Loring	1.5	Metro Center	4.0
Dupont Circle	3.0	Minnesota Avenue	1.5
East Falls Church	1.5	Morgan Boulevard	2.0
Eastern Market	2.5	Mt Vernon Square	3.0
National Airport	1.5	Tysons East	1.5
Navy Yard	2.5	Tysons West	1.5
Naylor Road	1.0	Union Station	1.5
New Carrollton	1.5	U-Street-Cardozo	2.5
New York Ave NE.	1.5	Van Dorn Street	1.0
Shaw-Howard Univ	2.5	Van Ness-UDC	3.0
Silver Spring	1.0	Vienna	2.0
Smithsonian	2.0	Virginia Square	2.5
Southern Avenue	2.0	Waterfront	2.5
Stadium Armory	2.0	West Falls Church	1.5
Suitland	2.0	West Hyattsville	1.5
Takoma	1.5	Wheaton	4.5
Tenleytown	4.0	White Flint	1.5
Twinbrook	2.0	Wiehle Ave	1.5
Tysons Central RT123	1.5	Woodley Park-Zoo	4.5

B. Maximum Walk and Drive Distances

Based on survey data and results of assigning the transit survey data, the maximum walk and drive distances were adjusted.

The walk access program generates walk access links for each zone to any bus stop within a search radius equal to 1.5 times the square root of the area of the zone. The maximum length of any walk link is 2 miles. Zones that do not find a connection within the search radius are allowed a larger search radius and walk distance (up to 150% of the maximum). Analysis of the survey data indicated that the maximum walk distance of 2 miles is too short to capture all walk to transit trips. Various the maximum walk distances were tested during pathbuilding and assignment of the observed transit trip tables. The conclusion of the survey assignment testing was that both the search radius and maximum walk distance should be doubled in order to capture the majority of the observed walk to transit trips.

The maximum drive distances are controlled separately for Metrorail and commuter rail drive-to-transit paths. PNR stations are assigned a code that is used to determine the size of the search radius for drive to transit trips. If a zone is within the search radius of a PNR lot, then the drive time to the station is taken from the congested highway skim matrix. Station types and their associated maximum drive sheds are shown in Table 9.

Table 9: Park-and-Ride Codes and Maximum Drive Sheds

	Maximum Drive Distance by Mode (miles)				
Type Code	Metrorail	Commuter Rail	Light Rail	Bus Rapid Transit	Bus
1	45.0	15.0	5.0	5.0	5.0
2	30.0	5.0	NA	NA	NA
3	15.0	NA	NA	NA	NA
4	7.5	NA	NA	NA	NA
0	3.0	3.0	3.0	3.0	3.0

C. Hierarchy of Modes and Weights

The hierarchy of modes and accompanying pathbuilding weights are shown in Table 10. Designating light rail as a subordinate mode to Metrorail, and bus rapid transit as subordinate to light rail is a correction from MDAAI, which treated all of these fixed guideway modes as equal. The 2.5 weight on Metrorail trips in the commuter rail alternative is a result of testing the assignment of observed survey data. Several tests of maximum drive distances for Commuter Rail were performed. The longer maximum drive distances toward the end of the commuter rail lines yielded a better match of estimated to observed drive to commuter rail trips. However, the longer drive to commuter rail maximum drive distances at the far commuter rail stations resulted in Metrorail park-and-ride lots falling within the Commuter Rail drive to transit distance. Therefore, a 2.5 Metrorail path weight was applied in conjunction with the increased maximum Commuter Rail drive distance.

Table 10: Pathbuilding Hierarchy of Modes and Weight

Mode	Description in Doc./Scripts	Notes	Created by prgm:	File Name[2]	Wgt	LB[3]	BR[2]	LR[2]	MR[2]	CR[2]
1	Metrobus Local		Manual coding	Mode1am.tb		1.0	1.2	1.2	1.2	1.2
2	Metrobus Express		Manual coding	Mode2am.tb		1.0	1.2	1.2	1.2	X
3	Metrorail		Manual coding	Mode3am.tb		X	X	X	1.0	2.5
3	Metrorail	created from rail_tpp.bse & sta_tpp.base	staprotp_v1	met_link.tb		X	X	X	NA	NA
4	Commuter Rail		Manual coding	Mode4am.tb		X	X	X	X	1.0
4	Commuter Rail	created from rail_tpp.bse & sta_tpp.base	staprotp_v1	com_link.tb		X	X	X	X	NA
5	Light Rail		Manual coding	Mode5am.tb		X	1.2	1.0	1.2	1.2
5	Light Rail	created from rail_tpp.bse & sta_tpp.base	staprotp_v1	lrt_link.tb		X	NA	NA	NA	NA
6	Primary Local Bus		Manual coding	Mode6am.tb		1.0	1.2	1.2	1.2	1.2
7	Primary Express Bus		Manual coding	Mode7am.tb		1.0	1.2	1.2	1.2	X
8	Secondary Local Bus		Manual coding	Mode8am.tb		1.0	1.2	1.2	1.2	1.2
9	Secondary Express Bus		Manual coding	Mode9am.tb		1.0	1.2	1.2	1.2	X
10	Bus Rapid Transit		Manual coding	Mode10am.tb		X	1.0	1.2	1.2	1.2
10	Bus Rapid Transit	created from rail_tpp.bse & sta_tpp.base	staprotp_v1	new_link.tb		X	NA	NA	NA	NA
11	Drive to transit (Metrorail, commuter rail and bus)	• connects centroids to PNR lots (Bus, MR, CR, LRT, and BRT)[4] for PNR • connects centroids to stations for KNR	autoacc3 (autoall.asc=all drive access link files appended)	busam.asc	1.0					X
				newam.asc		X		X		X
				lrtam.asc		X	X			X
				mrpram.asc		X				X
				mrkram.asc		X				X
		•		cram.asc		X	X	X	X	
12	• Bus-metro links and transfer cards • Bus-commuter rail links and transfer cards	• connects MR, CR, LRT and BRT stations to Bus stops • connects MR, CR, LRT and BRT stations to each other	staprotp_v1	new_bus.tb	2.0	X				
				lrt_bus.tb		X				
				met_bus.tb		X				
				com_bus.tb		X				
13	Sidewalk Network		Walkacc_v2	sidewalk.asc	2.0					
15	PNR connectors (bus to PNR, Metrorail to PNR, and Commuter Rail to PNR)	• Connects MR (and CR) stations to MR (and CR) PNR lots • Connects Bus stops to Bus PNR lots	parker	busampnr.tb	2.0					
				newampnr.tb		X		X		
				lrtampnr.tb		X	X			
				metampnr.tb		X				
				comampnr.tb		X	X	X	X	
16	Walk to local transit		Walkacc_v2	walkacc.asc	2.0					

Notes: Drive to MR and Drive to Bus are prohibited in the CR paths. CR PNR skims are used for CR KNR mode choice. Bus paths allow parking at MR stations. Express bus IVTT is not permitted in the CR skims.

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[2] To simplify the chart, all peak periods (AM and PM) are referenced as AM. All files referencing links have an accompanying file referencing nodes. Mode##am.tb files are assumed for modes 1-10.

[3] Path-building Hierarchy (& MODEFAC). "X" = not available in path-building.

D. Transfer Prohibitions and Penalties

Transfer prohibitions and penalties are shown in Table 11. In MDAAI, walk to Metrorail transfers were inadvertently prohibited. This was a holdover from previous versions, which included a bus/Metrorail alternative separate from the Metrorail only alternative. Walk to Metrorail had been prohibited in the bus/Metrorail alternative and was inadvertently carried over to MDAAI combined Metrorail alternative. This was the primary reason for the unacceptably high bus boardings in the Metrorail paths in MDAAI. It has been corrected in MDAAII.

E. Bus Speed Model

A substantial change in MDAAII over MDAAI was the introduction of the bus speed model. MDAAI reflected no relationship between highway speeds and bus speeds. During the development of MDAAII, a bus speed model was developed and validated using total route runtimes in the base year networks as the observed bus speeds. A correlation was developed (by area type and facility type) between these "observed" bus speeds and congested highway speeds. For each unique combination of area type and facility type, average variances between link level highway times and bus times were calculated. For combinations of facility type and area type that have few links with observed transit time, manual smoothing is used to obtain consistent, reasonable additional delays. Additional manual adjustments are made to minimize the system-wide route percent root-mean-square error (RMSE) between the total run times derived with the estimated bus speed model and RUNTIMES coded on the bus line cards.

The resulting additional minutes of delay by area type and facility type are shown in Table 12.

The model is implemented by creating a highway network specifically for skimming the transit networks. Travel times on the highway links are adjusted according the minutes of delay for the link's area type and facility type.

This approach prohibits assigning a different bus delay to express bus modes running on the same links as local bus modes. In many cases, limited-stop buses run on the same roads as local buses. This bus speed model does not distinguish between these bus modes. To accommodate differences between operating characteristics of bus modes, an additional analysis of bus run times at the link level was performed. Differences between observed link level bus times by mode resulted in the adjustment factors shown in Table 13. These adjustments are applied using the TIMEFAC parameter in the mode files.

Table 11: Transfer Prohibitions and Penalties

		Transit Modes										Access Modes					
		Local Bus	**Express Bus**	**Metrorail**	**Commuter Rail**	**LRT**	**Other Local Bus**	**Other Express Bus**	**Other Local Bus**	**Other Express Bus**	**BRT**	**Drive**	**Walk Connector**	**Sidewalk**	**Unused**	**PNR Connector**	**Walk**
Transit Modes	Local Bus	5.0	5.0	2.0	2.0	2.0	5.0	5.0	Prhbt	Prhbt	2.0	Prhbt	0.0	0.0	0.0	Prhbt	0.0
	Express Bus	5.0	5.0	2.0	2.0	2.0	5.0	5.0	Prhbt	Prhbt	2.0	Prhbt	0.0	0.0	0.0	Prhbt	0.0
	Metrorail	5.0	5.0	0.0	2.0	2.0	5.0	5.0	Prhbt	Prhbt	2.0	Prhbt	0.0	0.0	0.0	Prhbt	0.0
	Commuter Rail	5.0	5.0	2.0	2.0	2.0	5.0	5.0	Prhbt	Prhbt	2.0	Prhbt	0.0	0.0	0.0	Prhbt	0.0
	LRT	5.0	5.0	2.0	2.0	0.0	5.0	5.0	Prhbt	Prhbt	2.0	Prhbt	0.0	0.0	0.0	Prhbt	0.0
	Other Local Bus	5.0	5.0	2.0	2.0	2.0	5.0	5.0	Prhbt	Prhbt	2.0	Prhbt	0.0	0.0	0.0	Prhbt	0.0
	Other Express Bus	5.0	5.0	2.0	2.0	2.0	5.0	5.0	Prhbt	Prhbt	2.0	Prhbt	0.0	0.0	0.0	Prhbt	0.0
	Other Local Bus	5.0	5.0	2.0	2.0	2.0	5.0	5.0	5.0	5.0	2.0	Prhbt	0.0	0.0	0.0	Prhbt	0.0
	Other Express Bus	5.0	5.0	2.0	2.0	2.0	5.0	5.0	5.0	5.0	2.0	Prhbt	0.0	0.0	0.0	Prhbt	0.0
	BRT	5.0	5.0	2.0	2.0	2.0	5.0	5.0	5.0	5.0	0.0	Prhbt	0.0	0.0	0.0	Prhbt	0.0
Access Modes	Drive	5.0	5.0	2.0	2.0	2.0	5.0	5.0	5.0	5.0	2.0	Prhbt	Prhbt	0.0	Prhbt	0.0	0.0
	Walk Connector	8.0	8.0	2.0	2.0	2.0	8.0	8.0	8.0	8.0	2.0	Prhbt	Prhbt	0.0	0.0	Prhbt	0.0
	Sidewalk	5.0	5.0	2.0	2.0	2.0	5.0	5.0	5.0	5.0	2.0	Prhbt	0.0	0.0	0.0	Prhbt	0.0
	Unused	5.0	5.0	2.0	2.0	2.0	5.0	5.0	5.0	5.0	2.0	Prhbt	0.0	0.0	0.0	Prhbt	0.0
	PNR Connector	5.0	5.0	2.0	2.0	2.0	5.0	5.0	5.0	5.0	2.0	Prhbt	Prhbt	Prhbt	Prhbt	Prhbt	Prhbt
	Walk	5.0	5.0	2.0	2.0	2.0	5.0	5.0	5.0	5.0	2.0	Prhbt	0.0	0.0	0.0	Prhbt	Prhbt

Table 12: Bus Speed Model, Additional Minutes of Delay per Mile

	Facility Type						
Area Type	**Centroid**	**Freeway**	**Major Arterial**	**Minor Arterial**	**Collector**	**Expressway**	**Ramps**
1	0.00	0.00	0.00	3.25	0.00	0.00	0.00
2	0.00	0.00	1.71	1.29	3.25	0.00	0.00
3	0.00	0.00	0.77	1.29	0.73	0.00	0.00
4	0.00	0.00	0.00	0.46	0.67	0.00	0.00
5	0.00	0.00	0.00	0.46	0.66	0.00	0.00
6	0.00	0.00	0.00	0.08	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 13: Bus Mode Adjustment Factors – Local vs. Limited Stop

Bus Mode/Type	Adjustment Factor
Mode 1 – Local WMATA	1.0972
Mode 2 – Express WMATA	0.9017
Mode 6 – Other Local	1.0292
Mode 7 – Other Express	0.9755
Mode 8 – Other Local	0.9844
Mode 9 – Other Express	0.9371

F. Fare Model

Another substantial change from MDAAI was the introduction of the transit fare model. MDAAI created an accurate Metrorail distance-based fare matrix and used a complex set of district systems to allocate fares for all bus and commuter rail modes. The difficulty was twofold: 1) fares for local buses, express buses, some commuter buses, and for commuter rail modes were recognized by the model as equal; and 2) it was difficult to reliably implement baseline bus alternatives or new modes that might have vastly different fares.

Neither MDAAI nor MDAAII used fare in pathbuilding.

The MDAAII fare model contains three components: boarding-based bus fares, distance-based Metrorail fares, and zonal based fares for commuter rail and MTA commuter buses.

An inventory of bus boarding and transfer fares for all bus systems in the Region was compiled and the 2005 fares associated with these systems identified. Thirty-nine unique fare policies and therefore 39 new fare modes were identified. A 39-mode fare matrix was created.

A procedure was developed to translate the MDAAII model's 10 mode codes into the 39 mode codes based on route name and the route's associated operator. The fares were then skimmed using the new 39-mode line files. Zonal-based modes were captured during the skimming process using the TP+ FARELINKS option.

The Metrorail portion of any path was assigned a fare of $0.00 during the fare skimming process. The distance-based Metrorail fares were then added to the fare skims using the Metrorail station-to-station fares and the station-to-station skim matrices generated by the fare skimming described above.

It should be noted that the fare skims are not 100% the same paths as those generated by the model's regular 10-mode transit skimming step. Because composite headways can only be calculated within the same mode, disaggregating the 10 modes into 39 modes results in some paths not finding a combined headway in the 39-mode fare skims where combined headways are found in the 10-mode regular skims. In addition, transfer penalties between modes can change the paths. Every effort was made to match the 10-mode paths by eliminating transfer penalties and extending the maximum transit travel time. Tests indicated that the 39-mode fare skims reasonably approximated the 10-mode regular skims.

G. Coefficients

Several changes were made to the MDAAI coefficients and utility expressions to make them more consistent with current standard practice.

1. Coefficients on In-Vehicle Time

Coefficients on in-vehicle time were changed to correspond with standard accepted practice. Further, the auto access in-vehicle time and the walk-time coefficients should be 2 times the in-vehicle time coefficient. Coefficients on out-of-vehicle time and transit-boarding penalty should be 2.5 times the in-vehicle time coefficient. These standards were adopted for MDAAII and are shown in Table 14.

Table 14: Original and Revised Coefficients

Original Coefficients	HBW	HBO	NHB	Relation to IVTT
In-vehicle time	-0.02128	-0.02322	-0.02860	
Auto access time	-0.03192	-0.05805	-0.07150	2.5
Out-vehicle time and terminal time	-0.05320	-0.03483	-0.04290	1.5
Transit boarding penalty	-0.05320	-0.05805	-0.07150	2.5
Walk access time	-0.04256	-0.04644	-0.05720	2.0
Revised Coefficients				
In-vehicle time	-0.0250	-0.0200	-0.0200	
Auto access time	-0.0500	-0.0400	-0.0400	2.0
Out-vehicle time and terminal time	-0.0625	-0.0500	-0.0500	2.5
Transit boarding penalty	-0.0625	-0.0500	-0.0500	2.5
Walk access time	-0.0500	-0.0400	-0.0400	2.0

2. Wage Rates and Income Groups

Income coefficients in MDAAI and the revised MDAAII income coefficients are shown in Table 15. It is unclear how the original income coefficients were derived; however, COG documentation provides regional wage rates as documented by the 2000 Census. The MTA used these documented wage rates to calculate income stratified coefficients for HBW purposes. HBO cost coefficients were set to be one-sixth of HBW coefficients, and NHB coefficients were set to be one-half of HBW, consistent with standard accepted practice.

Table 15: Revised Wage Rates and Cost Coefficients

<table>
<tr><th colspan="5">Original Cost Coefficients</th></tr>
<tr><th>Income Group</th><th></th><th>HBW</th><th>HBO</th><th>NHB</th></tr>
<tr><td>inc1</td><td></td><td>-0.00185</td><td>-0.00202</td><td>-0.00994</td></tr>
<tr><td>inc2</td><td></td><td>-0.00092</td><td>-0.00101</td><td>-0.00994</td></tr>
<tr><td>inc3</td><td></td><td>-0.00059</td><td>-0.00065</td><td>-0.00994</td></tr>
<tr><td>inc4</td><td></td><td>-0.00044</td><td>-0.00048</td><td>-0.00994</td></tr>
<tr><th colspan="5">Revised Cost Coefficients</th></tr>
<tr><th>Income Group</th><th>Wage Rate</th><th>HBW</th><th>HBO</th><th>NHB</th></tr>
<tr><td>inc1</td><td>$6.60</td><td rowspan="2">-0.00389</td><td rowspan="2">-0.01866</td><td rowspan="4">-0.00386</td></tr>
<tr><td>inc2</td><td>$17.92</td></tr>
<tr><td>inc3</td><td>$30.19</td><td>-0.00124</td><td>-0.00596</td></tr>
<tr><td>inc4</td><td>$60.39</td><td>-0.00062</td><td>-0.00298</td></tr>
</table>

Calibration efforts suggested that income groups one and two could be combined. Calculated income coefficients for income groups one and two were averaged.

3. Split Initial Wait Times

In the utility expressions, the initial wait times have been split into two parts: 5 minutes or less and greater than 5 minutes. The part that is 5 minutes or less is multiplied by the out-of-vehicle coefficient. The part greater than 5 minutes is multiplied by the in-vehicle time coefficient.

5. Model Calibration

MDAAII is a nested logit model with three nests (Table 16). A constant for PNR-to-local-bus was added to reflect un-included attributes. Specifically, PNR lots for buses are informal lots and substantially less secure and convenient than PNR lots at Metrorail and commuter rail stations.

Table 16: Nesting Structure and Asserted LogSum Coefficients

AUTO			TRANSIT								
0.5			0.5								
LOV	**HOV**		**WALK ACC**			**PNR ACC**			**KNR ACC**		
1.0	0.5		0.5			0.5			0.5		
	HOV2	**HOV3+**	**WLK CR**	**WLK LB**	**WLK MR**	**PNR CR**	**PNR LB**	**PNR MR**	**KNR CR**	**KNR LB**	**KNR MR**
	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

A. Other Constants

During calibration, several variables were evaluated for relevance to the utility of some of the transit alternatives for some of the purposes. Table 17 lists the constants that were developed by purpose. Final calibrated constants can be found in Appendix A.

Table 17: Additional Constants in the Utility Expressions

	HBW		HBO		NHB	
	Peak	**Off-Peak**	**Peak**	**Off-Peak**	**Peak**	**Off-Peak**
Zero-Car Households	Yes	Yes	Yes	Yes		
Distance	Yes	Yes	Yes	Yes	Yes	Yes
CBD Attraction	Yes	Yes	Yes	Yes		
CBD-Non-Core-East Attraction	Yes	Yes	Yes	Yes		
Pentagon Attraction	Yes	Yes	Yes	Yes		
CBD Production & Attraction					Yes	Yes
CBD-Non-Core-East Production & Attraction					Yes	Yes

The zero-car household production zones, distance stratification, and central business district (CBD) attraction zones as variables for constant calibration are not unusual in mode choice utility equations. The other constants are unique to Washington, DC's character. The zone containing the Pentagon and related office buildings is outside the CBD and yet represents a major attraction for unique work trips. A positive constant for trips destined to the Pentagon/Crystal City district was added.

The CBD-Non-Core-East District is the district east of the CBD but inside the district limits. This district is unique in that it has a mix of very-low-income, zero-car households and some pockets of higher-income residents. At the same time, small pockets of dense employment serve as attractors. Efforts to calibrate a constant for employment density in the CBD-Non-Core-East District failed because the character of the employment densities is similar to those in the CBD. Therefore, adding a constant on employment density did nothing to address the competition between the CBD and the CBD-Non-Core-East District for transit attractions. A separate constant was added to the transit utility calculations for all CBD-Non-Core-East District attractions.

The majority of the NHB transit trips (all Metrorail trips) were removed from the mode choice model to be addressed by the NHBDD model. Under the assumption that NHB transit trips are short trips to and from densely developed areas, a constant was developed for the NHB bus trips where both the production and attraction end of the trip are in the CBD. A similar constant was developed for bus trips completely within the CBD-Non-Core-East District.

B. Challenges to Calibration

Final constants are shown in Appendix A, and the observed and estimated comparisons by district, income, and distance stratification are shown in Appendix B.

An intractable challenge to satisfactorily calibrating the mode choice model was a high number of bus trips and correspondingly low number of Metrorail trips in the low-income markets. The inverse of this problem existed in the high-income markets—low numbers of bus trips and high numbers of Metrorail trips. Many tests attempted to understand the reasons for this dichotomy, but without success. The final (but not ideal) conclusion was the application of mode-specific constants stratified by income. These constants are shown in Appendix A. Another less-than-optimal result of the calibration effort was the negative commuter rail constants.

While evaluating these two issues, the decision was made to collapse the two lower-income groups into one low-income group. In addition, discounts on transit fare were introduced for the low- and high-income groups. The discounts were based on survey data that indicated the number of transit riders by income group that receive an employer subsidy for transit usage, as well as other information, suggesting the number and size of employer subsidies. High-income groups receive a 70% reduction in fares while low-income groups receive a 25% reduction.

C. Parking Capacity Restraint and Calibration

The Parking Capacity Restraint (PCR) mechanism was developed in MDAAI but only partially implemented for a few key stations in the PL and CCT Corridors. For MDAAII, improved observed data regarding parking capacities and costs were compiled, and the PCR was implemented for all stations.

The PCR model was implemented after calibration without restraint was complete. It was implemented for all Metrorail stations with full iterations of feedback for the peak HBW purpose. A final re-calibration of the peak HBW purpose with the skims resulting from the PCR was performed.

The result is a shadow price added to the Metrorail PNR connectors between the parking lots and the Metrorail stations. Table 18 shows the station parking capacities, the initial HBW Peak PNR trips to each station after the initial calibration and before the PCR, and the results of the implementation of the PCR on the shadow prices and PNR trips by station.

Implementing the PCR causes a slightly more positive Metrorail constant (to draw back Metrorail trips that were lost to the higher shadow prices) and a shift of 4,700 trips from PNR Metrorail trips to walk-to-Metrorail trips. The change in Metrorail constants by income group are shown in

Table 19. An additional 7,300 trips shift from stations that were over capacity to stations with excess capacity.

The following observed vs. estimated trip comparisons are provided in Appendix B.

1. Linked trips by Mode
2. District to District Trips by Purpose
3. Frequency Distribution of Trip Length by Production District and Purpose

6. Validation

The following comparisons of observed and estimated boardings were prepared and can be found in Appendix B.

1. Boardings by Alternative and Mode
2. Bus Boardings by System
3. Bus Boardings for Key Bus Routes
4. Metrorail Boardings by Line
5. Metrorail Boardings by Line Segment
6. Metrorail Boardings and Alightings by Station
7. Metrorail Boardings by Station and Access Mode
8. Commuter Rail Boardings by Station

Table 18: Parking Capacity Restraint Results

Station	Capacity	Model Assigned (Initial)	Percent Over Assigned	Initial[5] Impedance (min.)	Final Capacity Restrained Impedance (min.)	Final Capacity Restrained Assigned PNR Trips	PNR Trips Added	PNR Trips Removed
Shady Grove	6,662	1,838	0%	7.0	7.0	2,184	346	-
Rockville	645	1,011	57%	3.0	5.1	648	-	363
Twinbrook	1,097	494	0%	3.0	3.0	708	214	-
White Flint	1,270	162	0%	3.5	3.5	406	244	-
Grosvenor	1,796	2,184	22%	3.5	4.5	1,886	-	299
Bethesda	2,687	1,953	0%	3.5	3.5	1,983	30	-
Rhode Island Ave	540	1,392	158%	3.0	9.6	551	-	841
Fort Totten	608	2,326	282%	3.0	10.5	638	-	1,687
Silver Spring	3,895	1,709	0%	3.5	3.5	2,608	898	-
Forest Glen	844	818	0%	3.0	4.1	759	-	59
Wheaton	977	1,069	9%	3.0	4.5	965	-	105
Glenmont	1,781	3,756	111%	3.5	7.3	1,812	-	1,944
Greenbelt	3,999	2,428	0%	3.5	3.5	2,664	236	-
College Park	1,870	211	0%	3.5	3.5	311	100	-
PG Plaza	1,068	135	0%	3.0	3.0	961	826	-
West Hyattsville	524	433	0%	3.0	4.9	549	116	-
Anacostia	1,133	1,800	59%	3.0	5.6	1,186	-	614
Southern Avenue	3,429	899	0%	3.5	3.5	2,049	1,150	-
Naylor Road	892	1,132	27%	3.0	3.5	911	-	221
Suitland	2,204	2,753	25%	3.5	4.7	2,287	-	466
Branch Avenue	3,728	4,835	30%	3.5	5.3	3,878	-	957
Van Dorn Street	1,161	1,583	36%	3.0	5.8	1,218	-	365
Franconia-Springfield	5,166	3,209	0%	4.5	4.5	3,727	519	-

[5] Calculated from length of the access link and an assumed 3 mph walking speed. Link distances are automatically calculated and are a function of the size of the PNR lot.

Table 17: Parking Capacity Restraint Results (continued)

Station	Capacity	Model Assigned (Initial)	Percent Over Assigned	Initial Impedance (min.)	Final Capacity Restrained Impedance (min.)	Final Capacity Restrained Assigned	Trips Shifted to Stations with Capacity	Trips Lost from Over Capacity Stations
Huntington	3,090	4,303	39%	3.5	6.7	3,244	-	1,060
Vienna	5,950	3,178	0%	7.0	7.0	3,201	24	-
Dunn Loring	1,319	1,680	27%	3.5	4.4	1,382	-	298
West Falls Church	5,422	1,692	0%	4.5	4.5	2,108	416	-
East Falls Church	422	1,889	348%	3.0	19.5	442	-	1,448
Ballston	500	2,102	320%	3.0	18.3	525	-	1,578
Stadium Armory	500	1,199	140%	3.0	6.3	515	-	684
Minnesota Avenue	333	578	73%	2.0	5.4	327	-	250
Deanwood	294	328	11%	2.0	5.1	265	-	62
Cheverly	530	197	0%	3.0	3.0	517	320	-
Landover	1,866	783	0%	3.5	3.5	1,662	879	-
New Carrollton	5,331	316	0%	4.5	4.5	689	373	-
Capitol Heights	572	1,105	93%	3.0	4.7	596	-	509
Addison Road	1,268	1,160	0%	3.0	3.5	1,309	149	-
Morgan Boulevard	608	28	0%	3.0	4.6	512	484	-
Largo Town Center	2,299	3,215	40%	3.5	4.5	2,385	-	830
	78,280	61,883				54,563	7,322	7,319

Table 19: Affect of Parking Capacity Restraint on Metrorail Constants (in Equivalent Minutes)

	Low Income	Medium Income	High Income
Before	-7.4	7.9	34.2
After	-7.1	8.1	34.8

Appendix C

Corridor Cities Non-Included Attributes

The Federal Transit Administration (FTA), in their 2007 *Proposed Guidance on New Start / Small Starts Policies and Procedures*, proposed new guidelines for calculating and reporting user benefits associated with characteristics of a transit line not included in a travel demand model. Modeled attributes include travel time, frequency and wait time, and fares and parking costs. Service attributes not part of travel demand models include "*its visibility, reliability, span of service hours, comfort, protection from the weather, the chances of finding a seat, and passenger amenities*." These non-included attributes are theoretically part of the mode-specific constant for existing transit modes being modeled. New modes are required by the FTA to use a mode-specific constant of 0, but are now allowed to take credit for any non-included attributes by using a post-processing procedure that applies user benefits (time savings) to certain riders of the proposed transit line. Those user benefits are determined by the type and nature of the attributes of the new mode.

FTA proposes to credit projects that introduce a transit mode to an urban area with additional transportation benefits, the magnitude of which will depend on the characteristics of the proposed project and the number of transit trips predicted to use the project. The additional benefits will occur in three forms: (1) a relatively large positive constant for trips using the project via park & ride access and no dependence on local buses; (2) a smaller positive constant for all other trips on the project; and (3) a less onerous weight applied to the time spent riding on the new facility compared to the weight applied to time on all other modes. The large constant will not be applied to walk trips to the proposed project because of the inability of current travel models to distinguish the walk-to-guideway-only market from all other walk-to-transit markets, a limitation that would produce a gross over-estimation of the size of that market.

FTA will determine the values of the constants and travel-time weight based on three types of project characteristics that are not recognized in current methods for ridership forecasting:

<u>Guideway-like Characteristics</u>

- Reliability of vehicle arrival (up to four minutes for trips using park & ride access with no dependence on local bus, and up to two minutes for all other trips using the proposed project): depending on the extent that the vehicle right-of-way is grade-separated and the extent of traffic signal priority or pre-emption along portions of the alignment that are controlled by traffic signals;
- Branding/visibility/learnability (two minutes, one minute): depending on the extent that stations, vehicles, and right-of-way are distinctive, and the system is easy to use;
- Schedule-free service (two minutes, zero minutes): depending on the extent to which service headways are less than 10 minutes in the peak period and less than 15 minutes during the off-peak;

Span of Good Service

- Hours of frequent service (three minutes, zero minutes): depending on the extent to which weekday service extends beyond the peak period with headways that are less than 30 minutes;

Passenger Amenities

- Stations/stops (three minutes, two minutes): depending on the extent to which these have passenger amenities that relate to safety and security features, protection from the weather, retail activities, comfort, and other features valued by users;
- Dynamic schedule information (one minute, one minute): depending on the provision of real time information on vehicle arrivals at stations; and
- Vehicle amenities (discount on the weight applied to time spent on the transit vehicle of up to 20 percent): depending factors such as comfort, and the probability of getting a seat of the proposed service.

Because the values listed above are the maximum possible credit for each characteristic, the specific values assigned to each project will depend on specific characteristics of the project. For example, a project running at grade through intersections without traffic signal priority or pre- emption would have a significantly lower value for reliability compared to a project in a tunnel, on an aerial structure, or on other dedicated right-of-way for which travel is uninterrupted by cross traffic[1].

To derive the non-included benefits for a specific project, each of the attributes described above are assessed for the degree to which they are incorporated in the design of the proposed project. A premium only service, incorporating exclusive guideway, next train information, and clear signage and branding, can derive the maximum benefit, while areas of mixed traffic operations and fixed schedules will derive less benefit. The possible range for each attribute is shown below in Table 1.

Table 1: Potential Benefits from Non-included Attributes

	Max benefit		
Non-included attribute	Premium only	Premium + local	Local
Guideway-like characteristics	**8.0**	**3.0**	0
- reliability of vehicle arrival	4.0	2.0	0
- branding/visibility/learnability	2.0	1.0	0
- schedule-free service	2.0	0.0	0
Span of good service	**3.0**	0.0	0
Passenger amenities	**4.0**	**3.0**	0
- stations/stops	3.0	2.0	0

[1] FTA 2007 Proposed Guidance on New Start / Small Starts Policies and Procedures

- dynamic schedule information	1.0	1.0	0
TOTAL	**15.0**	**6.0**	0
IVT coefficient	0.85*Civt	0.95*Civt	Civt
- ride quality			
- vehicle amenities			
- reliability of travel time			
- availability of seat			

Corridor Cities LRT Non-included Attributes

The non-included attributes for the light rail mode match those already accepted by FTA for the Purple Line Study since light rail constructed in for the CCT project would match the Purple Line in all attributes. Non-included attributes for the CCT light rail are shown in Table 2 and described below.

Table 2: Non-included Attributes for CCT Light Rail

Non-included attribute	Premium Only	Premium + local
Guideway-like characteristics	**5.0**	**2.0**
- reliability of vehicle arrival	2.0	1.2
- branding/visibility/learnability	1.5	0.8
- schedule-free service	1.5	0.0
Span of good service	**2.0**	0.0
Passenger amenities	**2.5**	**2.0**
- stations/stops	1.5	1.0
- dynamic schedule information	1.0	1.0
TOTAL	**9.5**	**4.0**
IVT coefficient	0.90*Civt	0.95*Civt
- ride quality		
- vehicle amenities		
- reliability of travel time		
- availability of seat		

Guideway-like Characteristics

- Reliability of vehicle arrival (2.0 minutes for trips using park & ride access with no dependence on local bus, and 1.2 minutes for all other trips using the proposed project): Schedule adherence will be better than local bus but not as high as Metrorail. The CCT light rail alternative includes exclusive, grade-separated guideway for much of the corridor, allowing higher speeds and little or no delay from at-grade crossings. In several places CCT light rail would employ either a tunnel or aerial structure in order to avoid signalized intersections.
- Branding/visibility/learnability (1.5 minutes, 0.8 minute): CCT light rail will be very visible with much of the guideway at-grade, adjacent to major arterials. The vehicles will be new, low-floor, attractive light rail vehicles with bright interiors and air-conditioning. While stations will be generally easy to find and to use, some stations will be in the median of streets, and some of those will have side platforms necessitating passengers to determine the correct direction of travel.

- Schedule-free service (1.5 minutes, zero minutes): CCT light rail will operate at 6 minutes in the peak period and 10 minutes during the off-peak, providing service more frequent than the thresholds of 10 and 15 minutes respectively.

Span of Good Service

- Hours of frequent service (2.0 minutes, zero minutes): CCT light rail is expected to match the span of service of WMATA's Metrorail, with 20 hours of service Sunday through Thursday and 22 hours of service on Fridays and Saturdays.

Passenger Amenities

- Stations/stops (1.5 minutes, 1.0 minute): All stations will have canopies, benches, and platforms for level boarding. Stations will also have ticket vending machines and fare payment will be off-vehicle. CCT light rail stations will not be fully-enclosed, staffed stations like Metrorail.
- Dynamic schedule information (1.0 minute, 1.0 minute): All stations will have Next Train schedule information.
- Vehicle amenities (discount on the weight applied to time spent on the transit vehicle of up to 20 percent): The light rail cars will be low-floor, air conditioned, with large doors for easy boarding, and between 62 and 72 seats. Boardings and alightings will take place at front and back doors.

Together the non-included attributes for the CCT light rail totals 9.5 minutes of savings of a possible 15 minutes for Premium Only service and 4.0 minutes of a possible 6.0 minutes for Premium plus Local Bus service.

Corridor Cities BRT Non-included Attributes

The CCT bus rapid transit alternative is designed to have virtually the same characteristics and amenities as the light rail mode, with the only difference being the vehicle and guideway employed. Therefore, CCT bus rapid transit non-included attributes are expected to be the same as light rail. Non-included attributes for the CCT bus rapid transit are shown in Table 3 and described below.

Table 3: Non-included Attributes for CCT Bus Rapid Transit

Non-included attribute	Premium Only	Premium + local
Guideway-like characteristics	**5.0**	**2.0**
- reliability of vehicle arrival	2.0	1.2
- branding/visibility/learnability	1.5	0.8
- schedule-free service	1.5	0.0
Span of good service	**2.0**	0.0
Passenger amenities	**2.5**	**2.0**
- stations/stops	1.5	1.0
- dynamic schedule information	1.0	1.0
TOTAL	**9.5**	**4.0**
IVT coefficient	0.90*Civt	0.95*Civt
- ride quality		
- vehicle amenities		
- reliability of travel time		
- availability of seat		

Guideway-like Characteristics

- Reliability of vehicle arrival (2.0 minutes for trips using park & ride access with no dependence on local bus, and 1.2 minutes for all other trips using the proposed project): Schedule adherence will be better than local bus but not as high as Metrorail. The CCT bus rapid transit alternative includes exclusive, grade-separated guideway for much of the corridor, allowing higher speeds and little or no delay from at-grade crossings. In several places CCT bus rapid transit would employ either a tunnel or aerial structure in order to avoid signalized intersections.
- Branding/visibility/learnability (1.5 minutes, 0.8 minutes): CCT bus rapid transit will be very visible with much of the guideway at-grade, adjacent to major arterials. The vehicles will be new, low-floor, attractive 60-ft articulated buses. While stations will be generally easy to find and to use, some stations will be in the median of streets, and some of those will have side platforms necessitating passengers to determine the correct direction of travel.

- Schedule-free service (1.5 minutes, zero minutes): CCT bus rapid transit will operate at 6 minutes in the peak period and 10 minutes during the off-peak, providing service more frequent than the thresholds of 10 and 15 minutes respectively.

<u>Span of Good Service</u>

- Hours of frequent service (2.0 minutes, zero minutes): CCT bus rapid transit is expected to match the span of service of WMATA's Metrorail, with 20 hours of service Sunday through Thursday and 22 hours of service on Fridays and Saturdays.

<u>Passenger Amenities</u>

- Stations/stops (1.5 minutes, 1.0 minutes): All stations will have canopies, benches, and platforms for level boarding. Stations will also have ticket vending machines and fare payment will be off-vehicle. Unlike Metrorail, CCT bus rapid transit stations will be open air and unstaffed.
- Dynamic schedule information (1.0 minute, 1.0 minute): All stations will have Next Bus schedule information.
- Vehicle amenities (discount on the weight applied to time spent on the transit vehicle of up to 20 percent): CCT bus rapid transit will employ low-floor articulated buses. Boardings and alightings will take place at front and back doors.

Together the non-included attributes for the CCT bus rapid transit totals 9.5 minutes of savings of a possible 15 minutes for Premium Only service and 4.0 minutes of a possible 6.0 minutes for Premium plus Local Bus service.

Appendix D

I. Background and Objective

The current implementation of the MTA Model applies fixed end-to-end run times for buses. Run times for the base year are taken from the 2000 bus schedule times. Forecasted local bus times are degraded by a fixed factor, using a slightly larger factor for each incremental future year. Express bus run times are not degraded. The model assumes that local buses in the region's core during the peak period travel at speed that is 10% slower than in 2000 (see Table 1). Such an approach does not explicitly link roadway and bus speeds, and results in inaccurate future year bus travel times. In specific corridors where roadway congestion is expected to increase rapidly this approach can result in bus travel times that are forecasted to be unrealistically short relative to the travel times for the same roadways on which the buses are traveling.

Table 1: MCOG Local Bus Run Time Factors (percent of base year scheduled time)

	WMATA and Primary Local Bus	Secondary Local Bus
Peak	9.8%	23.9%
Off-Peak	6.9%	13.0%

The purpose of this task is to develop a function that will estimate additional link level bus time delay (over highway time) based the relationship between the highway time, the 'observed' transit time, facility type, area type, and time of day. This function is then applied to buses in the future year to estimate bus speeds relative to the congestion on the roadways on which they are operating. This delay is applied as follows:

Bus travel time = Highway travel time + delay (minutes per mile) * link distance

II. Methodology

The only source of 'observed' roadway and bus speeds are the speeds that are assumed for the base year (2000) calibrated/validated model. We have assumed that the RUNTIME variables in the bus route line cards adequately represent the observed time it takes for a bus to travel its route. The link-by-link bus travel times are generated by TRNBUILD. The roadway link-by-link congested travel times are calculated from the highway network after the network is built and the speed/capacity assumptions applied in the model stream. A TP+ script is used to export link level highway speeds, distances and times to a comma-delimited file.

The estimation of the bus speed delay rate is implemented in an Excel workbook. For each unique combination of area type and facility type, average variances between link level highway times and bus times are calculated. For combinations of facility type and area type that have few links with observed transit time, manual smoothing is used to obtain consistent, reasonable additional delays. Additional manual adjustments are made to minimize the system-wide route percent root-mean-square error (RMSE) between the total run times derived with the estimated bus speed model and RUNTIMES coded on the bus line cards.

The bus speed model assumes that highway congestion adequately reflects the difference in peak and off-peak bus speeds. Slowing down off-peak buses at a different rate than peak buses can result in the undesirable situation in which off-peak buses travel slower than peak buses on the same highway link (this can only occur in the implemented model if the off-peak highway speed is slower than the peak highway speed).

The service type (express vs. local) segmentation was eliminated because the TRNBUILD module of TP+ does not allow the user to specify separate expressions for transit time by mode. Therefore, we cannot specify one expression for express bus time and another for local bus time. As such, a single set of factors, used to represent all buses, are calibrated.

III. Results and Conclusions

After manual adjustments to the bus speed deterioration functions, a final percent RMSE of 29.5% was achieved. The estimated deterioration rates are shown in Table 1. These additional minutes of delay will be re-estimated after the final network edits are completed for the MDAA2 model (Phase II using the COG v2.2 model).

Table 2: Bus Speed Model -- Additional Minutes of Delay per Mile

	Facility Type						
Area Type	Centroid	Freeway	Major Arterial	Minor Arterial	Collector	Expressway	Ramps
1	0.00	0.00	0.00	3.25	0.00	0.00	0.00
2	0.00	0.00	1.71	1.29	3.25	0.00	0.00
3	0.00	0.00	0.77	1.29	0.73	0.00	0.00
4	0.00	0.00	0.00	0.46	0.67	0.00	0.00
5	0.00	0.00	0.00	0.46	0.66	0.00	0.00
6	0.00	0.00	0.00	0.08	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 1 shows a comparison of Peak "Observed" total run times by route to estimated run times based on the bus speed model. Figure 2 shows the same for the off-peak. The peak scatter plot shows a slope of 1.04 and an R^2 of 0.766 between observed and estimated. As noted above, the model was estimated on Peak period data, under the assumption that the relationship between highway congestion and transit travel times is independent of time of day.

Figure 1: Scatter Plot of "Observed" by Estimated Transit Run Times by Route -- Peak Period

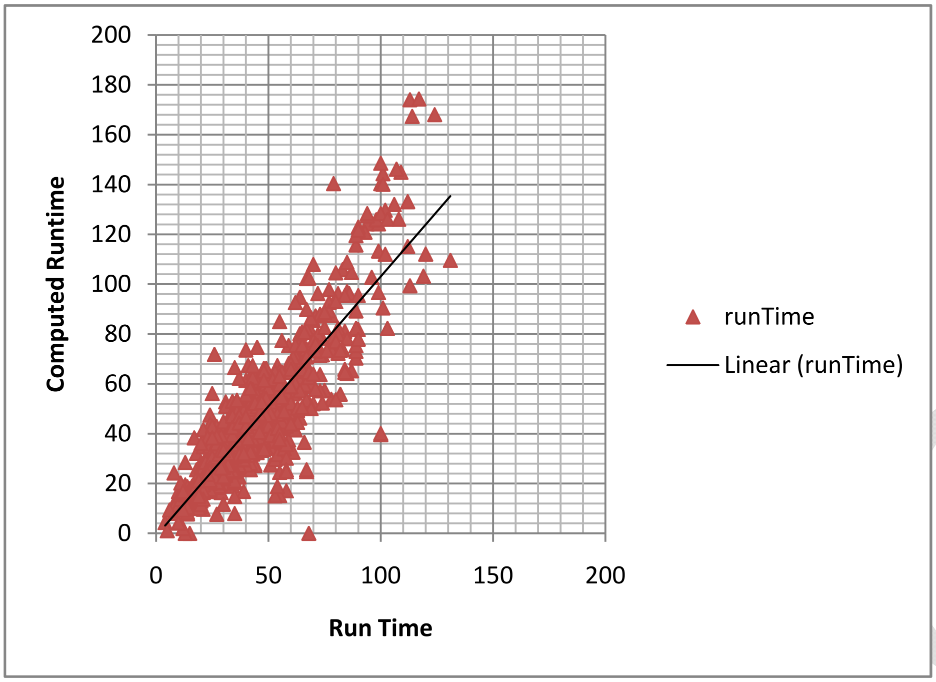
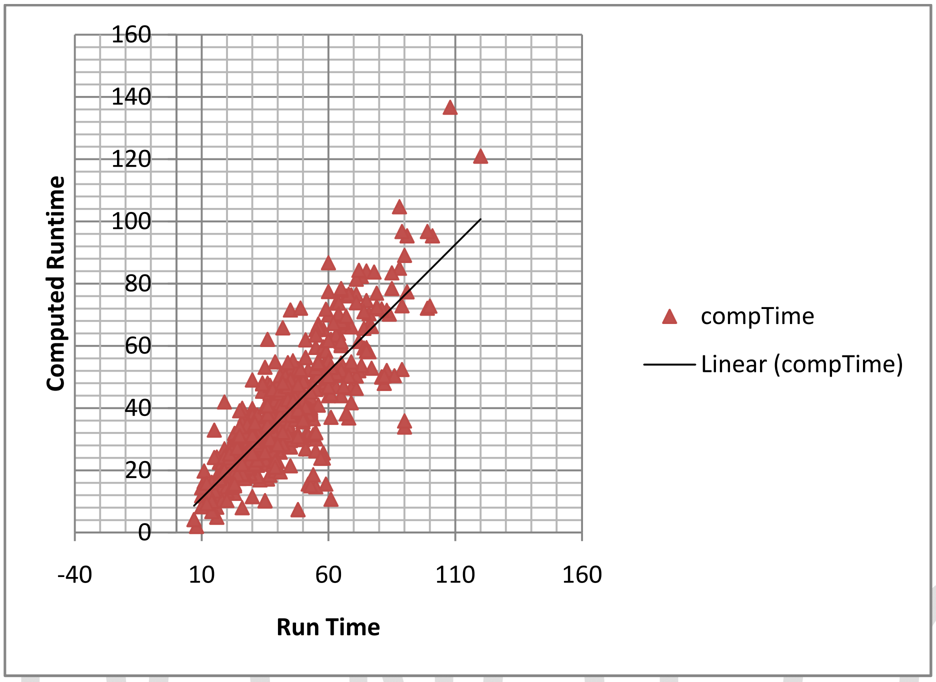


Figure 2: Scatter Plot of "Observed by Estimated Transit Run Times by Route -- Off Peak



IV. Implementation

A. Script Changes

The model stream was modified to allow for these deterioration factors to be added to the transit speeds.

The following changes were made to the transit skimming scripts:

1. A script is added before the transit skimming scripts to compute the peak and off-peak bus travel times for each link in the highway network. A background, temporary highway network (I6HWYP.BUS.NET) is created with these transit travel times to be referenced in the transit skimming scripts.
2. Each of the transit skimming and assignment scripts is modified, including the "shadow" skimming scripts (for parking capacity restraint).
3. The reference to the run time factors in the skimming scripts (LBus_TimFTRS.ASC) is removed. Also, the bus runtime factor variables "_IBFTR" and "_OBFTR" have been removed.
4. Global variables "PEAK_MODEL" and "OFF_PEAK_MODEL" are added to the global loops in the skimming scripts. This allows the use different bus times for the peak and off-peak skims.
5. The "HWYTIME" variable obtains its value from the temporary highway network, I6HWYP.BUS.NET.

6. "USERUNTIME = Y" is replaced with "USERUNTIME = N".

The following changes are made to the transit assignment scripts:

1. The "HWYTIME" variable obtains its value for peak time and off-peak transit travel times from the temporary highway network, I6HWY.BUS.NET.
2. USERUNTIME = Y" is replaced with "USERUNTIME = N".

B. Testing

The model was tested by applying these factors. Differences in mode choice model results are illustrated in Table 3. The magnitude of the change is considered inconsequential, and does not represent a problem for base year validation.

Table 3: Comparison of Mode Choice Results with and without Bus Speed Model -- 2000 Base

	MDAA Phase I Base Year (using static run time parameters)	Bus Speed Model	Difference	% Difference
Auto				
Drive Alone	10,549,120	10,544,175	-4,945	-0.05%
Shared Ride 2	6,513,663	6,511,720	-1,943	-0.03%
Shared Ride 3+	4,426,057	4,424,555	-1,502	-0.03%
Subtotal	**21,488,839**	**21,480,450**	**-8,389**	**-0.04%**
Transit				
Bus	338,412	351,291	12,879	3.81%
Metrorail	532,925	528,906	-4,019	-0.75%
Commuter Rail	23,100	22,630	-470	-2.04%
Subtotal	**894,437**	**902,826**	**8,389**	**0.94%**
Grand Total	**22,383,276**	**22,383,276**	**0**	**0%**

Appendix E

Modification of the Application of Transit Fares

I. Background and Objectives

The existing zone to zone fares that are generated by the MWCOG Travel Demand Model are a composite of fares for all transit modes. For regional modeling and conformity analysis this approach has worked well, but for purposes of detailed analysis of specific transit projects in narrow corridors, particularly when new modes with new fare policies are introduced, a means of distinguishing fares by mode is important. The objective of this task was to develop a method for extracting and applying zone to zone transit fares by major mode. So, for example, the commuter rail path from zone I to zone J would include the total cost of the Commuter rail transit fares including commuter rail and any feeder bus fares.

II. Methodology

The approach required the development of four data tables:

1. A unique set of system-fare-types (for bus and commuter rail trips only) and associated boarding fares. (Baker Engineering developed this list, which is documented in the attached memo (Attachment C), dated November 14, 2008. This memo outlined the initial fare structure concept, which has been modified as it was finally implemented.)
2. Transfer policies and fares associated with boardings and transfers between system-fare-types (see above mentioned memo from Baker Engineering and the final boarding and transfer fares used as shown in Attachment B).
3. Unique and temporary mode codes for each system-fare-type (see the cross-reference in Attachment A). Temporary mode codes are assigned based on a combination of prefixes and original mode codes.
4. Fare links with zone based fares for commuter buses.

An external program was developed to temporarily translate modes in the transit line files to new temporary bus fare modes. A TRNBUILD skimming script assigns a bus and/or commuter rail fare for each zone to zone skim based on the mode to mode transfers generated for each alternative. Where Metrorail in-vehicle time is found in a zone to zone path the station to station Metrorail fare is added to the bus fare. If no bus in-vehicle time is found in a Metrorail path a zero bus fare is added to the Metrorail fare. The mode modification program and revised TRANBUILD script have been incorporated into model stream for the MDAAII (Maryland Alternatives Analysis Phase II). Bus and commuter rail fares are assumed not to vary by time of day.

Existing Metrorail fare data (as of 12/02/2008) from each station to station pair was taken from WMATA website. These 2008 fares were scaled down to 2005 based on the data provided by Metrorail. Peak and off-peak final zone to zone fares are stored in separate dbf files and called by the fare building script.

III. Results and Conclusions

The following table shows the zone to zone fares for some selected zone to zone pairs for alternative major modes before and after the change in fare allocation process.

Peak Period, Walk to Transit Fares *(incl. transfers)*

FROM		TO		MDAAII			COG v2.2
TAZ		TAZ		Bus	Metrorail	Comm. Rail	
1043	Frederick	19	Metro Center	10.10	9.25	7.10	4.01
1619	Vienna	19	Metro Center	3.38	3.65	No Path	3.18
362	Silver Spring	64	Union Station	1.25	2.30	No Path	1.67
1967	Manassas	64	Union Station	9.35	9.65	4.29	2.76
927	New Carltn	64	Union Station	1.25	3.70	4.95	3.19
1337	Alexandria	64	Union Station	1.25	2.30	5.64	1.78

Attachment A: Routes and Temporary Mode Codes

Route	Mode	Prefix	Temp
FRED1I	4	FR	5
FRED1O	4	FR	5
FRED2I	4	FR	5
FRED3O	4	FR	5
MASS1I	4	MA	5
MASS1O	4	MA	5
MASS2O	4	MA	5
MBRU1I	4	MB	4
MBRU1O	4	MB	4
MBRU2I	4	MB	4
MBRU2O	4	MB	4
MBRU3I	4	MB	4
MCAM1I	4	MC	4
MCAM1O	4	MC	4
MCAM2I	4	MC	4
MCAM3O	4	MC	4
MCAM3O	4	MC	4
MCAM4O	4	MC	4
MFREDI	4	FR	5
MPEN1I	4	MP	4
MPEN1I	4	MP	4
MPEN1O	4	MP	4
MPEN1O	4	MP	4
MPEN2I	4	MP	4
MPEN2O	4	MP	4
MPEN3I	4	MP	4
VFRED1I	4	FR	5
VFRED1O	4	FR	5
VMASS1I	4	MA	5
VMASS1O	4	MA	5
VMASS2I	4	MA	5
VMASS2O	4	MA	5
ART41E	6	ART	17
ART41N	6	ART	17
ART41N	6	ART	17
ART41S	6	ART	17
ART41S	6	ART	17
ART41W	6	ART	17
ART51I	6	ART	17
ART51I	6	ART	17
ART51O	6	ART	17
ART51O	6	ART	17

Route	Mode	Prefix	Temp
ART52	6	ART	17
ART52I	6	ART	17
ART52I	6	ART	17
ART52O	6	ART	17
ART52O	6	ART	17
ART53E	6	ART	17
ART53E	6	ART	17
ART53W	6	ART	17
ART53W	6	ART	17
ART61L	6	ART	17
ART62	6	ART	17
ART66L	6	ART	17
ART67L	6	ART	17
ART73L	6	ART	17
ART74L	6	ART	17
ART75I	6	ART	17
ART75O	6	ART	17
ART82%	6	ART	17
ART82L	6	ART	17
ART90L	6	ART	17
DAT10	6	DAT	18
DAT10	6	DAT	18
DAT10I	6	DAT	18
DAT10I	6	DAT	18
DAT2%E	6	DAT	18
DAT2%E	6	DAT	18
DAT2%O	6	DAT	18
DAT2%W	6	DAT	18
DAT2%W	6	DAT	18
DAT2E	6	DAT	18
DAT2EI	6	DAT	18
DAT2W	6	DAT	18
DAT2W	6	DAT	18
DAT2WO	6	DAT	18
DAT3%4L	6	DAT	18
DAT3LI	6	DAT	18
DAT3O	6	DAT	18
DAT4%I	6	DAT	18
DAT4%O	6	DAT	18
DAT4I	6	DAT	18
DAT4LO	6	DAT	18
DAT5I	6	DAT	18

Route	Mode	Prefix	Temp
DAT5I	6	DAT	18
DAT5O	6	DAT	18
DAT5O	6	DAT	18
DAT6%	6	DAT	18
DAT6I	6	DAT	18
DAT6I	6	DAT	18
DAT6O	6	DAT	18
DAT6O	6	DAT	18
DAT7%I	6	DAT	18
DAT7I	6	DAT	18
DAT7I	6	DAT	18
DAT7O	6	DAT	18
DAT7O	6	DAT	18
DAT8%I	6	DAT	18
DAT8%I	6	DAT	18
DAT8%O	6	DAT	18
DAT8%O	6	DAT	18
DAT8I	6	DAT	18
DAT8I	6	DAT	18
DAT8O	6	DAT	18
DAT8O	6	DAT	18
DATLL	6	DAT	18
F101I	6	F	20
F101N	6	F	20
F101N	6	F	20
F101O	6	F	20
F101S	6	F	20
F101S	6	F	20
F102I	6	F	20
F103LI	6	F	20
F103LO	6	F	20
F105%I	6	F	20
F105%O	6	F	20
F105A	6	F	20
F105BI	6	F	20
F105CI	6	F	20
F105I	6	F	20
F105O	6	F	20
F106I	6	F	20
F106O	6	F	20
F107%I	6	F	20
F107O	6	F	20

Route	Mode	Prefix	Temp
F108I	6	F	20
F108O	6	F	20
F109	6	F	20
F109E	6	F	20
F109E	6	F	20
F109I	6	F	20
F109O	6	F	20
F109W	6	F	20
F109W	6	F	20
F110%I	6	F	20
F110I	6	F	20
F110O	6	F	20
F112L	6	F	20
F151CC	6	F	20
F151CC	6	F	20
F152C	6	F	20
F152C	6	F	20
F161CC	6	F	20
F161CC	6	F	20
F162C	6	F	20
F162C	6	F	20
F171E	6	F	20
F171E	6	F	20
F171W	6	F	20
F171W	6	F	20
F202I	6	F	20
F202O	6	F	20
F203I	6	F	20
F203O	6	F	20
F204I	6	F	20
F204O	6	F	20
F231CC	6	F	20
F232C	6	F	20
F232C	6	F	20
F301E	6	F	20
F301I	6	F	20
F301O	6	F	20
F301W	6	F	20
F303I	6	F	20
F303N	6	F	20
F303O	6	F	20
F303S	6	F	20
F304I	6	F	20
F304LI	6	F	20
F304LO	6	F	20
F304O	6	F	20
F305I	6	F	20

Route	Mode	Prefix	Temp
F307E	6	F	20
F307W	6	F	20
F310E	6	F	20
F310E	6	F	20
F310W	6	F	20
F310W	6	F	20
F311I	6	F	20
F311O	6	F	20
F321CC	6	F	20
F321CC	6	F	20
F322C	6	F	20
F322C	6	F	20
F331CC	6	F	20
F331CC	6	F	20
F332C	6	F	20
F332C	6	F	20
F401I	6	F	20
F401N	6	F	20
F401N	6	F	20
F401O	6	F	20
F401S	6	F	20
F401S	6	F	20
F402E	6	F	20
F402I	6	F	20
F403O	6	F	20
F403W	6	F	20
F404I	6	F	20
F404O	6	F	20
F504I	6	F	20
F504O	6	F	20
F505I	6	F	20
F505O	6	F	20
F556A	6	F	20
F556E	6	F	20
F556L	6	F	20
F574E	6	F	20
F574E	6	F	20
F574I	6	F	20
F574O	6	F	20
F574W	6	F	20
F574W	6	F	20
F605I	6	F	20
F605N	6	F	20
F605N	6	F	20
F605O	6	F	20
F605S	6	F	20
F605S	6	F	20

Route	Mode	Prefix	Temp
F922L	6	F	20
F922L	6	F	20
F924I	6	F	20
F924S	6	F	20
F926N	6	F	20
F926O	6	F	20
F927L	6	F	20
F927L	6	F	20
F929L	6	F	20
FRIBS1	6	FR	19
FRIBS1	6	FR	19
FRIBS2	6	FR	19
FRIBS2	6	FR	19
FRIBS3	6	FR	19
FRIBS3	6	FR	19
FRIBS4	6	FR	19
FRIBS4	6	FR	19
GO11L	6	GO	23
GO11L	6	GO	23
GO12L	6	GO	23
GO12L	6	GO	23
GO13L	6	GO	23
GO13L	6	GO	23
GO14E	6	GO	23
GO14E	6	GO	23
GO14W	6	GO	23
GO14W	6	GO	23
GO15E	6	GO	23
GO15E	6	GO	23
GO15W	6	GO	23
GO15W	6	GO	23
GO15X	6	GO	23
GO16N	6	GO	23
GO16N	6	GO	23
GO16S	6	GO	23
GO16S	6	GO	23
GO17N	6	GO	23
GO17N	6	GO	23
GO17S	6	GO	23
GO17S	6	GO	23
GO18N	6	GO	23
GO18N	6	GO	23
GO18S	6	GO	23
GO18S	6	GO	23
GO20	6	GO	23
GO20	6	GO	23
GO21	6	GO	23

Route	Mode	Prefix	Temp
GO21	6	GO	23
GO21S	6	GO	23
GO21XN	6	GO	23
GO21XS	6	GO	23
GO21XS	6	GO	23
GO22	6	GO	23
GO22N	6	GO	23
GO22N	6	GO	23
GO22S	6	GO	23
GO22S	6	GO	23
GO23	6	GO	23
GO23	6	GO	23
GO24	6	GO	23
GO24E	6	GO	23
GO24E	6	GO	23
GO24W	6	GO	23
GO24W	6	GO	23
GO25E	6	GO	23
GO25E	6	GO	23
GO25L	6	GO	23
GO25W	6	GO	23
GO25W	6	GO	23
GO26E	6	GO	23
GO26E	6	GO	23
GO26W	6	GO	23
GO26W	6	GO	23
GO27E	6	GO	23
GO27N	6	GO	23
GO27N	6	GO	23
GO27W	6	GO	23
GO28N	6	GO	23
GO28N	6	GO	23
GO28S	6	GO	23
GO28S	6	GO	23
GO30	6	GO	23
GO30	6	GO	23
GO32N	6	GO	23
GO32N	6	GO	23
GO32S	6	GO	23
GO32S	6	GO	23
GO33	6	GO	23
GO33	6	GO	23
GO34	6	GO	23
GO34	6	GO	23
GO51%L	6	GO	23
GO51%L	6	GO	23
GO51L	6	GO	23

Route	Mode	Prefix	Temp
GO51L	6	GO	23
GO53L	6	GO	23
GO53L	6	GO	23
ICCA	6	ICC	24
ICCB	6	ICC	24
ICCC	6	ICC	24
ICCD	6	ICC	24
ICCE	6	ICC	24
ICCF	6	ICC	24
REXS	6	REX	2
RIBS1L	6	RI	19
RIBS2L	6	RI	19
RIBS3L	6	RI	19
RIBS4L	6	RI	19
RO01	6	RO	24
RO01	6	RO	24
RO01BO	6	RO	24
RO01I	6	RO	24
RO02	6	RO	24
RO02	6	RO	24
RO02AO	6	RO	24
RO02I	6	RO	24
RO03O	6	RO	24
RO04	6	RO	24
RO04	6	RO	24
RO05B	6	RO	24
RO05B	6	RO	24
RO05I	6	RO	24
RO05O	6	RO	24
RO06AI	6	RO	24
RO06BI	6	RO	24
RO06BI	6	RO	24
RO06DO	6	RO	24
RO06DO	6	RO	24
RO07AI	6	RO	24
RO07I	6	RO	24
RO07O	6	RO	24
RO08	6	RO	24
RO08A	6	RO	24
RO08A	6	RO	24
RO09	6	RO	24
RO09A	6	RO	24
RO09A	6	RO	24
RO09I	6	RO	24
RO09O	6	RO	24
RO10	6	RO	24
RO10	6	RO	24

Route	Mode	Prefix	Temp
RO100	6	RO	24
RO100	6	RO	24
RO100R	6	RO	24
RO100R	6	RO	24
RO11I	6	RO	24
RO11O	6	RO	24
RO11O	6	RO	24
RO12	6	RO	24
RO12	6	RO	24
RO124I	6	RO	24
RO124O	6	RO	24
RO12I	6	RO	24
RO12O	6	RO	24
RO13I	6	RO	24
RO13O	6	RO	24
RO14	6	RO	24
RO14AI	6	RO	24
RO14AI	6	RO	24
RO14BI	6	RO	24
RO14BI	6	RO	24
RO14O	6	RO	24
RO14O	6	RO	24
RO15	6	RO	24
RO15	6	RO	24
RO15I	6	RO	24
RO15O	6	RO	24
RO16	6	RO	24
RO16	6	RO	24
RO16AI	6	RO	24
RO16AO	6	RO	24
RO17	6	RO	24
RO17	6	RO	24
RO17I	6	RO	24
RO17O	6	RO	24
RO18	6	RO	24
RO18	6	RO	24
RO18AI	6	RO	24
RO18AO	6	RO	24
RO18B	6	RO	24
RO18B	6	RO	24
RO18I	6	RO	24
RO18O	6	RO	24
RO19AO	6	RO	24
RO19I	6	RO	24
RO19O	6	RO	24
RO20DO	6	RO	24
RO20DO	6	RO	24

Route	Mode	Prefix	Temp
RO20I	6	RO	24
RO20I	6	RO	24
RO20O	6	RO	24
RO22I	6	RO	24
RO22O	6	RO	24
RO23	6	RO	24
RO23I	6	RO	24
RO23I	6	RO	24
RO23O	6	RO	24
RO23O	6	RO	24
RO24I	6	RO	24
RO25I	6	RO	24
RO25I	6	RO	24
RO25O	6	RO	24
RO25O	6	RO	24
RO26	6	RO	24
RO26	6	RO	24
RO26I	6	RO	24
RO26O	6	RO	24
RO28I	6	RO	24
RO28I	6	RO	24
RO29	6	RO	24
RO29	6	RO	24
RO30	6	RO	24
RO30AI	6	RO	24
RO30AI	6	RO	24
RO30O	6	RO	24
RO30O	6	RO	24
RO31	6	RO	24
RO32BI	6	RO	24
RO32O	6	RO	24
RO33	6	RO	24
RO33I	6	RO	24
RO33I	6	RO	24
RO33O	6	RO	24
RO34B	6	RO	24
RO34B	6	RO	24
RO34BI	6	RO	24
RO34BO	6	RO	24
RO34I	6	RO	24
RO35	6	RO	24
RO36	6	RO	24
RO36	6	RO	24
RO36AO	6	RO	24
RO36I	6	RO	24
RO36O	6	RO	24
RO37AI	6	RO	24
RO37O	6	RO	24
RO38	6	RO	24
RO38BO	6	RO	24
RO38CI	6	RO	24
RO38CI	6	RO	24
RO38I	6	RO	24
RO38O	6	RO	24
RO39AO	6	RO	24
RO39I	6	RO	24
RO41	6	RO	24
RO41	6	RO	24
RO42	6	RO	24
RO42	6	RO	24
RO42I	6	RO	24
RO42O	6	RO	24
RO43	6	RO	24
RO43	6	RO	24
RO44	6	RO	24
RO45	6	RO	24
RO45	6	RO	24
RO46	6	RO	24
RO46	6	RO	24
RO47	6	RO	24
RO47	6	RO	24
RO48	6	RO	24
RO48	6	RO	24
RO49	6	RO	24
RO49	6	RO	24
RO51	6	RO	24
RO52I	6	RO	24
RO52O	6	RO	24
RO53	6	RO	24
RO54	6	RO	24
RO54	6	RO	24
RO55	6	RO	24
RO55	6	RO	24
RO56	6	RO	24
RO56	6	RO	24
RO57	6	RO	24
RO57	6	RO	24
RO58	6	RO	24
RO58	6	RO	24
RO59	6	RO	24
RO59	6	RO	24
RO60	6	RO	24
RO61	6	RO	24
RO61	6	RO	24
RO63	6	RO	24
RO63	6	RO	24
RO64	6	RO	24
RO64	6	RO	24
RO65	6	RO	24
RO66	6	RO	24
RO67	6	RO	24
RO70I	6	RO	24
RO70O	6	RO	24
RO71	6	RO	24
RO74I	6	RO	24
RO74I	6	RO	24
RO74O	6	RO	24
RO74O	6	RO	24
RO75	6	RO	24
RO75	6	RO	24
RO76I	6	RO	24
RO76I	6	RO	24
RO76O	6	RO	24
RO78I	6	RO	24
RO78O	6	RO	24
RO79	6	RO	24
RO81	6	RO	24
RO82	6	RO	24
RO83	6	RO	24
RO83	6	RO	24
RO90	6	RO	24
RO90	6	RO	24
RO92	6	RO	24
RO92I	6	RO	24
RO93	6	RO	24
RO96	6	RO	24
RO96	6	RO	24
RO96%I	6	RO	24
RO96AI	6	RO	24
RO96AO	6	RO	24
RO97	6	RO	24
RO97	6	RO	24
RO98	6	RO	24
RO98	6	RO	24
SGOLD1	6	SG	21
SGOLD1	6	SG	21
SGOLD2	6	SG	21
SGOLD2	6	SG	21
SGRN1	6	SG	21
SGRN1	6	SG	21
SGRN2	6	SG	21

Route	Mode	Prefix	Temp
SGRN2	6	SG	21
TSMA	6	TSM	24
TSMB	6	TSM	24
TSMC	6	TSM	24
TSMD	6	TSM	24
TSME	6	TSM	24
VREEZN	6	VRE	19
VREEZS	6	VRE	19
DAT3I	7	DAT	18
DAT3O	7	DAT	18
DAT4%I	7	DAT	18
DAT4I	7	DAT	18
DAT4O	7	DAT	18
F1	7	F	20
F1	7	F	20
F2I	7	F	20
F2I	7	F	20
F2O	7	F	20
F2O	7	F	20
F306I	7	F	20
F306N	7	F	20
F306O	7	F	20
F306S	7	F	20
F380N	7	F	20
F380S	7	F	20
F383I	7	F	20
F384I	7	F	20
F384O	7	F	20
F385I	7	F	20
F3I	7	F	20
F3I	7	F	20
F3O	7	F	20
F3O	7	F	20
F425LI	7	F	20
F425LI	7	F	20
F425LO	7	F	20
F425LO	7	F	20
F427LI	7	F	20
F427LI	7	F	20
F427LO	7	F	20
F427LO	7	F	20
F505E	7	F	20
F505I	7	F	20
F505O	7	F	20
F505W	7	F	20
F505W	7	F	20
F551E	7	F	20
F551I	7	F	20
F551O	7	F	20
F551W	7	F	20
F552E	7	F	20
F552I	7	F	20
F553AI	7	F	20
F553E	7	F	20
F554E	7	F	20
F554I	7	F	20
F557E	7	F	20
F557I	7	F	20
F585E	7	F	20
F585E	7	F	20
F585I	7	F	20
F585O	7	F	20
F585W	7	F	20
F595E	7	F	20
F597E	7	F	20
F621I	7	F	20
F621LI	7	F	20
F621LO	7	F	20
F621O	7	F	20
F622I	7	F	20
F622L	7	F	20
F622O	7	F	20
F623I	7	F	20
F623LI	7	F	20
F623LO	7	F	20
F623O	7	F	20
F950E	7	F	20
F950E	7	F	20
F950I	7	F	20
F950O	7	F	20
F950W	7	F	20
F950W	7	F	20
F951O	7	F	20
F952O	7	F	20
F952W	7	F	20
F952W	7	F	20
F980E	7	F	20
F980I	7	F	20
F980W	7	F	20
F984I	7	F	20
F984O	7	F	20
F989I	7	F	20
CCLS1	8	CC	28
CCLS1	8	CC	28
CCLS2	8	CC	28
CCLS2	8	CC	28
CCLS3	8	CC	28
CCLS3	8	CC	28
CCPF1I	8	CC	28
CCPF1L	8	CC	28
CCPF1L	8	CC	28
CCPF1O	8	CC	28
CCPF2I	8	CC	28
CCPF2L	8	CC	28
CCPF2O	8	CC	28
CCPFBI	8	CC	28
CCPFBI	8	CC	28
CCPFBO	8	CC	28
CCPFBO	8	CC	28
CCPFL	8	CC	28
CCPFMC	8	CC	28
CCPFMC	8	CC	28
CCPFSI	8	CC	28
CCPFSI	8	CC	28
CCPFSO	8	CC	28
CCPFSO	8	CC	28
CCS1	8	CC	28
CCS2	8	CC	28
FBRNI	8	FB	25
FBRNI	8	FB	25
FBRNO	8	FB	25
FBRNO	8	FB	25
FCECOI	8	FC	25
FCECOI	8	FC	25
FCECOO	8	FC	25
FCECOO	8	FC	25
FCT10I	8	FC	25
FCT10I	8	FC	25
FCT10O	8	FC	25
FCT10O	8	FC	25
FCT20	8	FC	25
FCT20	8	FC	25
FCT30	8	FC	25
FCT30	8	FC	25
FCT40	8	FC	25
FCT40	8	FC	25
FCT50	8	FC	25
FCT50	8	FC	25
FCT60	8	FC	25
FCT60	8	FC	25
FCT70	8	FC	25

Route	Mode	Prefix	Temp
FCT70	8	FC	25
FCT85	8	FC	25
FEMTI	8	FE	25
FEMTO	8	FE	25
FT801	8	FT	25
FT802	8	FT	25
FT803	8	FT	25
FTMARC	8	FT	25
FTMDAY	8	FT	25
FTMDAY	8	FT	25
FTWALK	8	FT	25
HTBL1I	8	HT	26
HTBL1I	8	HT	26
HTBL1O	8	HT	26
HTBL2I	8	HT	26
HTBL2O	8	HT	26
HTBLUI	8	HT	26
HTBLUN	8	HT	26
HTBLUO	8	HT	26
HTBLUS	8	HT	26
HTBR1I	8	HT	26
HTBR1I	8	HT	26
HTBR1O	8	HT	26
HTBR1O	8	HT	26
HTBR2I	8	HT	26
HTBR2I	8	HT	26
HTBR2O	8	HT	26
HTBR2O	8	HT	26
HTBRN	8	HT	26
HTBRNI	8	HT	26
HTBRNO	8	HT	26
HTGRNL	8	HT	26
HTGRNL	8	HT	26
HTORGL	8	HT	26
HTPUR	8	HT	26
HTPURN	8	HT	26
HTPURN	8	HT	26
HTPURS	8	HT	26
HTPURS	8	HT	26
HTRDXI	8	HT	26
HTRDXI	8	HT	26
HTRDXO	8	HT	26
HTRDXO	8	HT	26
HTRED2	8	HT	26
HTREDI	8	HT	26
HTREDI	8	HT	26
HTREDO	8	HT	26

Route	Mode	Prefix	Temp
HTREDO	8	HT	26
HTSLVI	8	HT	26
HTSLVO	8	HT	26
HTUS1L	8	HT	26
HTUS1N	8	HT	26
HTYE2I	8	HT	26
HTYE2O	8	HT	26
HTYELI	8	HT	26
HTYELI	8	HT	26
HTYELO	8	HT	26
HTYELO	8	HT	26
HTYELX	8	HT	26
LA00AI	8	LA	27
LA00AI	8	LA	27
LA00AI	8	LA	27
LA00AO	8	LA	27
LA00AO	8	LA	27
LA00AO	8	LA	27
LB00A	8	LB	27
LB00A	8	LB	27
LB00AI	8	LB	27
LB00AI	8	LB	27
LB00AO	8	LB	27
LB00AO	8	LB	27
LC00A	8	LC	27
LC00A	8	LC	27
LC00AI	8	LC	27
LC00AO	8	LC	27
LC00AO	8	LD	27
LD00AI	8	LD	27
LD00AI	8	LD	27
LD00AO	8	LD	27
LD00AO	8	LD	27
LE00AI	8	LE	27
LE00AI	8	LE	27
LE00AO	8	LE	27
LE00AO	8	LE	27
LF00AO	8	LF	27
LG00AI	8	LG	27
LG00AI	8	LG	27
LG00AO	8	LG	27
LG00AO	8	LG	27
LJ00AI	8	LJ	27
LJ00AI	8	LI	27
LJ00AI	8	LI	27
LJ00AO	8	LJ	27
LJ00AO	8	LI	27

Route	Mode	Prefix	Temp
LJ00AO	8	LI	27
LK00AI	8	LK	27
LK00AI	8	LK	27
LK00AO	8	LK	27
LK00AO	8	LK	27
LK00O	8	LK	27
LL00AL	8	LL	27
LM00AL	8	LM	27
LT01L	8	LT	31
LT02L	8	LT	31
LT03L	8	LT	31
LT04L	8	LT	31
LT05L	8	LT	31
LT06L	8	LT	31
LT07I	8	LT	31
LT07I	8	LT	31
LT07O	8	LT	31
LT07O	8	LT	31
LT08I	8	LT	31
LT09O	8	LT	31
LT2DE	8	LT	31
LT2DE	8	LT	31
LT2DW	8	LT	31
LT2DW	8	LT	31
LTAC	8	LT	31
LTAC	8	LT	31
LTAFI	8	LT	31
LTAFI	8	LT	31
LTAFO	8	LT	31
LTAFO	8	LT	31
LTARS	8	LT	31
LTARS%	8	LT	31
LTAVI	8	LT	31
LTAVI	8	LT	31
LTAVO	8	LT	31
LTAVO	8	LT	31
LTBLU	8	LT	31
LTBLU	8	LT	31
LTBRM	8	LT	31
LTBRM	8	LT	31
LTGRN	8	LT	31
LTGRN	8	LT	31
LTPCE	8	LT	31
LTPCE	8	LT	31
LTPCW	8	LT	31
LTPUR	8	LT	31
LTPUR	8	LT	31

Route	Mode	Prefix	Temp
LTPVCE	8	LT	31
LTPVCE	8	LT	31
LTPVCW	8	LT	31
LTPVCW	8	LT	31
LTSCI	8	LT	31
LTSCI	8	LT	31
LTSCO	8	LT	31
OLBRA	8	OL	32
OLBRA	8	OL	32
OLBRA%	8	OL	32
OLBRA1	8	OL	32
OLBRB	8	OL	32
OLBRB	8	OL	32
OLBRB%	8	OL	32
OLBRB1	8	OL	32
OLCC1	8	OL	32
OLCC1I	8	OL	32
OLCC1O	8	OL	32
OLCCE	8	OL	32
OLCCE	8	OL	32
OLCCW	8	OL	32
OLCCW	8	OL	32
OLDCI	8	OL	32
OLDCI	8	OL	32
OLDCO	8	OL	32
OLDCO	8	OL	32
OLDLEI	8	OL	32
OLDLEO	8	OL	32
OLDMFI	8	OL	32
OLDMFI	8	OL	32
OLDMFO	8	OL	32
OLDMFO	8	OL	32
OLMNI	8	OL	32
OLMNI	8	OL	32
OLMNO	8	OL	32
OLMNO	8	OL	32
OLMPKA	8	OL	32
OLMPKA	8	OL	32
OLMPKB	8	OL	32
OLMPKB	8	OL	32
OLRT1I	8	OL	32
OLRT1I	8	OL	32
OLRT1O	8	OL	32
OLRT1O	8	OL	32
OWDMFO	8	OW	32
STCCI	8	ST	30
STCCI	8	ST	30

Route	Mode	Prefix	Temp
STCCO	8	ST	30
STCCO	8	ST	30
STCHN	8	ST	30
STCHN	8	ST	30
STCHS	8	ST	30
STCHS	8	ST	30
STGML	8	ST	30
STGML	8	ST	30
STLPLT	8	ST	30
STLPLT	8	ST	30
STLTL	8	ST	30
STLTL	8	ST	30
STLTLP	8	ST	30
STLTLP	8	ST	30
STNRTL	8	ST	30
STNRTL	8	ST	30
STRT5N	8	ST	30
STRT5N	8	ST	30
STRT5S	8	ST	30
STRT5S	8	ST	30
STSRTL	8	ST	30
STSRTL	8	ST	30
UMD01	8	UMD	40
UMD01	8	UMD	40
UMD02	8	UMD	40
UMD02	8	UMD	40
UMD03	8	UMD	40
UMD03	8	UMD	40
UMD04	8	UMD	40
UMD04	8	UMD	40
UMD05	8	UMD	40
UMD05	8	UMD	40
UMD06	8	UMD	40
UMD07	8	UMD	40
UMD07	8	UMD	40
UMD08	8	UMD	40
UMD08	8	UMD	40
UMD09	8	UMD	40
UMD09	8	UMD	40
UMD10	8	UMD	40
UMD10	8	UMD	40
UMD11	8	UMD	40
UMD11	8	UMD	40
VBLKE	8	VG	29
VBLKI	8	VG	29
VBLKI	8	VG	29
VBLKO	8	VG	29

Route	Mode	Prefix	Temp
VBLKW	8	VG	29
VBLUA	8	VG	29
VBLUA	8	VG	29
VBLUB	8	VG	29
VBLUB	8	VG	29
VBRNO	8	VG	29
VGOLDN	8	VG	29
VGOLDS	8	VG	29
VGOLDS	8	VG	29
VGRAY	8	VG	29
VGRAYL	8	VG	29
VGRNA	8	VG	29
VGRNAL	8	VG	29
VGRNB	8	VG	29
VGRNBL	8	VG	29
VORGAO	8	VG	29
VPURN	8	VG	29
VPURS	8	VG	29
VREDAN	8	VG	29
VREDAN	8	VG	29
VREDAS	8	VG	29
VREDBL	8	VG	29
VWHTE	8	VG	29
VWHTE	8	VG	29
VWHTW	8	VG	29
VWHTW	8	VG	29
VYELL	8	VG	29
VYELL	8	VG	29
LC01I	9	LC	27
LC02I	9	LC	27
LC04I	9	LC	27
LCSD12	9	LCS	33
LCSD15	9	LCS	33
LCSD5E	9	LCS	33
LCSD6W	9	LCS	33
LCSD7E	9	LCS	33
LCSD9E	9	LCS	33
LCSDNI	9	LCS	33
LCSDTC	9	LCS	33
LCSGWI	9	LCS	33
LCSM1O	9	LCS	33
LCSWF1	9	LCS	33
LCSWF2	9	LCS	33
LINK1I	9	LINK	38
LINK1I	9	LINK	38
LINK1O	9	LINK	38
LINK1O	9	LINK	38

Route	Mode	Prefix	Temp
MT01AI	9	MT	39
MT01AO	9	MT	39
MT01AO	9	MT	39
MT01BI	9	MT	39
MT01BO	9	MT	39
MT01CO	9	MT	39
MT02AI	9	MT	39
MT02AO	9	MT	39
MT02AO	9	MT	39
MT02BI	9	MT	39
MT02BO	9	MT	39
MT02CO	9	MT	39
MT03AI	9	MT	39
MT03AO	9	MT	39
MT04AI	9	MT	39
MT04AO	9	MT	39
MT04AO	9	MT	39
MT04BI	9	MT	39
MT05AI	9	MT	39
MT05AO	9	MT	39
MT05AO	9	MT	39
MT05BI	9	MT	39
MT05BO	9	MT	39
MT05CO	9	MT	39
MT07AI	9	MT	39
MT07BI	9	MT	39
MT09AI	9	MT	39
MT13AI	9	MT	39
MT15AI	9	MT	39
MT15BI	9	MT	39
MT15CI	9	MT	39
MT15CO	9	MT	39
MT15DO	9	MT	39
MT21AI	9	MT	39
MT21AI	9	MT	39
MT21AO	9	MT	39
MT21AO	9	MT	39
MT21BI	9	MT	39
MT22AI	9	MT	39
MT22BI	9	MT	39
MT29AI	9	MT	39
MT29BI	9	MT	39
MT29BI	9	MT	39
MT29BO	9	MT	39
MT29BO	9	MT	39
MT50AI	9	MT	39
MT50BI	9	MT	39

Route	Mode	Prefix	Temp
MT91AI	9	MT	39
MT91AO	9	MT	39
MT91AO	9	MT	39
MT91BI	9	MT	39
MT95AI	9	MT	39
MT95BI	9	MT	39
MT95CI	9	MT	39
MT95DI	9	MT	39
ORC1I	9	OR	34
ORD1I	9	OR	34
ORD1O	9	OR	34
ORD2I	9	OR	34
ORD3I	9	OR	34
ORD3O	9	OR	34
ORDC2I	9	OR	34
ORDMX1	9	OR	34
ORDN3I	9	OR	34
ORDS1I	9	OR	34
ORFC1O	9	OR	34
ORFC2I	9	OR	34
ORFC2O	9	OR	34
ORFC4I	9	OR	34
ORFCI	9	OR	34
ORFCML	9	OR	34
ORFSDI	9	OR	34
ORFSDO	9	OR	34
ORFSI	9	OR	34
ORFSL	9	OR	34
ORFSL	9	OR	34
ORFSO	9	OR	34
ORL1I	9	OR	34
ORL203	9	OR	34
ORL204	9	OR	34
ORL2I	9	OR	34
ORL4I	9	OR	34
ORLHI	9	OR	34
ORLMX1	9	OR	34
ORM3I	9	OR	34
ORM3RI	9	OR	34
ORM4RI	9	OR	34
ORMC1O	9	OR	34
ORMC1O	9	OR	34
ORMC4I	9	OR	34
ORMCI	9	OR	34
ORMFSI	9	OR	34
ORMI	9	OR	34
ORMVI	9	OR	34

Route	Mode	Prefix	Temp
ORMX1I	9	OR	34
ORMX2O	9	OR	34
ORMX2O	9	OR	34
ORMX3O	9	OR	34
ORMX3O	9	OR	34
ORMX4O	9	OR	34
ORMX5O	9	OR	34
ORMX6A	9	OR	34
ORMX6B	9	OR	34
ORNR2I	9	OR	34
ORRI	9	OR	34
ORRSI	9	OR	34
ORRT1I	9	OR	34
ORWFCI	9	OR	34
ORWFCI	9	OR	34
ORWFML	9	OR	34
PQ01I	9	PQ	35
PQ03I	9	PQ	35
PQ05I	9	PQ	35
PQ07I	9	PQ	35
PQ09I	9	PQ	35
PQ12I	9	PQ	35
PQ13I	9	PQ	35
PQ14I	9	PQ	35
PQ15I	9	PQ	35
PQ16I	9	PQ	35
PQ17I	9	PQ	35
SDC10I	9	SDC	36
SDC12I	9	SDC	36
SDC14I	9	SDC	36
SDC5I	9	SDC	36
SDC6I	9	SDC	36
SDC7I	9	SDC	36
SDC8I	9	SDC	36
SDC9I	9	SDC	36

Attachment B: Boarding and Transfer Fares

FARE.DAT

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;**************************************************************************
;                        MDAA
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;
;**************************************************************************
; FILE NAME: FARE.DAT
; FILE DESCRIPTION: Transit Fares for 2005 Transit Network
;                   Actual Cash Fares in 2005 Dollars
; PURPOSE:  Mode Choice Model for MDAA
; FILE HISTORY:   * Created by FL, Baker, 9/2008
;                 * Update 2/09
;                 * [sra-pb] 01/21/09 --> Metro Rail Fare column is set to zeros
;                 * [sra-pb] 01/20/10 --> University Purpose Removed - mode 40 has been taken out
;***************************************************************************
;2005 Fares
;-------- DEFINE TRANSFER FARES -(CENTS) --------------
 XFARE[1]  =  0,210,0,370,429,135,135,135,135,0, 6*0,  0,  0,  0,210, 0,  0,  0,  0,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[2]  =  0,210,0,370,429,135,135,135,135,0, 6*0,  0,  0,  0,210, 0,  0,  0,  0,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[3]  = 35,210,0,370,429,135,135,135,135,0, 6*0, 35, 35, 35,210,35, 35, 35, 35,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[4]  =125,300,0,370,429,135,135,135,135,0, 6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[5]  =125,300,0,370,429,135,135,135,135,0, 6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[6]  =125,300,0,370,429,  0,135,135,135,0, 6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[7]  =125,300,0,370,429,135,  0,135,135,0, 6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[8]  =125,300,0,370,429,135,135,  0,135,0, 6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[9]  =125,300,0,370,429,135,135,135,  0,0, 6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[10] =125,300,0,370,429,135,135,135,135,0, 6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275

;             1   2 3   4   5   6   7   8  9 10  11-16 17  18  19  20 21  22  23  24  25  26  27  28  29  30  31  32  33  34   35  36   37   38  39
 XFARE[17] =  0,210,0,370,429,135,135,135,135,0,  6*0,  0,  0,  0,200, 0,  0,  0,  0,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[18] =  0,210,0,370,429,135,135,135,135,0,  6*0,  0,  0,  0,200, 0,  0,  0,  0,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[19] =  0,175,0,370,429,135,135,135,135,0,  6*0,  0,  0,  0,200, 0,  0,  0,  0,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[20] =  0,175,0,370,429,135,135,135,135,0,  6*0,  0,  0,  0,  0, 0,  0,  0,  0,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[21] =  0,210,0,370,429,135,135,135,135,0,  6*0,  0,  0,  0,200, 0,  0,  0,  0,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[22] =  0,210,0,370,429,135,135,135,135,0,  6*0,  0,  0,  0,200, 0,  0,  0,  0,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[23] =  0,210,0,370,429,135,135,135,135,0,  6*0,  0,  0,  0,200, 0,  0,  0,  0,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[24] =  0,210,0,370,429,135,135,135,135,0,  6*0,  0,  0,  0,200, 0,  0,  0,  0,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[25] =125,300,0,370,429,135,135,135,135,135,6*0, 35, 35,100,200, 75,100,75,125,  0,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[26] =125,300,0,370,429,135,135,135,135,135,6*0, 35, 35,100,200, 75,100,75,125,110,  0,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[27] =125,300,0,370,429,135,135,135,135,135,6*0,125,100,100,300,075,100,75,125,110,150,  0,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[28] =125,300,0,370,429,135,135,135,135,135,6*0,125,100,100,300,075,100,75,125,110,150,200,  0,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[29] =125,300,0,370,429,135,135,135,135,135,6*0,125,100,100,300,075,100,75,125,110,150,200,150,  0,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[30] =125,300,0,370,429,135,135,135,135,135,6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,  0,050,100,700,550, 650, 625, 650, 900,275
 XFARE[31] =125,300,0,370,429,135,135,135,135,135,6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,  0,100,700,550, 650, 625, 650, 900,275
 XFARE[32] =125,300,0,370,429,135,135,135,135,135,6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,  0,700,550, 650, 625, 650, 900,275
 XFARE[33] =125,300,0,370,429,135,135,135,135,135,6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,  0,550, 650, 625, 650, 900,275
 XFARE[34] =125,300,0,370,429,135,135,135,135,135,6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,700,  0, 650, 625, 650, 900,275
 XFARE[35] =125,300,0,370,429,135,135,135,135,135,6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,700,550,   0, 625, 650, 900,275
 XFARE[36] =125,300,0,370,429,135,135,135,135,135,6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,700,550, 650,   0, 650, 900,275
 XFARE[37] =125,300,0,370,429,135,135,135,135,135,6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,700,550, 650, 625,   0, 900,275
 XFARE[38] =125,300,0,370,429,135,135,135,135,135,6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,700,550, 650, 625, 650,   0,275
 XFARE[39] =125,300,0,370,429,135,135,135,135,135,6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275


;------- DEFINE BOARDING FARES -(CENTS) ----------------
 XFARE[11] =125,300,0,370,429,135,135,135,135,135,6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[12] =125,300,0,370,429,135,135,135,135,135,6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[13] =125,300,0,370,429,135,135,135,135,135,6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[14] =125,300,0,370,429,135,135,135,135,135,6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[15] =125,300,0,370,429,135,135,135,135,135,6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275
 XFARE[16] =125,300,0,370,429,135,135,135,135,135,6*0,125,100,100,300,075,100,75,125,110,150,200,150,100,100,050,100,700,550, 650, 625, 650, 900,275


/*
1               WMATA
2               WMATA
3               WMATA
4               MTA
5               NVTC/PRTC
6               DDOT/WMATA
```

FARE.DAT

```
7               MTA LRT
8               MTA BRT
9               BRT
10
17      VA      Arlington
18              City of Alexandria
19              Fairfax County
20              Fairfax County
21              Fairfax City
22              Tyson's Circulator
23      MD      Prince Georges
24              Montgomery
25              Frederick County
26              Howard County
27              City of Laurel
28              Calvert
29              Charles County
30              St. Mary's County
31      VA      Loudound County
32              Prince William Co (PRTC)
33              Loudound County Commuter
34              Prince William Co (PRTC) Commuter
35              Quicks Commuter Bus
36              National Coach Cummer Bus
37              Lee Coaches Commuter Bus
38              Washington Flyer-Dulles/WFC
39      MD      MTA
*/

;Non-Transit Modes:
;11 Drive access
;12 Bus/rail walk connect
;13 'Downtown' walk link
;14 Unused
;15 PNR/rail walk connect
;16 Zonal walk access/egress link



;-------- DEFINE BUS FARE ZONE LINKS -(CENTS) ---------
 FARELINKS FARE=75  MODES=39  L=13373-13374     ;MTA 991 Mono MARC16203-13375
 FARELINKS FARE=75  MODES=39  L=19019-19018     ;MTA 991 Mono MARC
 FARELINKS FARE=75  MODES=39  L=13632-13630     ;MTA 915 & 929 13719-13760  13640-13639
;FARELINKS FARE=75  MODES=39  L=13630-13632     ;MTA 929o
 FARELINKS FARE=75  MODES=39  L=3103-9201       ;MTA 915/929 Silver Spring
 FARELINKS FARE=150  MODES=39  L=13624-13740     ;MTA 99513764-13791
 FARELINKS FARE=150  MODES=39  L=13841-13015     ;MTA 921 922,950
 FARELINKS FARE=75  MODES=39  L=4736-4714        ;MTA 921O
 FARELINKS FARE=75  MODES=39  L=14080-14023      ;MTA 902 14026-14025
 FARELINKS FARE=75  MODES=39  L=14015-14014      ;MTA 902 14085-14017
 FARELINKS FARE=75  MODES=39  L=14006-14003      ;MTA 902
 FARELINKS FARE=75  MODES=39  L=14005-13811      ;MTA 904
 FARELINKS FARE=75  MODES=39  L=16720-16722      ;MTA 904
 FARELINKS FARE=75  MODES=39  L=14252-14304      ;MTA 903,905,909
 FARELINKS FARE=75  MODES=39  L=4557-19058       ;MTA 903,909
 FARELINKS FARE=75  MODES=39  L=4615-4596        ;MTA 905
 FARELINKS FARE=75  MODES=39  L=14147-14154      ;MTA 909
 FARELINKS FARE=75  MODES=39  L=14171-14122      ;MTA 909
 FARELINKS FARE=150  MODES=39  L=14221-14267      ;MTA 901,907
```

Attachment C: Baker Engineering Memo

Baker
Engineering & Energy

CORRIDOR CITIES TRANSITWAY

Memo

Project:	MDAA	**Date:**	Nov 14, 2008
Subject:	**Bus Transit Fare Skim**	**CC:**	Bill Thomas
To:	Elizabeth Harper	**From:**	Feng Liu

This memo summarizes the bus fare structure proposed for implementation for the MDAA analysis in the Phase II model development and application.

1. Bus Fare Structure

In this bus fare process, the original mode files (1 through 10) are retained. However, transit modes are re-numbered as shown in Table 1. Essentially, modes 1 through 3 remain intact, while the other transit modes are renumbered. Non-transit modes are still kept the same as the original MWCOG definition.

Based on this transit mode definition, a bus fare matrix was established to reflect the fare structure in 2005. The published fare structures from various transit providers are the data sources for these fares. Regular fares were used for all modes, except for four private commuter service providers, namely, National Coach Commuter Bus, Lee Coaches Commuter Bus, Quicks Commuter Bus, and Washington Flyer-Dulles/WFC. These services charge a very high price for a single ticket, which, if used in the fare skims, would make those fares appear to be outliers compared with the rest of the fare systems in the region. Considering the nature of their commuter services, it seems to be reasonable to believe that regular users of these services will not likely pay for single ticket price, but rather monthly or bi-weekly prices, which appear to be reasonable compared with similar public service providers. A transfer fare matrix was also constructed, based on the inter-modal, intra-agency, and inter-agency transfer policies.

Almost all bus fares are flat shares as shown in Table 1, except for MTA commuter bus services. MTA charges its commuter bus riders, based on a zonal system. Table 2 shows MTA's commuter bus services and their zone designation.

All bus fares described above were coded in FARE.DAT, which should be placed in the input file directory and needs to be updated to reflect fare policies for different years and different scenarios.

Baker
Engineering & Energy

CORRIDOR CITIES TRANSITWAY

Table 1. Mode Definition

New Mode #	Old Mode #	Transit System	Service Type	Service Name	Prefix	Fare*
1	1	WMATA	Local Bus	MetroBus	WM	125
2	2	WMATA	Express	MetroBus	WM	300
3	3	WMATA	Metrorail	Metrorail	M	135*
4	4	MTA	Commuter Rail	MARC	MB	370*
5	4	NVTC/PRTC	Commuter Rail	VRE	FR MA	429*
6	5	DDOT/WMATA	LRT	Anacostia LRT Line		135
7	5	MTA LRT	LRT	CCT/Purple Line		135
8	10	MTA BRT	BRT	CCT/Purple Line		135
9	10	BRT	BRT	VA BRT		135
10						
17	6	Arlington	Local Bus	ART		125
18	6	City of Alexandria	Local Bus	VA-Dash		100
19	6	Fairfax County	Local Bus	Fairfax Connector	F	100
20	7	Fairfax County	Express Bus	Fairfax Connector	F	300
21	6	Fairfax City	Local Bus	CUE Bus	SG	75
22	6	Tyson's Circulator	Local Bus		TYSL	100
23	6	Prince Georges	Local Bus	The Bus	GO	75
24	6	Montgomery	Local Bus	Ride-On	RO	125
25	8	Frederick County	Local Bus	TranIT	FT	110
26	8	Howard County	Local Bus	Howard Transit	HT	150
27	8	City of Laurel	Local Bus	Connect-A-Ride	L	200
28	8	Calvert	Local Bus	Calvert County Route 4 Flyer	CC	150
29	8	Charles County	Local Bus	VanGO	VG	100
30	8	St. Mary's County	Local Bus	STS	ST	100
31	8	Loudoun County	Local Bus	Loudoun County Transit	LT	50
32	8	Prince William Co (PRTC)	Local Bus	OMNI LINK	IL	100
33	9	Loudoun County	Commuter Bus	Loudoun County Transit	LCS	700
34	9	Prince William Co (PRTC)	Commuter Bus	OMNI-RIDE	ORC	550
35	9	Quicks Commuter Bus	Commuter Bus	Quicks	PQ	650
36	9	National Coach Commuter Bus	Commuter Bus	National Coach	SDC	625
37	9	Lee Coaches Commuter Bus	Commuter Bus	Less Coaches	LC	650
38	9	Washington Flyer-Dulles/WFC	Express Bus	Washington Flyer	LINK	900
39	9	MTA	Commuter Bus	MTA Commuter	MT	275*

* Fares are in cents. All are flat fares except for WMATA Metrorail which is distance-based with a 2005 base fare of $1.35, MTA MARC which is zone-based with a base fare of $3.7, MTA Commuter, which is zone-based with a base fare of $2.75, and VRE which is zone-based with a base fare of $4.29. Definition of future transit services such as CCT and Purple Line is to be adopted and provided elsewhere.

Table 2. MTA Commuter Bus Service

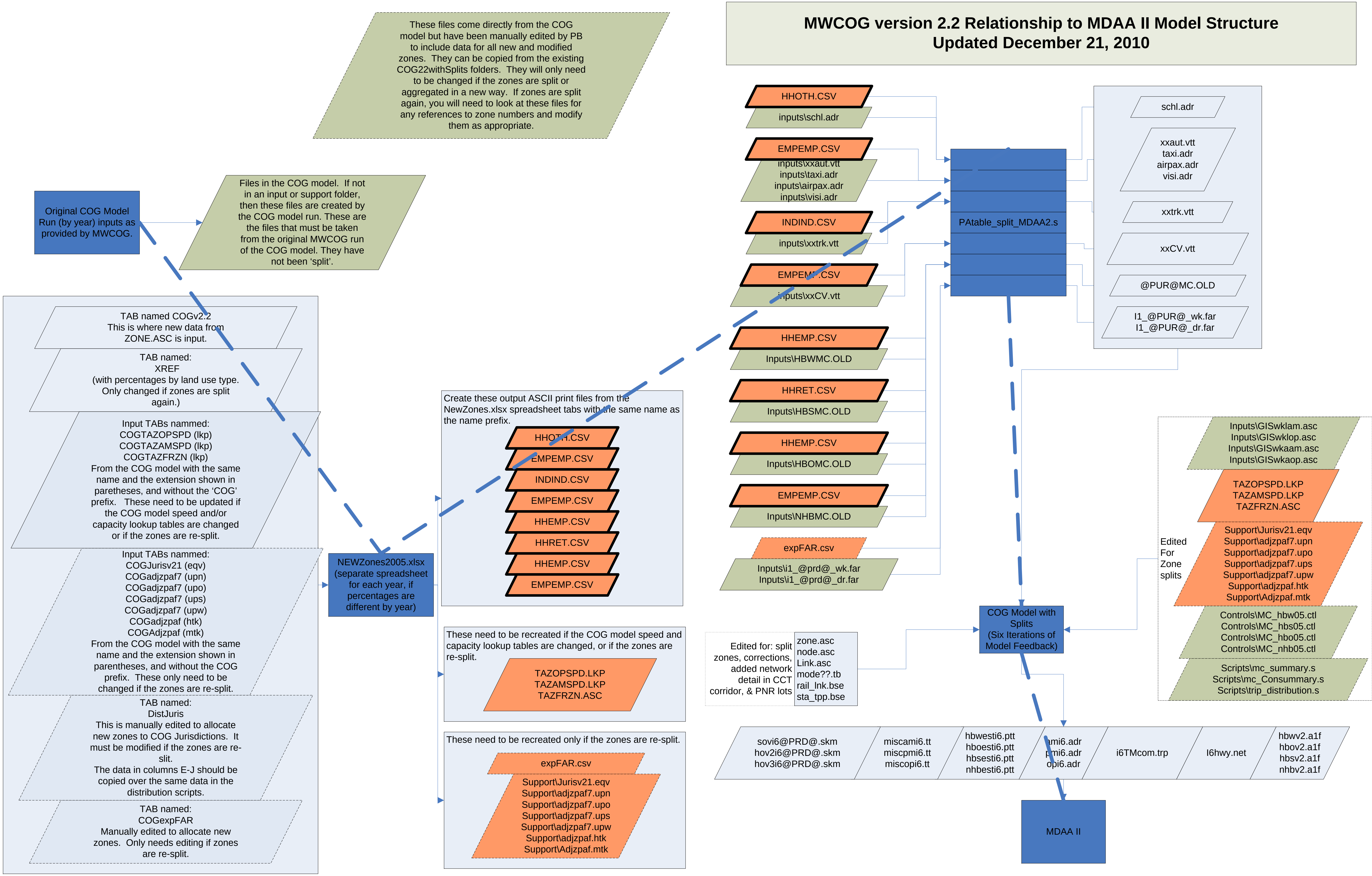
RT#	Origins and Destinations	Zone
901	Washington to Waldorf and La Plata:	Zone 3
902	Washington to Dunkirk: Washington to Sunderland, Prince Frederick, and Fairgrounds: Washington to St. Leonard:	Zone 2 Zone 3 Zone 4
903	Suitland Metro Station to Waldorf and Charlotte Hall: Washington to Waldorf and Charlotte Hall:	Zone 2 Zone 3
904	Washington to Equestrian Center through Pindell: Washington to Owings and North Beach:	Zone 2 Zone 3
905	Washington to Waldorf and Charlotte Hall: Washington to California:	Zone 3 Zone 5
907	Washington to Waldorf and La Plata:	Zone 3
909	Washington to Charlotte Hall: Washington to California:	Zone 3 Zone 5
913	Waldorf to Suitland Metrorail Station:	Zone 2
915	Silver Spring to Burtonsville, Scaggsville, and Columbia: Washington to Burtonsville, Scaggsville, and Columbia:	Zone 2 Zone 3
921	Davidsonville to Prince George's County: Annapolis to Prince George's County:	Zone 1 Zone 2
922	Washington to Annapolis: Washington to Kent Island:	Zone 3 Zone 4
929	Silver Spring to Burtonsville, Scaggsville, and Columbia: Washington to Burtonsville, Scaggsville, and Columbia:	Zone 2 Zone 3
950	Washington to Annapolis: Washington to Kent Island:	Zone 3 Zone 4
991	Shady Grove to Rock Spring: Monocacy and Urbana to Shady Grove: Monocacy and Urbana to Rock Spring:	Zone 2 Zone 2 Zone 3
995	Washington to Columbia, Ellicott City, and Clarksville:	Zone 3

2. All Bus Fare Skim

The bus fares between one TAZ and another are skimmed in the transit skim process. Transit_Skims_AB.s script file was modified to generate zone-to-zone bus fares, which were calculated as the sum of the boarding fare, any applicable mode-mode transfer fare, and zonal fare surcharges for MTA commuter routes.

The script generates TAZ-to-TAZ fare tables as a component of the transit skim matrices, which include six skim matrices (by time of day and access mode). Representative TAZ pairs were selected and traced to examine the reasonableness of their fare values.

Appendix F

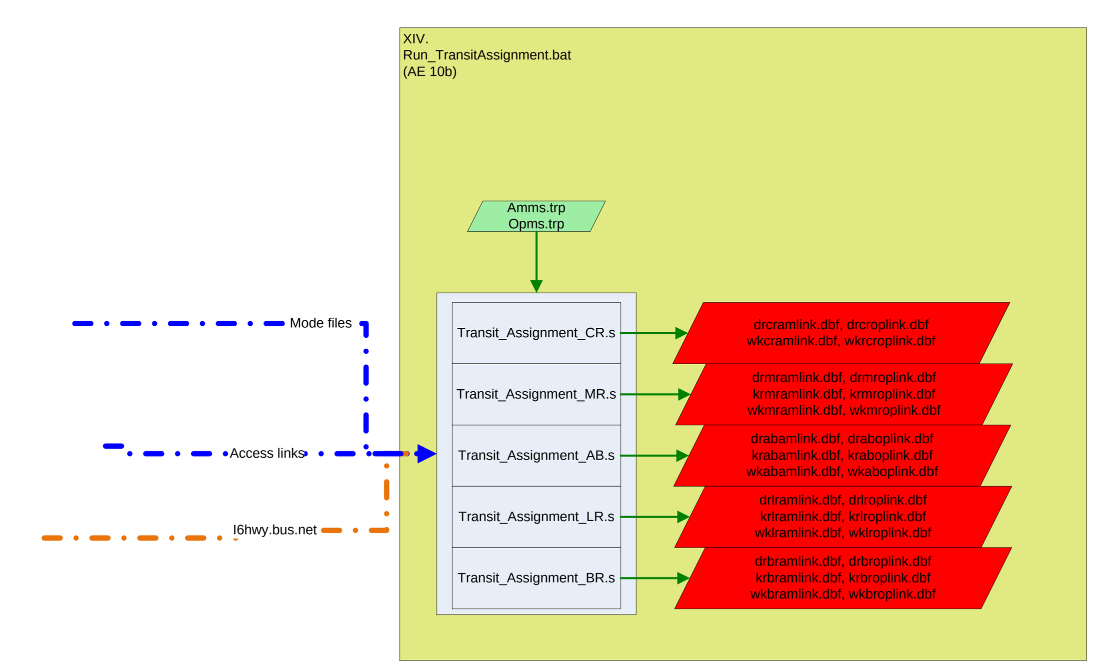

MWCOG version 2.2 Relationship to MDAA II Model Structure
Updated December 21, 2010
These files come directly from the COG model but have been manually edited by PB to include data for all new and modified zones. They can be copied from the existing COG22withSplits folders. They will only need to be changed if the zones are split or aggregated in a new way. If zones are split again, you will need to look at these files for any references to zone numbers and modify them as appropriate.
Original COG Model Run (by year) inputs as provided by MWCOG.
Files in the COG model. If not in an input or support folder, then these files are created by the COG model run. These are the files that must be taken from the original MWCOG run of the COG model. They have not been 'split'.
TAB named COGv2.2
This is where new data from ZONE.ASC is input.
TAB named:
XREF
(with percentages by land use type. Only changed if zones are split again.)
Input TABs nammed:
COGTAZOPSPD (lkp)
COGTAZAMSPD (lkp)
COGTAZFRZN (lkp)
From the COG model with the same name and the extension shown in paretheses, and without the 'COG' prefix. These need to be updated if the COG model speed and/or capacity lookup tables are changed or if the zones are re-split.
Input TABs nammed:
COGJurisv21 (eqv)
COGadjzpaf7 (upn)
COGadjzpaf7 (upo)
COGadjzpaf7 (ups)
COGadjzpaf7 (upw)
COGadjzpaf (htk)
COGAdjzpaf (mtk)
From the COG model with the same name and the extension shown in parentheses, and without the COG prefix. These only need to be changed if the zones are re-split.
TAB named:
DistJuris
This is manually edited to allocate new zones to COG Jurisdictions. It must be modified if the zones are re-slit.
The data in columns E-J should be copied over the same data in the distribution scripts.
TAB named:
COGexpFAR
Manually edited to allocate new zones. Only needs editing if zones are re-split.
NEWZones2005.xlsx (separate spreadsheet for each year, if percentages are different by year)
Create these output ASCII print files from the NewZones.xlsx spreadsheet tabs with the same name as the name prefix.
HHOTH.CSV
EMPEMP.CSV
INDIND.CSV
EMPEMP.CSV
HHEMP.CSV
HHRET.CSV
HHEMP.CSV
EMPEMP.CSV
These need to be recreated if the COG model speed and capacity lookup tables are changed, or if the zones are re-split.
TAZOPSPD.LKP
TAZAMSPD.LKP
TAZFRZN.ASC
These need to be recreated only if the zones are re-split.
expFAR.csv
Support\Jurisv21.eqv
Support\adjzpaf7.upn
Support\adjzpaf7.upo
Support\adjzpaf7.ups
Support\adjzpaf7.upw
Support\adjzpaf.htk
Support\Adjzpaf.mtk
HHOTH.CSV
inputs\schl.adr
EMPEMP.CSV
inputs\xxaut.vtt
inputs\taxi.adr
inputs\airpax.adr
inputs\visi.adr
INDIND.CSV
inputs\xxtrk.vtt
EMPEMP.CSV
inputs\xxCV.vtt
HHEMP.CSV
Inputs\HBWMC.OLD
HHRET.CSV
Inputs\HBSMC.OLD
HHEMP.CSV
Inputs\HBOMC.OLD
EMPEMP.CSV
Inputs\NHBMC.OLD
expFAR.csv
Inputs\i1_@prd@_wk.far
Inputs\i1_@prd@_dr.far
PAtable_split_MDAA2.s
schl.adr
xxaut.vtt
taxi.adr
airpax.adr
visi.adr
xxtrk.vtt
xxCV.vtt
@PUR@MC.OLD
I1_@PUR@_wk.far
I1_@PUR@_dr.far
Inputs\GISwklam.asc
Inputs\GISwklop.asc
Inputs\GISwkaam.asc
Inputs\GISwkaop.asc
TAZOPSPD.LKP
TAZAMSPD.LKP
TAZFRZN.ASC
Support\Jurisv21.eqv
Support\adjzpaf7.upn
Support\adjzpaf7.upo
Support\adjzpaf7.ups
Support\adjzpaf7.upw
Support\adjzpaf.htk
Support\Adjzpaf.mtk
Controls\MC_hbw05.ctl
Controls\MC_hbs05.ctl
Controls\MC_hbo05.ctl
Controls\MC_nhb05.ctl
Scripts\mc_summary.s
Scripts\mc_Consummary.s
Scripts\trip_distribution.s
Edited For Zone splits
COG Model with Splits (Six Iterations of Model Feedback)
Edited for: split zones, corrections, added network detail in CCT corridor, & PNR lots
zone.asc
node.asc
Link.asc
mode??.tb
rail_lnk.bse
sta_tpp.bse
sovi6@PRD@.skm
hov2i6@PRD@.skm
hov3i6@PRD@.skm
miscami6.tt
miscpmi6.tt
miscopi6.tt
hbwesti6.ptt
hboesti6.ptt
hbsesti6.ptt
nhbesti6.ptt
ami6.adr
pmi6.adr
opi6.adr
i6TMcom.trp
I6hwy.net
hbwv2.a1f
hbov2.a1f
hbsv2.a1f
nhbv2.a1f
MDAA II

Appendix G

Maryland Alternatives Analysis Phase II Model Structure

Based on MWCOG version 2.2 with Transit Component

September, 2010 Chart version 8


XIV.
Run_TransitAssignment.bat
(AE 10b)
Amms.trp
Opms.trp
Mode files
Access links
I6hwy.bus.net
Transit_Assignment_CR.s
Transit_Assignment_MR.s
Transit_Assignment_AB.s
Transit_Assignment_LR.s
Transit_Assignment_BR.s
drcramlink.dbf, drcroplink.dbf
wkcramlink.dbf, wkcroplink.dbf
drmramlink.dbf, drmroplink.dbf
krmramlink.dbf, krmroplink.dbf
wkmramlink.dbf, wkmroplink.dbf
drabamlink.dbf, draboplink.dbf
krabamlink.dbf, kraboplink.dbf
wkabamlink.dbf, wkaboplink.dbf
drlramlink.dbf, drlroplink.dbf
krlramlink.dbf, krlroplink.dbf
wklramlink.dbf, wklroplink.dbf
drbramlink.dbf, drbroplink.dbf
krbramlink.dbf, krbroplink.dbf
wkbramlink.dbf, wkbroplink.dbf