



TRANSIT PERFORMANCE & SERVICE EXPANSION



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Section 1 – Introduction

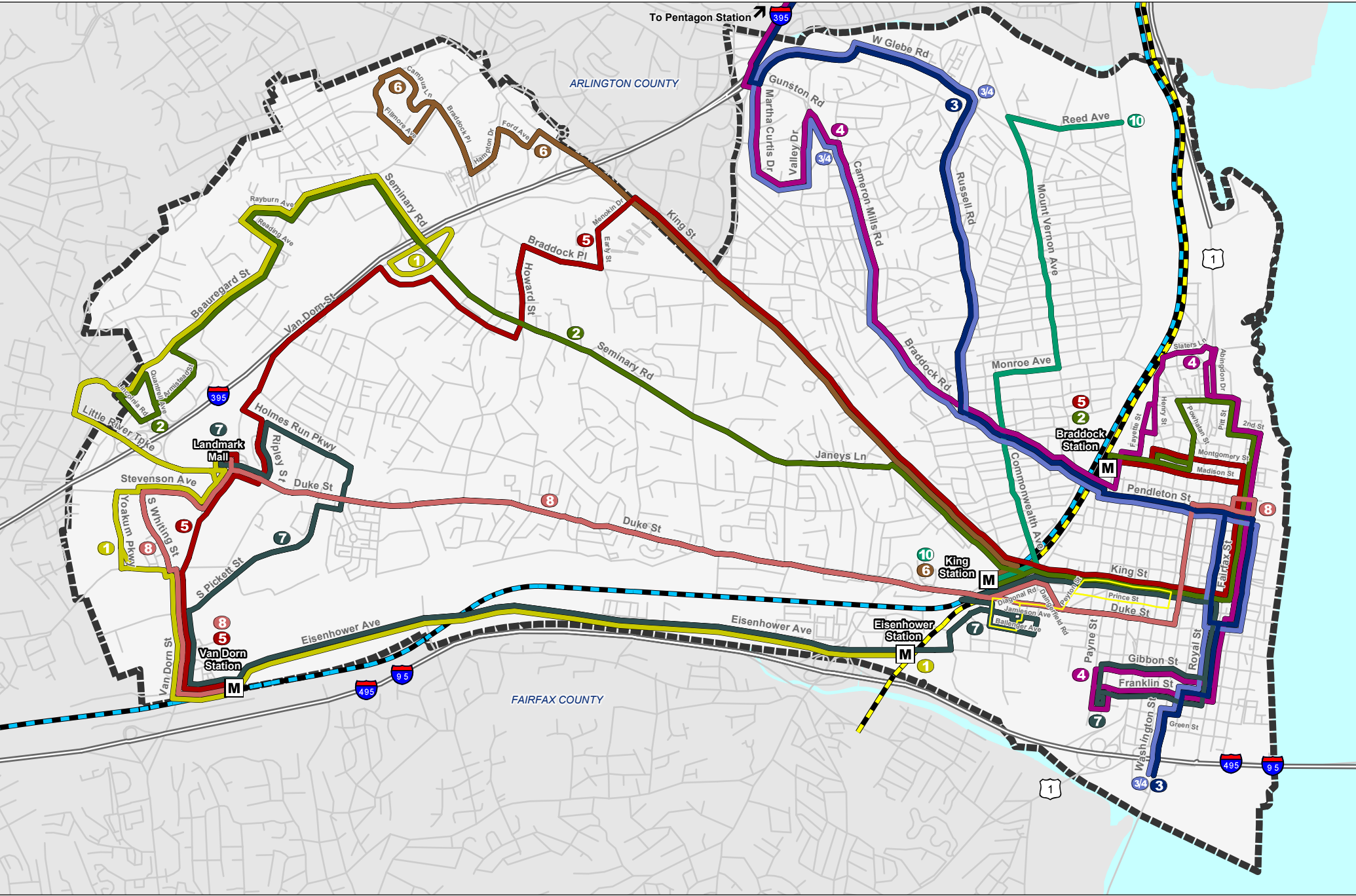
The Alexandria Transit Corporation (ATC) has developed a transit expansion plan as part of its 2008 Transit Development Plan (TDP). ATC will utilize this plan to prioritize service changes based upon funding availability. ATC requested independent review and analysis of these changes based upon existing ridership, demographic information, traffic, and other data.

The intent of ATC's TDP, covering the years 2010 to 2015, is to move the transit system in the direction established in the Transportation Master Plan. The TDP has three components:

- A Service Expansion Plan including nine new crosstown or community circulator routes which will link the main transit corridors or provide collection/distribution between Metro Stations and major activity centers or high density residential centers. This expansion plan will take advantage of the operating capacity of the forthcoming ATC operating facility, which will allow growth of the existing system to 130 peak buses by FY2015 or FY2020 under a constrained plan.
- A Traffic Congestion Plan which identifies existing problem areas for public transit (e.g., slow travel speeds, long waits at traffic signals, etc.), current or planned traffic congestion mitigation projects, and specific recommendations for additional infrastructure improvements to further improve bus speeds.
- A Bus Stop Guidelines Manual providing standards for bus stop spacing, site/location, and provision of passenger amenities. This manual will also provide guidance for local developers regarding specific transit related site improvements (e.g., bus pull-outs, shelter pads, etc.) that should be considered as part of new development projects in the City.

Given the overall direction of the Transit Development Plan towards expanding the DASH bus system to play a more significant role in local transportation, the goals of the report are as follows:

- Rationalize the proposed expansion plan crosstown and circulator routes to maximize the service efficiency of the new routes, minimize service duplication, and maximize service effectiveness by targeting new service coverage to areas with transit-supportive demographic and land-use characteristics.



DASH Bus Network 2008

- Phase and prioritize the service improvements to track with ATC's planned fleet improvement schedule, with the eventual target of 130 peak buses in FY2015 or FY2020 under a constrained approach.
- Recommend new infrastructure improvements to improve bus travel speeds and reduce congestion.
- Develop a bus stop manual for ATC staff; develop guidelines for transit-friendly improvements that developers can incorporate into new development projects.

In order to review and analyze changes as well as propose modifications the following data sources were reviewed:

2004 Comprehensive Operational Analysis

In 2004, The Alexandria Transit Corporation (ATC) conducted a Comprehensive Operations Analysis (COA) with the objectives of:

- Compiling detailed information on ATC's fixed-route DASH transit services to provide a comprehensive understanding of the existing services, including ridership patterns, operating conditions, and service performance;
- Defining service improvements that could be made to the existing route structure to better serve the community; and,
- Identifying opportunities to provide additional service to improve connections, area coverage, travel time, and schedule reliability;
- Improving the matching of routes and schedules to origin-destination (O/D) patterns;
- Determining accurate travel times in a very congested urban area;
- Improving transfer connections and schedule coordination; and
- Determining where/how best to use additional buses.

The 2004 COA recommendations attempted to rationalize the DASH route network to:

- Minimize service duplication through consolidation to improve the productivity of over-served segments
- Simplify and streamline routings in downtown Alexandria to improve travel speeds and on-time performance
- Incorporate weak-performing route segments into new standalone community shuttles or into new crosstown services to improve network productivity.



As a precaution, ATC commissioned a follow-up Origin/Destination Survey to ensure that the proposed COA service recommendations would not have a significant negative impact upon existing ridership. The survey findings were that 3% of ATC riders would be negatively impacted by the service proposals. No existing riders were completely disenfranchised; the negative impacts upon riders were increased transfers, longer trip times, or longer walk to access transit service.

ATC has implemented several service recommendations from the COA, notably:

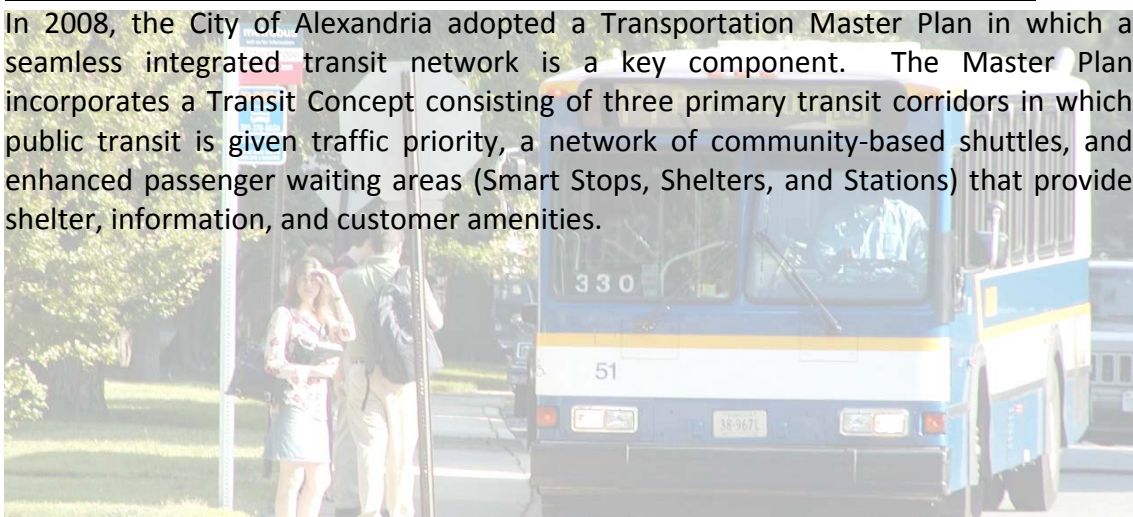
- Modifying the downtown alignment on route AT3 to use Pendleton Street.
- Shrinking the downtown terminal loop routing on the Route AT3/4 Loop
- Incorporating a Landmark Mall/King Street Metro shortline pattern on Route AT8
- Route AT10 provides the connection between King Street Metro Station and Potomac Yard as proposed by the COA for the new route AT12, although the southern alignment is different than proposed in the COA, based upon recommended adjustments from public comments.

Since the completion of the COA, ATC has also expanded service coverage in a few areas, notably:

- Route AT4 alignment was expanded north of Montgomery St. to serve a portion of the new Route AT12 that was recommended in the 2004 COA.
- A new Route AT1 was added between Seminary Plaza and Van Dorn Metro, with peak period service extended to Eisenhower Metro Station. This route's addition effectively double service on Beauregard St. between Landmark Mall and Seminary Plaza.

City of Alexandria Master Transportation Plan/ATC FY2008 Six-Year Transit Plan

In 2008, the City of Alexandria adopted a Transportation Master Plan in which a seamless integrated transit network is a key component. The Master Plan incorporates a Transit Concept consisting of three primary transit corridors in which public transit is given traffic priority, a network of community-based shuttles, and enhanced passenger waiting areas (Smart Stops, Shelters, and Stations) that provide shelter, information, and customer amenities.



Section 2 – Market Analysis

This section examines existing and projected future characteristics of the DASH service area, including population and employment, distribution of transportation-disadvantaged populations, travel demand patterns, and planned developments to evaluate their impact on transit improvements.

Population and Employment Densities

According to population forecasts developed by the Metropolitan Washington Council of Governments, the City of Alexandria's population is expected to increase approximately 1% per year, reaching nearly 150,000 by 2015. During the period 2005-2015, employment is projected to increase by more than 24,000 jobs, which represents a 23% increase.

Maps using population and employment density Census data for 2005 and projections for 2010 and 2015 in the ATC service area as a tool for evaluating the impacts of transit changes are included in Appendix C.

The DASH bus system currently serves an area where the strongest transit-supportive densities are at the edges of the service network. The highest population densities (exceeding 40 residents per residential Acre) occur in the northern peripheries of the system in the Arlandria, Fort Ward Heights, and Lincolnia neighborhoods. Mid to high population densities (20 to 40 persons per acre) occur in the neighborhoods immediately east of the Braddock and King Metro Stations, in the Warwick Village, Brookville and Varsity Park neighborhoods, and in the areas immediately east and south of Landmark Mall.

Similarly, the highest employment densities (exceeding 40 jobs per commercial acre) occur in Old Town Alexandria along King St. and Fairfax St. and in the areas surrounding the Braddock, King, Eisenhower, and Van Dorn Metro Stations. Areas of mid to high employment density (20 to 40 jobs per acre) occur in at Landmark Mall, in Cameron Valley, in the area east of Van Dorn Metro Station, in the areas both east and west of Van Dorn St. south of Edsall Rd., and in Shirlington in adjacent Arlington County.

The projections for 2010 show that population densities will increase southeast of I-395 between Edsall Rd and Seminary Rd., and northwest of I-395 between Seminary Rd. and Glebe Rd. Additionally, population densities will increase along Duke St., in the Mt. Vernon Rd. corridor and in the Parkfairfax and Braddock Heights neighborhoods. The overall effect is that low-density area in Central Alexandria is



gradually intensifying in population. Concerning employment density, the most significant change between 2005 and 2010 is increases in job density at Mark Center.

The projections for 2015 show a continuation of these trends with continued population infill in the center of Alexandria, with only a few areas exhibiting low population densities. Concerning job densities, no significant changes are apparent between 2010 and 2015.

Overall, these changes in population and employment densities support the development of Priority Transit Corridors, as identified in the City's Master Transportation Plan, on the US 1, Duke St., and Van Dorn Rd. corridors.

Youth Populations

Youth population (ages under 16) densities follow the general pattern of overall population density with the exception that high densities occur along Duke Street in the vicinity of Jordan Street and in the vicinity of Foxchase Shopping Center.

Senior Citizen/Low-Income Populations

The highest densities of senior citizens are located in the far northwestern part of the DASH service area, in the vicinity of Beauregard Medical Center and to the immediate east and south of Landmark Mall. There are additional pockets of medium to high senior density in Old Town Alexandria, along Jordan Street north and South of Duke Street, and northeast of I-395 and Seminary Street.

The highest densities of persons living below the poverty level occur in the neighborhoods surrounding Landmark Mall, near Foxchase Shopping Center, in the Arlandria and Warwick Village neighborhoods, and in the Fort Ward Heights area.

Travel Demand (2004 DASH Rider Survey)

As part of the ATC DASH Comprehensive Operational Analysis in 2004, a passenger survey was performed that identified DASH passenger origin-destination travel patterns.

Within Alexandria, demand was spread across the City. The areas with the most passenger demand were in the zones including:

- King Street Metro Station
- Braddock Road Metro Station
- Van Dorn Street Metro Station
- City Hall
- Patent and Trademark Office
- Edsall/Whiting
- Southern Towers
- Parkfairfax



- Cameron Station

Although workers residing in Alexandria and working at the Pentagon may have responded at a higher rate than average, travel from northeast Alexandria to the Pentagon is the major regional travel pattern. Within Alexandria, major origin/destination pairs exist between King Street Metro and downtown Alexandria, between Braddock Street Metro and Downtown, between the Wakefield neighborhood and King Street Metro, and between King Street Metro and the King Street corridor. These travel patterns support transit improvements, including transit priority measures and improved service frequencies in the Duke Street corridor.

New Developments

New development or redevelopment activities are planned both for the Landmark Mall area, which has traditionally been a significant focus of DASH bus service, as well as the Potomac Yard area, located just east of the Arlandria and Warwick Hills neighborhoods in northeast Alexandria, which are significant passenger generators for ATC.

- Landmark Mall/Van Dorn Area Plan: The Landmark/Van Dorn Area Plan effort began in the summer of 2004 with the goal of developing recommendations for revitalization of the Van Dorn Street Corridor and Landmark Mall. A conceptual plan for the area was developed in June 2006. The plan will continue to be revised and updated as new information on proposals for the Mall, new information on economic, transportation and other factors that affect planning in the area emerge.

General Growth Properties approached the City in 2004 with the intent to redevelop the 51-acre Landmark Mall site. The site presents the City with significant challenges and opportunities. It is one of the largest redevelopment opportunities in the West End and has the potential to encourage the revitalization of nearby sites. However, separate corporate mergers involving Sears, Hecht's (now Macy's) and General Growth Properties have delayed agreement among these parties on the Mall's revitalization.



Recently, General Growth Properties has renewed its commitment to redevelopment of the shopping center as a mixed-use center better integrated into the fabric of its surrounding community. This provides the City with an opportunity to help create a “place” that provides a community focus for the West End.

Some of the major transit improvements being suggested for the study include development of a transit center at Landmark Mall, exclusive bus routes along Van Dorn and operation of circulator routes through neighborhood areas that would connect with both Landmark Mall transit center and the Van Dorn Metrorail station.

- Potomac Yard: The Potomac Yard project has been split into two major parts. The first phase, Potomac Yard Shopping Center, opened in 1995 with a mix of restaurants, movie theaters, specialty retail and big box retail. The second phase of the project includes development of 1.9 million square feet of office space, 135,000 square feet of retail (in addition to the existing 600,000 square foot Potomac Yard Shopping Center), and 1,700 residential units.

An important element of the continued development of this site is the completion of the transportation management plan that was adopted in 1999. The plan included a number of items that would support enhanced transit service, including providing a transportation management plan coordinator, promotion of alternative transportation modes, ridesharing, the sale of discounted transit media, and the establishment of a transportation fund.

Shuttle services will be implemented as the projects start to open and funds are collected in the transportation fund.

A major transit improvement in the Potomac Yard area will be the implementation of the Crystal City/Braddock Road BRT project that will operate between the Braddock Road Metro station and the Crystal City Metro Station with future extensions to the Pentagon and connections to the Columbia Pike BRT and Streetcar project.



Summary of Findings:

- The overall projected trend in population and job growth is for existing patterns to intensify, with job and employment densities on the “edges” of Alexandria intensifying as well as densities increasing in the central; portions of

the community. These development patterns support the City's Transit Concept plans for priority transit corridors, as well as ATC's plans for a Lincolnia/Potomac Yard cross-town service.

- The densities of senior population in the neighborhoods adjacent to Landmark Mall and in the Fort Ward Heights neighborhoods support the concept of introducing community-based shuttles in those neighborhoods.
- The redevelopment of Landmark Mall into a true community focal point creates an opportunity for a stronger DASH route anchor than exists today.

Section 3 – Existing DASH Fixed-Route Services

DASH Objectives

The Alexandria Transit Company (ATC) operates DASH fixed-route transit services within portions of the City of Alexandria and between the city and the Pentagon Metro station. DASH bus services are intended to supplement the regional rail and bus service provided by WMATA with local bus service designed to support specific community objectives, including:



- Improved internal circulation within the city, particularly in areas not served by Metrobus.
- Improved access to Metrorail stations.
- Development of growth areas identified in the City's Master Plan.
- Relief of traffic-congested corridors and the avoidance of alternative expenditures for highway and parking facilities.
- Decrease in the amounts that otherwise would be paid by the City of Alexandria for Metrobus service.

ATC Service Standards

ATC has service standards used in planning, operating, and evaluating the transit services. The following is a brief summary of those ATC standards dealing with service performance:

- Service Frequency
 - Determinations regarding the frequency of service involve a trade-off between convenience to the transit user and transit service costs. The basic factor in such determinations is the level of ridership.
 - During peak periods, frequency of service is determined principally by loading standards (see "ATC Vehicle Load Standards" below). The minimum peak period frequency shall be 30 minutes. ATC's goal is to achieve 15-minute peak frequencies throughout the system.
 - During off-peak periods, the minimum acceptable frequency is 1 hour. Whenever patronage warrants, this will be reduced to 30 minutes or less.

- Service Reliability

ATC has the following service reliability standards concerning schedule construction and schedule adherence.

- Schedules shall be constructed so that sufficient time is available under normal traffic conditions, using safe driving practices and adhering to speed limits, to maintain the schedule and complete a trip on time. When traffic conditions vary seasonally or by the day of the week or the time of day, schedules shall be adjusted to reflect conditions on the street. When schedule adherence becomes difficult because of traffic conditions, the Alexandria Transit Company will urge the appropriate officials to remedy the situation or to provide preferential treatment for transit vehicles. These failing, schedules shall be adjusted.
- 95% of all scheduled service should be on time, which is defined as zero minutes early to five minutes late at time points.
- Vehicle Loads
Loading in excess of 1.00 is permitted during peak periods when the average standing time does not ordinarily exceed 15 minutes. Since the loading standard is an average, individual trips may exceed the standard, but the passenger load on any bus shall not exceed the safe or legal limit for that vehicle. When a loading standard is consistently exceeded, the schedule shall be adjusted or service increased over the route or route segment so as to conform to these standards.

Table 3.1—ATC Vehicle Load Standards

	Passenger/ Seat Ratio
Peak	1.50
Off-Peak	1.00
Evening, Saturday, Sunday	1.00

- Performance Standards:
Currently ATC does not have any minimum performance standards, such as a minimum threshold for boardings per revenue hour or a maximum acceptable subsidy per passenger boarding.

Current DASH Performance

System Ridership: In reviewing at the performance of the core DASH routes (excluding Dashabout, Lunch Loop, and other miscellaneous services), average daily system boardings have increased by approximately 5% across the board from FY2007 to FY2008. (Please note that, because of the introduction of Route AT1 and adjustment of AT2 in the second half of FY2008, Routes AT1 and AT2 have been combined in Chart 3.1 to Chart 3.3.)

Table 3.2—Average Daily Boardings

	Average Daily Boardings		
	Weekday	Saturday	Sunday
FY2007	12,785	6,033	3,575
FY2008 YTD	13,434	6,318	3,763
% change 2008 vs. 2007	5.1%	4.7%	5.3%

Route Ridership: Figures 2 through 4 show average route boardings by service day for FY2007 and the first 3 quarters of FY2008.

Chart 3.1—DASH Weekday Boardings

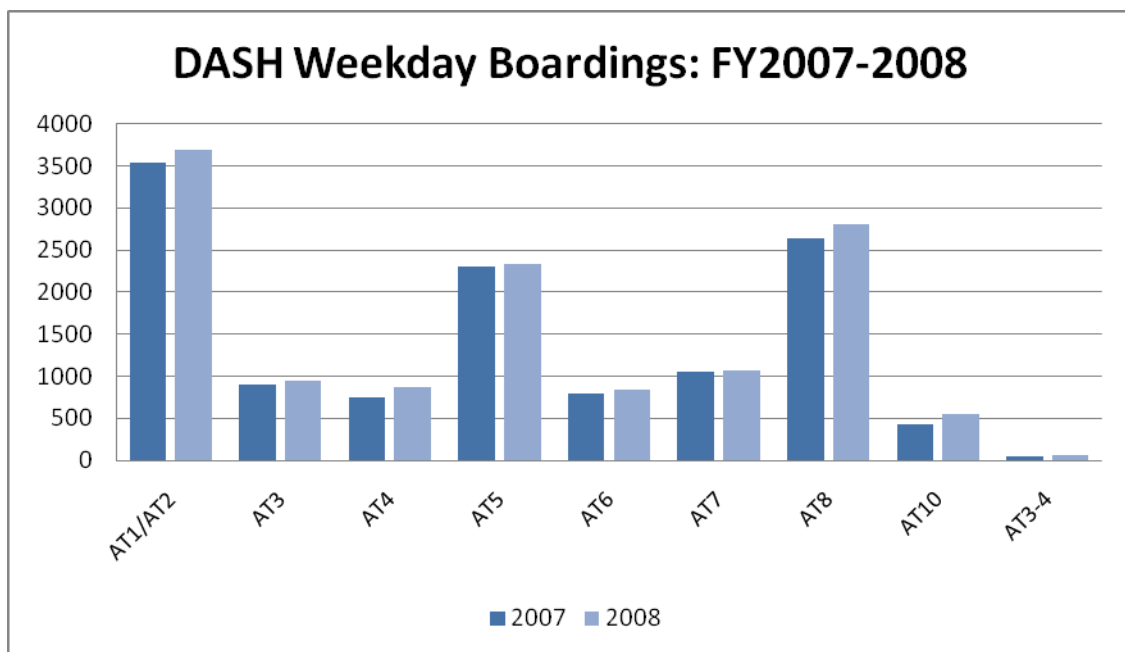


Chart 3.2—DASH Saturday Boardings

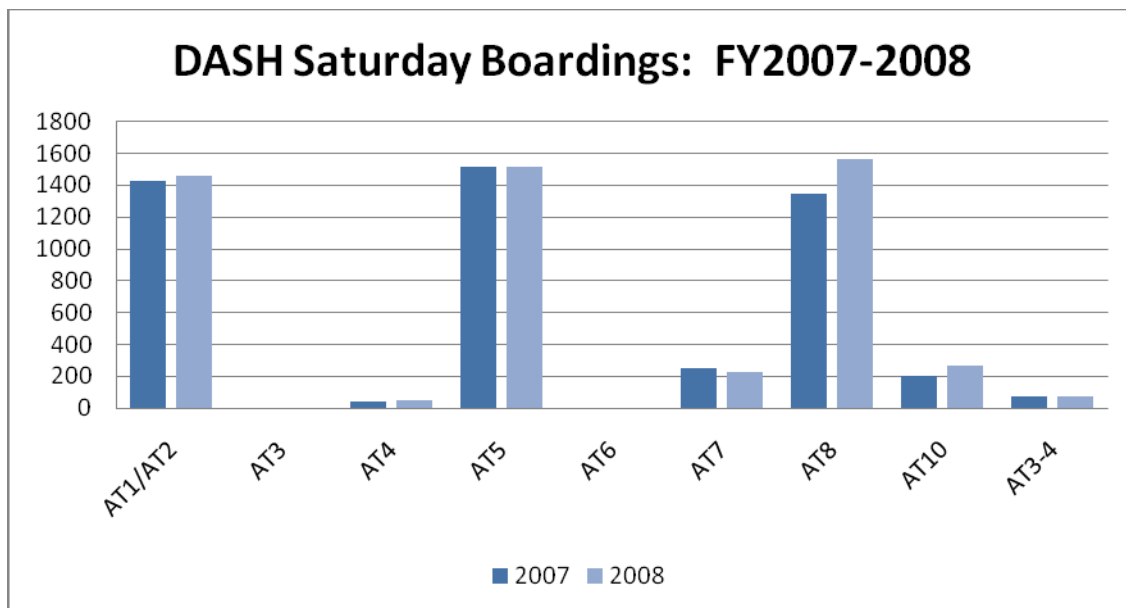
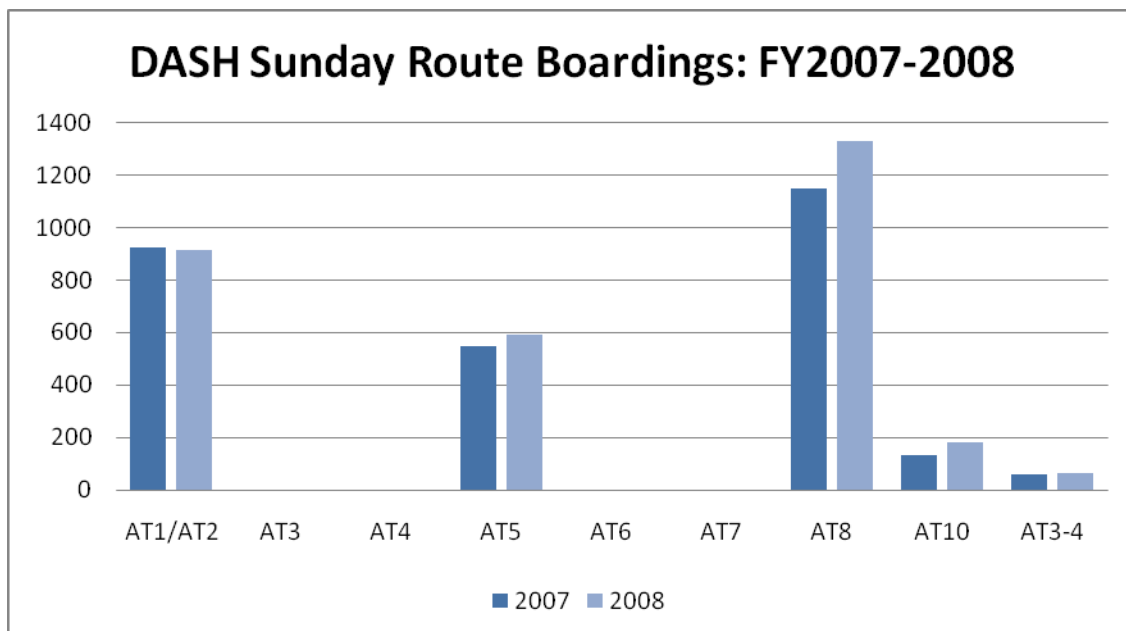


Chart 3.3—DASH Sunday Boardings



Routes AT2, AT5, and AT8 continue to be the strong, seven-day-a-week contributing routes to system ridership. At the other end of the spectrum, the AT 3-4 loop continues to perform poorly, not exceeding an average of 100 daily boardings,

Route Productivity: Chart 3.4 below shows the comparative weekday passenger productivities for core DASH routes (excluding Dashabout, Lunch Loop and miscellaneous service) for the 2004 COA, FY2007, and the first 3 quarters of FY2008.

Routes AT2, AT3 (peak), AT5, AT6, AT8, and AT10 have been averaging 30 boardings per hour or greater in FY2007 and FY2008. Route AT8 on Duke Street consistently displays the best passenger weekday productivity averaging well over 45 boardings per hour. Routes AT1 (new route), AT4, and AT7 have averaged 20 to 30 boardings per revenue hour on weekdays. The off-peak route AT3-4 loop consistently displays the lowest productivity, hovering just above 10 boarding per revenue hour.

Note: It is currently ATC's practice to report passenger productivity performance in terms of boardings per in-service hour. Many transit agencies report boardings per true revenue hour (which includes layover time) rather than per in-service hour because it more closely reflects the actual service resources required to both satisfy driver labor agreements as well as maintain service reliability. These additional hours for layover/recovery time are currently in the 25% to 30% range for DASH bus.

Chart 3.4—Comparative Weekday Passenger Productivity

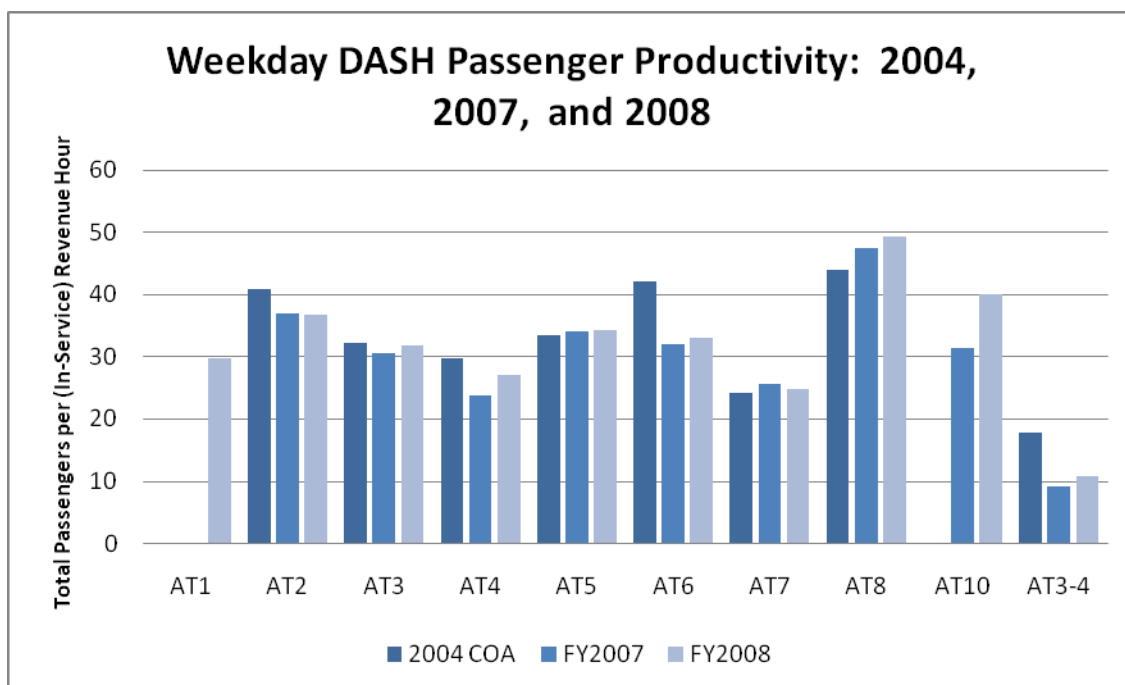


Chart 3.5 and Chart 3.6 similarly show Saturday and Sunday DASH route productivity.

Chart 3.5—Comparative Saturday Passenger Productivity

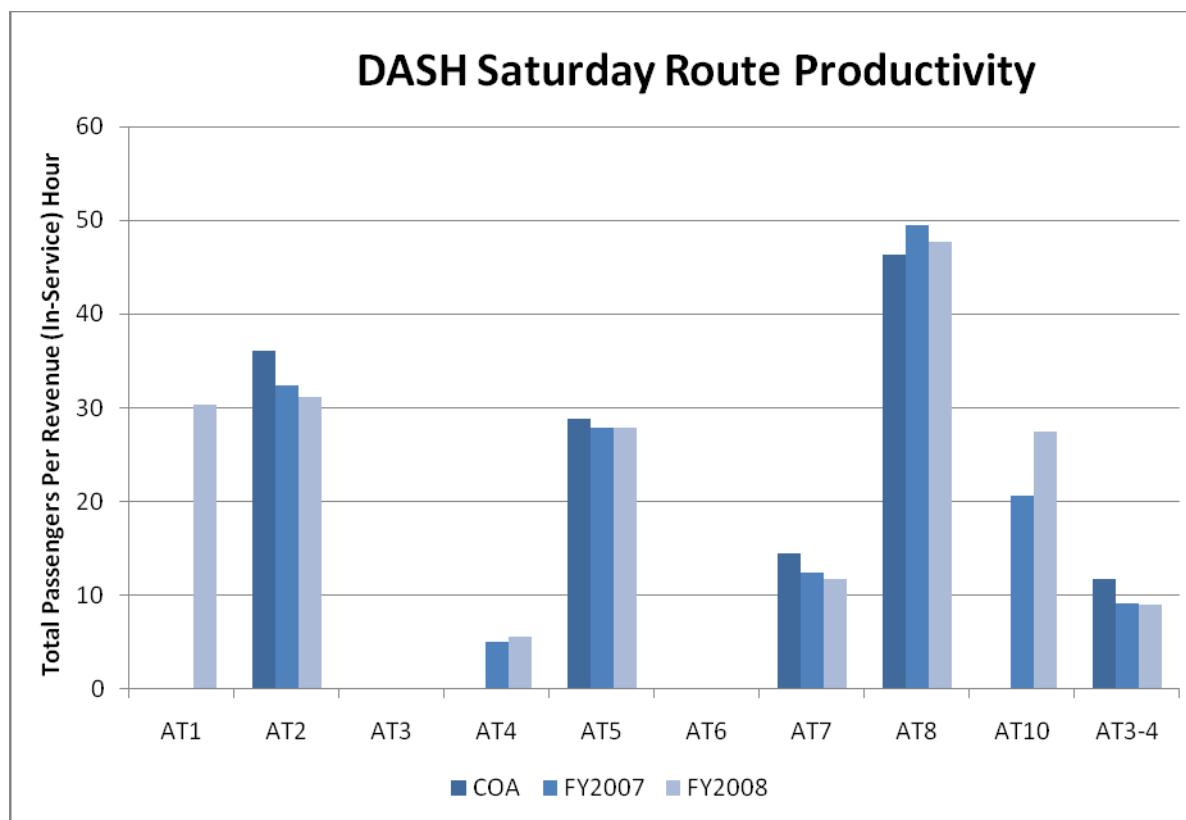
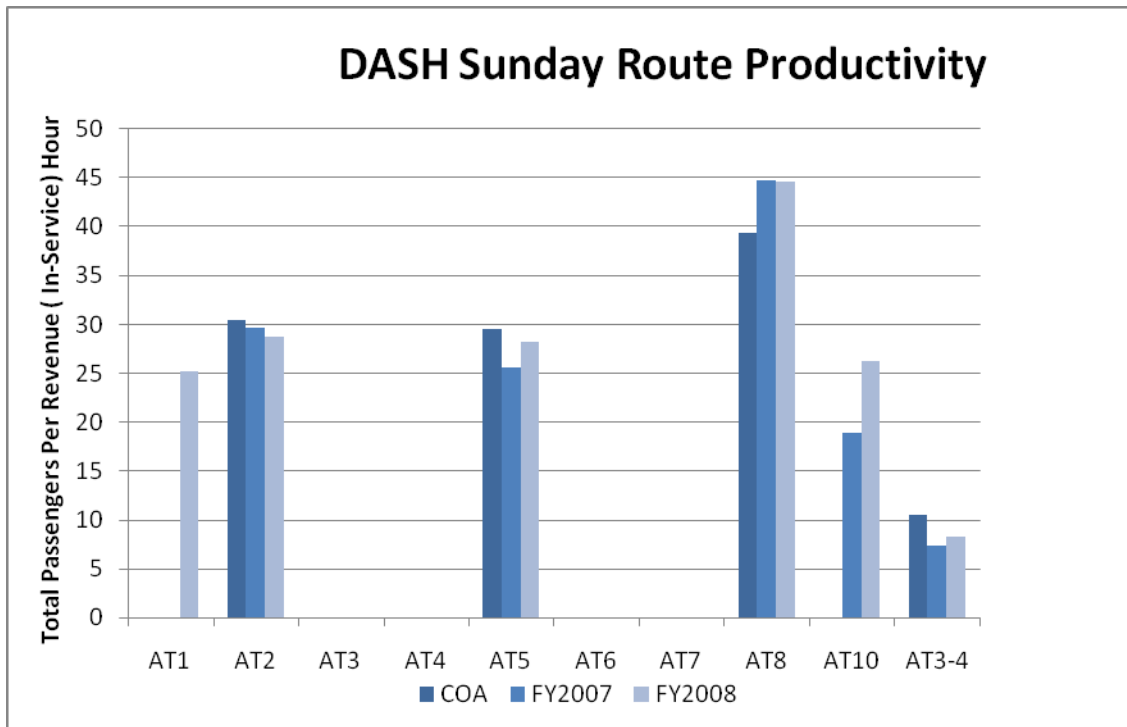


Chart 3.6—Comparative Sunday Passenger Productivity



Route AT8 maintains high passenger productivity on weekends, exceeding 40 boardings per revenue hour throughout the weekend. Routes AT2 and AT5 generate nearly 30 boardings per revenue hour on the weekends, with Sunday performance being slightly lower than Saturdays. Route AT10's performance on the weekend has improved, just as on weekdays – its weekend performance is roughly the same as that of AT2 and AT5 averaging nearly 30 boardings per hour.

At the other end of the performance spectrum, the Route AT3/4 doesn't perform as well as other routes on the weekends with less than 10 boardings per revenue hour. Saturday AT4 service is generating about 5 boardings per revenue hour the lowest of all weekend productivity.

Vehicle Loads

Vehicle overcrowding does not appear to be a major issue on DASH routes, according to the 2007 ridecheck data. The DASH fleet is comprised of 35-foot coaches seating 36 or 37 passengers. Examining the 2007 ridecheck data, the only routes that experienced any instances of overcapacity (on-board load exceeding 36) were Routes AT2 and AT8 as follows:

- Route AT2:
 - On weekdays in the eastbound direction, one AM peak trip had standees in the vicinity of King Street Metro for 2 stops.
 - On Saturday, the first morning eastbound trip had standees from Beauregard/Sanger until Southern Towers.
- Route AT8:
 - On weekdays in the eastbound direction, two AM peak and one early afternoon trip exceeded seated capacity. In the westbound direction, one PM peak and one early evening trip exceeded seated capacity. These situations all occurred approaching or leaving King Street Metro station and only lasted for a few stops; the largest onboard load was 44. Weekday -- 1 eastbound trip
 - Saturday – 1 eastbound and one westbound trip. On Saturdays, one morning and one afternoon trip eastbound had standees; the largest load was 44 and the standees occurred within a few stops of King Street Metro.
 - On Sundays, one morning eastbound trip had standees approaching King Street Metro.

Service Efficiency

Service efficiency is a measure of how efficiently service resources are converted into revenue service. To ensure reliable service, it is necessary to build additional, non-service time, called recovery time into schedules to ensure that successive trips depart on time.

Additionally, driver labor agreements typically require a minimum amount of non-service time (layover time) be provided to afford drivers the opportunity to use the bathroom, take a break, etc. Layover time may be stipulated as a particular percentage of in-service time, or it may be a flat amount of driver time per run. Typically, in the construction of schedules, recovery and layover are combined. Typical schedule building practice involves providing at least 10% layover recovery just to ensure schedule reliability. Typically, layover percentage exceeding 20% are considered excessive, unless additional recovery is needed to ensure transfers, as in a timed-transfer network.



Table 3.3 illustrates the ratio of revenue time to in-service time for each DASH route by service day for the first three quarters of FY2008.

Table 3.3 – Revenue Hours to In-Service Hours Ratio for DASH Routes For FY2008

	Total	AT1	AT2	AT3	AT4	AT5	AT6	AT7	AT8	AT10	AT3-4
Weekday	1.28	1.32	1.26	1.27	1.34	1.20	1.42	1.24	1.26	1.52	1.39
Saturday	1.34	1.39	1.24	N/A	1.62	1.36	N/A	1.26	1.39	1.39	1.43
Sunday	1.27	1.16	1.18	N/A	N/A	1.23	N/A	N/A	1.39	1.37	1.23

On the average, ATC is providing at least a ratio of 1.27 or 27% layover recover time. Some of this may be due to traffic congestion problems which are chronic in certain areas and corridors. Some review of ATC schedules may be warranted, to update running times so that they are more reflective of actual conditions. With ATC considering significant service expansion in the next six years, it would be prudent to optimize existing service schedules to the extent possible. ATC appears to do significant route interlining for operational efficiency. By continuing this practice, updating running times, and adhering to industry best practices concerning layover/recovery time (within the constraints of driver labor agreements), it may be possible to absorb some of the costs of future service expansion through improved schedule efficiency.

Schedule Adherence

ATC monitors and reports on-time performance based upon supervisor observations of schedule adherence at major timepoints. Figure 9 shows the reported on-time performance for each core DASH route by service day for FY2007 and the first 3 quarters of FY2008.

Table 3.4 – DASH route On-Time Performance Based on Supervisor Observations

	Weekday		Saturday		Sunday	
Route	FY2007	FY2008	FY2007	FY2008	FY2007	FY2008
AT1	N/A	95%	N/A	92%	N/A	95%
AT10	91%	89%	96%	95%	98%	99%
AT2	91%	89%	87%	89%	91%	94%
AT3	93%	93%				
AT3/4	99%	90%	87%	84%	92%	89%
AT4	94%	91%	98%	96%		
AT5	94%	93%	93%	89%	93%	93%
AT6	92%	87%				
AT7	87%	86%	97%	94%		
AT8	94%	93%	92%	93%	94%	94%
Total	92%	91%	92%	91%	93%	94%

The 2007 DASH ridecheck data provides timepoint observations along all the routes for weekday and weekend service. Table 3.5 to Table 3.7 below summarizes the percentage of early, late, and on-time timepoint observations from the ridecheck for Weekday, Saturday and Sunday trips.

Table 3.5 – DASH 2007 Weekday Ridecheck On-Time performance

Route	East or North			West or South		
	# Early	# Late	% OT	# Early	# Late	% OT
AT2	12.2%	22.7%	65.1%	12.9%	29.9%	57.3%
AT3	9.1%	20.5%	70.5%	11.0%	4.4%	84.6%
AT4	9.1%	10.9%	80.0%	9.4%	15.1%	75.5%
AT3/4	7.5%	34.0%	58.5%	--	--	--
AT5	10.4%	13.9%	75.7%	11.5%	20.9%	67.6%
AT6	11.1%	23.5%	65.4%	15.3%	5.6%	79.2%
AT7	9.5%	18.4%	72.2%	8.3%	20.0%	71.7%
AT8	10.6%	19.0%	70.4%	18.1%	8.0%	73.9%
Total	10.5%	19.2%	70.3%	12.7%	18.5%	68.8%

Table 3.6 – DASH 2007 Saturday Ridecheck On-Time performance

Route	East or North			West or South		
	# Early	# Late	% OT	# Early	# Late	% OT
AT2	19.7%	23.7%	56.6%	10.7%	33.5%	55.8%
AT3	--	--	--	--	--	--
AT4	--	--	--	--	--	--
AT3/4	6.0%	19.0%	75.0%	--	--	--
AT5	5.0%	20.8%	74.2%	10.0%	39.8%	50.2%
AT6	--	--	--	--	--	--
AT7	2.4%	43.4%	54.2%	9.5%	9.5%	81.0%
AT8	4.1%	19.5%	76.4%	17.9%	0.9%	81.1%
Total	8.3%	23.8%	67.8%	11.5%	27.2%	61.3%

Table 3.7 – DASH 2007 Sunday Ridecheck On-Time performance

Route	East or North			West or South		
	# Early	# Late	% OT	# Early	# Late	% OT
AT2	6.3%	6.3%	87.4%	28.3%	10.0%	61.7%
AT3	--	--	--	--	--	--
AT4	--	--	--	--	--	--
AT3/4	10.1%	3.8%	86.1%	--	--	--
AT5	25.6%	5.8%	68.6%	11.3%	30.2%	58.5%
AT6	--	--	--	--	--	--
AT7	--	--	--	--	--	--
AT8	9.5%	15.5%	75.0%	28.4%	0.9%	70.7%
Total	12.2%	8.4%	79.3%	23.1%	13.2%	63.7%

The ridecheck data shows that for all timepoints, DASH service was operating on time ranging from 65% of the time on Saturday to 73% of the time on Sundays with

weekday service operating 70% on-time. In contrast to the supervisor observations of schedule adherence, the ridecheck analysis shows early departures from timepoints nearly 12% of the time on weekdays, nearly 10% of the time on Saturdays and 17% of the time on Sundays. The significant number of early departure observations warrants a closer examination of the running time data from the ridecheck to correct this problem.



System/Route level Performance findings:

- The core route ridership is increasing for all service days.
- Routes AT2, AT5, and AT8 are the major contributing routes to overall DASH ridership.
- Route AT8 consistently displays the highest passenger productivity on all service days. It is more productive than Route AT2 on weekdays, even though AT2 has higher total weekday boardings.
- Routes AT2 and AT 5 display passenger productivities exceeding 25 boardings per revenue hour throughout the week.
- Route AT10 serving Potomac Yard is improving in passenger productivity on all days, reaching levels comparable to Route AT2 and AT5.
- Saturday performance on route AT7 is about half of the weekday performance.
- The route AT3/4 loop continues to perform consistently poorly on all service days, averaging 10 boardings per revenue hour or less.
- Saturday AT4 service, although less than a year old, has the worst productivity of any core DASH service, averaging 5 boardings per revenue hour.
- There are currently few instances of standees on DASH routes. These occur mainly on routes AT2 and AT8 and occur in the vicinity of King Street Metro.
- ATC schedules greater than 25% layover recovery for DASH routes. This is somewhat high by normal industry practices.
- Examination of the 2007 ridecheck data indicates that for all timepoints, DASH service operates on-time 65% to 73% of the time. With over 10 percent of trips leaving early.

Section 4 – DASH Expansion Plan

Guiding Principles

The Transit Expansion Plan is predicated on the Transit Concept within the City's Master Transportation Plan. The City's goal is to develop an attractive, integrated network of transit services that will offer a viable alternative to driving for work, shopping, recreation, and other trip needs.

The city wants to enhance the existing DASH bus system by:

- Making significant transit priority investments in three corridors – Duke Street, arterials paralleling I-395 including Van Dorn Street and Beauregard Street, and the U.S. 1 corridor.
- Adding new intermediate crosstown and community shuttle routes to provide transit access to those portions of the community not currently within walking distance of primary transit routes

Based upon existing transit performance, market conditions, and the City's long-term transit goals, the following general service guiding principles have been developed and used in updating the Transit Expansion Plan:

- Strengthen the route network, particularly on weekdays, by improving service frequencies on the system's high performance routes (AT2, AT5, and AT8) to at least 15 minutes in peak periods.
- In keeping with the City's Transit Concept, as developed in the Master Transportation Plan, improve access to those areas currently not within ¼ mile walk access of transit. Improve network connectivity by introducing crosstown services that not only connect the core radial routes but that also connect major activity centers.
- Where high density employment or residential centers are located proximate to Metro Stations or transit centers, consider introducing employment or neighborhood shuttles as an alternative to employing route deviations to serve these activity centers. Streamline core services in conjunction with the introduction of these shuttles.

Hierarchy of service types

The proposed Transit Expansion Plan envisions three tiers of transit service:

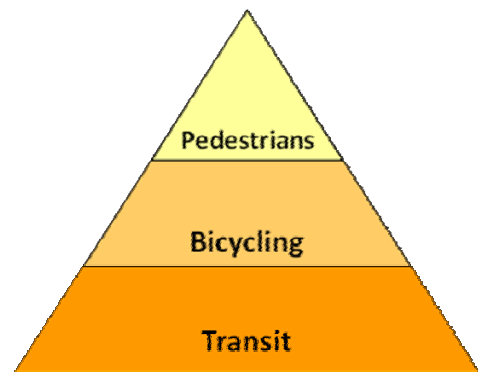
- Core Transit routes: These would be the existing DASH routes which are primarily radially oriented
- Crosstown Routes: These routes should provide linkages between the core route corridors. They should be designed to provide transit access to transit supportive areas not currently within a ¼ mile walk of existing DASH service.

- **Community Circulator routes:** These routes should provide local connections within a community between residential and employment, retail, medical, and other destinations, as well as provide a connection to transit hubs where other DASH bus services (core or crosstown) or regional services (Metrorail, Metrobus) can be accessed.

Sustainable Mobility

As sustainable mobility options such as transit, biking, and walking become more prevalent travel modes, the city core is the area where sustainable travel can be positioned to serve all trips. Key characteristics of a core city area include medium to high residential densities, centralized employment, major retail and entertainment destinations, and corridor-based development. DASH should actively work with planning departments to develop future land use scenarios which function well within a transit, bicycle, and pedestrian environment.

Sustainable Mobility Success Pyramid



Addressing first-mile and last-mile aspects of trip-making is key in promoting transit as an attractive travel choice. When traveling becomes more difficult due to an inability to completely access a trip's origin or destination, automobile travel becomes the more viable option. Well-placed park n' ride lots with passenger information help address this issue, especially for commuters, by providing a convenient way to access transit. Transfer points with amenities such as real-time information also assist passengers in reaching their destinations.

Concentrate on improving travel time and service directness.

Both out-of-vehicle wait time and in-vehicle travel time play important roles in customers' travel choices, and transit travel is often viewed as significantly more inconvenient or slow than driving. Out-of-vehicle wait time is often perceived by passengers as larger than its actual value. Within the DASH network's core area, frequency improvements could help to generate more walk-up trip-making. Real-time passenger information at key stops also helps alleviate the inconvenience of waiting, as passengers can be confident about when their next bus will arrive.

Reducing in-vehicle travel time also contributes to a positive passenger experience. Bus routes should be designed to operate as directly as possible between their origins and destinations. Route deviations, especially towards the middle of routes, add substantial travel time for through-riding passengers. Within the DASH network, routes are most productive when they operate on major thoroughfares instead of

deviating into neighborhoods. For route deviations to be considered worthwhile, they must generate enough ridership to offset the inconvenience to through riders.

Bus stops placed quite closely together can increase the amount of time the bus spends at stops rather than traveling. Spacing stops slightly further apart may increase walk distance for passengers, but improves the travel experience for those on the bus. Industry research shows that at stops where many passengers board the bus, the dwell time is significantly smaller per passenger boarding than at stops where only one or two passengers board.

Provide an enhanced traveling experience.

As time spent traveling makes up a significant portion of many people's days, the quality of that time is important when choosing a travel mode. Comfort, ease of use, attractive surroundings, and safety all contribute to a pleasant travel experience. Some key steps that DASH can take in providing an attractive travel atmosphere include upgraded shelters, passenger information, branding, and increased security measures at problem areas or at night.

The most productive lines and key nodes should be prioritized as far as the quality and quantity of passenger facilities. High-volume stops may include attractive facilities, lighting, full transit schedules, and real-time next-bus information. Facilities and vehicles which are designed to coordinate with one another and stand out on the street help to make transit more visible to customers (e.g. LA Metro's color-coordinated red Rapid buses and orange Local buses).

Expansion Plan Overview

Based upon the previous service guiding principles and service type hierarchy, the following service proposals have been developed to achieve the city's Transit Concept.

Principle #1 - Strengthen Route Network by Improving Core Route Frequencies

- Improve weekday peak service frequency on Route AT8 to 10 minutes. Route AT8 is consistently ATC's most productive route, in terms of passenger productivity. This route connects Van Dorn Metro Station with Landmark Mall, the Shops at Foxchase, Alexandria Commons, King Metro Station, and downtown Alexandria. Route AT8 operates on the Duke Street corridor, one of the three transit priority corridors identified by the City in its Transportation Plan. The route's current success and its earmarking as a transit priority corridor make it an excellent candidate for investment in additional peak-period capacity.

In keeping with the long-term goal of investing in Duke Street as a priority transit corridor, the proposal is to increase weekday peak period headways to every 10 minutes from the existing 15 minutes. As currently operated during

the weekday midday period, it is proposed to add a peak shortline pattern between Landmark Mall and King Street Metro. This shortline pattern would operate every 20 minutes and would be coordinated with the long-line service between Van Dorn Metro, Fairfax and Pendleton, with a resulting 10-minute service frequency between Landmark Mall and King Street Metro Station. Instituting a 10-minute service frequency should generate new riders who will be attracted by being able to walk to the stop and wait for the next bus, instead of needing to plan their trip. Assuming a headway elasticity of 0.5, this improvement will generate an additional 260 weekday boardings.

Improving the peak period headway by adding the shortline will require two additional peak buses.

Concurrent with improvements to peak-period AT8, WMATA Metrobus service in the Duke Street corridor should operate as a limited stop service in Alexandria during the weekday peak period. Metro has already identified this service corridor for evaluation to add “Metro Extra” limited stop service.

- Improve weekday peak service frequency on Route AT2 to 15 minutes. (Note that AT2 and AT5 improvements need to be implemented concurrently due to trunk service concerns.) Route AT2 has the highest daily boardings in the DASH system and the second highest passenger productivity. The proposal is to increase peak service frequency from the current 20 minutes to every 15 minutes. Assuming a headway elasticity of 0.5, this improvement will generate an additional 200 weekday boardings. For schedule coordination along the shared route trunk in Old Town Alexandria, this improvement should occur concurrently with any peak improvements with route AT5

This is estimated to cost an additional three peak buses operating the full route length.

- Improve weekday peak service frequency on Route AT5 to 15 minutes. Route AT5 has the third highest daily boardings in the DASH system and the third highest passenger productivity. The proposal is to increase peak service frequency from the current 30 minutes to every 15 minutes. This is estimated to cost an additional 5 peak buses operating the full route length. The estimate ridership increase due to this frequency change is 150 weekday boardings. For schedule coordination along the shared route trunk in Old Town Alexandria, this improvement should occur concurrently with any peak improvements with route AT2.

This is estimated to cost an additional 5 peak buses operating the full route length.

- Improve weekday peak service frequency on Route AT10 to 15 minutes. This route's ridership and productivity has been improving over the past 2 years. Improving peak frequency to 15 minutes will require 2 additional buses. It is estimated that weekday service will generate an additional 140 weekday boardings.

This change will add a total of two peak buses.

- Improve weekday peak service frequency on Routes AT1 to 15 minutes. Because the South Van Dorn St./Beauregard Street is a strong ridership area, as well as one of the designated transit priority corridors in the City's Master Transportation plan, it is proposed to increase peak period frequency on Route AT1 in the weekday peak periods to every 15 minutes.

This change will require four additional peak buses.

- Improve weekday peak service frequency on Routes AT3 and AT4 to 15 minutes. Based upon current peak ridership, it is estimated that this change will generate an additional 150-175 week day boardings for each route.

This change will require two additional peak buses.

- Improve weekday peak service frequency on Routes AT6 to every 15 minutes. Peak service will be improved to every 15 minutes to improve the attractiveness of these services for commute trips. These changes will add a total of 3 peak buses. It is estimated that this frequency increase will generate an additional 100 weekday boardings.

These changes will add a total of three peak buses.

- Improve weekday peak service frequency on Route AT7 to 15 minutes between Eisenhower Metro Station and Landmark Mall. Route AT7 currently averages over 1,000 boardings per weekday. Improving peak service to every 15 minutes will require 3 additional buses. It is estimated that this frequency increase will generate an additional 150 weekday boardings.

These changes will add a total of two peak buses.

Table 4.1– Summary of Principle #1 (Improve Service Frequency) Changes

PRINCIPLE	SERVICE	SERVICE DAY	PEAK FREQUENCY	ADDITIONAL PEAK BUSES	ESTIMATED ANNUAL HOURS	ESTIMATED ANNUAL MILES	ESTIMATED ANNUAL COST (2009 DOLLARS)	DAILY BOARDINGS	ESTIMATED ANNUAL RIDERSHIP
1 - IMPROVE SERVICE FREQUENCIES	Improve AT8 Peak Frequency	Weekday	10	2	3,060	25,092	\$195,000	200	51,000
	Improve AT2 Peak Frequency	Weekday	15	3	4,590	30,906	\$276,000	200	51,000
	Improve AT5 Peak Frequency	Weekday	15	3	4,590	70,380	\$375,000	150	38,250
	Improve AT10 Peak Frequency	Weekday	15	2	3,060	22,644	\$189,000	140	35,700
	Improve AT1 Peak Frequency	Weekday	15	4	6,120	24,174	\$325,000	280	71,400
	Improve AT3 Peak Frequency	Weekday	15	1	1,530	24,174	\$127,000	140	35,700
	Improve AT4 Peak Frequency	Weekday	15	1	1,530	26,010	\$132,000	140	35,700
	Improve AT6 Peak Frequency	Weekday	15	3	4,590	89,964	\$424,000	200	51,000
	Improve AT7 Peak Frequency	Weekday	15	3	4,590	70,992	\$376,000	150	38,250
TOTAL	PRINCIPLE 1			22	33,660	384,336	\$2,419,000	1600	408,000

Principle #2—Introduce Crosstown Routes Linking Radial Routes & Activity Generators

- Introduce Potomac Yard Crosstown/Van Dorn Plaza Crosstown. In keeping with the long term principles of increasing service coverage by adding new crosstown services, this proposed route will operate between the vicinity of Van Dorn Plaza in the southwest portion of the DASH network to Potomac Yard in the northeast corner of the network. Justifications for this new service are:
 - It will provide a circumferential crosstown connector linking all the other main DASH routes across the outer portion of the network where route spacing is greatest. Lack of crosstown service was a network deficiency identified in the 2004 COA.
 - This route will provide a one-seat ride between the high-density residential neighborhoods in both south Van Dorn Street and Alexandria and the Cameron Station office complex, the Shops of Foxchase, Potomac Yard Shopping Center.
 - It will also provide a one-seat ride between northeast Alexandria and Alexandria Hospital.
 - Because this circumferential route is linking routes at the outer edge of the network, it is relatively long (10.0 miles). Because ample alternatives services are available to both the Van Dorn Metro Station and Landmark Mall and because start-up resources are constrained in 2009, it was decided to terminate this new service in the high-density neighborhoods near Van Dorn Plaza rather than to extend coverage to Van Dorn Metro Station or Landmark Mall.

The proposed route alignment will utilize Whiting Street, Stevenson Avenue, Van Dorn Street, Edsall Road, Reynolds Street, Duke Street, Jordan Street, Howard Street, Seminary Road, Kenmore Avenue, Van Dorn Street, King Street, Kenwood Avenue, Valley Drive, Martha Custis Drive, Glebe Road, Executive Avenue, Mt. Vernon Avenue, and Reed Avenue. The one way route length is approximately 10.0 miles. The route should be able to perform a round-trip cycle in 120 minutes.

It is initially proposed to operate this route on weekdays only, for approximately a 12 hour service span with 60-minute headways. Based upon evaluation of existing ridership on similar route segments and taking into consideration the initial abbreviated schedule it is estimated that this route will generate approximately 400 boardings per weekday.

This will increase the peak bus requirement by two buses.

- Improve Potomac Yard Crosstown/Van Dorn Plaza Crosstown. Weekday frequencies will be improved to every 30 minutes in the peak. Additionally Saturday and Sunday service will be added at 60 minute frequencies.

These changes will add two additional peak buses.

- Introduce Southern Towers-Potomac Yard Crosstown. This route is being proposed to connect the Southern Towers Office complex with the Potomac Yard Complex. It would serve Mark Center, Southern Towers, the NVCC campus, the Health Department, Bradlee Shopping center and Potomac Yard.

The benefits of implementing this new route would be as follows:

- It will provide a direct link between the residential areas in northeast Alexandria and Northern Virginia Community College;
- It will provide a one-seat trip between the northeast Alexandria neighborhoods and the employment centers (e.g., the Mark Center) west of I-395.
- It will provide a direct link connecting both the high-density residential areas in northwest Alexandria west of I-395 and the Southern Towers Apartments with the Potomac Yard Shopping Center.

The proposed route alignment uses Mark Center Drive, Seminary Road, Beauregard Street, King Street, Quaker Lane, Fern Street, Kenwood Avenue, Valley Drive, and Glebe Road. This route passes through on or by numerous areas with at least medium population densities. Using ridership from existing or similar route segments, it is estimated that this new crosstown route will generate 400-500 weekday boardings.

The route is 5.8 miles long one-way, and should easily cycle in 90 minutes, allowing for 30-minute service frequency.

This change will require three buses.

- Introduce Van Dorn Metro-Shirlington Crosstown. This new crosstown route is intended to provide a north-south crosstown connection between the Van Dorn Metro station and Shirlington Station, Arlington County Transit's new transit hub located near the I-395/Shirlington Road interchange. This route will link Van Dorn Metro Station, Van Dorn Shopping Center, Cameron Station, Shops at Foxchase, Alexandria Commons, Bradlee Shopping Center, and Shirlington Station.

Benefits of this route would be as follows:

- It provides a regional connection between DASH bus services, Metrobus and Arlington Transit services at Shirlington Station and Fairfax Connector services at Van Dorn Street Metrorail station.
- It will augment service in the Duke Street corridor.

The proposed route alignment uses Eisenhower Avenue, Van Dorn Street, Picket Street, Duke Street, Yale Drive, Jenney's Lane, Quaker Lane, and I-395 ramps to Shirlington Station. This alignment has a one-way length of 6.6 miles.

Using existing ridership levels on existing and similar route segments, it is estimated that weekday service will generate 800 to 900 weekday boardings.

This route should be able to complete a round-trip cycle in 90 minutes, allowing for 30-minute weekday headways.

It will require three additional peak buses.

- Introduce Lincolnia to Braddock Metro Crosstown. This proposed route will provide a direct link between Braddock Metro Station and the Braddock Road corridor with Alexandria Hospital and Bradlee Shopping center as well as providing new service coverage to the residential areas between Duke Street and Seminary Road where the existing route spacing is wide.

Benefits of this service will be:

- It will provide a crosstown connection between the Lincolnia neighborhood, served by Routes AT1 and AT2 and the Braddock Road Metro Station, as transfer opportunities with routes AT3, AT4, AT3/4 loop, AT 6, and AT10.
- It provides new service coverage to higher density residential areas on Taney Avenue
- It provides a one-seat ride between the Alexandria Hospital and both the Lincolnia neighborhood and Braddock Road Metro Station.

In an eastbound direction, the proposed route will start in the vicinity of Landmark Plaza and will utilize Lincolnia Road, N. Chambliss Street, N. Morgan Street, Beauregard Street, N. Sanger Avenue, Van Dorn Street, Taney Avenue, Jordan Street, Howard Street, and Braddock Road to the Braddock Road Metro Station. The route is approximately 7.3 miles long one-way. This route will encounter existing traffic congestion problems and accompanying slow travel speeds both at the western and eastern ends of the route. However, it should reliably cycle within a two-hour round trip cycle.

Using existing segment-level ridership on currently served streets combined with ridership from segments of similar development density, it is estimated that this new crosstown route will generate 325 to 450 daily boardings on weekdays.

Initially, it is envisioned that the route will operate 30-minute weekday headways, *requiring four additional peak buses*. On Saturdays and Sundays, it is proposed to operate every 45 minutes.

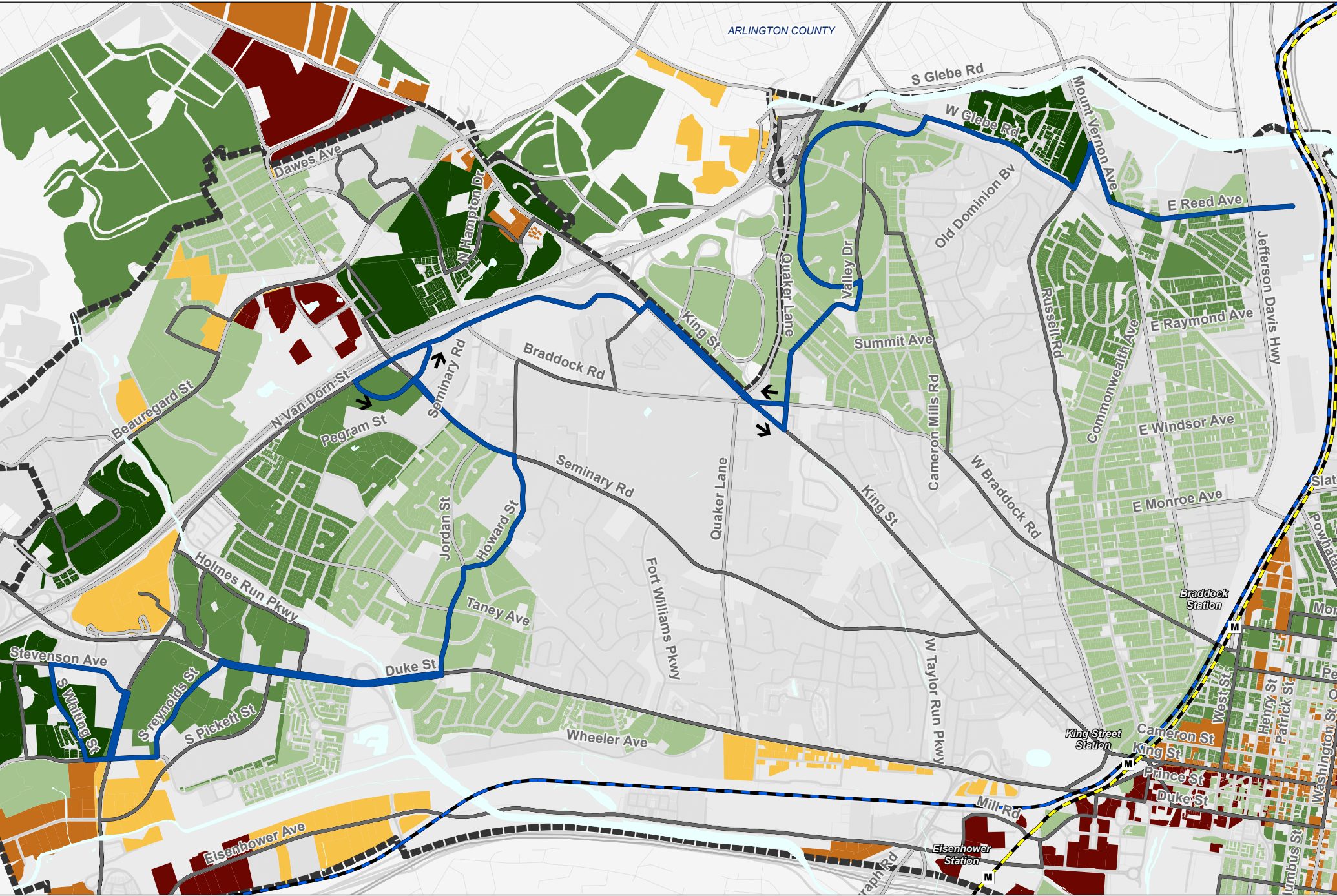
- Improve peak frequencies on the ATC Crosstown route to every 15 minutes.

The associated vehicle requirements are as follows:

- *Van Dorn Road/Potomac Yard: Four additional buses*
- *Southern Towers/Potomac Yard: Three buses*
- *Van Dorn Metro/Shirlington: Three buses*
-

Table 4.2 – Summary of Principle #2 (Add Crosstown Routes) Changes

PRINCIPLE	SERVICE	SERVICE DAY	PEAK FREQUENCY	ADDITIONAL PEAK BUSES	ESTIMATED ANNUAL HOURS	ESTIMATED ANNUAL MILES	ESTIMATED ANNUAL COST (2009 DOLLARS)	DAILY BOARDINGS	ESTIMATED ANNUAL RIDERSHIP
2 - INTRODUCE CROSSTOWN ROUTES	Add Van Dorn Plaza/Potomac Yard Crosstown - Phase 1	Weekday	60	2	4,080	40,800	\$279,000	400	102,000
	Improve Van Dorn Plaza/Potomac Yard - Phase 2	Weekday	30	2	8,160	81,600	\$557,000	395	100,725
	Improve Van Dorn Plaza/Potomac Yard - Phase 2	Saturday	60	0	3,060	13,200	\$165,000	200	11,000
	Improve Van Dorn Plaza/Potomac Yard - Phase 2	Sunday	60	0	2,040	11,000	\$116,000	100	5,500
	Add Southern Towers/Potomac Yard Crosstown	Weekday	30	3	7,650	53,244	\$464,000	450	114,750
	Add Southern Towers/Potomac Yard Crosstown	Saturday	45	0	1,430	10,182	\$88,000	225	12,994
	Add Southern Towers/Potomac Yard Crosstown	Sunday	45	0	1,320	8,485	\$79,000	210	11,550
	Add Van Dorn/Shirlington Crosstown	Weekday	30	3	7,650	60,588	\$482,000	800	204,000
	Add Van Dorn/Shirlington Crosstown	Saturday	45	0	1,320	11,587	\$86,000	400	22,000
	Add Van Dorn/Shirlington Crosstown	Sunday	45	0	1,320	9,656	\$82,000	200	11,000
	Add Braddock Metro/Lincolnia Crosstown	Weekday	30	4	9,180	67,014	\$564,000	395	100,725
	Add Braddock Metro/Lincolnia Crosstown	Saturday	45	0	1,430	12,816	\$94,000	200	11,000
	Add Braddock Metro/Lincolnia Crosstown	Sunday	45	0	1,320	10,680	\$84,000	100	5,500
	Improve Van Dorn Plaza/Potomac Peak Frequency	Weekday	15	4	6,120	91,800	\$495,000	800	204,000
	Improve Southern Towers/Potomac Yd. Peak Frequency	Weekday	15	3	4,590	35,496	\$287,000	125	31,875
	Improve Van Dorn/Shirlington Crosstown	Weekday	15	3	4,590	44,676	\$310,000	125	31,875
TOTAL	PRINCIPLE 2			24	65,260	562,824	\$4,232,000	5125	980,494



Potomac Yard to Van Dorn Plaza

Weekday

Peak Freq.	Additional Peak Buses	Annual Hours	Annual Miles	Annual Cost	Annual Ridership
60	2	4,080	40,800	\$293k	102,000

Persons

- More Than 40
- 20 - 40
- 10 - 20
- Fewer Than 10

Year 2015

More Than 40

20 - 40

10 - 20

Fewer Than 10

Employment

-
-
-
-

Featured Route

DASH Network

Metro Bus Network

Date Updated: June 2008

Metro Station

Metro Yellow Line

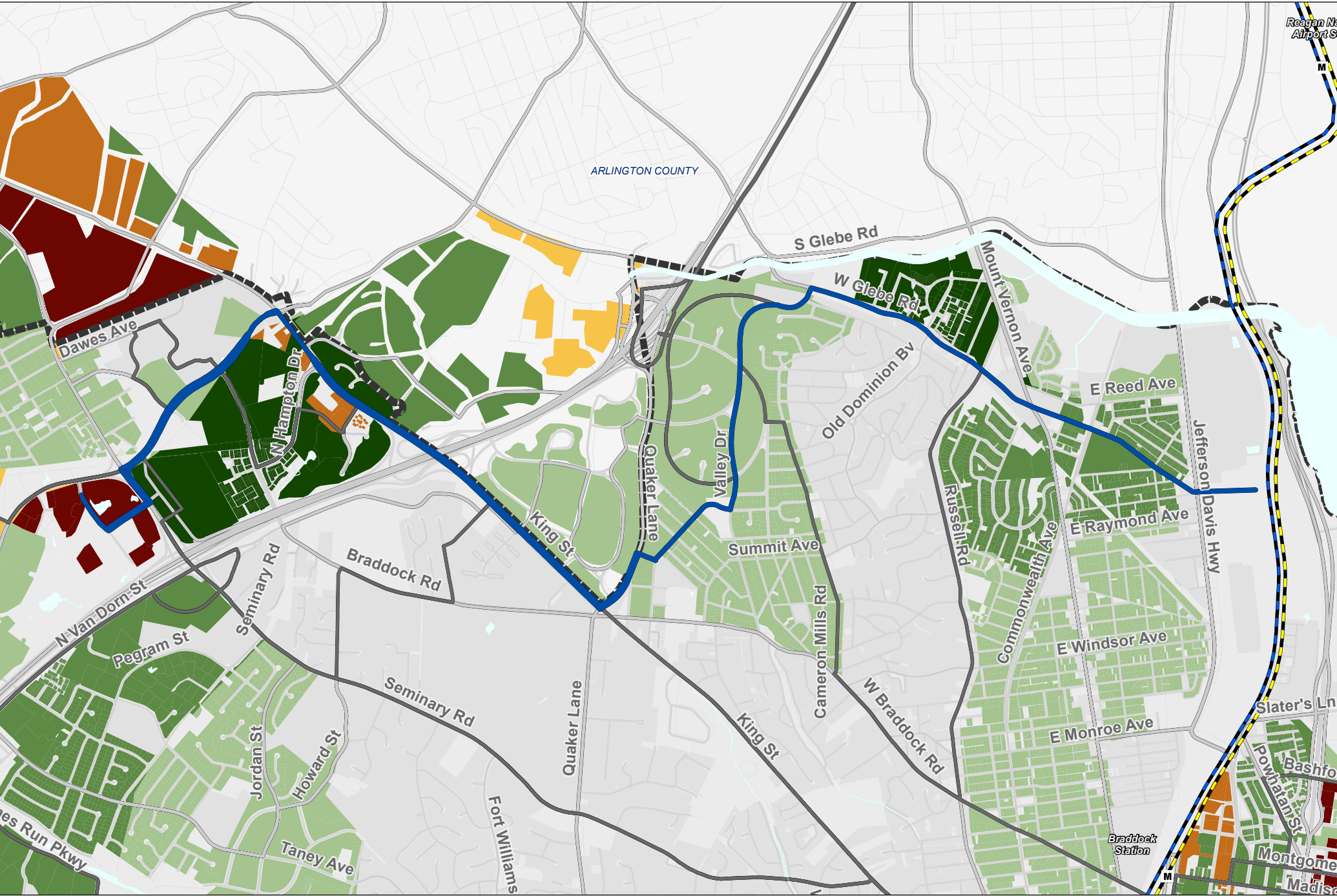
Metro Blue Line

Data Sources: DASH

0 0.25 0.5

Mile

TMD



South Towers to Potomac Yard



	Peak Freq.	Additional Peak Buses	Annual Hours	Annual Miles	Annual Cost	Annual Ridership
Weekday	30	3	7,650	53,244	\$537k	114,750
Saturday	45	0	1,430	10,182	\$101k	12,994
Sunday	45	0	1,320	8,485	\$91k	11,550

Persons	Year 2015	Employment
	More Than 40	
	20 - 40	
	10 - 20	
	Fewer Than 10	

Featured Route

DASH Network

Metro Bus Network

Metro Station

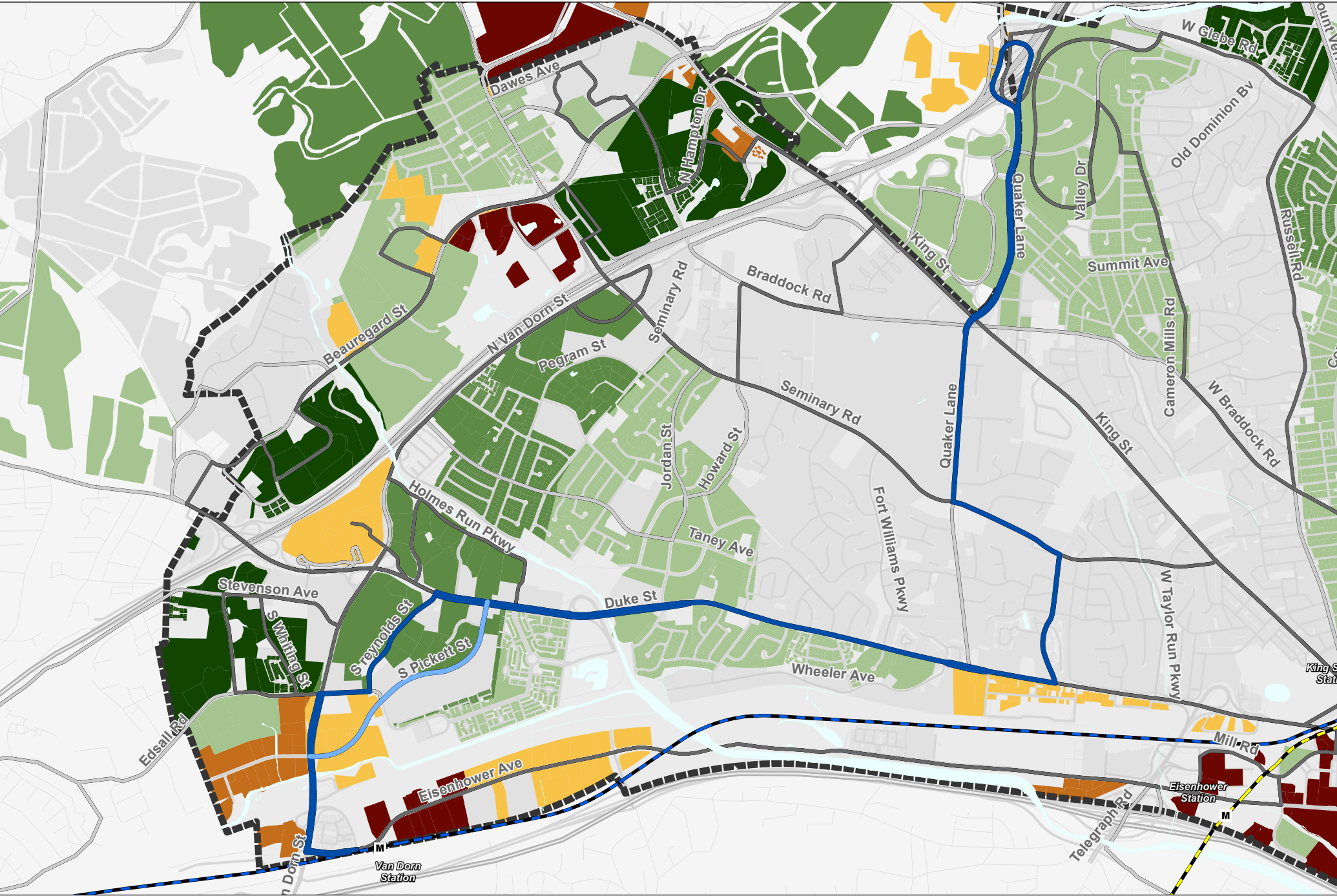
Metro Yellow Line

Metro Blue Line

Date Updated: June 2008

Date Sources: DASH

0 0.25 0.5 Mile



Van Dorn to Shirlington

	Peak Freq.	Additional Peak Buses	Annual Hours	Annual Miles	Annual Cost	Annual Ridership
Weekday	30	3	7,650	60,588	\$586k	204,000
Saturday	45	0	1,320	11,587	\$105k	22,000
Sunday	45	0	1,320	9,656	\$99k	11,000

Persons

- More Than 40
- 20 - 40
- 10 - 20
- Fewer Than 10

Year 2015

- More Than 40
- 20 - 40
- 10 - 20
- Fewer Than 10

Employment

- More Than 40
- 20 - 40
- 10 - 20
- Fewer Than 10

Legend

- Featured Route
- DASH Network
- Metro Bus Network
- Metro Station
- Metro Yellow Line
- Metro Blue Line

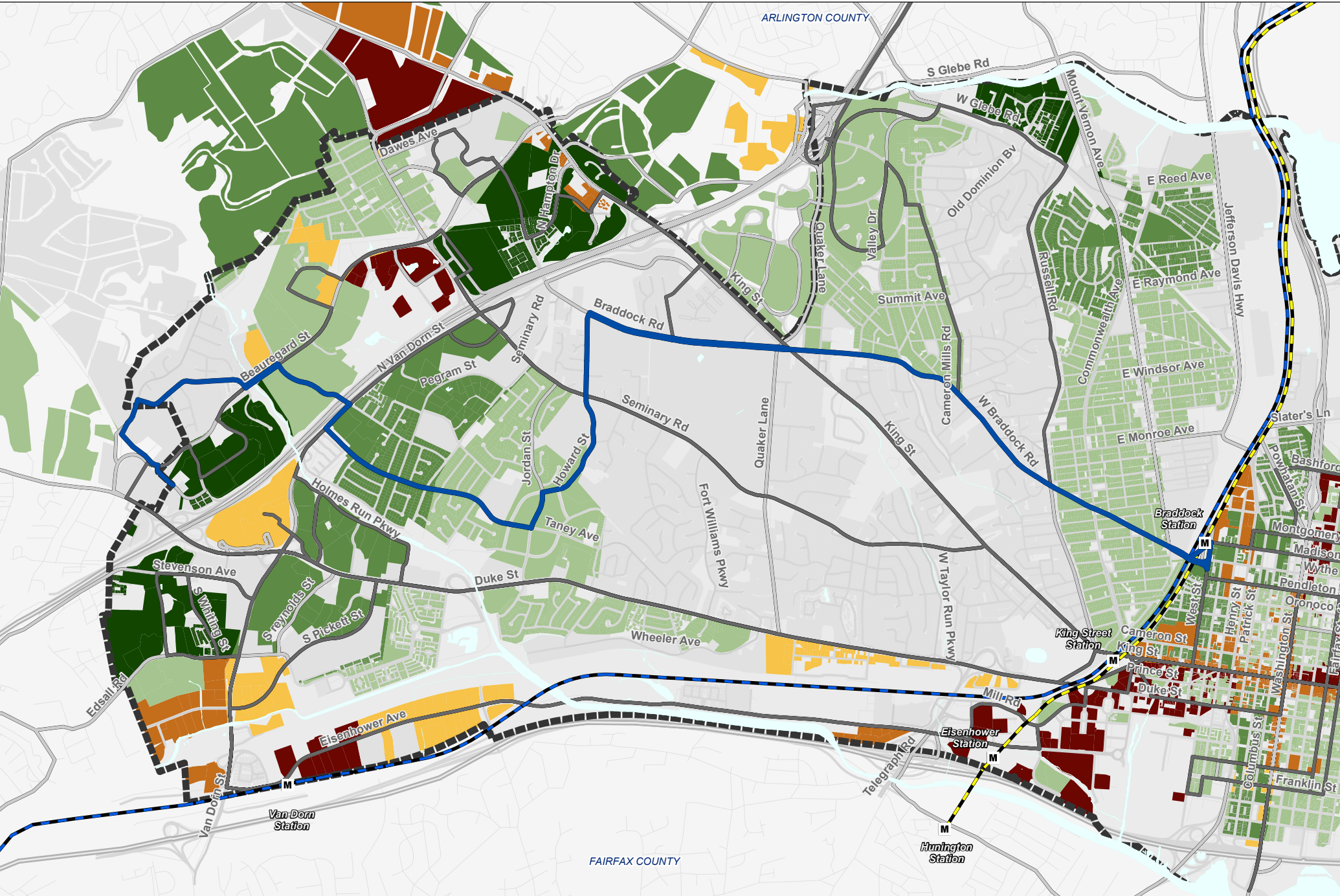
Date Updated: June 2008

Data Sources: DASH

0 0.25 0.5 Mile

TMD





Braddock to Lincolnia



	Peak Freq.	Additional Peak Buses	Annual Hours	Annual Miles	Annual Cost	Annual Ridership
Weekday	30	4	9,180	67,014	\$686k	100,725
Saturday	45	0	1,248	12,117	\$103k	10,400
Sunday	45	0	1,392	13,515	\$115k	5,800

Persons	Year 2015	Employment
	More Than 40	
	20 - 40	
	10 - 20	
	Fewer Than 10	

Featured Route
 DASH Network
 Metro Yellow Line
 Metro Blue Line

Metro Station
 Metro Yellow Line
 Metro Blue Line

Date Updated: June 2008
 Data Sources: DASH

Principle # 3 — Introduce community-based shuttles in areas of high employment density close to Metro Stations or Transit Centers

- Assume Operation of the King Street Trolley. In conjunction with the initiation of Water Taxi service between National Harbor and Old Town Alexandria, King Street Trolley service was initiated in April 2008. This service is currently operated by a private contractor (Gray Line) and managed by the City using some funding from the former Dashabout service.

It is ATC's intent to assume direct operation of the King Street Trolley in 2010. Assuming that ATC maintains the current schedule, which meets the National Harbor water taxis every 30 minutes every day between 10 am and 10 pm., three buses can maintain a 15-minute schedule which will meet both arriving and departing water taxis. Because the water taxis seat nearly 100 passengers and the trolleys seat 32 passengers, some provision will need to be made for potential overcapacity situations every 30 minutes, particularly separating from Old Town Alexandria. This could be handled by having a standby bus to be used as needed.

- Introduce Old Town Circulator. This proposed circulator route is intended to provide circulation throughout Old Town Alexandria. It would be oriented to tourists and conventioners attending functions at the National Harbor Convention Center. It would work in conjunction with the King Street Trolley and the National Harbor Water Taxi service.

The benefits of this proposed service are:

- It will connect the main DASH corridors on Duke Street and Pendleton Street in Old Town, as well as provide direct connections to the King Street and Braddock Road Metro Stations
- It will provide a one-seat ride connecting most of Old Town Alexandria, from West Street to Fairfax Street and from Bashford Lane to Franklin Street
- By operating frequent service on this route to perform circulation in Old Town, ATC will have the opportunity to shorten and streamline its core routes, resulting in operational savings.

Leaving King Street Metro Station, the proposed route (clockwise would be use King Street, West Street, Madison Street, Alfred Street, Montgomery Street, Powhattan Street, Bashford, Pitt Street, 2nd Street, Fairfax Street, Prince Street, Royal Street, Franklin Street, Jefferson St., Payne St., Gibbon St., Henry St., Duke St., and Dangerfield Rd. back to King St. This loop is 5.4 miles long. Assuming slow speeds in Old Town, This route could cycle in 37.5 minutes,

allowing for 15 minute service in both the clockwise and counterclockwise directions, with buses alternating between clockwise and counterclockwise trips either at King Street Station or at King St./Royal St.

These changes will add a total of five peak buses. These can be trolley-style coaches.

The City may wish to combine the King Street Trolley and Old Town Circulator and develop a streetcar network for Old Town. This report includes a streetcar section located in Appendix B.

- Introduce Landmark Mall to South Van Dorn Circulator. This Circulator route is intended to link the Van Dorn Metro Station with high density population and employment centers on both sides of Van Dorn Street north to Holmes Run Parkway. The route would serve Van Dorn Shopping Center, van Dorn Plaza, Landmark Mall, and the Trade Center.

The value of introducing this route would be:

- It would provide a collection/distribution between ATC's Landmark Mall hub and the Van Dorn Street Metrorail Station. This area has medium to high density residential development north of Edsall Street on both sides of Van Dorn Street as well as medium density commercial development south of Edsall Street.
- By introducing this service to provide collection/distribution on south Van Dorn Street, ATC would have an opportunity to either streamline/or possibly truncate its core routes in this area, there by saving resources. Streamlining services in the south Van Dorn corridor would be consistent with the City's vision for a Transit Priority corridor in the South Van Dorn-Beauregard Street area.

The route alignment would utilize Eisenhower Avenue, Van Dorn Street, Edsall Road, Yoakum parkway, Stevenson Avenue, Land mark Mall Roadways, Van Dorn Street, Holmes Run Parkway, Paxton Street, Duke Street, Reynolds Street, and Edsall Road back to Van Dorn Street. This would operate as a bidirectional loop. The round trip distance is approximately 5.2 miles.

Using ridership from existing or similar route segments, it is estimated that this new crosstown route will generate 500 to 600 weekday boardings.

A 15-minute peak service could be maintained, alternating clockwise and counterclockwise trips, *with four buses.*

- Introduce Cameron Station Peak-Period Circulator. This proposed route is envisioned as a weekday peak-period community shuttle linking the residential neighborhoods along Cameron Station Boulevard and South Pickett Street with the Van Dorn Metro Station. This service will operate from Van Dorn Metro Station (AM route) by way of Eisenhower Avenue, South Van Dorn Street, South Pickett Street, Cameron Station Boulevard, Duke Street, South Pickett Street, South Van Dorn Street, and Eisenhower Avenue. In the PM, the loop would be reversed to operate via South Pickett, Duke, and Cameron Station.

The benefit of this new service will be:

- It will provide additional peak-period commute service linking high density residential neighborhoods at Cameron Station and on South Pickett Street with the Van Dorn Street Station.
- It will provide additional peak-period reverse-commute service linking the Van Dorn Street Station with Van Dorn Shopping Center and the Trade Center.

The round trip route length is approximately 3.8 miles. To the extent possible, these trips should be offset from Route AT7 trips to maximize service frequency for the residential neighborhoods.

Based upon demonstrated ridership generation on routes AT7 and AT8, it is estimated that this shuttle will generate 120 to 140 daily boardings. With future plans to add another circulator in this area, consideration should be given to possible truncation of route AT7 at Van Dorn Metro.

Even with the relatively fast operating speeds on the streets in this area, it will *require two peak buses* to maintain a 15-minute peak headway for this service.

- Introduce Potomac Yard Circulator. This route will connect both the King and Braddock Metro station to the Potomac Yard retail/residential area. The proposed alignment will use King Street, Mt. Vernon Avenue, Monroe Avenue, and U.S. 1, and Reed Avenue.

The benefits of this circulator are:

- It will provide a direct link between both the King Street and Braddock Road Stations and their connecting rail and bus services and the Potomac Yard complex.
- The U.S. 1 alignment will allow for more direct service to new phases of the development south of the Retail Center as they come online.

It is estimated that this new crosstown route will generate 225-300 weekday boardings.

This route is approximately 2.3 mile s long. It should easily cycle within 45 minutes which will permit 15-minute service frequencies on weekdays *with 3 vehicles*.

Introduce Eisenhower East Circulator: In keeping with ATC's goal of introducing intermediate services and community shuttles, this route would be introduced to serve the high-density employment centers east of the Eisenhower Metro Station. This area includes the U.S Patent Office, Federal Courthouse, and the Meridian and Carlyle Towers apartment complexes.

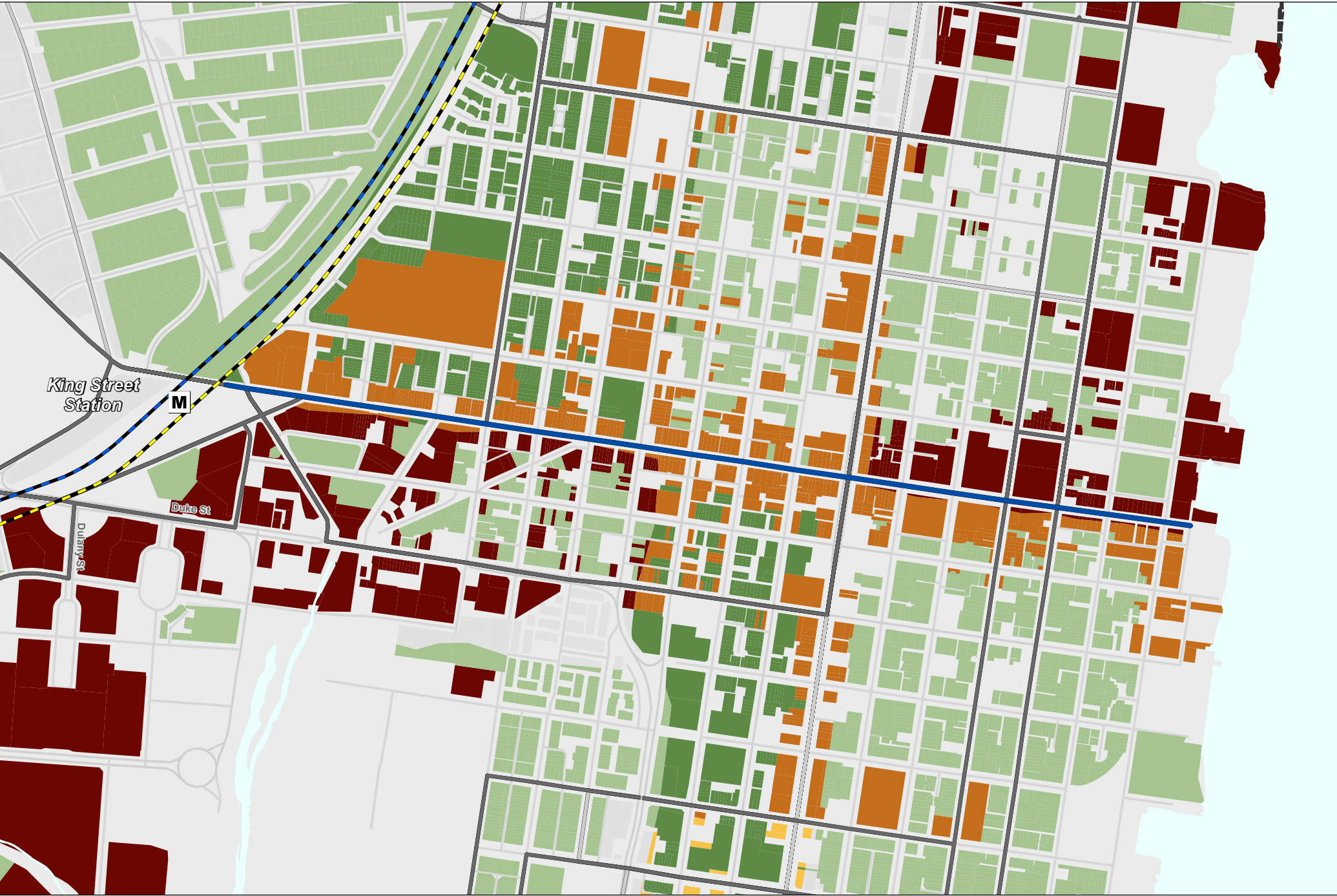
The benefits of this service will be:

- It will provide very frequent connecting service between Blue and Yellow Line Metrorail service at King Street Station and numerous Federal office buildings including the U.S District Courthouse, the U.S. Patent and Trademark Office (PTO), the U.S Attorney for the Eastern District of Virginia, and several defense related Federal facilities on Stovall Street.
- It will also provide a link between the Carlyle Towers and Meridian apartments and the various Metrorail, Metrobus, and DASH bus services at King Street station.

The proposed route alignment (clockwise-direction) from King Street Station will utilize Diagonal Road, Duke Street, John Carlyle Street, Jamieson Avenue, Holland lane, Eisenhower Avenue, Stovall Street, Mill Road, Jamieson Avenue, Ballenger Avenue, Dulaney Street, Duke Street, Diagonal Road back to King Street Station. The complete one-way loop is approximately 2.1 miles long. This route should cycle in 20 minutes allowing for peak 10-minute frequencies in both directions *with a total of 5 buses*.

Table 4.3 – Summary of Principle #3 (Add Community-Based Shuttles) Changes

PRINCIPLE	SERVICE	SERVICE DAY	PEAK FREQUENCY	ADDITIONAL PEAK BUSES	ESTIMATED ANNUAL HOURS	ESTIMATED ANNUAL MILES	ESTIMATED ANNUAL COST (2009 DOLLARS)	DAILY BOARDINGS	ESTIMATED ANNUAL RIDERSHIP
3 - ADD COMMUNITY-BASED SHUTTLES	Add King Street Trolley	Weekday	15	3	7,650	26,928	\$398,000	400	102,000
	Add King Street Trolley	Saturday	15	0	1,980	5,808	\$100,000	400	20,800
	Add King Street Trolley	Sunday	15	0	1,980	5,808	\$100,000	400	23,200
	Add Old Town Circulator	Weekday	15	5	10,710	82,620	\$669,000	750	191,250
	Add Old Town Circulator	Saturday	30	0	1,980	17,820	\$131,000	400	22,000
	Add Old Town Circulator	Sunday	30	0	1,320	10,692	\$84,000	365	20,075
	Regular Route Savings with Old Town Circulator	Weekday	--	(2)	(3,060)	(36,720)	(\$224,000)	365	--
	Add Landmark.S. Van Dorn Circulator	Weekday	15	4	9,180	95,472	\$636,000	550	140,250
	Add Landmark.S. Van Dorn Circulator	Saturday	30	0	1,320	13,728	\$92,000	275	15,125
	Add Landmark.S. Van Dorn Circulator	Sunday	45	0	660	7,608	\$48,000	200	11,000
	Regular Route Savings from S. Van Dorn Circulator	Weekday	--	(2)	(3,060)	(36,720)	(\$224,000)	200	--
	Add Eisenhower East Circulator	Weekday	10	4	9,180	57,834	\$541,000	550	140,250
	Add Eisenhower East Circulator	Saturday	30	0	660	2,772	\$36,000	275	15,125
	Add Eisenhower East Circulator	Sunday	30	0	660	2,310	\$35,000	200	11,000
	Regular Route Savings from Eisenhower East Circulator	Weekday	30	(1)	(1,530)	(18,360)	(\$112,000)	200	11,000
	Add Potomac Yard Circulator	Weekday	15	3	7,650	42,228	\$436,000	260	66,300
	Add Potomac Yard Circulator	Saturday	60	0	660	3,036	\$37,000	130	7,150
	Add Potomac Yard Circulator	Sunday	60	0	660	2,530	\$35,000	130	7,150
	Add Cameron Staion Peak Circulator	Weekday	15	2	3,060	46,512	\$249,000	130	33,150
TOTAL	PRINCIPLE 3			16	51,660	331,906	\$3,067,000	6,180	836,825



King Street Trolley

	Peak Freq.	Additional Peak Buses	Annual Hours	Annual Miles	Annual Cost	Annual Ridership	Persons	Year 2015	Employment
Weekday	15	3	7,650	26,928	\$418k	102,000	More Than 40		
Saturday	15	0	1,980	5,808	\$105k	20,800	20 - 40		
Sunday	15	0	1,980	5,808	\$105k	23,200	10 - 20		
							Fewer Than 10		

Featured Route

DASH Network

Metro Bus Network

Metro Station

Metro Yellow Line

Metro Blue Line

Date Updated: June 2008

Data Sources: DASH

0

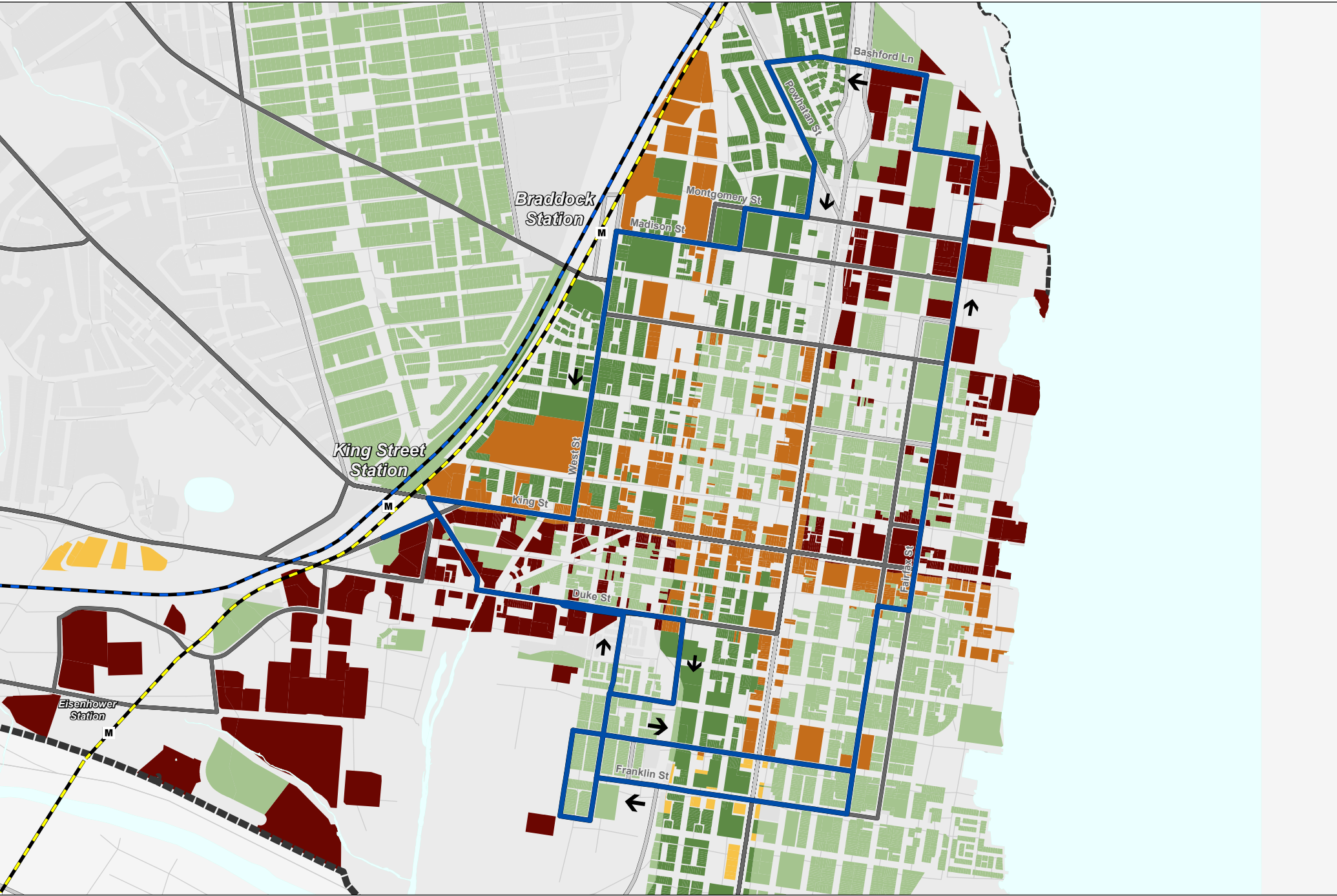
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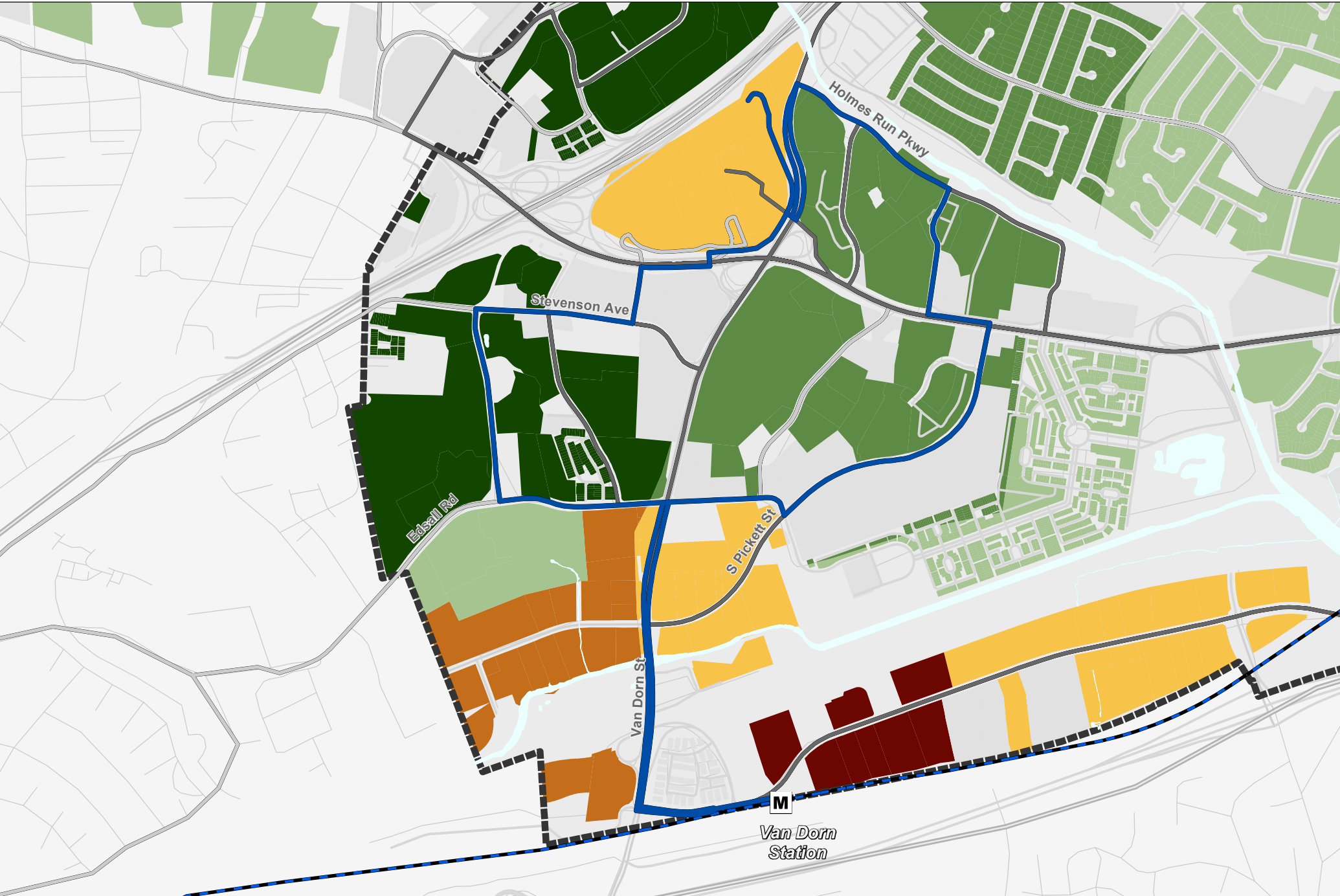
Mile

TMD





Old Town Circulator							Persons		Year 2015	Employment		Date Updated: June 2008		Data Sources: DASH	
	Peak Freq.	Additional Peak Buses	Annual Hours	Annual Miles	Annual Cost	Annual Ridership									
Weekday	15	5	10,710	82,620	\$775k	191,250	Dark Green	More Than 40	Dark Red	Featured Route	Metro Station				
Saturday	30	0	1,980	17,820	\$151k	22,000	Medium Green	20 - 40	Orange	DASH Network	Metro Yellow Line				
Sunday	30	0	1,320	10,692	\$97k	20,075	Light Green	10 - 20	Yellow	Metro Bus Network	Metro Blue Line				
							Grey	Fewer Than 10	Grey						



**Landmark to
S. Van Dorn Circ.**

	Peak Freq.	Additional Peak Buses	Annual Hours	Annual Miles	Annual Cost	Annual Ridership
Weekday	15	4	9,180	95,472	\$773k	140,250
Saturday	30	0	1,320	13,728	\$112k	15,125
Sunday	45	0	660	7,608	\$58k	11,000



Persons

More Than 40

20 - 40

10 - 20

Fewer Than 10

Year 2015

More Than 40

20 - 40

10 - 20

Fewer Than 10

Employment

Featured Route

DASH Network

Metro Bus Network

Date Updated: June 2008

M Metro Station

Metro Yellow Line

Metro Blue Line

Data Sources: DASH

0 0.1 0.2 Mile



Potomac Yard Circulator

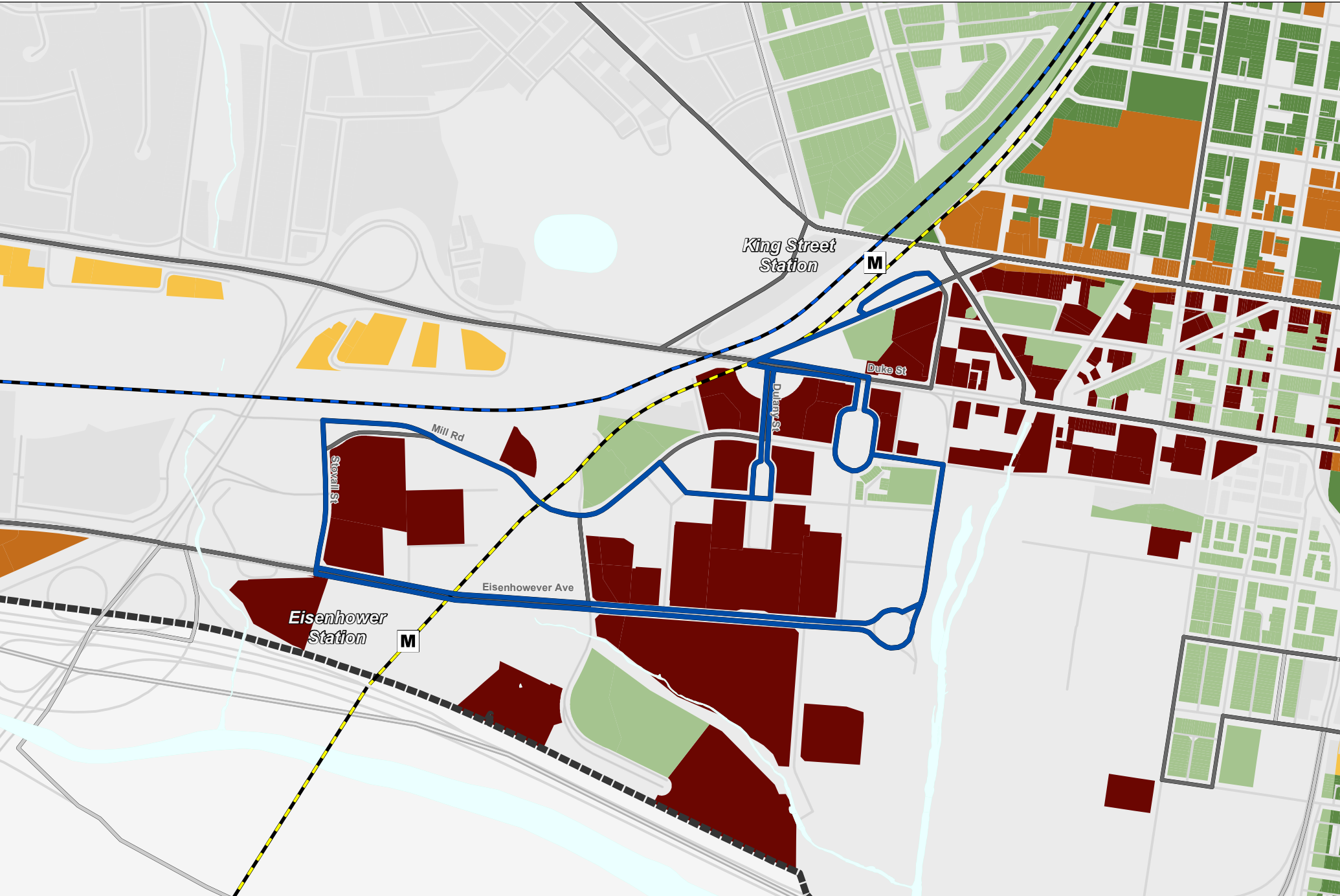


	Peak Freq.	Additional Peak Buses	Annual Hours	Annual Miles	Annual Cost	Annual Ridership	Persons	Year 2015	Employment
Weekday	15	3	7,650	42,228	\$557k	66,300	More Than 40		
Saturday	60	0	660	3,036	\$47k	7,150	20 - 40		
Sunday	60	0	660	2,530	\$45k	7,150	10 - 20		
							Fewer Than 10		

Featured Route
 DASH Network
 Metro Bus Network

Metro Station
 Metro Yellow Line
 Metro Blue Line

Date Updated: June 2008
 Date Sources: DASH



Eisenhower East Circulator



	Peak Freq.	Additional Peak Buses	Annual Hours	Annual Miles	Annual Cost	Annual Ridership
Weekday	10	4	9,180	57,834	\$725k	140,250
Saturday	30	0	660	2,772	\$48k	15,125
Sunday	30	0	660	2,310	\$46k	11,000

Persons

More Than 40

20 - 40

10 - 20

Fewer Than 10

Year 2015

More Than 40

20 - 40

10 - 20

Fewer Than 10

Employment

Featured Route

DASH Network

Metro Bus Network

M

Metro Station

Metro Yellow Line

Metro Blue Line

Date Updated: June 2008

Date Sources: DASH

0

0.1

0.2

Mile

TMD

Prioritizing Transit Expansion Plan Proposals

Tables 4.4 to Table 4.6 assign the Transit Expansion Plan proposals into three priority categories (1,2, and 3) for implementation, as well as showing the net impacts to peak buses, vehicle hours, vehicle miles, operating costs (in 2009 dollars), and ridership (daily and annual). Table 4.7 illustrates the grand total for all implementations. To the extent possible, the implementation prioritization has followed the Service Principles in the following order:

- Strengthen core routes by Improving weekday headways to at least 15 minutes
- Introduce new crosstown routes that improve service coverage
- Introduce new Community Shuttles

There has been some adjustment to the prioritization in recognition of specific local service concerns (e.g., establishing an initial crosstown service the City assuming direct operation of the King Street Trolley); however, to the extent possible, the prioritization schedule adheres to the hierarchy of service principles..

Table 4.4 – Priority 1 Transit Expansion Plan Proposals and Their Resource Impacts

PRIORITY	SERVICE	DAY	PEAK FREQUENCY	ADDITIONAL PEAK BUSES	ESTIMATED ANNUAL HOURS	ESTIMATED ANNUAL MILES	ESTIMATED ANNUAL COST (2009 DOLLARS)	DAILY BOARDINGS	ESTIMATED ANNUAL RIDERSHIP
1.01	Improve AT8 Peak Frequency	Weekday	10	2	3,060	25,092	\$195,000	200	51,000
1.02	Add Van Dorn Plaza/Potomac Yard Crosstown - Phase 1	Weekday	60	2	4,080	40,800	\$279,000	400	102,000
1.04	Improve AT2 Peak Frequency	Weekday	15	3	4,590	30,906	\$276,000	200	51,000
1.05	Improve AT5 Peak Frequency	Weekday	15	3	4,590	70,380	\$375,000	150	38,250
1.03	Add King Street Trolley	Weekday	15	3	7,650	26,928	\$398,000	400	102,000
1.03	Add King Street Trolley	Saturday	15	0	1,980	5,808	\$100,000	400	20,800
1.03	Add King Street Trolley	Sunday	15	0	1,980	5,808	\$100,000	400	23,200
1.06	Improve AT10 Peak Frequency	Weekday	15	2	3,060	22,644	\$189,000	140	35,700
1.07	Improve Van Dorn Plaza/Potomac Yard - Phase 2	Weekday	30	2	8,160	81,600	\$557,000	395	100,725
1.07	Improve Van Dorn Plaza/Potomac Yard - Phase 2	Saturday	60	0	3,060	13,200	\$165,000	200	11,000
1.07	Improve Van Dorn Plaza/Potomac Yard - Phase 2	Sunday	60	0	2,040	11,000	\$116,000	100	5,500
1.08	Improve AT1 Peak Frequency	Weekday	15	4	6,120	24,174	\$325,000	280	71,400
1.09	Improve AT3 Peak Frequency	Weekday	15	1	1,530	24,174	\$127,000	140	35,700
1.10	Improve AT4 Peak Frequency	Weekday	15	1	1,530	26,010	\$132,000	140	35,700
1.11	Improve AT6 Peak Frequency	Weekday	15	3	4,590	89,964	\$424,000	200	51,000
1.12	Improve AT7 Peak Frequency	Weekday	15	3	4,590	70,992	\$376,000	150	38,250
TOTAL	ALL PRIORITY 1			29	62,610	569,480	\$4,134,000	3895	773,225

Table 4.5 – Priority 2 Transit Expansion Plan Proposals and Their Resource Impacts

PRIORITY	SERVICE	DAY	PEAK FREQUENCY	ADDITIONAL PEAK BUSES	ESTIMATED ANNUAL HOURS	ESTIMATED ANNUAL MILES	ESTIMATED ANNUAL COST (2009 DOLLARS)	DAILY BOARDINGS	ESTIMATED ANNUAL RIDERSHIP
2.01	Add Old Town Circulator	Weekday	15	5	10,710	82,620	\$669,000	750	191,250
2.01	Add Old Town Circulator	Saturday	30	0	1,980	17,820	\$131,000	400	22,000
2.01	Add Old Town Circulator	Sunday	30	0	1,320	10,692	\$84,000	365	20,075
2.01	Regular Route Savings with Old Town Circulator	Weekday	--	(2)	(3,060)	(36,720)	(\$224,000)	365	--
2.02	Add Southern Towers/Potomac Yard Crosstown	Weekday	30	3	7,650	53,244	\$464,000	450	114,750
2.02	Add Southern Towers/Potomac Yard Crosstown	Saturday	45	0	1,430	10,182	\$88,000	225	12,994
2.02	Add Southern Towers/Potomac Yard Crosstown	Sunday	45	0	1,320	8,485	\$79,000	210	11,550
2.03	Add Van Dorn/Shirlington Crosstown	Weekday	30	3	7,650	60,588	\$482,000	800	204,000
2.03	Add Van Dorn/Shirlington Crosstown	Saturday	45	0	1,320	11,587	\$86,000	400	22,000
2.03	Add Van Dorn/Shirlington Crosstown	Sunday	45	0	1,320	9,656	\$82,000	200	11,000
2.04	Add Braddock Metro/Lincolnia Crosstown	Weekday	30	4	9,180	67,014	\$564,000	395	100,725
2.04	Add Braddock Metro/Lincolnia Crosstown	Saturday	45	0	1,430	12,816	\$94,000	200	11,000
2.04	Add Braddock Metro/Lincolnia Crosstown	Sunday	45	0	1,320	10,680	\$84,000	100	5,500
TOTAL	ALL PRIORITY 2			13	43,570	318,664	\$3,257,000	4860	493,519

Table 4.6 – Priority 3 Transit Expansion Plan Proposals and Their Resource Impacts

PRIORITY	SERVICE	DAY	PEAK FREQUENCY	ADDITIONAL PEAK BUSES	ESTIMATED ANNUAL HOURS	ESTIMATED ANNUAL MILES	ESTIMATED ANNUAL COST (2009 DOLLARS)	DAILY BOARDINGS	ESTIMATED ANNUAL RIDERSHIP
3.01	Add Landmark-S. Van Dorn Circulator	Weekday	15	4	9,180	95,472	\$636,000	550	140,250
3.01	Add Landmark-S. Van Dorn Circulator	Saturday	30	0	1,320	13,728	\$92,000	275	15,125
3.01	Add Landmark-S. Van Dorn Circulator	Sunday	45	0	660	7,608	\$48,000	200	11,000
3.01	Regular Route Savings from S. Van Dorn Circulator	Weekday	--	(2)	(3,060)	(36,720)	(\$224,000)	200	--
3.02	Add Eisenhower East Circulator	Weekday	10	4	9,180	57,834	\$541,000	550	140,250
3.02	Add Eisenhower East Circulator	Saturday	30	0	660	2,772	\$36,000	275	15,125
3.02	Add Eisenhower East Circulator	Sunday	30	0	660	2,310	\$35,000	200	11,000
3.02	Regular Route Savings from Eisenhower East Circulator	Weekday	30	(1)	(1,530)	(18,360)	(\$112,000)	200	11,000
3.03	Add Potomac Yard Circulator	Weekday	15	3	7,650	42,228	\$436,000	260	66,300
3.03	Add Potomac Yard Circulator	Saturday	60	0	660	3,036	\$37,000	130	7,150
3.03	Add Potomac Yard Circulator	Sunday	60	0	660	2,530	\$35,000	130	7,150
3.04	Add Cameron Station Peak Circulator	Weekday	15	2	3,060	46,512	\$249,000	130	33,150
3.05	Improve Van Dorn Plaza/Potomac Peak Frequency	Weekday	15	4	0	0	\$0	125	0
3.06	Improve Southern Towers/Potomac Yd. Peak Frequency	Weekday	15	3	4,590	35,496	\$287,000	125	31,875
3.07	Improve Van Dorn/Shirlington Crosstown	Weekday	15	3	4,590	44,676	\$310,000	125	31,875
TOTAL	ALL PRIORITY 3			20	38,280	299,122	\$2,406,000	3,475	521,250

Table 4.7 – Grand Total of Priority Transit Expansion Plan Proposals and Their Resource Impacts

	ADDITIONAL PEAK BUSES	ESTIMATED ANNUAL HOURS	ESTIMATED ANNUAL MILES	ESTIMATED ANNUAL COST (2009 DOLLARS)	DAILY BOARDINGS	ESTIMATED ANNUAL RIDERSHIP
GRAND TOTAL	62	144,460	1,187,266	\$9,797,000	12,230	1,787,994

Section 5 – Transit Expansion Plan Implementation

Unconstrained versus Constrained Plans

There are two approaches to implementing the Transit Expansion Plan. The Unconstrained plan, an aggressive approach based upon the original ATC 2009 TDP bus replacement schedule, phases in the service changes over the seven-year period from 2009 through 2015. The Constrained Plan provides a more conservative 12-year implementation schedule which ends in 2020.

Both implementation plans expand the existing DASH fleet to the maximum capacity. The new DASH operating facility, scheduled to open in 2010, will hold 130 buses. The ATC 2009 TDP replacement and expansion schedule assumed the fleet reaching 129 vehicles by 2015. Assuming a 20% spare ratio is maintained throughout the expansion, the peak requirement by the end of the expansion can grow to 109 buses, which represents an increase of 62 buses over the current peak of 47 buses (average of 46 AM and 48 PM).

Assumptions – Operating and Capital Costs, Ridership Growth, Revenue

Charts 5.1.1 through 5.1.4 show cumulative operating costs, DASH ridership, fare revenues, and required subsidy over the period from 2009 through 2020 for both implementation plans. (The detailed year by year calculations for both plans can be found in tabular form in the Appendix.) Tables 5.1.2 and 5.1.3 show the year by year fleet impacts of the Unconstrained and Constrained Plans.

The assumptions used in calculating operating and capital (bus) costs and fare revenues are as follows:

- The estimated operating costs were calculated using FY2009 baseline unit costs of \$43.08 per revenue mile and 2.51 per revenue hour.
- A yearly inflation rate of 5% was assumed for years 2010 through 2015.
- ATC's 2009 estimated ridership of 3,770,000 was the baseline ridership. The ridership estimates for service improvements are phased in according to the implementation schedule. A 2% yearly increase in ridership for existing services was assumed.
- For revenue calculations, average fare was estimated at \$0.62 per ride for revenue calculations. This was calculated from ATC's estimated 2009 passenger fare revenues (assuming no fare increase) of \$2,537,000 divided by projected 2009 ridership of 3,770,000 (Source: 2009 Transit Development Program, Alternate Table 5).
- For bus purchases TMD used a baseline unit cost of \$510,000 for a hybrid bus, and inflated by 5% for each succeeding year. This value was derived from the

2009 Transit Development Program, Capital Outlay Items section, in which ATC programmed the purchase of 19 buses for a cost of \$9.69M.

Fiscal Implications of the Implementation Plans

Table 5.1 below compares operating costs, ridership, passenger fare revenues, operating subsidy, and bus acquisition costs for the two implementation plans, both for their implementation phases and for the full 12-year period from 2009 through 2020. The two plans have been compared to the ATC's baseline 2008 service condition to determine the magnitude of additional operating and capital expenditure needed to implement the transit Expansion Plan.

The key financial differences between the two plans are:

- Additional operating subsidies to fully implement the Transit Expansion Plan: The Unconstrained Plan will require \$19.2M (average \$2.8M annually) in additional operating subsidies. The Constrained Plan will require \$44.7M (average \$3.8M annually) in additional operating subsidies.
- Fleet expansion costs to fully implement the Transit Expansion Plan: The Unconstrained Plan requires \$44.7M (or \$6.4M annually) in additional bus purchases to complete the Transit Expansion Plan, while the Constrained Plan requires \$51M (or \$4.3M annually).
- Combined additional operating subsidies and fleet expansion costs to fully implement the Transit Expansion Plan: The Unconstrained Plan requires \$63.9M (or \$9.2M annually) to complete the Transit Expansion Plan, while the Constrained Plan requires \$95.6M (or \$8.0M annually).
- Combined additional operating subsidies and fleet expansion costs from 2009 through 2020: The Unconstrained Plan will cost \$118.4M (or \$9.2M annually) over the 12-year period (seven years of implementation plus five years full operation), while the Constrained Plan will cost \$95.6M (or \$8.0M annually) to fully implement the Transit Expansion Plan.

Plan Comparison

The Transit Development Plan represents a rapid expansion of DASH fixed-route transit services for the City of Alexandria, including more than doubling its existing fixed-route fleet and a near doubling of annual vehicle miles and vehicle hours. The City's goal in evaluating various implementation schedules is to identify the operating and capital resources necessary to realize the Transit Expansion Plan according to an investment schedule that is within the City's financial capacity.

Table 5.1- Cost Comparison of Unconstrained and Constrained Plan

	UNCONSTRAINED PLAN			CONSTRAINED PLAN
	Implementation Phase: 2009-2015	2016-2020	2009-2020	Implementation: 2009-2020
Total Operating Costs	\$130,392,000	\$160,808,000	\$291,200,000	\$258,669,000
Total Ridership	35,432,000	33,992,000	69,424,000	63,772,719
Total Revenue	\$21,988,000	\$21,116,000	\$43,104,000	\$39,615,613
Total Net Transit Costs (with expansion)	\$108,404,000	\$139,692,000	\$248,096,000	\$219,053,387
Baseline 2008 Net Transit Costs	\$71,750,000	\$102,633,000	\$174,383,000	\$174,383,000
Additional Net Transit Cost	\$36,654,000	\$37,059,000	\$73,713,000	\$44,670,387
Total Bus Purchase Costs	\$65,028,000	\$11,103,000	\$76,131,000	\$81,902,000
Bus Replacement Costs	\$21,943,000	\$11,103,000	\$33,046,000	\$32,848,000
Additional Bus Purchase Costs	\$43,085,000	\$0	\$43,085,000	\$49,054,000
Additional Net Transit and Bus Purchase Costs	\$79,739,000	\$37,059,000	\$116,798,000	\$93,725,000

From the perspective of the total fiscal resources required to fully realize the Transit Expansion Plan, the Unconstrained Plan is less costly (\$79.8M versus \$93.8M for the Constrained Plan.) However, on an average annual basis, the Unconstrained Plan costs more to complete the Transit Expansion Plan. When considering the total additional operating and capital expenses required over the FY2009 - FY2020 period, the Constrained Plan is less expensive in both total dollars (\$93.8M versus \$116.8M for the Unconstrained Plan) and on an average annual basis. *From the perspective of affordability and sustainability, it is recommended that the City follow the 12-year Constrained Plan.*

Chart 5.1—Estimated Cost for Service Expansion Plan

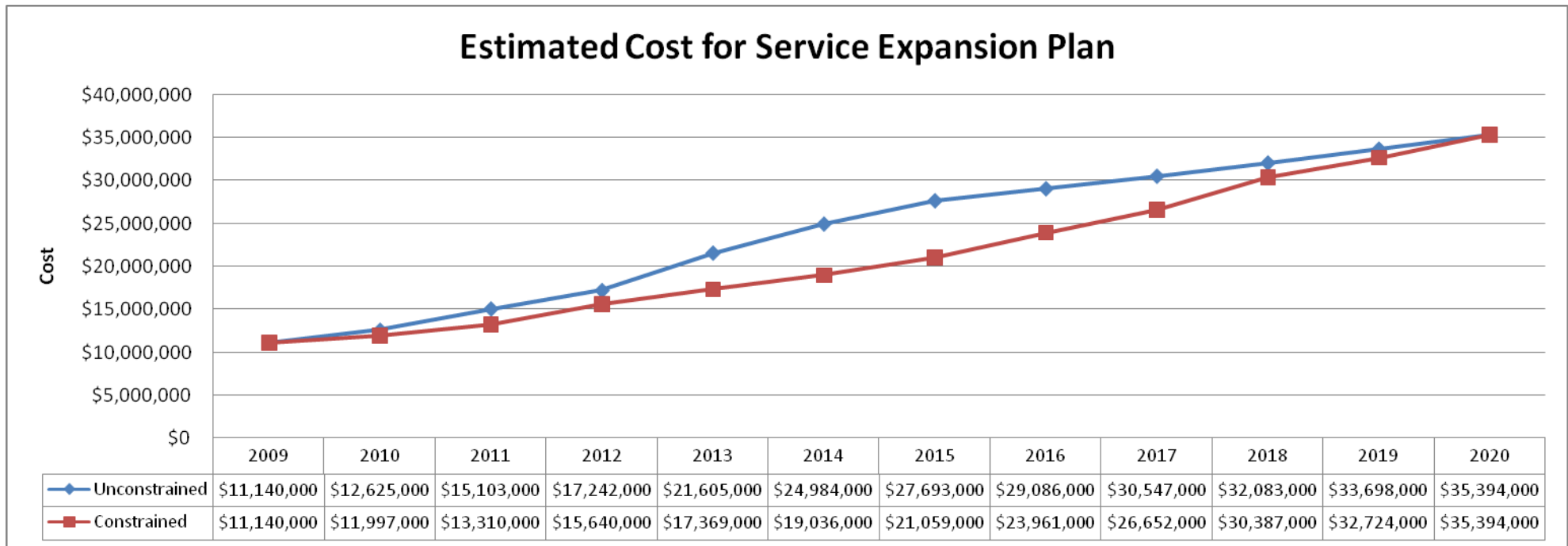


Chart 5.2-- Estimated Ridership for Service Expansion Plan

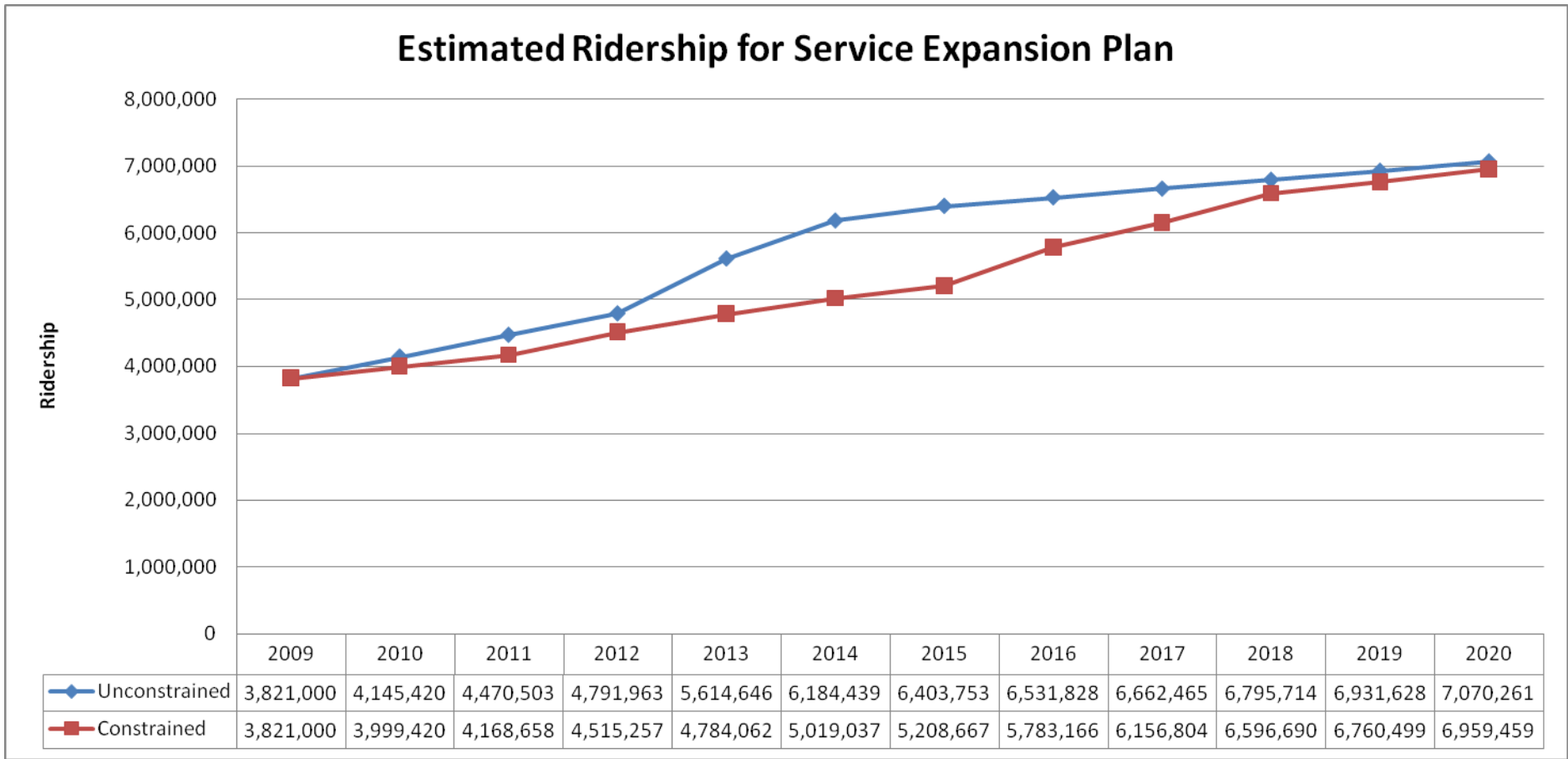


Chart 5.3—Estimated Fare Revenue for Service Expansion Plan

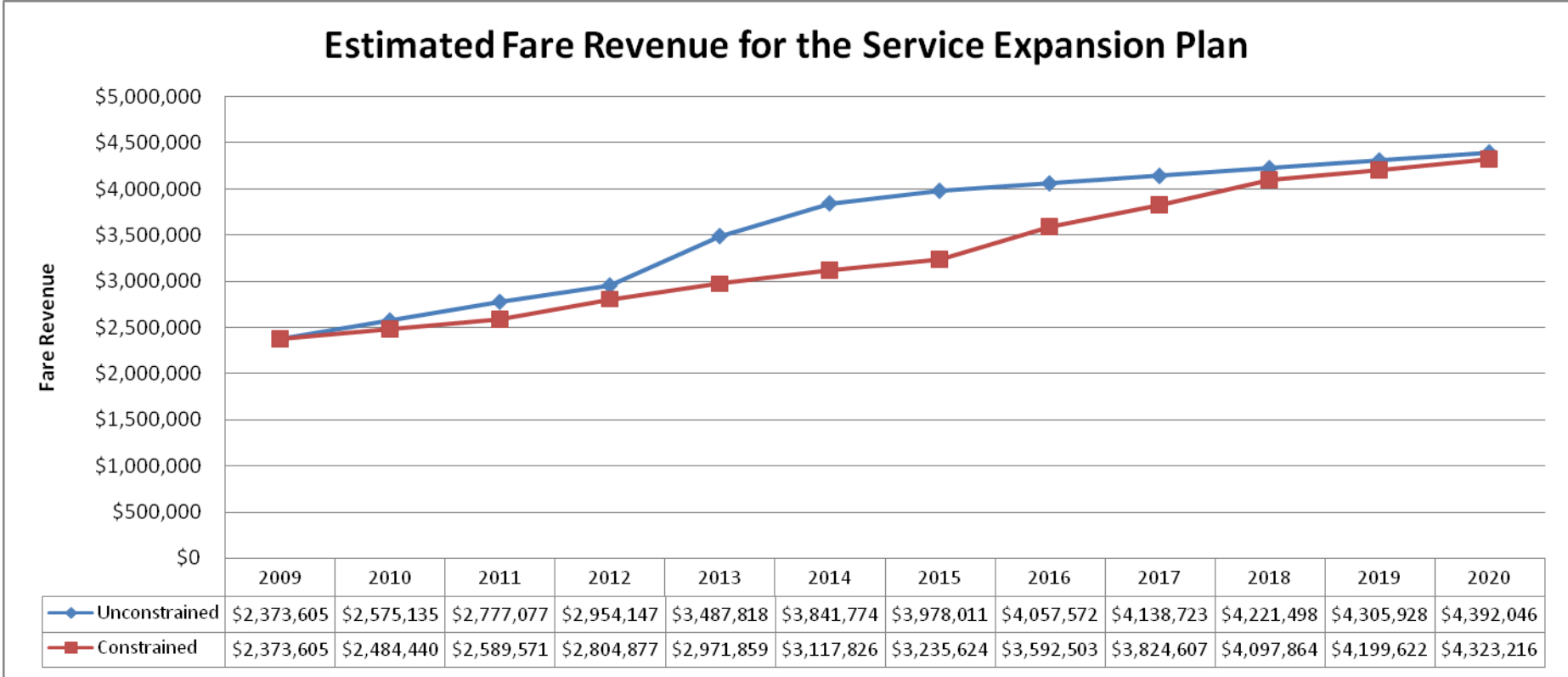


Chart 5.4--Estimated Route Subsidy for Service Expansion Plan

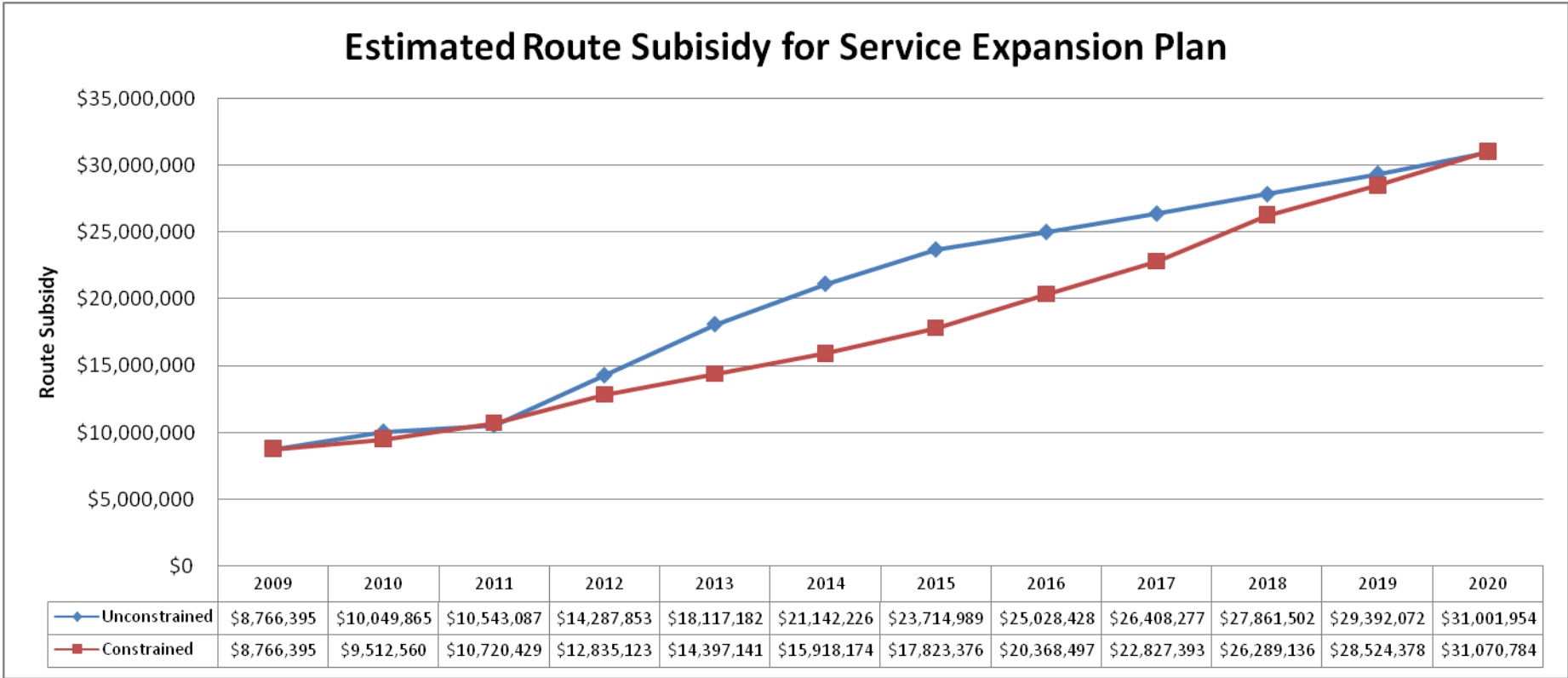


Table 5.2-- Unconstrained (7-Year) Transit Implementation Plan and Impacts Upon ATC Fleet

FISCAL YEAR	2009	2010	2011	2012	2013	2014	2015	Out years
Service Proposal/Priority								
1.01 AT8 peak improvements	2							
1.02 Van Dorn Plaza /Potomac Yard Crosstown		2						
1.03 Assume King Street Trolley Operation		3						
1.04 Improve AT2 peak service			3					
1.05 Improve AT5 peak service			3					
1.06 Improve AT10 peak frequency			2					
1.07 Van Dorn Plaza/Potomac Yard Crosstown--30 min. weekdays			2					
1.08 AT1 peak improvements				4				
1.09 AT3 peak improvements				1				
1.10 AT4 peak improvements				1				
1.11 AT6 peak improvements				3				
1.12 AT7 peak improvements				3				
2.01 Old Town Circulator					5			
2.01 Savings from regular routes when Old Town Circulator is implemented					-2			
2.02 Southern Towers/Potomac Yard Crosstown					3			
2.03 Van Dorn Metro/Shirlington Crosstown					3			
2.04 Braddock Road Metro/Lincolnia Crosstown					4			
3.01 Landmark/South Van Dorn Circulator						4		
3.01 Savings from regular routes when Landmark/S. Van Dorn Circulator is implemented						-2		
3.02 Eisenhower East Circulator						4		
3.02 Savings from regular routes when Eisenhower East Circulator is implemented						-1		
3.03 Potomac Yard Circulator						3		
3.04 Cameron Station Circulator						2		
3.04 Increase Van Dorn Plaza/Potomac Yard Crosstown to 15							4	
3.05 Increase Southern Towers/Potomac Yd. to 15							3	
3.06 Increase Van Dorn Metro/Shirlington to 15							3	
Net change in peak bus requirement	2	5	10	12	13	10	10	0
Current peak bus requirement	49	51	56	66	78	91	101	111
Total peak bus requirement	51	56	66	78	91	101	111	111
Transit peak requirement	51	53	63	70	83	93	103	103
Trolley peak requirement	0	3	3	8	8	8	8	8

Table 5.3— Unconstrained (12-Year) Transit Implementation Plan and Impacts to ATC Fleet

FISCAL YEAR	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Service Proposal/Priority												
1.01 AT8 peak improvements	2											
1.02 Van Dorn Plaza /Potomac Yard Crosstown		2										
1.04 Improve AT2 peak service			3									
1.05 Improve AT5 peak service			3									
1.03 Assume King Street Trolley Operation				3								
1.07 Van Dorn Plaza/Potomac Yard Crosstown--30 min. weekdays				2								
1.06 Improve AT10 peak frequency					2							
1.08 AT1 peak improvements					4							
1.09 AT3 peak improvements					1							
1.10 AT4 peak improvements					1							
2.02 Southern Towers/Potomac Yard Crosstown						3						
1.11 AT6 peak improvements							3					
1.12 AT7 peak improvements							3					
2.01 Old Town Circulator								5				
2.01 Savings from regular routes when Old Town Circulator is implemented								-2				
2.03 Van Dorn Metro/Shirlington Crosstown								3				
3.02 Eisenhower East Circulator									4			
3.02 Savings from regular routes when Eisenhower East Circulator is implemented									-1			
3.03 Potomac Yard Circulator									3			
2.04 Braddock Road Metro/Lincolnia Crosstown										4		
3.01 Landmark/South Van Dorn Circulator										4		
3.01 Savings from regular routes when Landmark/S. Van Dorn Circulator is implemented										-2		
3.04 Cameron Station Circulator										2		
3.04 Increase Van Dorn Plaza/Potomac Yard Crosstown to 15											4	
3.05 Increase Southern Towers/Potomac Yd. to 15												3
3.06 Increase Van Dorn Metro/Shirlington to 15												3
Net change in peak bus requirement	2	2	6	5	8	3	6	6	6	8	4	6
Current peak bus requirement	49	51	53	59	64	72	75	81	87	93	101	105
Total peak bus requirement	51	53	59	64	72	75	81	87	93	101	105	111
Transit peak requirement	51	53	59	61	69	72	78	79	85	93	97	103
Trolley peak requirement	0	0	0	3	3	3	3	8	8	8	8	8

FISCAL YEAR	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
<i>Existing fleet</i>	64	64	67	74	80	90	93	100	105	112	122	127
<i>Fleet Expansion</i>	0	3	7	6	10	3	7	5	7	10	5	7
Total fleet	64	67	74	80	90	93	100	105	112	122	127	134
<i>Transit coaches</i>	64	67	68	76	86	89	96	95	102	112	117	124
<i>Trolley coaches</i>	0	0	0	4	4	4	4	10	10	10	10	10
Spare ratio (overall)	25.5%	26.4%	25.4%	25.0%	25.0%	24.0%	23.5%	20.7%	20.4%	20.8%	21.0%	20.7%
<i>Transit spare ratio</i>	25.5%	26.4%	25.4%	24.6%	24.6%	23.6%	23.1%	20.3%	20.0%	20.4%	20.6%	20.4%

<i>Fleet Expansion</i>	0	3	7	6	10	3	7	5	7	10	5	7
<i>Scheduled Bus</i>												
<i>Replacement</i>	5	5	5	6	6	6	4	3	4	2	5	0
Total Bus Purchase												
Required	5	8	12	12	16	9	11	8	12	12	10	7
Cost of Required Bus												
Purchase	\$2,550,000	\$4,284,000	\$6,748,000	\$7,085,000	\$9,919,000	\$5,859,000	\$7,518,000	\$5,741,000	\$8,289,000	\$9,495,000	\$8,308,000	\$6,106,000
Cumulative Cost of Bus												
Purchase (2009-2020)												\$81,902,000

Section 6 – Traffic Congestion Plan

Existing Conditions

Using 2007 weekday ridecheck data, a series of maps have been developed to depict the actual observed bus speeds including dwell time on the various street segments over which DASH bus services operate. As traffic volumes or congestion increase, traffic speeds decrease, as established in traffic engineering formulas and curves that show speed as a function of the traffic volume to capacity ratio. This results in additional time being required to travel a fixed distance.

Traffic congestion imposes a substantial operational and monetary penalty on bus transportation by increasing the time required to provide service. Congestion in Alexandria is high and is forecasted to be greater in the future; traffic volumes are predicted to increase by seven percent by 2010 over the levels in 2005, and 18 percent by 2015. The roadway network in Alexandria currently operates at or above its defined capacity at many locations during the peak periods. Consequently, even small increases in traffic volume will result in significant increases in traffic delay and cost. Transit buses operate almost exclusively in mixed traffic sharing Alexandria roadways with autos and trucks. Therefore, measured congestion will not only impact auto drivers and passengers and truck operators but also bus riders.

However, several congestion impacts are unique to buses. Heavy traffic may delay buses trying to pull into traffic after stopping at a bus stop. When the streets are congested, many service and delivery vehicles that cannot find legal street parking or stopping space use the bus stops for short stops or double park immediately before or after the bus stop, requiring a difficult maneuver for the bus to access the stop. This study also found that the difference between bus and auto speeds is greater when the streets are more congested. At the maximum speeds recorded in the study, buses are moving at about 59 percent of the auto speed, while at the lowest speed, buses are moving at only 42 percent of auto speed. This is consistent with the observation that under very congested conditions, buses are doubly affected: first, by the low speed of the stream of traffic, and second by interference from other vehicles when moving in and out of the stream of traffic at bus stops.

The following table depicts average bus speed compared to auto speed and the corresponding ratio. Using the data, it is easy to see the impact congestion has on transit.

Table 6.1—Average Bus Speed vs. Average Auto Speed

	Times (min/mile)		Speeds (mph)		Difference	Ratio
	Bus	Auto	Bus	Auto	Auto-Bus	Bus/Auto
Average	11.00	6.10	5.50	9.80	4.30	0.56
Minimum	4.70	2.80	2.20	5.20	3.00	.42
Maximum	27.00	11.50	12.70	21.40	8.70	.59

Based upon calculations from FY 2007, ATC DASH hours are increased approximately 8 percent due to congestion, at a cost of \$313,000 annually, this will increase by over \$100,000 in future years based upon projected congestion.

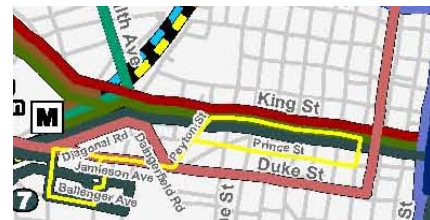
Table 6.2—Current and Future Effects of Congestion

	Current			Future	
	FY 2007	Part due to Congestion	Without Congestion	Congestion Increment	Total
Vehicle Hours	92,829	7,330	85,499	9,000	94,499
Operating Variable Expense	\$3,708,000	\$313,000	\$3,395,000	\$415,000	\$3,781,000
Total Expense	\$5,559,000	\$313,000	\$5,246,000	\$415,000	\$5,618,000

While congestion affects overall transit service in Alexandria, there are specific areas in which congestion is especially problematic and certain types of mitigation can be accomplished to reduce the impact to ATC.

Congestion affects bus traffic throughout weekday service. Specific areas are east of the King Street Metro Station on Duke and King Streets, and Fairfax Street. A large portion of ATC's service is affected by congestion through this area. In addition, the impacts of stop signs along Fairfax St, and competition of passenger car traffic along King and Duke streets are the predominate reasons for transit slow down in this area. There are some minor changes that can be completed to mitigate this slow down:

- Reduce or eliminate left turns along King Street in Old Town
 - Left turns cause backups along King Street causing traffic to weave around those turning left. Generally speaking traffic in activity centers such as Downtown Alexandria should be diverted away from the core area utilizing alternative or bypass routes such as Cameron St. An example of this is in Old Town Pasadena, CA.



- Reroute pedestrian and automobile traffic near the King Street Metro Station

- The King Street Metro Station serves as ATC's highest boarding location on weekdays. It is also one of the most congested areas in the system, due to its proximity to Old Town and Downtown Alexandria, as well as the traffic patterns through the area. Providing buses with a bus only lane bypassing traffic on Diagonal Rd. from the exit of the station north to the crosswalk with a queue jumper at the crosswalk back into the regular lane would mitigate significant delays. In order to complete this, pedestrian and auto traffic must be rerouted around the bus entryway to the station.



- Restructure Duke St and Callahan Drive intersection to provide bus only turns.
 - Allowing buses to turn left from Duke Street to Callahan Drive from the far right lane will significantly reduce delays at this intersection. This can be handled by a bus only turn signal that effectively stops traffic along Duke to allow DASH buses to avoid long waits at the signal.



The following discussion will highlight additional problem areas in the network.

Weekday Inbound to Alexandria

AM Peak: The very slowest operations (less than 10 MPH) occurred in the following areas:

- King Street and Duke Street in downtown Alexandria
- Royal and Fairfax in downtown Alexandria
- Along most of the alignment of routes AT3 and AT4 between I-395 and Pendleton Street/Fairfax Street;
- Beauregard Street between Armistead and Seminary Road
- Seminary Road east and west of I-395
- Duke Street between Jordan Street and Van Dorn Road
- Van Dorn and Ripley between Pickett and Sanger
- Streets surrounding Van Dorn Plaza including Stevenson, Whiting, and Edsall

Midday: The very slowest operations (less than 10 MPH) occurred in the following areas:

- King Street and Pendleton Street in downtown Alexandria
- Royal and Fairfax in downtown Alexandria
- Beauregard Street between Armistead and Sanger
- Seminary Road east and west of I-395
- Duke Street between Jordan Street and Van Dorn Road
- Van Dorn and Ripley between Pickett and Sanger
- Streets surrounding Van Dorn Plaza including Stevenson, Whiting, and Edsall

PM Peak: The very slowest operations (less than 10 MPH) occurred in the following areas:

- King Street and Duke Street in downtown Alexandria
- Royal and Fairfax in downtown Alexandria
- Along most of the alignment of routes AT3 and AT4 between I-395 and Pendleton Street/Fairfax Street;
- Beauregard Street between Duke Street and Seminary Road
- Seminary Road east and west of I-395
- Duke Street between Jordan Street and Van Dorn Road
- Van Dorn and Ripley between Pickett and Sanger
- Streets surrounding Van Dorn Plaza including Stevenson, Whiting, and Edsall

Evening: The very slowest operations (less than 10 MPH) occurred in the following areas:

- King Street, Duke Street, and Pendleton Street in downtown Alexandria
- Royal in downtown Alexandria
- Beauregard Street between Armistead and Sanger
- Seminary Road east and west of I-395
- Duke Street between Jordan Street and Van Dorn Road
- Van Dorn and Ripley between Pickett and Sanger

- Streets surrounding Van Dorn Plaza including Stevenson, Whiting, and Edsall

Overall, streets that have slow transit operations inbound throughout the weekday are:

- Downtown – King Street, Duke Street, Pendleton Street, Fairfax Street, and Royal Street.
- Northeast Alexandria – Streets comprising routes AT3, AT4, and the AT3-4 Loop, including Braddock Road, Russell Street, and West Glebe Road.
- Western Alexandria – Duke Street and Seminary Road west of Jordan Street to Beauregard Street; Beauregard Street; Van Dorn Street south of Sanger

Outbound from Alexandria

AM Peak: The very slowest operations (less than 10 MPH) occurred in the following areas:

- King Street and Duke Street in downtown Alexandria
- Royal Street south of King Street in downtown Alexandria
- Beauregard Street between Duke Street and Seminary Road
- Seminary Road immediately east and west of I-395
- Duke Street between Jordan Street and Beauregard Street
- Streets surrounding Van Dorn Plaza including South Whiting Street and Van Dorn street
- Bashford Lane and Powhatan Street

Midday: The very slowest operations (less than 10 MPH) occurred in the following areas:

- King Street and Duke Street in downtown Alexandria
- Royal Street south of King Street in downtown Alexandria
- Beauregard Street between Duke Street and Seminary Road
- Seminary Road immediately east and west of I-395
- Duke Street between Jordan Street and Beauregard Street
- Van Dorn Street from Stevenson to Eisenhower Avenue

PM Peak: The very slowest operations (less than 10 MPH) occurred in the following areas:

- King Street and Duke Street in downtown Alexandria
- Royal Street south of King Street in downtown Alexandria
- Bashford Lane and Powhatan Street
- Beauregard Street between Duke Street and Seminary Road
- Seminary Road east and west of I-395
- Duke Street between Jordan Street and Beauregard Street
- Van Dorn and Ripley between Sanger and Eisenhower
- Streets surrounding Van Dorn Plaza including Stevenson, Whiting, and Edsall

Evening: The very slowest operations (less than 10 MPH) occurred in the following areas:

- King Street between Commonwealth Avenue and Fairfax Street

- Duke Street between Dangerfield and Washington
- Franklin Street between Fayette and Royal Streets
- Royal Street between Price and Franklin Streets
- Duke Street between Jordan and Van Dorn Streets
- South Whiting Street
- Beauregard Street between Lincolnia Road and Sanger Avenue
- Martha Custis Drive/Valley Drive

Overall, streets that have slow transit operations inbound throughout the weekday are:

- Downtown – King Street, Duke Street, Pendleton Street, Fairfax Street, and Royal Street.
- Northeast Alexandria – Streets comprising routes AT3, AT4, and the AT3-4 Loop, including Braddock Road, Russell Street, and West Glebe Road.
- Western Alexandria – Duke Street and Seminary Road west of Jordan Street to Beauregard Street; Beauregard Street; Van Dorn Street south of Sanger

Programmed Traffic signal Improvements

Evening – Inbound to Alexandria: The very slowest operations (less than 10 MPH) occurred in the following areas:

- King Street, Duke Street, and Pendleton Street in downtown Alexandria
- Royal in downtown Alexandria
- Beauregard Street between Armistead and Sanger
- Seminary Road east and west of I-395
- Duke Street between Jordan Street and Van Dorn Road
- Van Dorn and Ripley between Pickett and Sanger
- Streets surrounding Van Dorn Plaza including Stevenson, Whiting, and Edsall

From field observations and discussions with ATC staff, the following areas/locations are chronic chokepoints for DASH bus movements:

- Left-hand turn from eastbound Duke to Callahan Drive (Possible queue jumper)
- Diagonal Road outside the King Street Metro Station
- King Street in Old Town (discourage through traffic without removing on-street parking access by prohibiting turns at Patrick and Henry Sts. and creating transit only blocks eastbound between Columbus and Washington and westbound between St. Asaph and Washington)
- King St. next to the Masonic Temple eastbound heading towards King Street Metro Station (Possible Queue jumper)

Industry best practices for delay mitigation

There are a number of options that have been developed to deal with traffic congestion and can be applied to ATC's service area. These generally fall into three categories as described by the FHWA:

Add more capacity

Adding more lanes to existing highways and building new ones has been the traditional response to congestion. In some metropolitan areas, however, it is becoming increasingly difficult to undertake major highway expansions because of funding constraints, increased right-of-way and construction costs, and opposition from local and national groups. However, it is clear that adding new physical capacity for highways, transit, and railroads is an important strategy for alleviating congestion, the City of Alexandria has recommended, through its Transportation Master Plan, against adding additional roadway capacity as a solution.

In those locations where the lack of physical capacity is the greatest contributor to congestion, addition of new capacity is critical. In such locations, the addition of new capacity is critical. Further, the addition of new capacity presents an excellent opportunity to combine it with other types of strategies. This often means that highway designers must think "outside the box" and find creative ways to incorporate new designs and travel alternatives that accommodate the concerns of diverse groups and a variety of system users. Since the worst highway bottlenecks tend to be freeway-to-freeway interchanges, advanced design treatments that spread out turning movements and remove traffic volumes from key merge areas have been developed, often by using multilevel structures that minimize the footprint of the improvement on the surrounding landscape.

Adding new freeways or additional lanes to existing freeways will add large amounts of capacity to the roadway network. However there are other improvements to the transportation system that can reduce or manage congestion, albeit in a more localized area. Widening arterial roads, providing street connectivity, provide grade separations at congested intersections and providing high-occupancy vehicle (HOV) lanes all will help to mitigate congestion. Also, adding capacity to the transit system, whether it is to the bus system, urban rail system or commuter rail system will assist in relieving congestion on the roadway network. For transit a variety of options exist to improve service and mitigate congestion. These include:

- Vehicle tracking through automated vehicle location (AVL) systems
- Fare strategies such as congestion pricing or discounting during peak periods
- Signal priority and synchronization
- Bus ramp bypasses and queue jumpers
- Real-time transit information (Nextbus)

- Service routes and demand-responsive service

Maximizing existing capacity

In recent years, transportation engineers and planners have increasingly embraced strategies that deal with the *operation* of existing highways, rather than just building new infrastructure. The philosophy behind Transportation System Management and Operations (TSM&O) is to mitigate the effects of a wide variety of roadway events and to manage short-term demand for existing roadway capacity.

TSM&O includes the application of advanced technologies using real-time information about highway conditions to implement control strategies. Collectively referred to as ITS, real-time control of highway operations through a transportation management center (TMC) has become a major activity undertaken by transportation agencies. ITS control strategies take many forms: metering flow onto freeways, dynamically retiming traffic signals, managing traffic flow during incidents, monitoring transit vehicles in real-time, electronic screening of trucks, and providing travelers with information about travel conditions, alternative routes, and other modes.

In addition to ITS, other TSM&O strategies to improve the efficiency of the existing road system have been implemented, including reversible commuter lanes, movable median barriers to add capacity during peak periods, and restricting turns at key intersections. There are numerous congestion mitigation strategies that are enhanced by the use of advanced technologies or ITS. There are several other effective strategies that do not rely on advanced technology, including geometric improvements to roads and intersections, converting streets to one-way operations and access management.

The idea behind TSM&O strategies is to increase the efficiency of the existing transportation infrastructure. That is, roadway events essentially "steal" roadway capacity and TSM&O seeks to get it back. The deployment of TSM&O strategies and technologies is increasing and evaluations have shown their impact to be highly cost-effective. However, relying on TSM&O alone is a limited approach to addressing the congestion problem. A sound base infrastructure already must exist before TSM&O can be used or TSM&O strategies can be added along with capacity improvements. Also, only so much extra efficiency can be squeezed out of an already stressed highway system.

Improving the efficiency and reliability of the freeway, street, transit, and freight systems is an aspect of the transportation program that in many cases can be accomplished in shorter time, with more public support and at a lower cost than some other strategies. The size of the benefits from any single project may not be of the magnitude of a new freeway lane or rail transit line, but the cost and implementation time also are not as high. One key to understanding the benefits from operational projects is to think of these strategies as enhancing the return on investment in the infrastructure projects.

Use Travel Demand Management to Encourage Travel and Land Use

Other approaches to the problem of congestion involve managing the demand for highway travel. These strategies include putting more people into fewer vehicles (through ridesharing, increased public transportation ridership, or dedicated highway lanes for high-occupancy vehicles), shifting the time of travel (e.g., through staggered work hours), and eliminating the need for travel altogether (e.g., through telecommuting). The major barrier to the success of TDM strategies is that they require an adjustment in the lifestyles of travelers and the requirements of employers. Flexible scheduling is not simple for many American workers their employers and families, which limits the effectiveness of TDM strategies. Investing in non-automotive modes of travel—such as rail and bus transit systems and bikeways—is another strategy for reducing the number of personal use vehicles on the highway system. These approaches can be an excellent supplement to the highway system, particularly for commuter trips. However, in most metropolitan areas, the level of investment required to meet transportation demand solely through these means is massive and infeasible.

Another approach that is being recently considered in many urban areas is managing demand through pricing schemes. Pricing strategies include charging for the use of HOV lanes either by the number of persons in the vehicle, by time of day, or both. This strategy is known most commonly as "value pricing," but has also been called "congestion pricing" and "peak-period pricing." Value pricing is a way of harnessing the power of the market to reduce congestion and the economic and environmental costs that congestion imposes. For example, since February 2003 the City of London, U.K. has charged a fee for driving private automobiles in its central area during weekdays as a way to reduce traffic congestion and raise revenues to fund transport improvements. This has significantly reduced traffic congestion, improved bus and taxi service, and generates substantial revenues. Public acceptance has grown and there is now support to expand the program to other parts of London and other cities in the U.K.

In the United States, experience with the variably tolled Express Lanes on SR 91 in Orange County, California has clearly demonstrated the ability of pricing to maximize freeway efficiency. The Express Lanes became operational in December 1995. By 1997, congestion had increased on the free lanes as demand increased due to development growth in Riverside County. Analysts have noted that the SR 91 Express Lanes represent only 33 percent of the highway's capacity (i.e., two out of six lanes in each direction), but are carrying 40 percent of the traffic in the busiest peak hours, at speeds of 65 mph versus 10 to 20 mph in the adjacent free lanes. This is due to the fact that congestion results in reduced throughput on the regular lanes, accounting for the higher relative throughput on the free flowing Express Lanes in peak hours.

Land use management is another type of strategy that can influence congestion. The historical cycle of suburban growth has led to an ever-increasing demand for travel.

Suburban growth was originally fueled by downtown workers who moved from city centers to the urban fringe to take advantage of lower land prices and greater social amenities. In the past 20 years, businesses also have moved to the suburbs to be closer to their employees and to take advantage of lower rents. This in turn allows workers to live even further away from city centers, thereby perpetuating suburban expansion. To influence these processes, strategies that attempt to manage and direct urban growth have been used in several metropolitan areas. These include land use controls (zoning), growth management restrictions (urban growth boundaries and higher development densities), development policies (transit-oriented design, which provides land use densities and forms to favor transit use) and taxation policy (incentives for high-density development). The main problem with many of these strategies is that they often are contrary to market trends, increasing consumer costs and dampening economic efficiency, at least in the short term. Unless a truly regional approach is followed—with cooperation of all jurisdictions within the region—sprawl may simply be pushed into areas not conforming to growth policies.

Existing Congestion Mitigation Projects

Road Commission of Oakland County (RCOC) FAST-TRAC Project: Advanced Traffic Signal Coordination. Oakland County, located just north of Detroit, is one the largest and most affluent metropolitan counties in the United States. Although its population exceeds 1.2 million Oakland County has a limited freeway system and relies on major arterials, generally spaced a mile apart, for much of its roadway capacity. Starting in 1992, the Road Commission of Oakland County began implementing a program to improve traffic flow along arterial roadways. The key element of this program is the Sydney Coordinated Adaptive Traffic System (SCATS). About 600 of Oakland County's 1,300 signalized intersections are now on the SCATS system. SCATS takes advantage of several different technologies to ease the commute for Oakland County residents through improved timing of traffic signals.

SCATS intersections are outfitted with video detection cameras. These cameras include computer software that enables them to count the number of cars stopped at intersection, the number of cars going through on green signals and vehicle speeds. This information is sent to a central computer, which compares current traffic flows to trends over the past few years and to traffic conditions at other intersections along the same street. The SCATS computer can then calculate the mix of green and red signal time that will minimize the total time for all drivers on the system.

Other key elements are AutoscopeTM video detection cameras installed at each FAST-TRAC intersection and a Traffic Operations Center. Incorporated into the TOC is the Traffic Information Management System (TIMS), which is FAST-TRAC's comprehensive information processing tool. The TOC is able to share data and videos with Michigan DOT's regional ITS center in Detroit. About 600 of Oakland County's 1,300 signalized intersections are currently part of FAST-TRAC. Oakland County also participates in a consortium with other jurisdictions in the area to improve signal coordination for those intersections that are not part of FAST-TRAC.

Real-time traffic information is displayed on the RCOC web site and information on freeway conditions and major traffic incidents in the region is exchanged with MDOT's ITS Center. The RCOC web site is unusual in that it provides information on arterial congestion levels. Since describing arterial congestion levels in terms of speed and/or travel time is very difficult, RCOC uses general description (heavy, moderate, light, no congestion) as noted by color. The web site combines local arterial information with MDOT's freeway data. Camera images and DMS messages, both of which are provided by MDOT, can be called up on the RCOC screen. Even though the arterial information is general in nature, this is one of the few web sites in the United States that can be effectively used to plan and assess alternative arterial routes that can be used to avoid freeway incidents and/or congestion.

Integrated Corridor Management ITS Initiative. Recognizing the importance of maximizing the operational effectiveness of an entire corridor, the U.S. DOT's ITS program includes "Integrated Corridor Management" (ICM) Systems as one of nine Major Initiatives. The basic premise behind the ICM initiative is that these independent systems and their cross-network linkages could be operated in a more coordinated and integrated manner resulting in significant improved operations across the corridor. As stated in the ICM vision, "metropolitan areas will realize significant improvements in the efficient movement of people and goods through aggressive and proactive integration and management of major transportation corridors." In essence, integrated corridor management consists of the operational coordination of specific transportation networks and cross-network connections comprising a corridor, and the coordination of institutions responsible for corridor mobility.

The goal of the Integrated Corridor Management Initiative is to provide the institutional guidance, operational capabilities, and ITS technology and technical methods needed for effective Integrated Corridor Management Systems. Currently, the ICM initiative consists of the following four phases:

1. **Foundational Research** – Working with multimodal stakeholders, develop an understanding of the institutional, operational, and technical integration needs and issues of developing and deploying an integrated corridor management system. Phase 1 activities include developing definitions; identifying corridor types, operational approaches and strategies, and the associated integration requirements; reviewing existing and simulated corridor operations; and developing initial guidance for "ICM Planning and Implementation," including a Concept of Operations for a generic corridor.
2. **Operations and Systems Development** –Based on the Phase 1 findings, structure the development phase to address the corridor ITS integration issues that may include alternative shared operations management schemes and cross network operations strategies. Modify or develop analytical tools and methods that will enable the development and evaluation of integrated corridor management strategies. This

phase also includes laboratory and limited field-testing of component integration interfaces and component operations of an integrated corridor management system.

3. **Model Deployment** – Candidate model deployment sites will be selected with a "request for application" process. These candidate model deployment sites will become key members of the ICM Stakeholder group and be provided funding and support to develop a site-specific Concept of Operations for their proposed corridor. The final model deployment site will be chosen from the candidate sites at a later date. The selection will take into account each site's ability to demonstrate the ICM concept and successful implementation of an ICM system. The model deployment will demonstrate the application of institutional, operational, and technical integration approaches in the field, and document implementation issues and operational benefits. An independent evaluation will be conducted to document the results.
4. **Knowledge and Technology Transfer** – Formal technology transfer efforts will be initiated to disseminate the knowledge gained from Phase 1 and Phase 2. Towards the end of the model deployment effort, those outreach activities will provide guidance and transfer the tools and technologies needed to support successful integrated corridor management strategies.

U.S. DOT is currently working with stakeholders to identify the ICM institutional, operational, and technical integration issues; and revise the program to address these issue and support stakeholder implementation needs. U.S. DOT is also developing a Model Deployment/ICM Demonstration approach. The innovative approach provides for the joint development of Model Deployment/ICM Demonstrations. The U.S. DOT will work with stakeholders to collectively craft what can be done to effectively demonstrate how ICM can be implemented and its operational benefits.

Section 7 – Bus Stop Developer Guidelines

Developer Responsibilities

When a development is constructed adjacent to an existing or proposed bus stop location, the developer should consider alternatives to automobile access by providing amenities as described in this design manual. It is helpful if the developer installs, when appropriate, shelters that conform to local standards for passenger recognition and ease of maintenance. For best outcomes, developers should submit a copy of all street improvement and re-development plans to the City's Offices of Transit Services and DASH to ensure proper coordination and placement of transit amenities (turnouts, bus pad, etc.)

Bus Stop Placement

The following will serve as guidelines for

Stop Spacing

In very high density centers, such as activity centers like hospitals, universities, etc., bus stops should be placed every 660-750 feet (1/8 mile). In high density urban areas (major employment centers and/or areas with population densities greater than or equal to 4,000 persons per square mile or more), bus stops should ideally be spaced at intervals no more than 1,320 feet (¼ mile) and no less than 600 feet along each route. In less dense suburban areas (areas with population densities 2,000 - 4,000 persons per square mile), bus stops should ideally be spaced at intervals no more than 2,000 feet and no less than 1,320 feet (¼ mile to ½ mile). In low density and rural areas bus stops should be every ½ mile to 1 mile or the route should allow for flag stops.

Stop Placement

Stop placement should take into consideration the major advantages and disadvantages of placing bus stops in certain locations relative to the street, such as whether or not to place a stop near side, far side, or mid block on a street. Certain conditions will favor certain stop placements. Near-side stops describe a bus stop before the crossing intersection. If the stop is on the farther and opposite end of the intersection it is described as far-side. Stops located in the middle of a block away from an intersection are described as mid-block stops.

Stop Access (turnouts, bulbs)

In determining the placement of bus stops, it's important to consider current conditions of the roadway. Certain conditions will warrant a turnout, bus bulb, paved shoulder, or another area of adequate curbside clearance.

Bus Stops and Driveways

Whenever possible, bus stops should not be placed near a driveway, however if placement near a driveway is unavoidable there are several actions one can take to mitigate the problem.

Additional Factors in Selecting a Bus Stop Location

Additional factors that should be considered when selecting a bus stop location include: sidewalk conditions, crosswalks, landscaping issues, and limited visibility over hills and around curves, on-street parking, proximity to major trip generators, transfer locations, and bicycle facilities.

Minimum Bus Stop Elements

Table 7.1 below illustrates what types of bus stop amenities that should be considered given the bus stop's activity during the day. It should be noted that, although the City of Alexandria has a goal to exceed these minimum standards, shelters have been installed at many locations with less than 100 daily boardings in order to promote transit usage.

Table 7.1—Bus Stop Amenities

Amenity	Customer Boarding Activity per Day		
	<50	51-100	101>
Bus Stop Sign	X	X	X
ADA Access	X	X	X
Lighting	X	X	X
Concrete Pad sidewalk	X	X	X
Concrete Pad roadway	X	X	X
Bench		X	X
Schedule		X	X
Trash receptacle		X	X
Standard Shelter			X
System Map			X
Bicycle Facilities			X
Real Time Travel Info			X

Landing Area

Bus stop sites should be chosen such that, to the maximum extent practicable, lifts or ramps can be deployed on a firm, stable surface as to permit a wheelchair or mobility aid user to maneuver safely onto or off the bus and bus stop.

Signage

Each bus stop must be marked with a sign indicating the transit operator(s) that serve(s) the stop and which route(s) service(s) that specific stop. Bus stop signs indicate to passengers and drivers where buses stop, as well as publicize the availability of the service.

Safety

Specific safety and security issues should be dealt with at each bus stop on a case by case basis. Some issues to look at or consider at bus stops include lighting, drainage, uneven surfaces, access issues, etc...

Passenger Amenities at Bus Stop

Shelters

Transit shelters should be installed at selected bus stops to provide weather protection as well as seating for waiting passengers.

Benches and Trash Receptacles

Benches should be installed inside all standard shelters. Benches may also be installed independently at bus stops that do not have shelters due to low passenger activity but where some level of amenity is justified. Trash receptacles should be installed at all standard shelters and may also be installed independently at bus stops that do not have shelters.

Smart Stations

Alexandria will look to utilize ITS features with their smart stations and stops.

Installation of ITS features are likely in the future, these include:

- Real-time “next-bus” arrival information
- Electronic posting of schedules
- Access to route information
- Installation of panic buttons or call boxes

Appendix A – Bus Stop Guidelines

INTRODUCTION

Purpose of Guidelines

The purpose of this document is to educate decision makers about the different issues and design concerns with regards to bus-related facilities and amenities. Bus stops are an important interface between buses and passengers as they provide facilities for waiting passengers and for the bus itself. Appropriate traffic management and public safety issues need to be addressed when deciding to place a bus stop. These guidelines are provided by DASH as a resource to the city of Alexandria and other local jurisdictions to help provide both comfortable and convenient transit facilities at bus stop locations, while considering the operational needs of DASH, the requirements of the Americans with Disabilities Act (ADA), and public safety. Currently the DASH bus fleet consists of 35'. This manual will provide both general and specific guidelines with regards to the following goals:

- Safe and accessible areas for transit riders and other pedestrians.
- Safe and convenient operations for transit vehicles and other vehicles.
- Encourage use of transit by providing highly visible, safe, and convenient areas for riders.
- Facilities that provide access for mobility and impaired patrons and complies with ADA requirements

The standards are organized in three parts:

- Part I: Bus Stop Placement, examines factors to be considered in selecting new bus stop locations along a route.
- Part II: Minimum Bus Stop Elements addresses the minimum characteristics needed in order for a bus stop to be functional for bus and customer use, including customers with disabilities.
- Part III: Passenger Amenities at Bus Stops, discusses additional bus stop features that enhance the attractiveness of transit as a transportation alternative.

Part I: Bus Stop Placement

In determining the placement of new bus stop locations, a number of factors should be considered that both provides a safe, accessible area for transit riders and provides efficient operations for transit vehicles. However each new or relocated stop must be examined on a case-by-case basis with regards to stop spacing and placement.

Stop Spacing

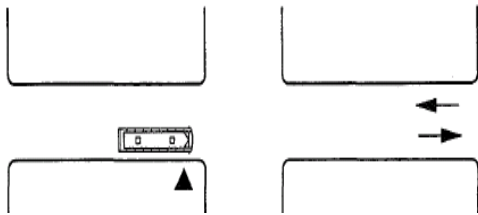
In very high density centers, such as activity centers like hospitals, universities, etc., bus stops should be placed every 660-750 feet (1/8 mile). In high density urban areas (major employment centers and/or areas with population densities greater than or equal to 4,000 persons per square mile or more), bus stops should ideally be spaced at intervals no more than 1,320 feet (¼ mile) and no less than 600 feet along each route. In less dense suburban areas (areas with population densities 2,000 - 4,000 persons per square mile), bus stops should ideally be spaced at intervals no more than 2,000 feet and no less than 1,320 feet (¼ mile to ½ mile). In low density and rural areas bus stops should be every ½ mile to 1 mile or the route should allow for flag stops.

Density Characteristics	Spacing Dimensions
VERY HIGH – Activity centers such as hospitals and universities	Every 660 – 750 ft (1/8 mile)
HIGH – 4,000 persons per square mile High Densities: Apartments, Senior Housing, offices, and commercial. Density = 4 units/acre	Approximately every ¼ mile
MEDIUM – 2,000 – 4,000 persons per square mile. Density = 3 units/acre	Every ¼ to ½ mile
LOW OR RURAL – Less than 2,000 persons per square mile. Density = 1-2 units/acre	Every ½ mile to 1 miles or flag stop

Stop Placement

The following summarizes the major advantages and disadvantages of placing bus stops in certain locations relative to the street. Three types of stop placements describe where a bus stop is placed. Near-side stops describe a bus stop before the crossing intersection. If the stop is on the farther and opposite end of the intersection it is described as far-side. Stops located in the middle of a block away from an intersection are described as mid-block stops.

Near Side



When placing a stop near side make sure there is at least 100' of curb clearance prior to the head sign 30-50' from the intersection. For bus stops that are shared with WMATA buses, an additional 50' should be added.

Stops should be placed near side under the following circumstances:

- When traffic is heavier on the far-side than on the approaching side of the intersection
- When pedestrian access and existing landing area conditions on the near-side are better than the far-side

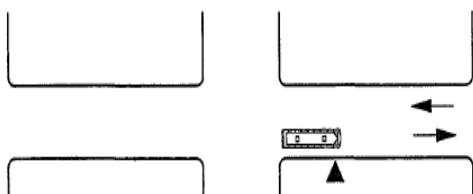
Advantages to placing stops near side include:

- Less potential conflict with traffic turning onto the bus route from a side street
- Passengers usually de-board closer to a sidewalk

Disadvantages to placing a stop near side include:

- Potential conflict with right-turning traffic as cars may cut in front of the bus while it's stopped
- The stopped bus obscures the sight distance of drivers entering from the right as well as crossing pedestrians
- At intersections controlled by a stop sign, the stopped bus may block visibility of the sign

Far Side



When placing a far near side make sure there is at least 75-80' of curb clearance after the intersection with the head sign 50' from the intersection. Additional curb clearance will be needed for stops following right-hand turns and may also be needed following left-hand turns. For bus stops that are shared with WMATA buses, an additional 50' should be added.

Stops should be placed far side under the following circumstances:

- When traffic is heavier on the near-side than on the far-side of the intersection.
- At intersections where heavy left of right turns occurred
- When pedestrians access and existing landing area conditions on the far-side are better than on the near-side
- At intersections where traffic conditions and signal patterns may cause delays.
- At intersections with transit signal priority treatments

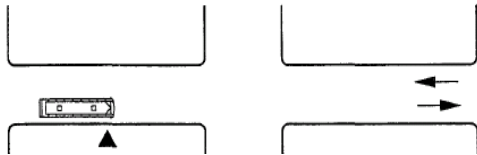
Advantages to placing stops far side include:

- Does not conflict with vehicles turning right off of the direction of the bus route
- Appropriate after the route has made a left-hand or right-hand turn
- The stopped bus does not obscure sight distance to the left for vehicles entering or crossing from the side street
- At signalized intersections, buses can more easily re-enter traffic.
- The stopped bus does not obscure traffic control devices or pedestrian movements at the intersection

Disadvantages to placing a stop far side include:

- The stopped bus obscures the sight distance to the right of drivers entering from the cross street to the right of the bus
- If the bus stopping area is of inadequate length, the rear of the stopped bus will block the cross street (especially an issue for stops where more than one bus may be stopped at a time)
- If the bus stops in the travel lane, it may result in queued traffic behind it blocking the intersection

Mid Block



Mid block stops require a minimum 90' of curb clearance with the header sign 25' from the far end of the pull-out area. If there is a mid-block crosswalk, the header sign should be at least 30' before or 50's after the crosswalk. For bus stops that are shared with WMATA buses, an additional 50' should be added.

Stops should be placed mid block under the following circumstances:

- When traffic or street/sidewalk conditions at the intersection are not conducive to a near-side or far-side stop
- When the passenger traffic generator is located in the middle of the block
- When the interval between adjacent stops exceeds stop spacing standards for the area
- When a mid-block stop is compatible with a corridor or district plan

Advantages to placing stops mid block include:

- The stopped bus does not obstruct sight distances at an intersection
- May be closer to major activity centers than the nearest intersection

Disadvantages to placing a stop far side include:

- Requires most curb clearance of the three options (unless a mid-block sidewalk extension is built)
- Encourages mid-block jaywalking
- May increase customer walking distances if the trip generator is close to an intersection

Bus Turnouts

A bus turnout is a specially constructed area separate from the travel lanes and off the normal section of the roadway the bus runs along. Turnouts provide for the pick up and alighting of passengers. This design allows through traffic to flow freely without the

obstruction of stopped buses. Bus turnouts are usually placed along high-volume or high-speed roadways, such as arterial roads. Bus turnouts are also frequently placed in more congested areas such as a downtown or shopping district where large numbers of passengers may board or alight.

In determining the placement of bus stops, it's important to consider current conditions of the roadway. One aspect to examine is the speed of the roadway. If traffic moves faster than 40 miles an hour and the bus stops in the travel lane, this can cause delays and hazardous conditions for other drivers on the road. Such conditions warrant a turnout, paved shoulder, or another area of adequate curbside clearance at least 12 feet wide. Bus turnouts are desirable where street traffic speeds are 40 mph or more and one of the following conditions exist:

- Peak period boarding average exceeds 20 boardings per hour
- Average peak period dwell time exceeds 30 seconds per bus
- The local jurisdiction becomes aware of a high frequency of accidents involving buses and/or pedestrians within the past year
- When traffic in the curb lane exceeds 250 vehicles during the peak hour and the curb lane is less than 20 feet wide or when bus volumes exceed 10 or more per peak hour
- Where bus stops in the curb lane are prohibited
- Where sight distances prevent traffic from stopping safely behind a stopped bus (e.g. hills, curves)
- At stops where there are consistent wheelchair lift boarding's
- Where buses are expected to layover at the end of a trip
- Where there is adequate space for turnout length and depth given to allow a bus to safely exit and enter into the flow of traffic

The far side of an intersection is the preferred location for turnouts. Nearside turnouts typically should be avoided because of conflicts with right turning vehicles, delays to transit service as buses attempt to re-enter the travel lane, and obstruction of pedestrian activity as well as traffic control devices. The exception would be where buses would use a right turn lane as a queue jump lane associated with a bus signal priority treatment at an intersection (where a far side pullout is not possible). Turnouts in mid-block locations are not desirable unless associated with key pedestrian access to a major transit-oriented activity center and subject to the general guidelines above.

Some of the advantages of bus turnouts are:

- Allows traffic to proceed around bus, reducing delays for general traffic
- Maximizes vehicular capacity of roads
- Clearly defines the bus stop
- Passenger loading and unloading can be conducted in a more relaxed manner

- Eliminates potential accidents such as rear end collisions and collisions caused by cars trying to go around a stopped bus

Bus turnouts also offer some disadvantages such as:

- More difficult to re-enter traffic, increasing bus delay and average travel times
- Uses additional space that may require right-of-way acquisition

One way to mitigate the potential delay caused by having to re-enter traffic is to place the turnout at a signalized intersection where the signal can create gaps in traffic allowing the bus to re-enter the street. Twelve foot width is desirable to reduce sideswipe accidents, ten foot width are minimum. On streets with bike lanes and where bus layovers occur, the turnout should be wide enough so that buses do not impede the bike lane

Bus Bulbs

At locations with curbside parking, extending a portion of the sidewalk out to the travel lane allows most of the curbside parking to remain while providing a connection between the travel land and sidewalk, allowing for easier access to the bus. The extension must be parallel to the roadway, at least 5 feet wide, and offer a paved surface at least 8 feet deep perpendicular to the roadway to meet ADA requirements. While a small sidewalk extension of these dimensions will meet minimum ADA standards, a 30' curb bulb is preferred to ensure both front and rear door access and egress for most buses. The recommended bulb is 6-feet deep in addition to curb face and gutter pan. Bulbs maximize the amount of on-street parking around bus stops while minimizing needed curb clearance.

Parking Restrictions at Bus Stops

Parking restrictions (either red curb or "No Parking" signs) should be placed at bus zones when parking is expected to impact bus operations. The lack of parking restrictions could impact bus operations, traffic movement, safe sight distance, and passenger access.

Potential issues include:

- The bus may have to double park when servicing a stop, which would interfere with traffic movements
- Passengers would have to maneuver between parked vehicles when entering or exiting the bus, which can endanger the passengers
- The bus would lack access to the curb/sidewalk area to board or alight wheelchair passengers

It is important that these parking regulations should be enforced in a consistent and expedient manner by the appropriate local jurisdiction

Bus Stops and Driveways

Whenever possible, bus stops should not be placed near a driveway. However, if a placement near a driveway is unavoidable:

- Attempt to keep at least one exit and entrance open to vehicles accessing the property while a bus is loading or unloading passengers. When there are two driveways to a parcel on the same street, the upstream driveway should be blocked forcing vehicles to turn behind the bus to access the driveway.
- It is preferable to fully, rather than partially, block a driveway to prevent vehicles from attempting to squeeze by the bus in a situation with reduced sight distance.
- Locate bus stops to allow good visibility for vehicles leaving the property and to minimize vehicle/bus conflicts. This is best accomplished by placing bus stops where driveways are behind the stopped bus.
- Ensure that passengers have a safe area to wait when loading must occur in or adjacent to a driveway

Additional Factors in Selecting a Bus Stop Location

- Sidewalk Conditions - Stops should be located and constructed to make use of existing sidewalk facilities, or new sidewalk facilities should be constructed to provide pedestrian access to the bus stop. At stops with heavy ridership, additional passenger waiting/standing areas should be constructed off of the main sidewalk so that waiting passengers do not block passage of other pedestrians.
- Crosswalks - Bus stops should ideally be located close to existing crosswalks to encourage safe pedestrian crossings, but also located so that a stopped bus will neither block a crosswalk nor obstruct pedestrian visibility of oncoming traffic and vice-versa. In general, it is safer to locate the bus stop on the far side of a crosswalk, so that passengers will cross behind, rather than in front of, the bus.
- Landscaping Issues - The presence of trees and bushes at a bus stop may necessitate periodic trimming at the stop to prevent buses from hitting tree branches and bushes from encroaching on sidewalks. Tall bushes are also a potential security problem, and additional lighting should be considered at stops with this issue.
- Limited Visibility Over Hills and Around Curves - Bus stops should not be located over the crest of a hill, immediately after a road curve to the right, or at other locations that limit the visibility of the stopped bus to oncoming traffic. If the bus stops in the travel lane at such locations, it is in danger of being struck from the rear. Even if the bus pulls off the road at such stops, pulling back into the travel lane presents accident potential. If a bus stop must be located at such a stop, approaching cars should be warned of the need to be prepared to stop.

- On-Street Parking – It would be desirable to remove parking at bus stops so the bus can pull off, service the stop, and re-enter the travel lane, or installation of a sidewalk extension or curb bulb to provide passenger access to the bus. Removing parking is problematic though, especially from the standpoint of business owners where the parking is located.
- Proximity to Major Trip Generators - When feasible, a bus stop should be located to minimize walking distances to the activity center that is expected to generate the most ridership
- Transfer Locations - Bus stops where transfer activity between routes is heavy, stops should be located to minimize street crossings of passengers transferring to other routes.
- Bicycle Facilities - To the extent feasible, bus stops should be located so they do not block bicycle travel lanes. Bus stops should also be located so that bicycle racks do not block pedestrian access to the bus boarding and alighting area.

Part II: Minimum Bus Stop Elements

Passenger amenities are placed at selected bus stops to help improve passenger comfort and the relative attractiveness of transit as a transportation alternative. Selection of bus stops to install certain amenities should take into account a variety of factors including:

- Average daily ridership
- Proximity to major trip generators
- Passenger transfer activity
- Planned neighborhood improvements
- Customer and community requests

Below is a table summarizing which amenities should be considered given the bus stops activity during the day:

Amenity	Customer Boarding Activity per Day		
	<50	51-100	101>
Bus Stop Sign	X	X	X
ADA Access	X	X	X
Lighting	X	X	X
Concrete Pad sidewalk	X	X	X
Concrete Pad roadway	X	X	X
Bench		X	X
Schedule		X	X
Trash receptacle		X	X
Standard Shelter			X
System Map			X
Bicycle Facilities			X
Real Time Travel Info			X

Landing Area

Bus stop sites shall be chosen such that, to the maximum extent practicable, lifts or ramps can be deployed on a firm, stable surface as to permit a wheelchair or mobility aid user to maneuver safely onto or off the bus and bus stop. New bus stops may not be established at locations that do not meet the following minimum standards for landing areas. Relocation or improvement of existing bus stops must also result in a landing area that meet or exceed the following standards.

- Dimensions - The minimum landing area requirement for a bus stop (the area from which passengers board the bus and onto which passengers alight from the bus) is a continuous, unobstructed solid area contiguous to the curb that measures at least 5' parallel to the street and at least 8' perpendicular to the street at the front door, and at least 10' parallel to the street and at least 8' perpendicular to the street at the back door. Distance between front and rear boarding area is 18 feet. These are the minimum dimensions needed to deploy a lift or ramp and allow a customer in a wheelchair to board or alight the vehicle.
- To provide for rear-door alighting from larger buses, the landing area should ideally be at least 30 feet long for stops served by 40' buses and at least 40' long for stops served by 60' articulated buses.
- Stops where more than one bus is boarding/alighting passengers at the same time will need additional boarding and alighting areas to be determined by the size and placement of the buses serving each stop.
- Slope - The slope of the landing area must be parallel to the slope of the roadway in order for the bus wheelchair lift or ramp to be effectively deployed. The slope should not exceed 1 foot vertical over 20 feet horizontal (5%), and the cross slope should not exceed 1 foot vertical over 50 feet horizontal (2%)
- Surface Material - The landing area must be firm, stable, and slip-resistant. Concrete is the preferred surface for the landing area. It is possible for the lift or ramp to span an area of another material, such as a grass or soil in a planter strip between the curb and the sidewalk. However, for the safety of ambulatory customers who may stumble on an uneven surface, it is strongly recommended to construct a continuous concrete pad. In newer developments where a new bus stop will be placed, a continuous surface from the curb and the sidewalk should be provided for the purposes of deploying a bus ramp or lift for wheelchairs or other mobility devices. In uncurbed shoulder areas, the landing area may be constructed of asphalt.
- Height Relative to the Street - It is also preferable that the landing area be elevated above street level for pedestrian safety. For stops served by low-floor, ramp-equipped buses a standard curb provides an acceptable ramp slope.
- Clearances - A horizontal clearance between obstructions of 48 inches, and a vertical clearance of 84 inches should be maintained in boarding area

Signage

- Bus Stop Sign - Each bus stop must be marked with a sign indicating the transit operator(s) that serve(s) the stop and which route(s) service(s) that specific stop. Bus stop signs indicate to passengers and drivers where buses stop, as well as publicize the availability of the service. The sign must be securely mounted on its own post or a light standard, at an angle perpendicular to the street. The sign must be easily

visible to the approaching bus driver, ideally within 4 feet of the edge of the street. The bus stop sign should neither block nor be blocked by other jurisdictional signs. To prevent the sign from being struck by the bus, mirrors, signs should be placed at a sufficient distance not to impede with bus mirrors and affect the pedestrian path of travel, generally no closer than 2 feet from the street. The header sign is the point at which the front of the bus should be aligned when the bus is servicing passengers and thus should be placed approximately one foot beyond the far side of the landing area for stops served by front-lift buses. The bottom edge of the sign should be positioned at a height of at least 80 inches from the ground.

- Each header sign should contain the names of routes that service the stop as well as the telephone number to call for more information. In order for the bus stop sign to meet ADA minimum specifications for signs posted at 80 inches, the letters and numbers must be at least 3" high. The ADA standards further specify that the characters have a width-to-height ratio between 3:5 and 1:1, and a stroke-to-width ratio between 1:15 and 1:10. These standards make signage accessible to persons with low vision. These requirements do not apply to route and schedule information posted at bus stops
- Route and Schedule Information - At bus stops that are near major trip generators, or where attracting additional ridership is desirable, an up-to-date route and schedule should be posted as well as information about fares, holiday schedules. Space must be provided on all four sides

Curb Ramps

Curb ramps are usually installed at corners or intersections to allow entrance to the street surface. Curb ramps are an integral part of the pedestrian access route leading to and from bus stop locations. Ramps shall be designed to conform to state and federal ADA design standards

Lighting

Bus stops that are served after dark should be lit to promote passenger safety and security and to improve visibility of waiting passengers to approaching bus drivers. Ideally, bus stops should be located to take advantage of existing street lights or other outside facility lighting. Alternately, installation of new lighting at the bus stop should be considered

Pedestrian Connections

To be fully useable, a landing area of 5 feet wide and 8 feet in length must be connected to a sidewalk of sufficient width and condition for a person in a wheelchair to use - the narrowest useable width is four (4) feet. Curb cuts with slopes no steeper than 1 inch of level change across 12 inches of distance are needed where level changes occur (such as a crosswalk). If items such as newspaper boxes, utility poles, trash cans, and encroaching grass or bushes constrict a portion of the sidewalk to less than 4', the sidewalk is not accessible to

wheelchair users. If necessary, the existing sidewalk should be widened or new sidewalk constructed to ensure that customers are able to get to and from the bus stop. To the extent feasible, sidewalk connections around bus stops should provide safe pedestrian access to the passenger trip generators near the bus stop.

Land uses should be designed to facilitate the movement, and minimize the distances between the development and the transit services. Good pedestrian access can be achieved by considering the following guiding principles:

- Pedestrian routes to bus stops should be designed to meet the needs of all users (including disabled, elderly, and children).
- The pedestrian system should provide convenient connections between destinations including residential areas, schools, shopping centers, public services and institutions, recreation, and transit.
- Provide a dedicated sidewalk and/or bike paths through new development that are safe and direct to the nearest bus stop or transit center.
- Minimize the distance between buildings and the bus stop through proximity and orientation. This can be encouraged by including transit accessibility concerns in zoning policies, setback guidelines, building orientation guidelines, and parking requirements to encourage transit-oriented development.
- Minimize the use of elements that restrict pedestrian movement such as meandering sidewalks, walled communities, and expansive parking lots. Pathways should be designed so pedestrians traverse as straight of path as possible.
- Eliminate barriers to pedestrian activity. This includes sound walls, landscaping, berms, or fences which impede pedestrian access or visibility. If there is restricted access, gates should be installed at access points.
- Pave pedestrian pathways and ensure they are accessible to everyone. Provide accessible circulation routes that include curb cuts, ramps, visual guides, signage (visual and Braille) and railings where needed. Place ADA compliant curb ramps at each corner of an intersection.
- Adequate drainage should be provided to avoid pooling and muddy conditions.
- Provide street lighting along bus stop access routes and safety lighting at intersections to promote safety and security for transit patrons. Ideally bus stops should be illuminated by street lighting; if not, consider installation of lighting at the bus stop.
- New residential development should provide breaks in walls between properties to allow pedestrian access to bus stops.
- Where a bus stop serves as a transfer point, there should be a paved connection to the connecting route stops.

- Pathway slope should not exceed 1 foot vertical over 20 feet horizontal (5%). Pathway cross slope should not exceed 1 foot vertical over 50 feet horizontal (2%).
- A minimum horizontal clearance of 48 inches (preferable 60 inches) should be maintained along the entire pathway.
- A vertical clearance of 84 inches should be maintained along the entire pathway.

Safety and Security

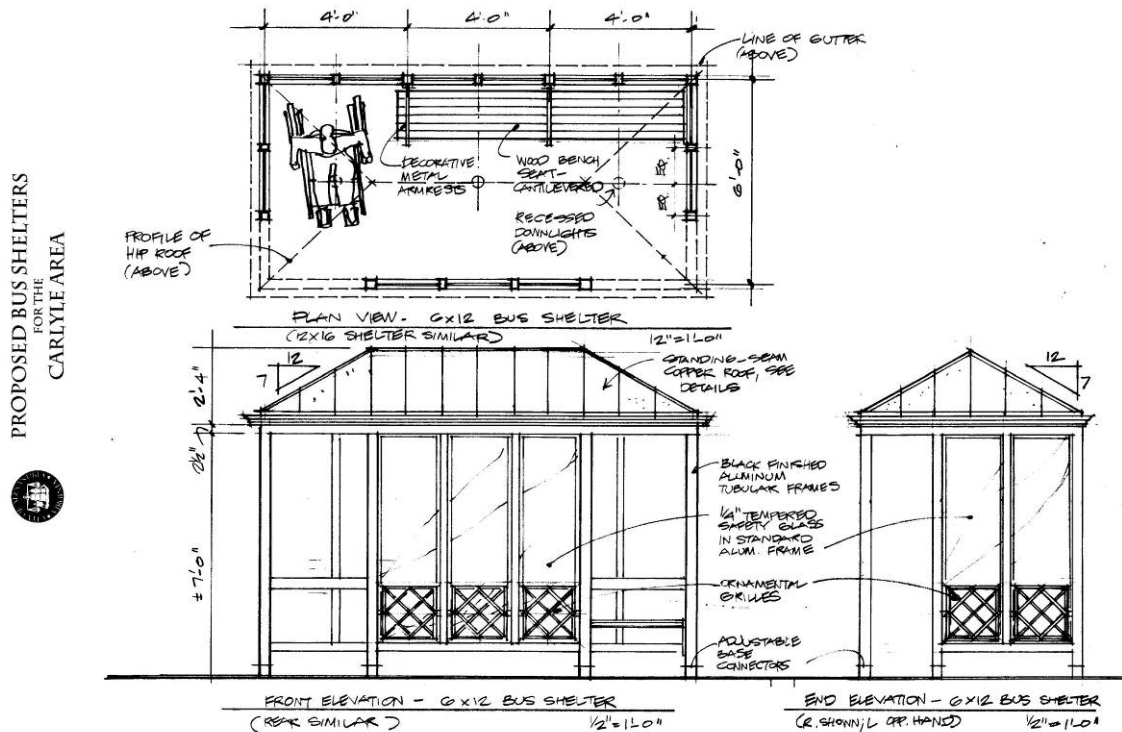
Traffic safety issues are discussed within the context of bus stop placement considerations. Curbside safety and security issues include:

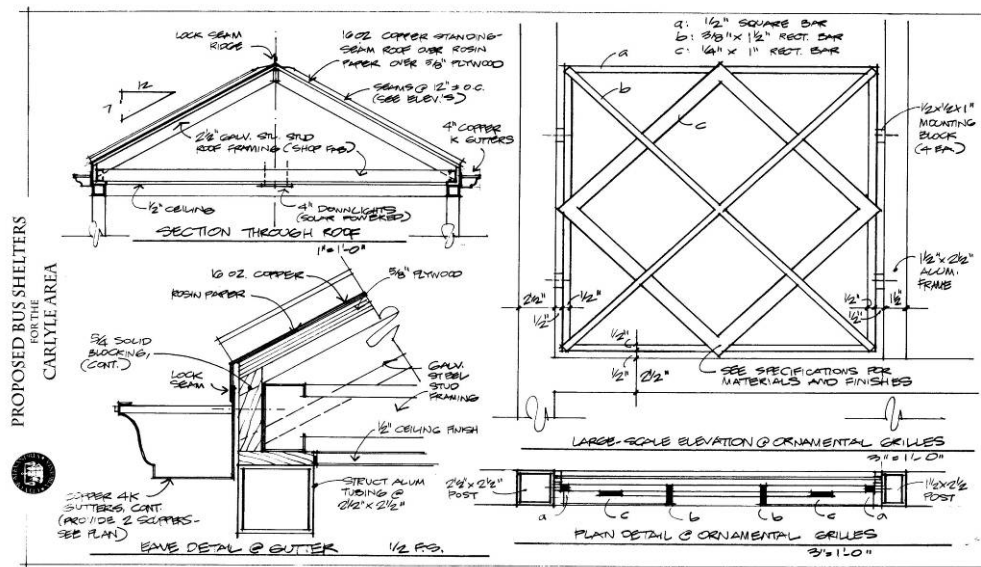
- Location of storm drains and catch basins, which put passengers at risk of catching a foot under one when boarding or alighting the bus. Water accumulation areas can also result in muddy and slippery surfaces
- Uneven surfaces and surface traction, which could result in a slip or fall
- Water accumulation areas, which can also result in muddy and slippery surfaces
- Overgrown bushes, which could potentially present a security hazard as well as encroach on the sidewalk and landing area
- Other obstacles in the sidewalk that, in addition to making it inaccessible, force pedestrians to walk in the street area lighting

Part III: Passenger Amenities at Bus Stop

Shelters

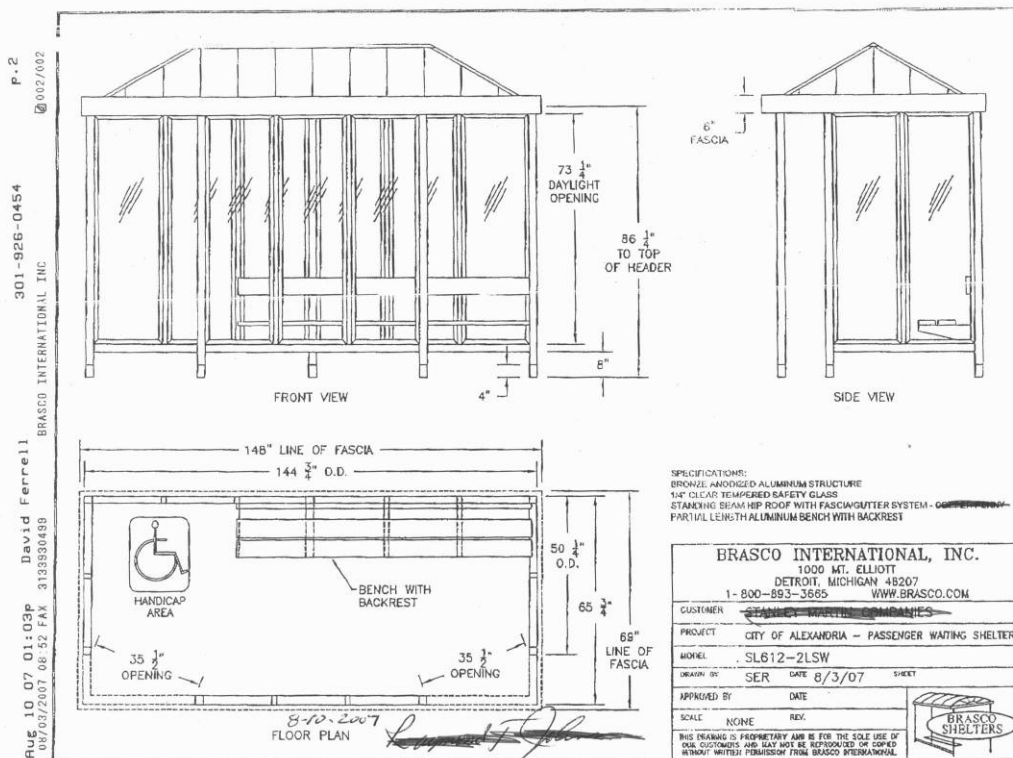
Transit shelters are installed at selected bus stops to provide weather protection as well as seating for waiting passengers. Bus stops used exclusively by DASH buses with ridership exceeding 100 boardings per day are priority candidates for new shelters, although it is the City's goal to provide a higher level of amenities including shelters at all bus stop locations in order to further promote the use of transit.





Bus Benches

Benches are installed inside all standard shelters. Benches may also be installed independently at bus stops that do not have shelters due to low passenger activity but where some level of amenity is justified. Local communities may also install benches as one element of an improved streetscape; in this case, efforts should be made to locate benches near bus stops where they do not create barriers to accessible bus boarding or sidewalk usage.



Trash Receptacles

Trash receptacles should be installed at all standard shelters and may also be installed independently at bus stops that do not have shelters. Trash receptacles should be positioned so that they encourage use by waiting passengers without blocking wheelchair or pedestrian access to the landing pad, bus, shelter, sidewalk, or information case. At bus stops where trash receptacles are installed, the receptacle should ideally be positioned to the immediate right or left of the shelter (although sidewalk conditions and right-of-way limitations may prevent this. Local communities may also install receptacles as part of an improved streetscape; in this case, efforts should be made to locate benches near bus stops where they do not create barriers to accessible bus boarding or sidewalk usage.

Bicycle Parking

Bicycle parking facilities, such as bike racks and storage lockers, may be provided at bus stops by local jurisdictions or adjacent property owners for the convenience of bicyclists using transit. Bicycle parking facilities discourage the practice of locking bicycles onto bus facilities or onto adjacent property. By confining bicycles to one area, the racks or lockers can reduce visual clutter and maintain appropriate pedestrian clearances. The guidelines for the placement of bicycle parking facilities are:

- Locate bike rack or lockers away from other pedestrian or bus patron activities to improve safety and reduce congestion.
- Coordinate the location of bicycle parking facilities with existing on-site or street lighting.
- Ensure parked bikes are visible at all times. Do not locate bicycle parking where views are restricted by a bus shelter, landscaping, or existing site elements, such as walls.
- Design and placement of bicycle parking facilities should complement other transit furniture at bus stop.
- Covered or weather protected parking locations are an important bonus to bicyclists.

When selecting bicycle bike rack or lockers devices, consider the following:

- Provide ability to lock bicycle frame and at least one wheel.
- Support bicycle without pinching or bending the wheel. If the wheel slot is too narrow, a mountain bike tire will not fit.
- Avoid scratching the paint on the frame of the bike.
- Provide a place to lean the bike while locking the bike.
- Locking procedure should be quick and easy to identify.
- Require minimal space.
- Design of bike rack or lockers device should not trap debris.
- Device should be easy to install but difficult to steal.

Intelligent Transportation Systems (ITS) Features and Smart Stations

Alexandria will look to utilize ITS features with their smart stations and stops.

Installation of ITS features are likely in the future, these include:

- Real-time “next-bus” arrival information
- Electronic posting of schedules
- Access to route information
- Installation of panic buttons or call boxes

In preparation for such technologies new bus stop locations and improvements to existing stops should provide for electrical and communications conduits.

A variety of amenities can be provided at transit Smart Stops, Shelters, and Station locations to enhance the attractiveness of public transportation and to provide important information and amenities to passengers. Some features that would set these Smart stops, stations, and shelters apart from traditional bus stops and shelters include:

- Use of wireless technology for personal passenger information
- Ticket machines/information kiosks
- Real-time travel information
- Cell phone text messaging for the next bus departure
- The use of environmental design and operation such as solar power
- Efficient layout of weather protected interior spaces, with the inclusion of off-vehicle fare collection technology.
- Designs that permit efficient, orderly and rapid flow of alighting and boarding passengers from the stop to the vehicle
- Bicycle and pedestrian amenities including bicycle racks, lockers, and benches.
- Vendors for coffee, newspaper, magazines, etc.

Smart Stations, Shelters, and Stops will vastly improve the quality and experience of public transit in Alexandria by providing users with weather protected access, access to traveler information systems, and electronic payment systems. All of these additional amenities will help by enhancing safety, scheduling, and improving the quality of service. These facilities will be fully accessible by pedestrians and bicyclists as well as providing adequate lighting for safety and varying levels of amenities depending on demand and location. Services and amenities provided at these facilities may include bicycle racks, lockers, coffee service, newspaper stands, and internet access.

Appendix B – Alexandria Streetcar Concept

A modern streetcar is an electrically powered, 66-foot long, 8-ft wide mass transit vehicle. Each vehicle can carry up to 150 passengers. It shares the existing roadway lane with vehicles on steel rail tracks set within the pavement.



Streetcars feature a pole that touches an overhead wire, called catenary. Once the power reaches the streetcar through the trolley pole, it is fed to motors, which are called traction motors that are located on each wheelset. The overhead wire, or catenary, isn't as visually obtrusive as one might imagine. Like street light poles, the catenary poles come in decorative styles that add to streetscapes. In many cases, poles can be combined with street lights and/or traffic signals to actually reduce the number of poles along the streets. The wires themselves are designed to blend in with the streetscape and do not pose aesthetic problems.

It takes one person, commonly referred to as a motorman or operator, to operate a streetcar. Since the rails do the steering, the operator regulates speed, controls the doors, and ensures the safe operation of the streetcar. At the end of the line, Streetcars can be ballooned, where they go through a loop or the operator can change ends. Many, if not all, streetcars are double ended so all an operator has to do is switch trolley poles and switch ends.

A Streetcar can travel at 45 mph; however, the operating speed will be set at the posted speed limit for the route.

Costs of streetcar lines vary widely because the specific needs of each community are different. Streetcar lines across the country have ranged from \$7.1 million per mile in Little Rock, Arkansas to \$12 million per mile of track in Portland, Oregon (these amounts include the cost of the streetcar vehicles). That cost includes all aspects, including steel rail, concrete, pedestrian-friendly stops, traffic signals, maintenance facility, power source, utility reconstruction, roadway reconstruction, and vehicles. Some other examples include:

- **Portland, Oregon**, The 4.6 mile loop line was constructed for \$12.4 million per mile, including seven modern streetcars.
- **Tampa, Florida**, a 2.3 mile line built for \$13.7 million per mile including eight Heritage streetcars.

- **Little Rock, Arkansas**, a 2.1 mile line built for \$7.1 million per mile, including three streetcars.
- **San Pedro, California**, built a 1.5 mile line for \$4 million per mile.

Streetcar lines are built three blocks at a time. It takes approximately three weeks to construct those three blocks. During construction, at least one lane of traffic will remain open in each direction. Streetcar track construction is relatively fast since most utilities generally do not need to be relocated. As a result, the impact to businesses and residences is minimized.

Unlike light rail, which requires the entire reconstruction of underground infrastructure to support the weight of the heavier light rail cars, streetcar rail is embedded into the street. Because of the lighter weight of streetcars, most modern streets can already support a streetcar. Construction of a streetcar line can be as basic as removing enough concrete in the road for the rails to seat, less disruption than repairing a simple underground water line.

Light rail systems costs approximately 3 times the cost for a Streetcar system, and a light rail system also requires its own dedicated lane of traffic. Simply stated, a light rail system is far too expensive and intrusive to the Central Avenue neighborhoods that we are trying to connect.

Modern Streetcars are ADA-compliant. Their low floor access allows passengers to enter or exit through wide doors at the same height as the transit stop platform, providing easy access for those with mobility difficulties as well as families with small children and strollers. Its exceptionally smooth operation enables wheelchairs with no need for tie-downs. As this project moves forward, project personnel will be continue to consult those with special needs (visual, hearing impaired) to ensure the streetcars and routes are designed appropriately.

Additionally, the Modern Streetcar's interior layout can be designed to allow bicycles to be brought on board using the wide passenger doors that are level with the station platforms.

Recent examples of the successful implementation of a streetcar system in a community are;

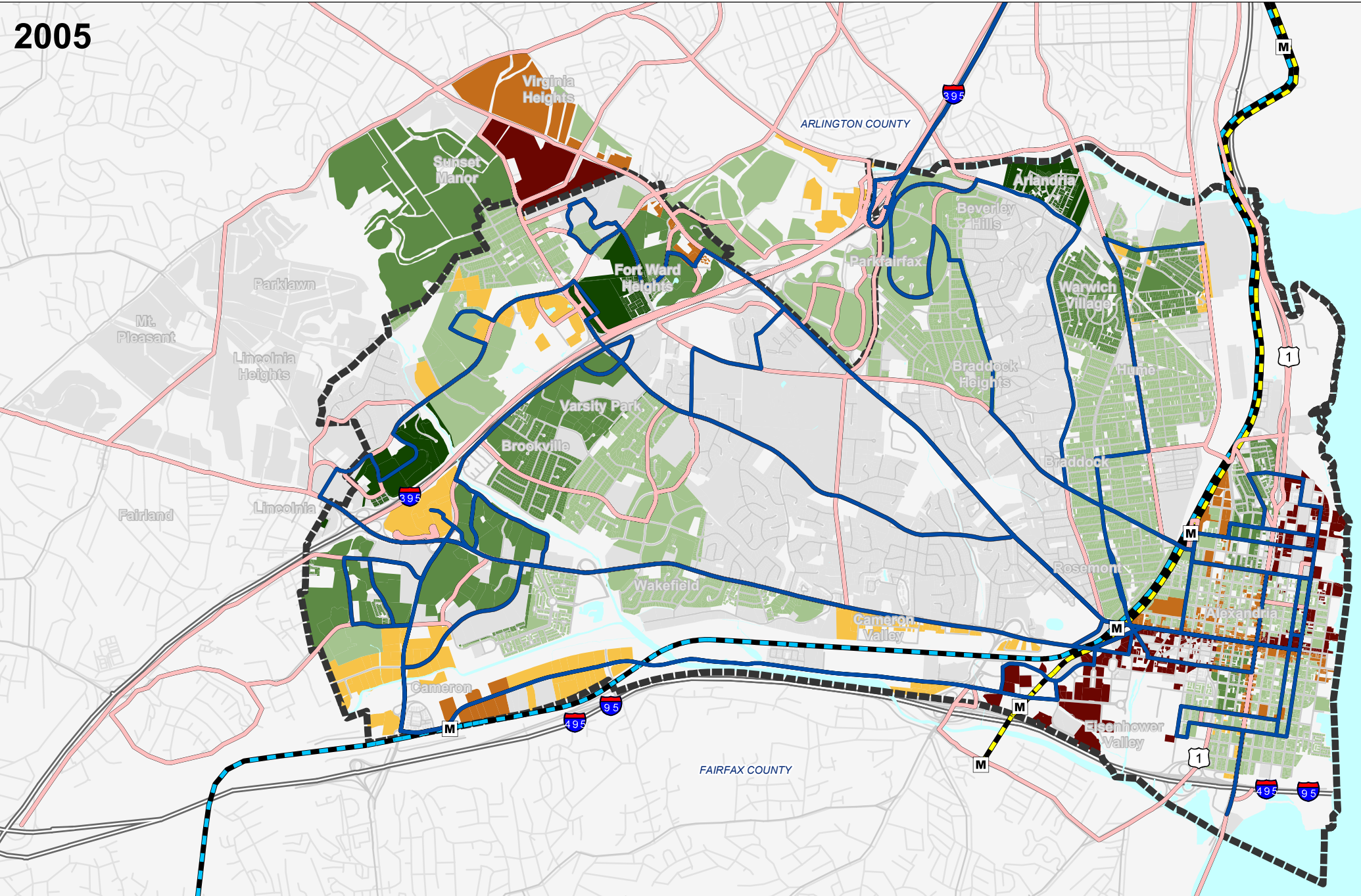
- **Kenosha, Wisconsin** (pop. 92,800) implemented a new system in 2000. \$150 Million in direct development has been generated to date. Currently 60,000 people ride the modern streetcar in Kenosha a year.
- **Little Rock, Arkansas** (pop. 184,000) implemented a new system in 2004. \$200 Million in direct development has been generated to date. Currently, 118,000 people ride the modern streetcar in Little Rock a year.
- **Tampa, Florida** (pop. 326,000) implemented a new system in 2003. \$1 Billion in direct redevelopment has been generated to date. Currently, 434,500 people ride the modern streetcar in Tampa a year.

- **Portland, Oregon** (pop. 556,000) implemented a new system in 2001. \$2.2 Billion in direct redevelopment has been generated to date. Since the streetcar was implemented, mass transit rider ship has increased 87%.

With the increase of alternative modes of transportation, the streetcar system is being looked at as a viable alternative in several communities across the nation.

Appendix C – Demographic Maps

2005



Population & Employment Density

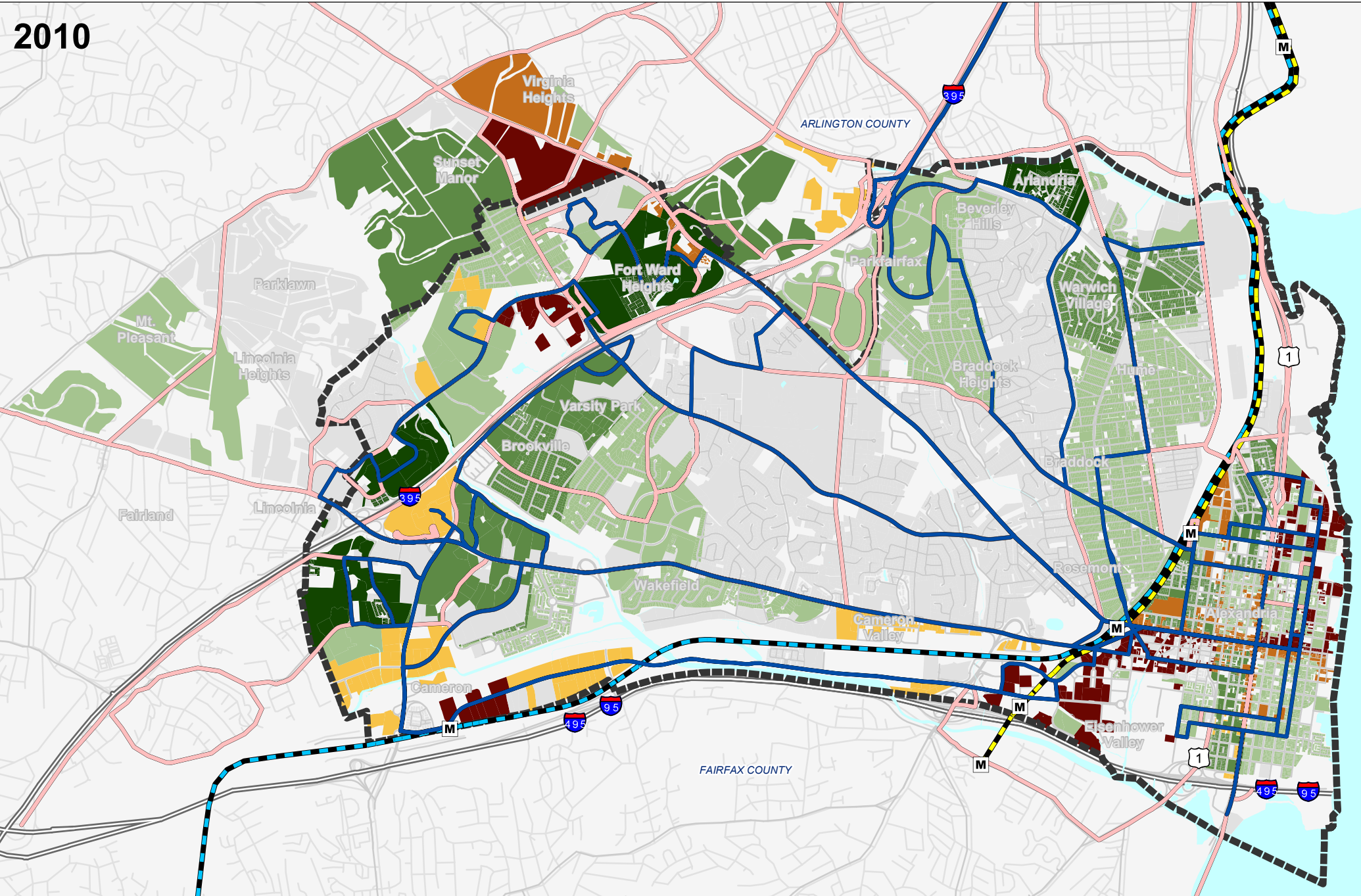
Persons	Employment
More Than 40	
20 - 40	
10 - 20	
Fewer Than 10	

- Legend**
- DASH Bus Network
 - Metro Bus Network
 - Metro Stations
 - Metro Yellow Line
 - Metro Blue Line

Date Updated: June 2008
Data Sources: DASH, U.S. 2000 Census
 Density calculated at the parcel level

0 0.25 0.5
 Mile

2010



Population & Employment Density

Persons	Employment
More Than 40	
20 - 40	
10 - 20	
Fewer Than 10	

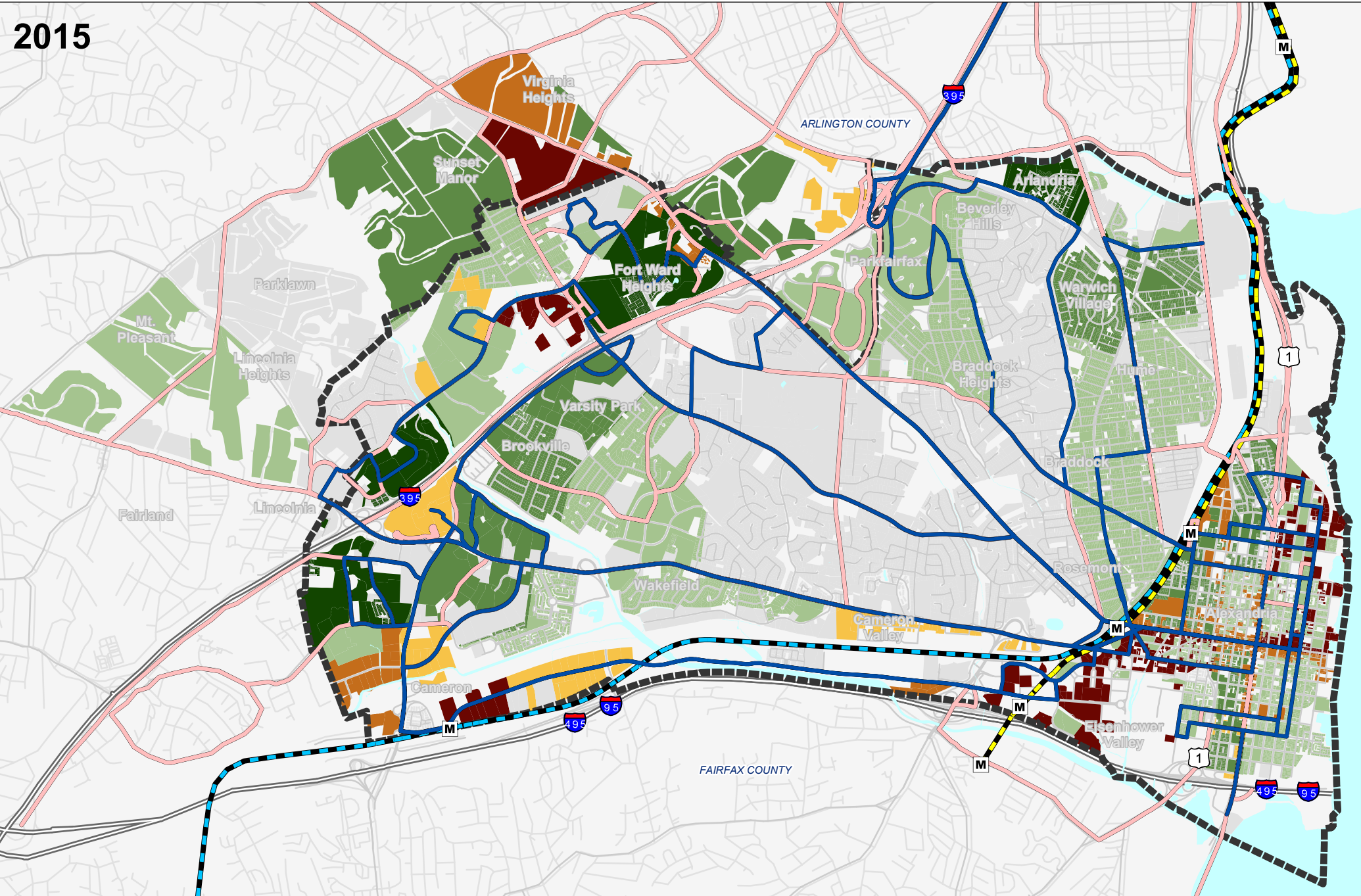
- Legend**
- DASH Bus Network
 - Metro Bus Network
 - Metro Stations
 - Metro Yellow Line
 - Metro Blue Line

Date Updated: June 2008
Data Sources: DASH, U.S. 2000 Census
 Density calculated at the parcel level

0 0.25 0.5 Mile



2015



Population & Employment Density

Persons		Employment	
	More Than 40		
	20 - 40		
	10 - 20		
	Fewer Than 10		

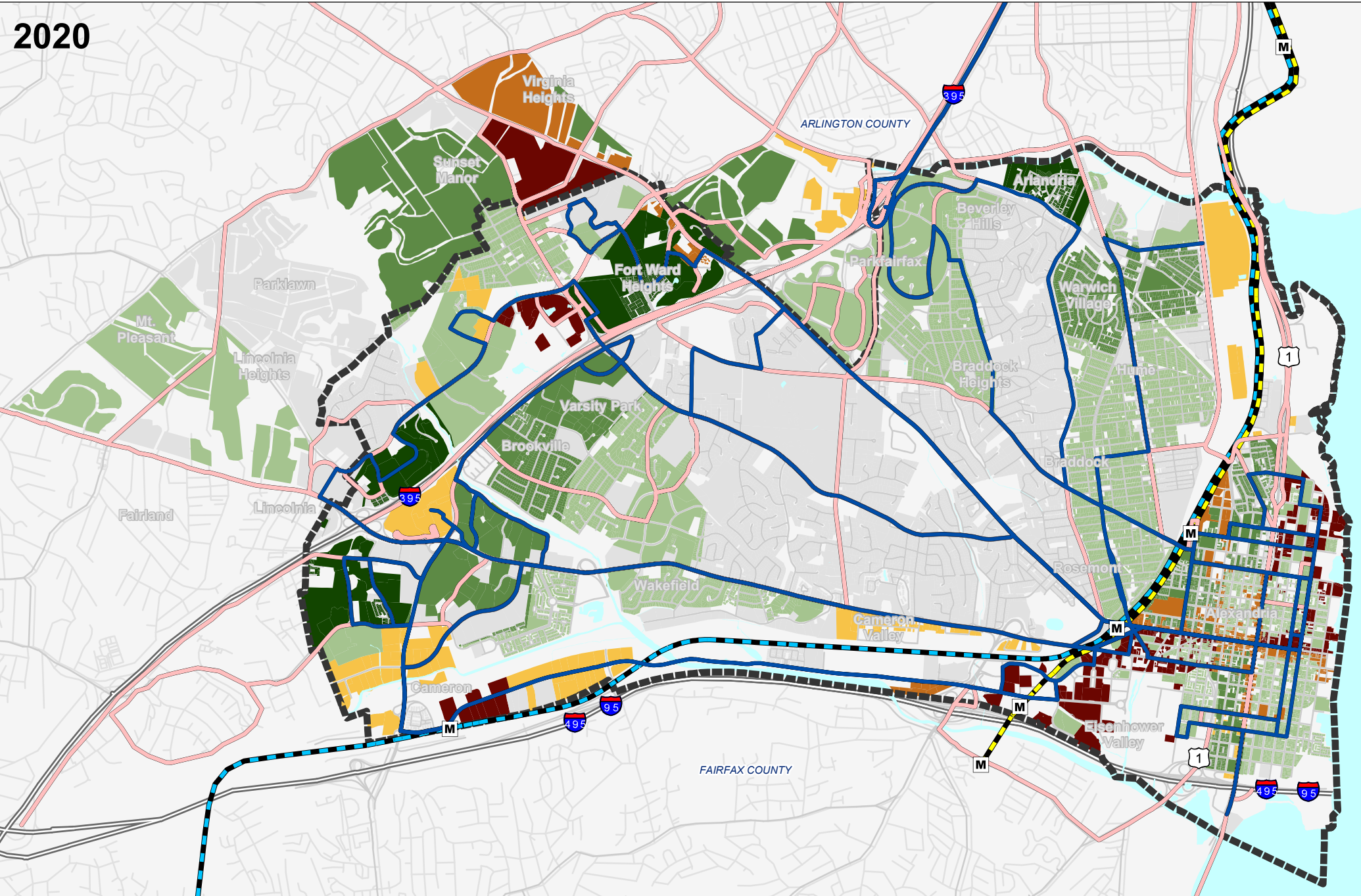
- Legend**
- DASH Bus Network
 - Metro Bus Network
 - Metro Stations
 - Metro Yellow Line
 - Metro Blue Line

Date Updated: June 2008
Data Sources: DASH, U.S. 2000 Census
 Density calculated at the parcel level

0 0.25 0.5
 Mile



2020



Population & Employment Density

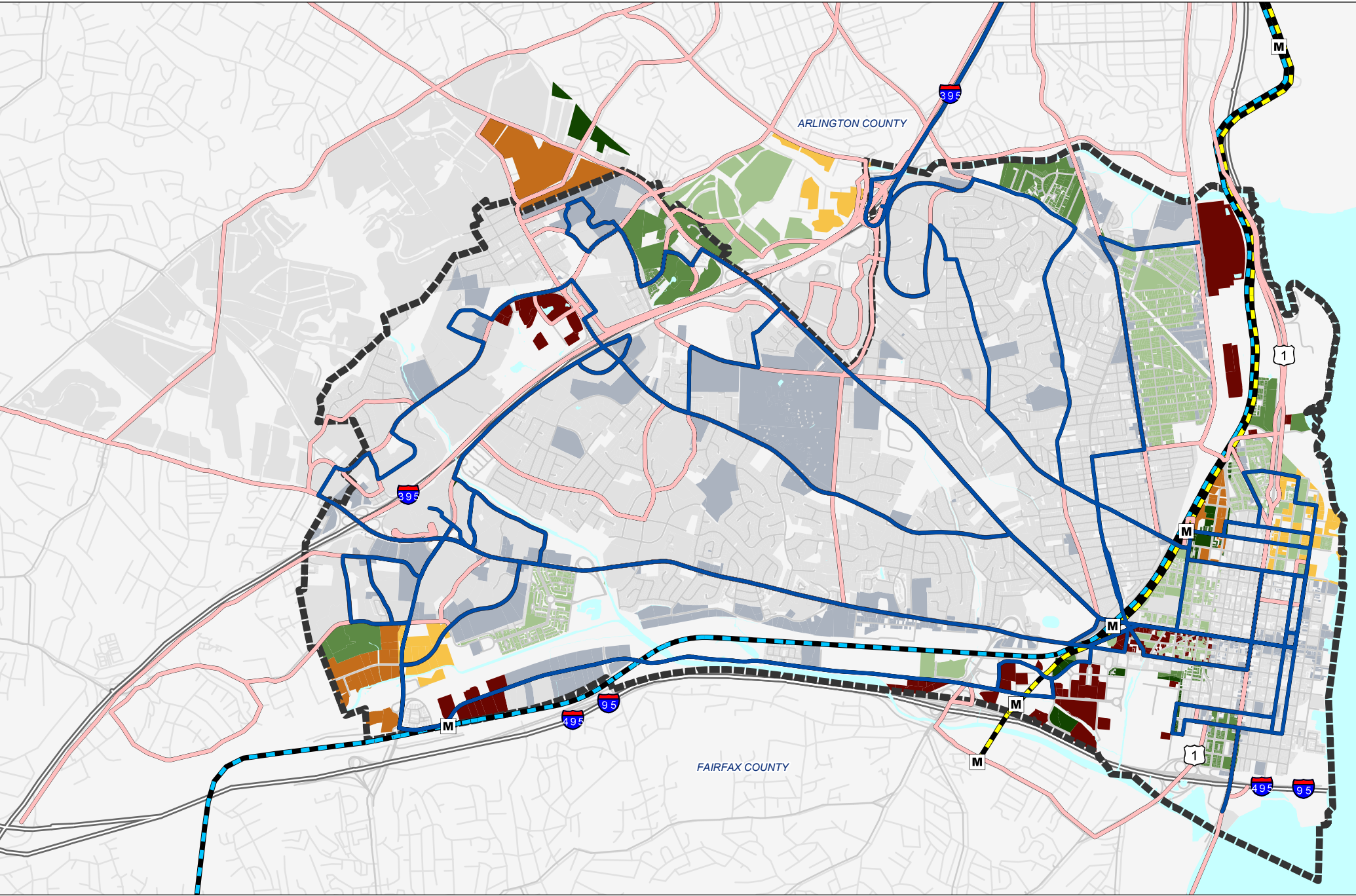
Persons	Employment
More Than 40	
20 - 40	
10 - 20	
Fewer Than 10	

- Legend**
- DASH Bus Network
 - Metro Bus Network
 - Metro Stations
 - Metro Yellow Line
 - Metro Blue Line

Date Updated: June 2008
Data Sources: DASH, U.S. 2000 Census
 Density calculated at the parcel level

0 0.25 0.5 Mile





Population & Employment Change - 2005 to 2020



Persons		Employment	
	More Than 8		
	4 - 8		
	2 - 4		
	Fewer Than 2		
	Negative Growth		
	N/A		

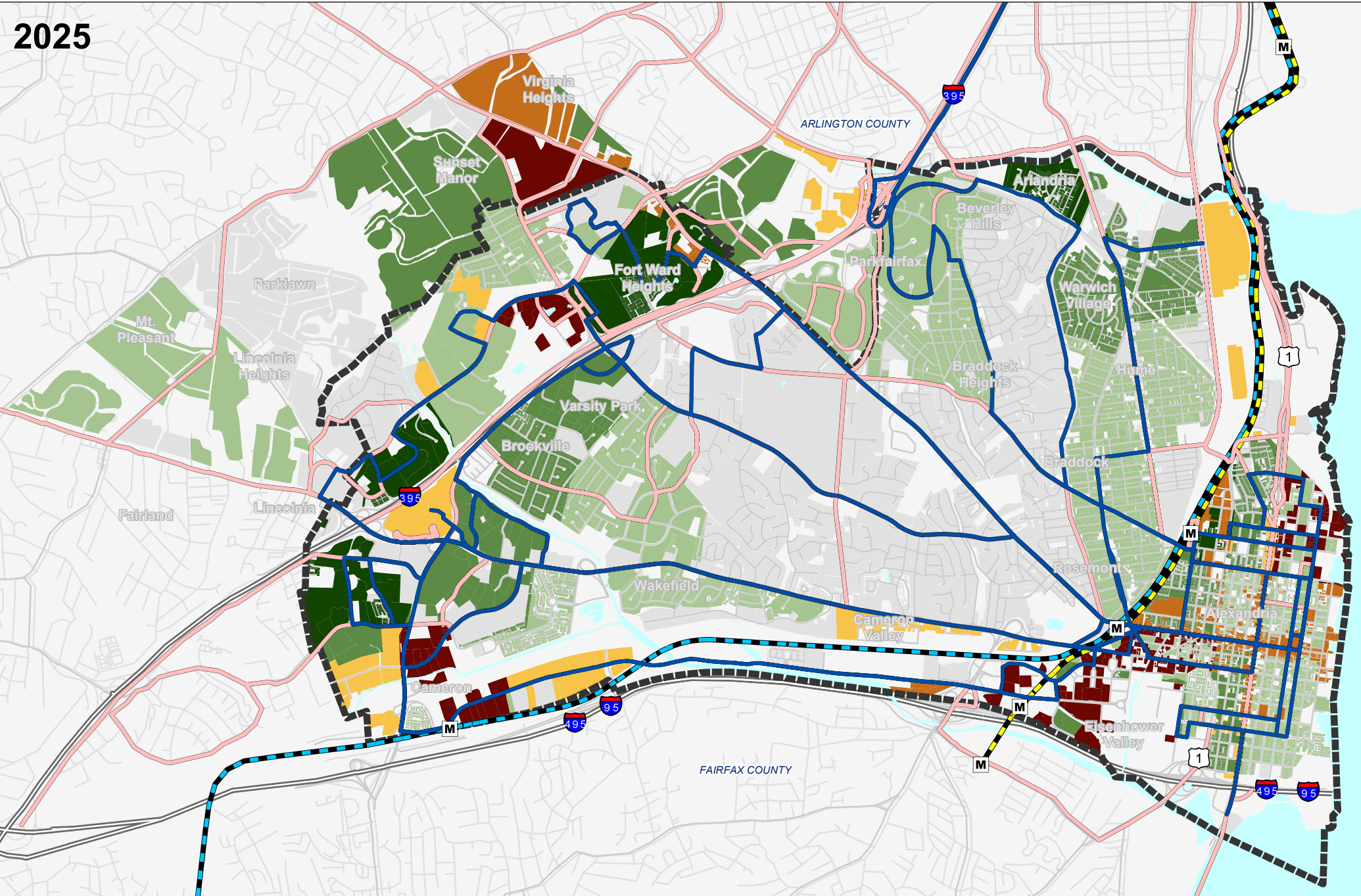
Legend	
	DASH Bus Network
	Metro Bus Network
	Metro Stations
	Metro Yellow Line
	Metro Blue Line

Date Updated: June 2008









Data Sources: DASH, U.S. 2000 Census






Density calculated at the parcel level

2025





Population & Employment Density

Persons		Employment	
	More Than 40		
	20 - 40		
	10 - 20		
	Fewer Than 10		

- Legend**
-  DASH Bus Network
 -  Metro Bus Network
 -  Metro Stations
 -  Metro Yellow Line
 -  Metro Blue Line

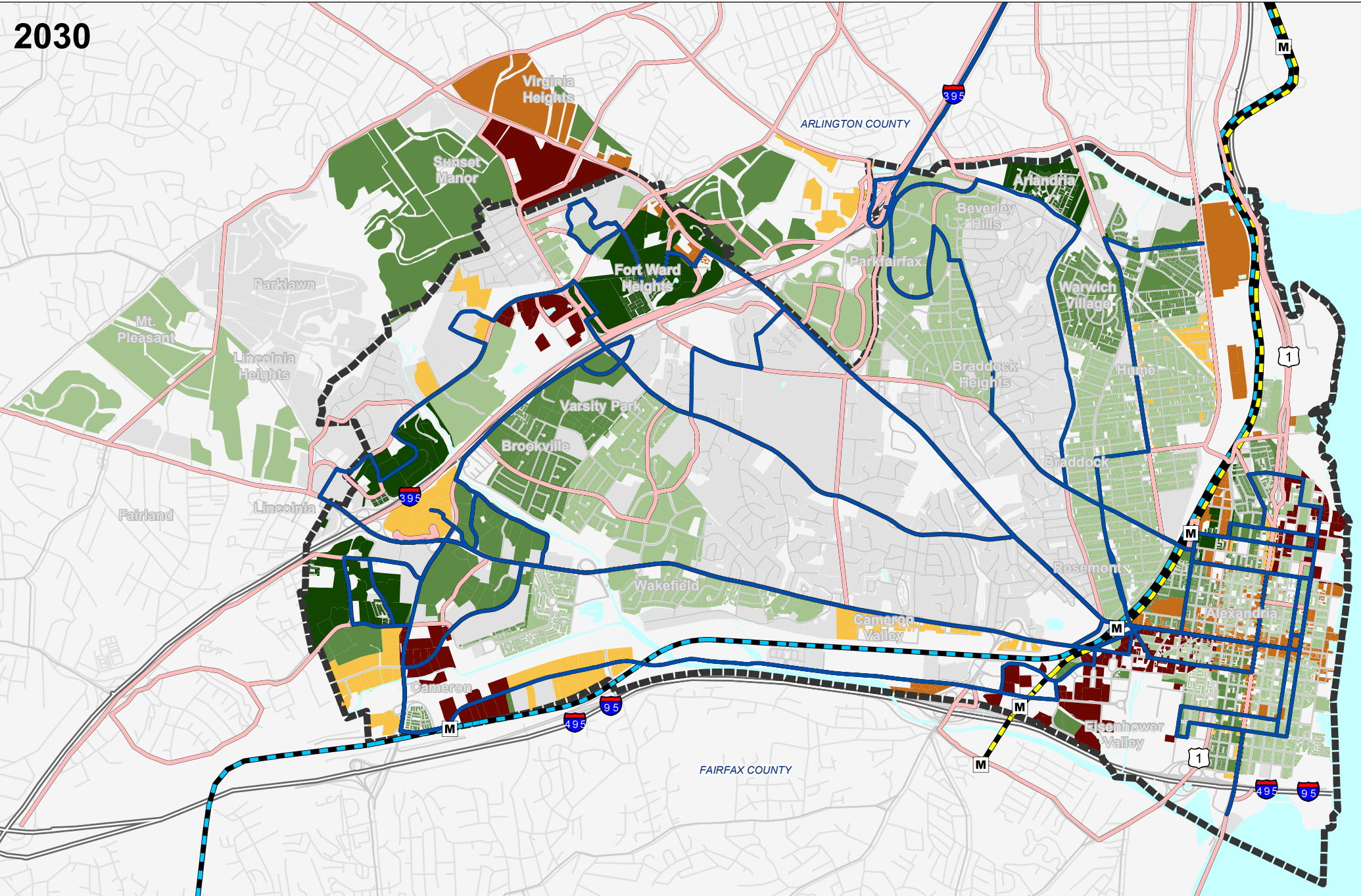
Date Updated: June 2008
Data Sources: DASH, U.S. 2000 Census
 Density calculated at the parcel level

0 0.25 0.5
 Mile









 







2030



Population & Employment Density



Persons		Employment	
	More Than 40		
	20 - 40		
	10 - 20		
	Fewer Than 10		

Legend

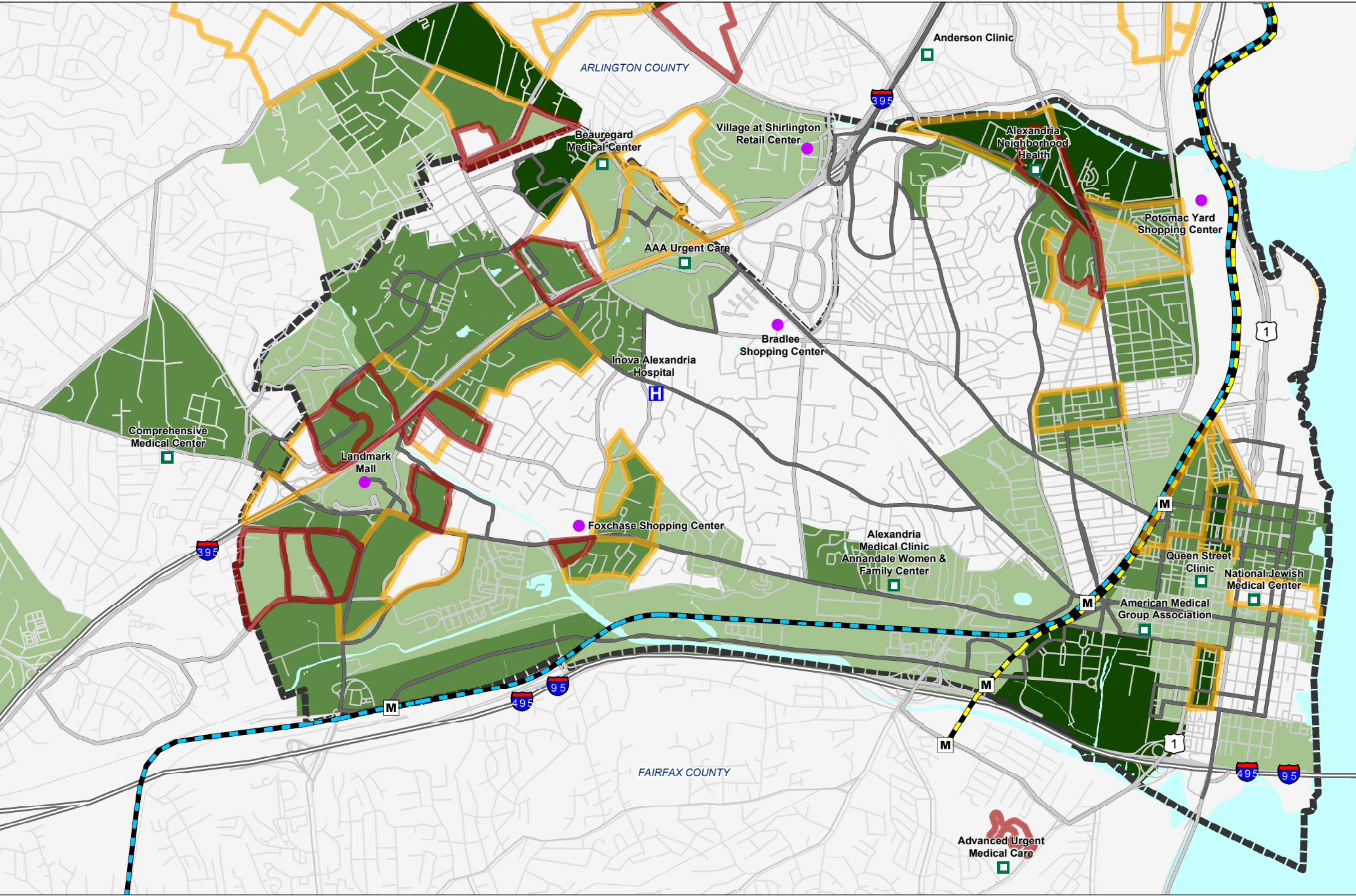
-  DASH Bus Network
-  Metro Bus Network
-  Metro Stations
-  Metro Yellow Line
-  Metro Blue Line

Date Updated: June 2008
Data Sources: DASH, U.S. 2000 Census
 Density calculated at the parcel level

0 0.25 0.5
 Mile





Poverty Population and VDPR

(Vehicle Density Population Ratio)



Driving Age Population Without Access to a Vehicle

- Above 30%
- 20% - 30%
- 10% - 20%
- Below 10%

Persons Below Poverty Level

- Above 30
- 20 - 30

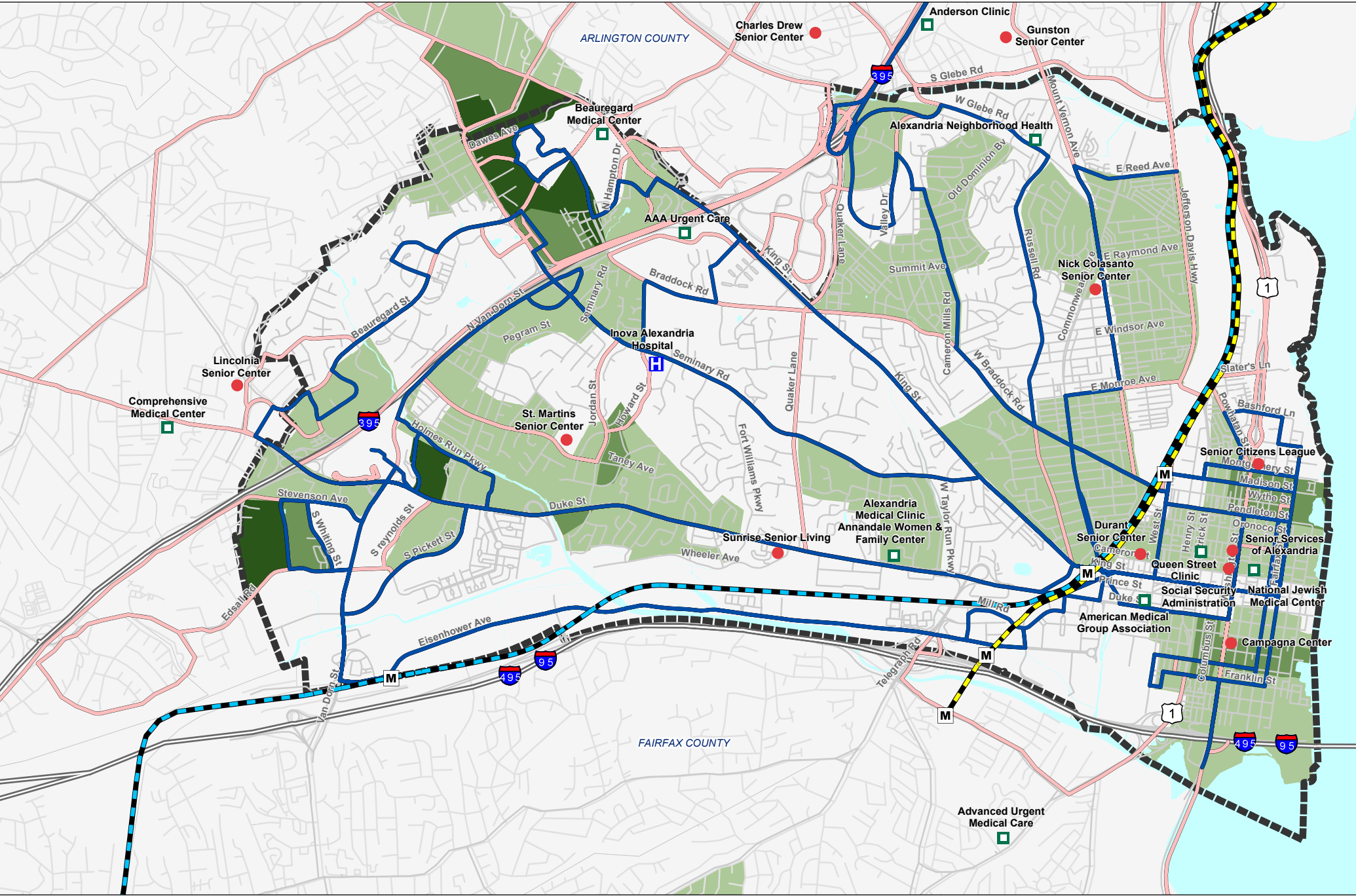
Legend

- DASH Bus Network
- Metro Bus Network
- Metro Stations
- Metro Yellow Line
- Metro Blue Line

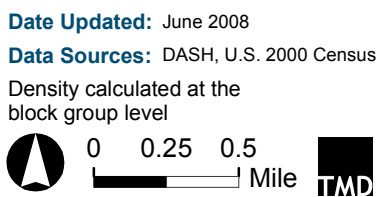
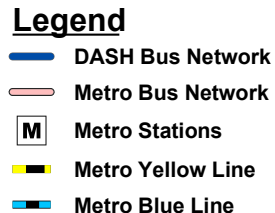
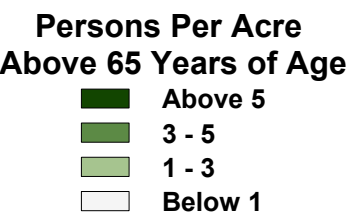
Date Updated: June 2008
Data Sources: DASH, U.S. 2000 Census
Density calculated at the block group level

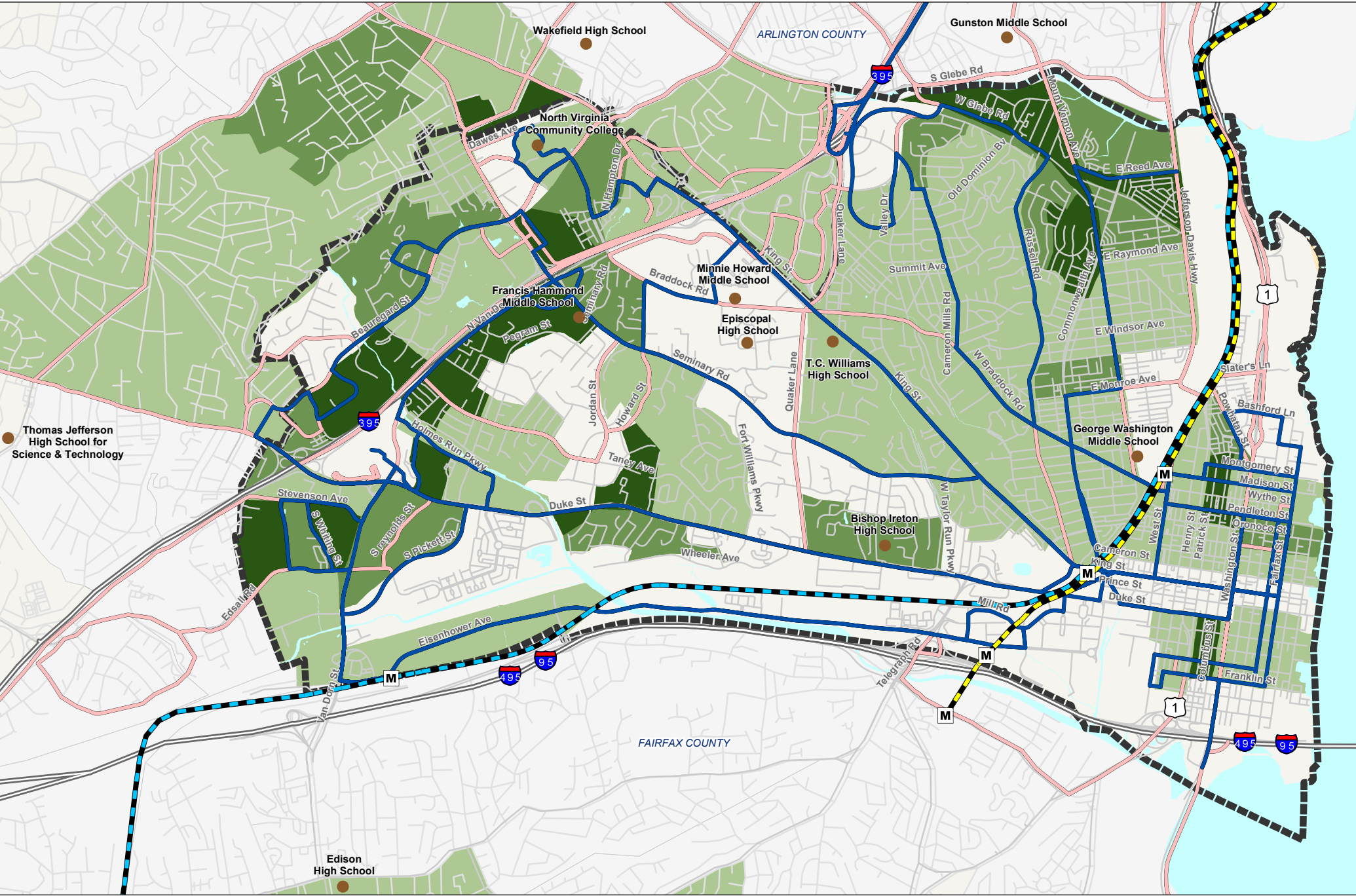
0 0.25 0.5 Mile

TMD



Senior Population





Youth Population

**Persons Per Acre
Below 16 Years of Age**

- Above 5
- 3 - 5
- 1 - 3
- Below 1

Legend

- DASH Bus Network
- Metro Bus Network
- M Metro Stations
- Metro Yellow Line
- Metro Blue Line

Date Updated: June 2008
Data Sources: DASH, U.S. 2000 Census
Density calculated at the block group level

TMD



Appendix D - Other Transit Services in Alexandria

DASH bus services are intended to serve the more localized needs of the City of Alexandria and to supplement and complement bus and rail services provided by the regional carrier, the Washington Metropolitan Area Transit Authority (WMATA).

Metrobus/Metrorail

WMATA currently provides both Metrobus and Metrorail service in the City of Alexandria. Metrorail serves primarily the eastern and southern portions of the City of Alexandria. The Metrorail Blue and Yellow Lines both serve the Braddock Road and King Street Stations. The Blue Line also serves the van Dorn Street station in the southwest part of the City, while the Yellow Line serves the Eisenhower Avenue station in the southeast part of Alexandria.

There are several families of Metrobus services operating in Alexandria. The route families are the 7, 8, 10, 21, 25, 28, and 29. Several of the services are oriented to work commutes to the Pentagon.

Routes 7A, B, C, F, W and X serve the Beauregard corridor Southern Towers, Shirlington and the Pentagon. Routes 7A and F operate all day weekdays and Saturdays every 30 minutes, except peak direction service on weekdays is provided by the 7W and X services. The 7A also operates every 60 minutes on Sundays. Routes 7W and X operate weekday peak periods to the Pentagon in the AM peak and from the Pentagon in the Pm peak every 10 minutes and also operating as express from Southern Towers to the Pentagon bypassing Shirlington. Routes 7B and C operate directional peak-only service on weekdays from the Park Center / Stonegate area to the Pentagon.

Routes 8S, X, W, and Z link west-central Alexandria with the Pentagon. These services are weekday peak only and are directional in nature, taking workers to the Pentagon in the morning and bringing them from the Pentagon in the afternoon. Routes 8X and 8Z operate every 10 to 15 minutes and Route 8W operates every 20 minutes. Route 8S is a reverse-commute service.

Routes 10A, B, and E serve the Mt. Vernon Avenue corridor, with Routes 10A and E serving the Pentagon and 10B serving Shirlington. Routes 10A and B serve Pendleton Street and Washington Street south to Hunting Towers, while Route 10E terminates at the Braddock Road Station. The 10A operates every 30 minutes from the early morning through early evening and every 60 minutes in the evening Monday through Saturday; on Sundays service is every 60 minutes. The 10E operates an average 15 minute directional peak-only service on weekdays, going to the Pentagon in the morning and from the Pentagon in the PM. This service supplements the 10A.

The 10B operates every 30 minutes from the early morning through late evening and every 60 minutes in the late evening Monday through Saturday; on Sundays service is every 60 minutes.

Routes 21A, B, C, D and F link southwest Alexandria with the Pentagon. These services are weekday peak only and are directional in nature. Route 21A and D operate every 40 minutes and route 21B operates every 20 minutes. Routes 21C and F are reverse-commute service.

Routes 25A, B, and C serve the northern and western portions of Alexandria. Routes 25A and C serve the South Fairlington and Parkfairfax neighborhoods in north central Alexandria en route from Pentagon Station to either Northern Virginia Community College or Ballston-MU Metrorail Station. Route 25B serves Seminary Road, Howard/Jordan Streets Taney Avenue, and the South Van Dorn corridor south of Taney to the Van Dorn Metrorail station.

Routes 28A and 28B both operate between King Street Metro Station and Southern Towers, with the 28A using Russell Road, Braddock Road, and King Street, while the 28B uses King Street, Janney's Lane, and Seminary Road. From Columbia Pike both branches use a common routing of the Leesburg Pike and Broad Street. Both branches operate every 60 minutes for most of the day on weekdays and Saturdays. On Sundays only the Seminary Road branch (28B) operates every 60 minutes. This corridor is being considered by WMATA for implementation of rapid bus service in 2009.

Routes 29K and 29N operate between Old Town Alexandria and Fairfax via the King Street Metro Station, using Pendleton, Washington and Duke Streets. This service operates Monday through Saturdays, with 30 minute peak service and hourly off-peak service. This corridor is under consideration by WMATA for possible the implementation of rapid bus service is 2010.

Bus Rapid Transit

As the City of Alexandria is considering establishing three transit priority corridors in the City, with the goal of improving bus speeds in traffic-congested corridors, the City should coordinate closely with WMATA to ensure that these transit priority investments are made where they will benefit the greatest amount of transit service. To deal with increasing ridership resulting from the recent increases in gasoline prices, WMATA is seriously considering introducing Rapid Bus Service in sixteen corridors over the next six years, including the Route 28A/28B and the 29K/29N corridors which both run through Alexandria.

Trolleys

Beginning in 2010, Alexandria Transit Corporation plan to assume operation of the King Street Trolley service that currently connects the Alexandria ferry landing with the King Street Metro Station. ATC is further planning developing an Old Town Alexandria downtown circulator loop, operated with trolley-style buses that would replace some of the passenger function currently being performed by core DASH routes. It is anticipated that DASH can

shorten the core routes in Old Town, thereby shortening trip times resulting in improved efficiency for the core DASH routes.

Ferries

Beginning in April 2007, improved ferry service commenced between National Harbor and Old Town Alexandria. The Potomac Riverboat Company, a private operator, operates every 30 minutes in both directions across the Potomac, with departures from both ends on the hour and half hour. With a capacity of 99 passengers, this service has a capacity of nearly 3,000 passengers in each direction daily. Currently, with funding from both grants and the City of Alexandria, trolley-style buses provide a free connection across King Street between the ferry landing in Alexandria and the King Street Metro Station.

Weekday Lunch Loop

With subsidy from the Patent Office, ATC operates a free Lunch Loop, which operates frequent (every 10 minutes) service from the Patent Office/Federal Court House to restaurants along King and Prince Streets.

Woodrow Wilson Bridge Rail Service

Ensuring that rail transit can be implemented in the future with minimum disruption has been a high priority of the Wilson Bridge Project. Project leaders have met more than 20 times over the past four years with representatives of WMATA to ensure the bridge and interchanges are designed and constructed with the flexibility to accommodate rail alternatives.

The interchanges at U.S. Route 1 (Virginia) and I-295 (Maryland) are designed around an “envelope” into which rail transit connections can be built. Recent decisions to defer HOV/Express Bus interchange ramp construction in Virginia and Maryland further simplify the potential construction of rail connections.

To ensure rail readiness, several critical elements have been incorporated into the new bridge's design:

- A local/express design configuration throughout the Project corridor, which can provide a future barrier separation between highway and rail traffic. This physical separation would allow implementation and ongoing maintenance of potential rail transit lanes, without completely disrupting highway traffic.
- Structural strength to support rail transit loads, reflected in the large number and size of piles driven into the riverbed to support the bridge deck.
- Wider space required for Metrorail's "footprint," related equipment controls and operation of trains.
- Space reserved in the drawbridge piers for future WMATA equipment
- Conduit in the drawbridge piers for future train controls, communications and traction power systems

While implementing rail transit within the Project corridor is beyond the current scope of the Wilson Bridge Project, the Project's design remains flexible to accommodate rail transit, as well as HOV or express bus service.

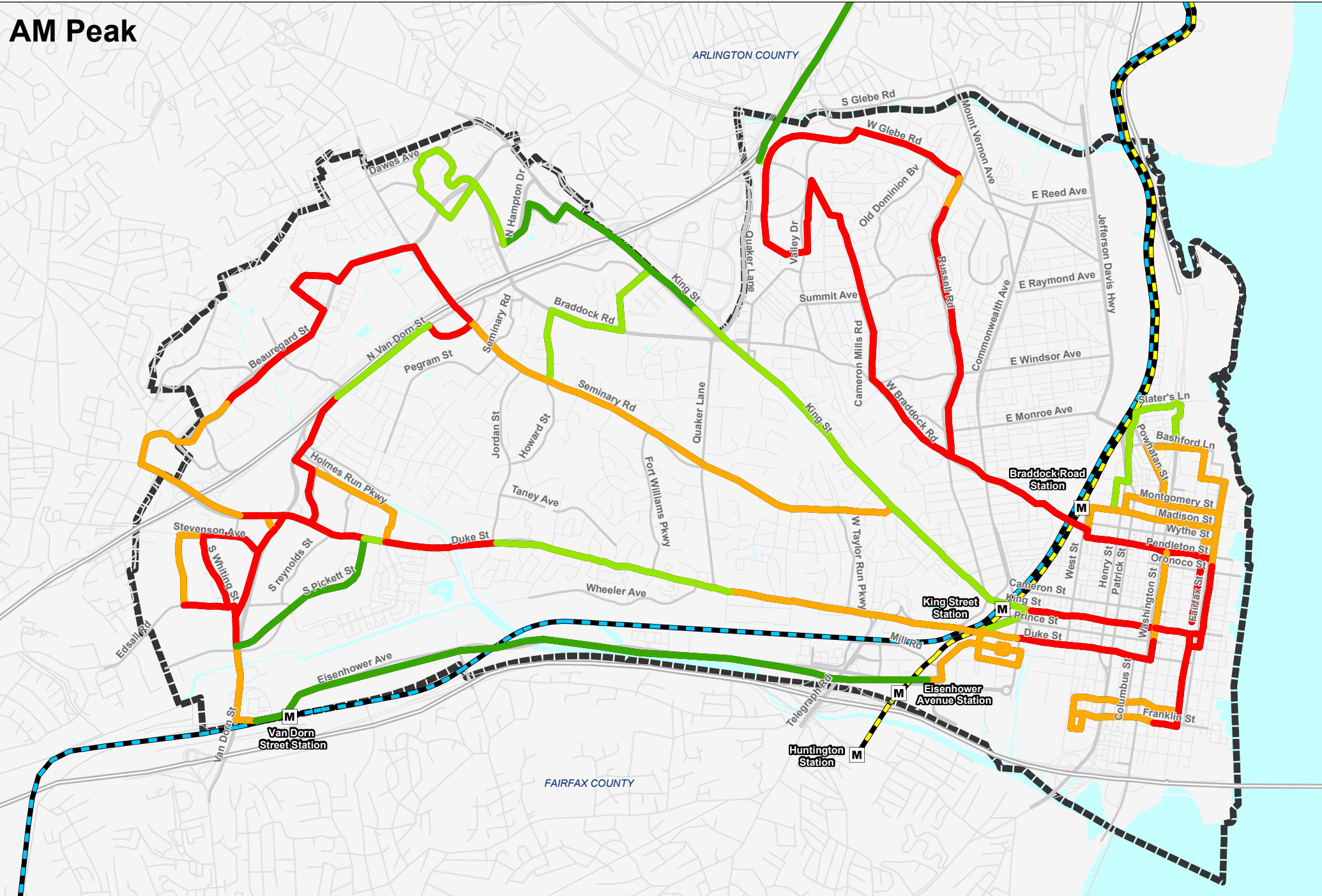
Rail service in the bridge corridor (from Branch Avenue in Maryland to Alexandria, Virginia) is included in WMATA's 2025 Transit Service Expansion Plan. Approved by the WMATA Board, this initiative is being studied under the annual Project Development Program and closely coordinated with all related parties, including Federal Transit Administration, and state and local governments. WMATA's order of magnitude cost estimates of a connection between Yellow/Blue Line in Virginia with the Green Line in Maryland range from \$1.2 billion and \$1.5

billion, depending on the selected alignment and number of stations (current plans estimate up to seven potential stations).

The Washington region's financially constrained long-range transportation plan through 2025, which requires identification of funding sources for projects, does not include rail transit across the new Wilson Bridge. At this time, potential funding sources have not been identified.

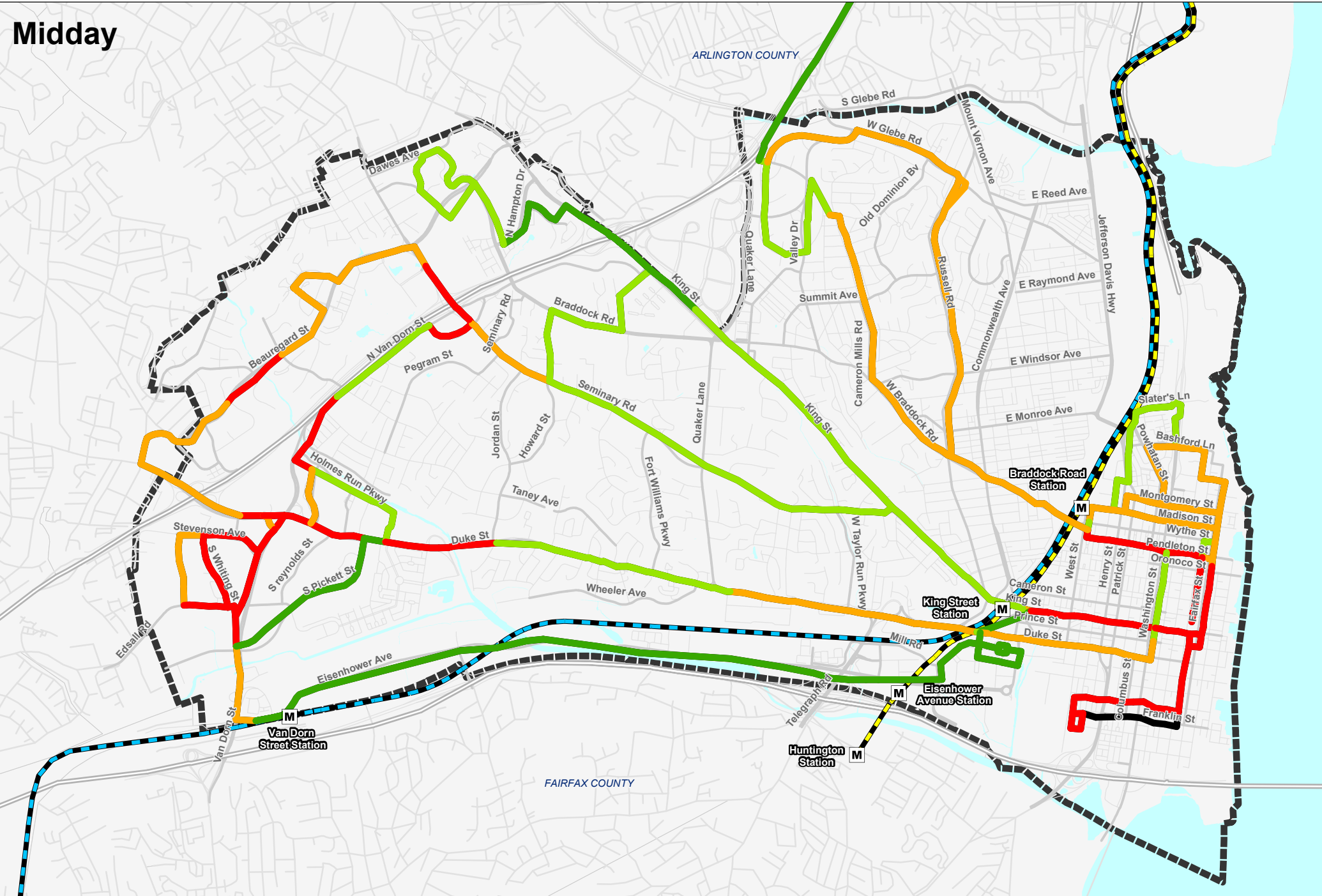
Appendix E – Bus Speed Maps

AM Peak



Average Speed Inbound

Midday



Average Speed Inbound



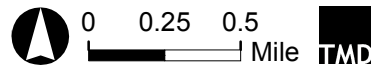
Combined Speed Per Street Segment

- 20 MPH or Better
- 15 - 20 MPH
- 10 - 15 MPH
- Less than 10 MPH

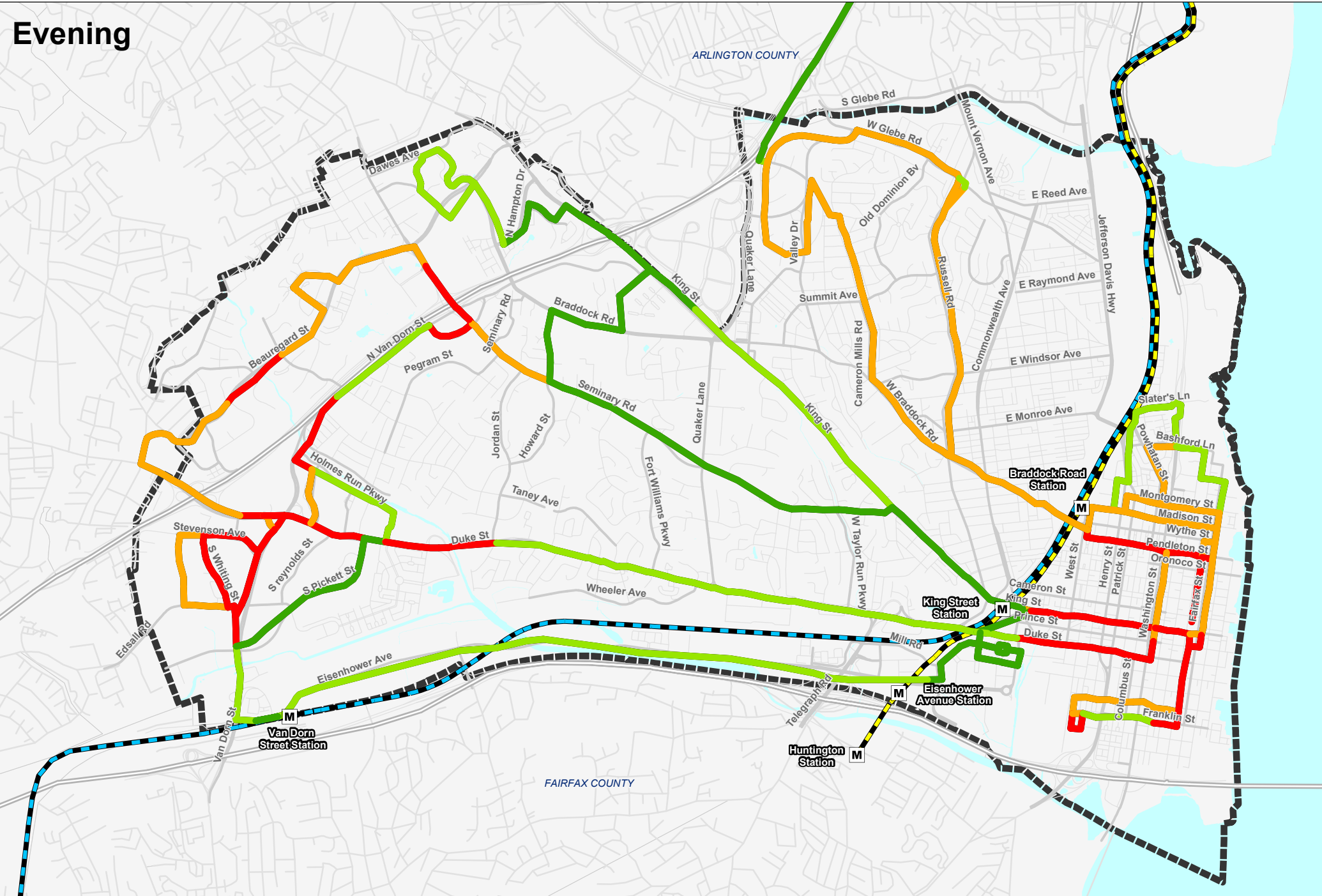
Legend

- M Metro Stations
- Yellow Line
- Blue Line

Date Updated: June 2008
Data Sources: DASH 2007



Evening



Average Speed
Inbound



Combined Speed Per Street Segment

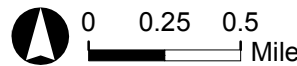
- 20 MPH or Better
- 15 - 20 MPH
- 10 - 15 MPH
- Less than 10 MPH

Legend

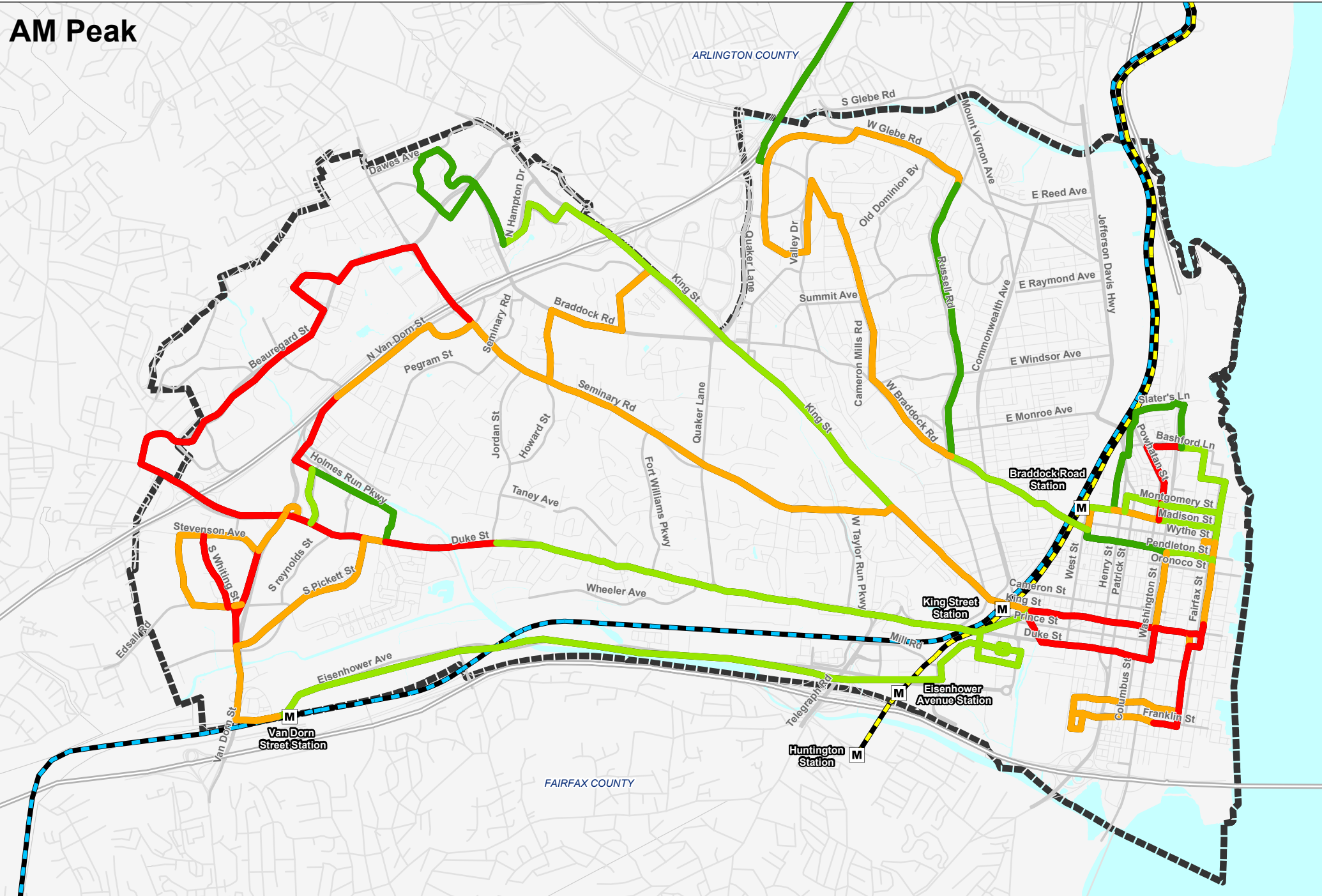
- M Metro Stations
- Yellow Line
- Blue Line

Date Updated: June 2008

Data Sources: DASH 2007

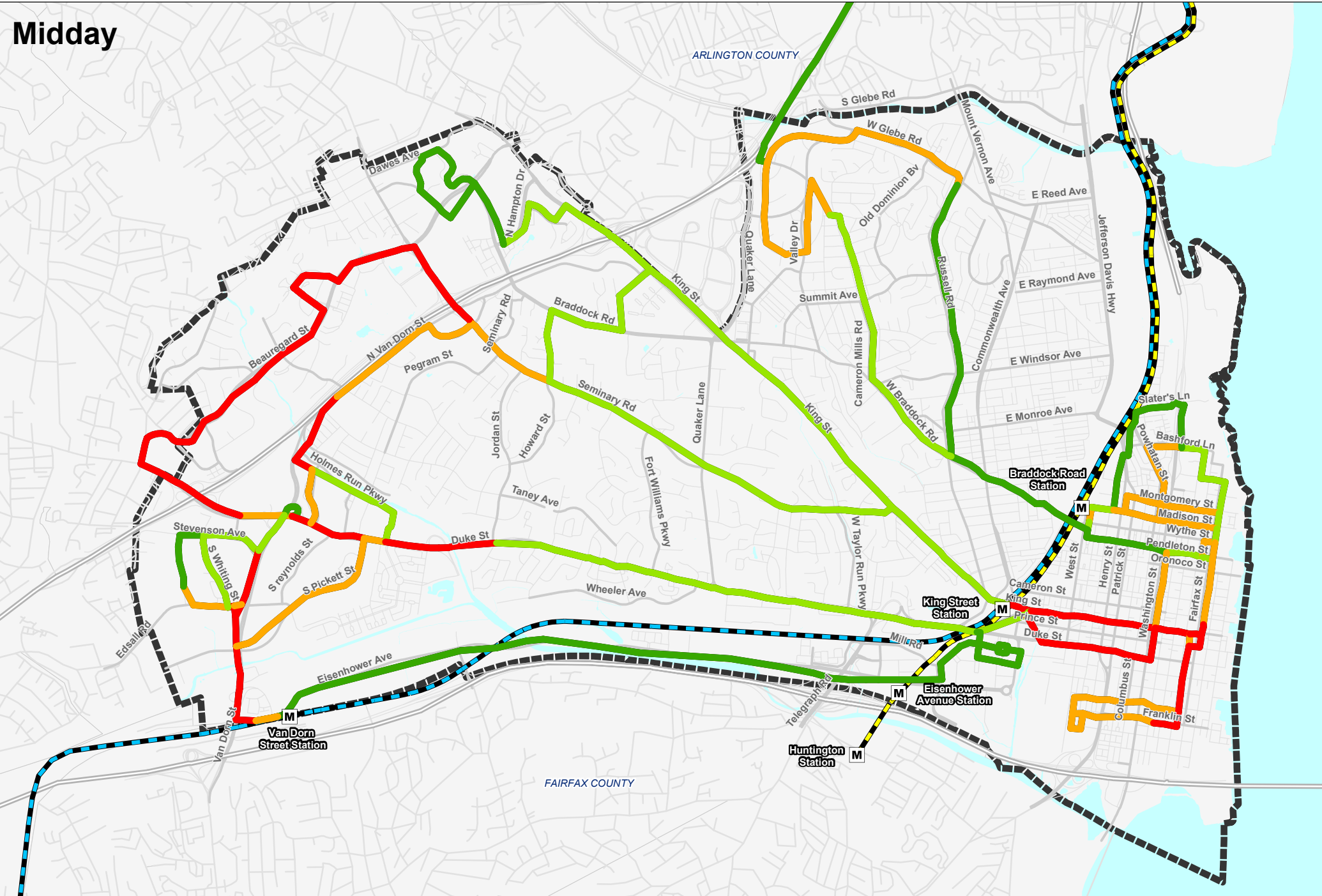


AM Peak



Average Speed Outbound

Midday



Average Speed Outbound



Combined Speed Per Street Segment

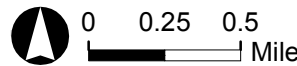
- 20 MPH or Better
- 15 - 20 MPH
- 10 - 15 MPH
- Less than 10 MPH

Legend

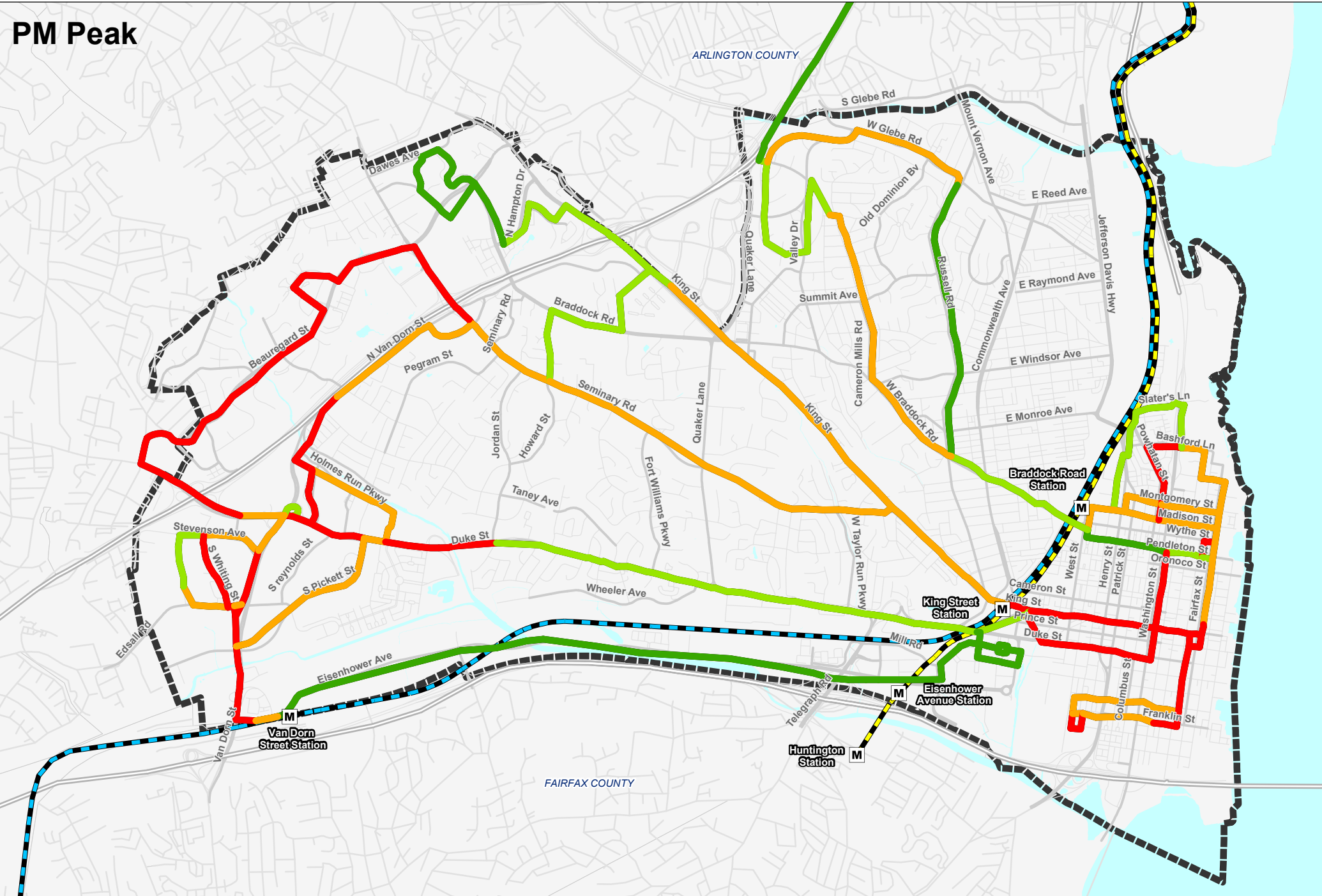
- M Metro Stations
- Yellow Line
- Blue Line

Date Updated: June 2008

Data Sources: DASH 2007



PM Peak



Average Speed Outbound



Combined Speed Per Street Segment

- 20 MPH or Better
- 15 - 20 MPH
- 10 - 15 MPH
- Less than 10 MPH

Legend

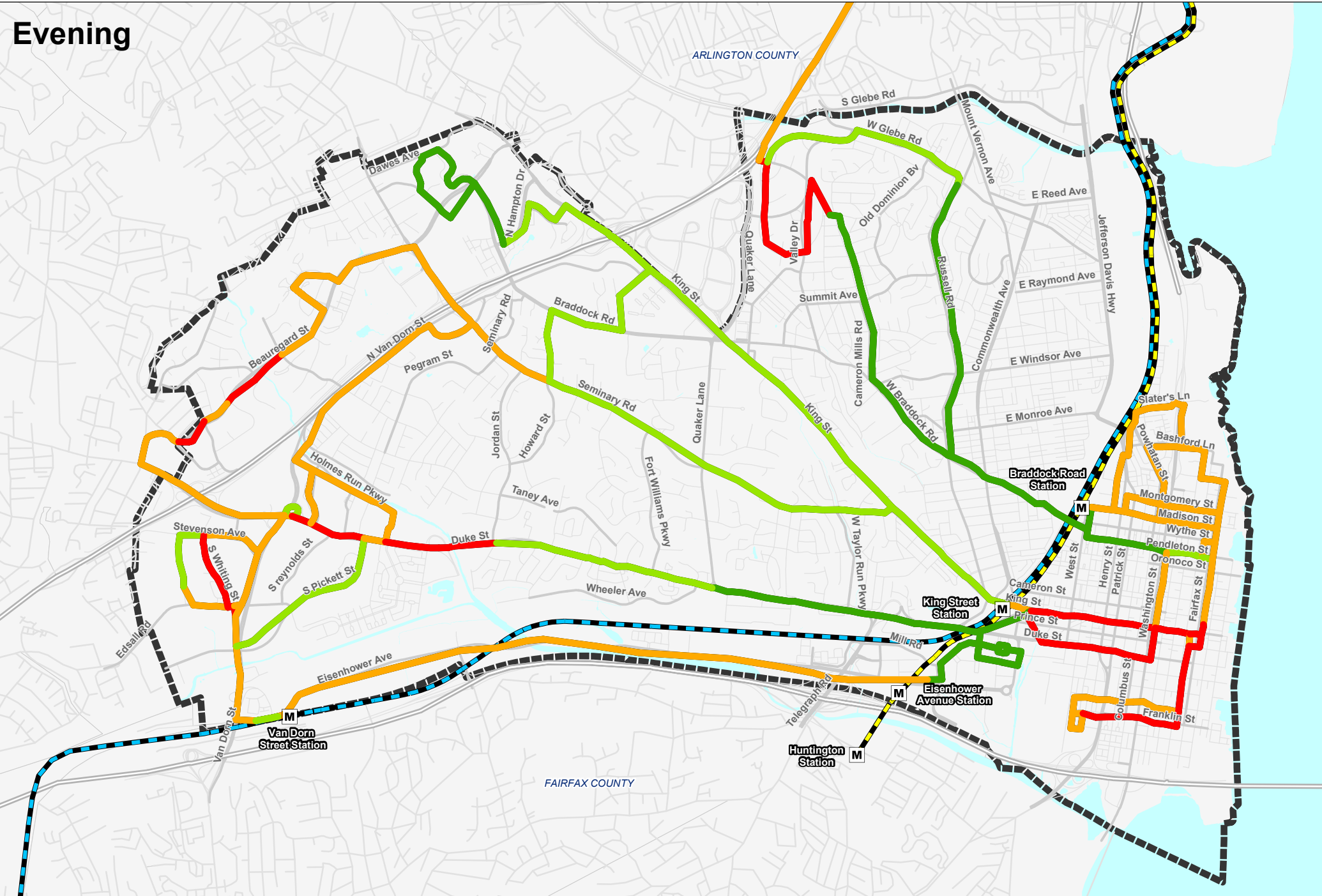
- M Metro Stations
- Yellow Line
- Blue Line

Date Updated: June 2008

Data Sources: DASH 2007



Evening



Average Speed Outbound



Combined Speed Per Street Segment

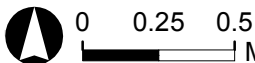
- 20 MPH or Better
- 15 - 20 MPH
- 10 - 15 MPH
- Less than 10 MPH

Legend

- M Metro Stations
- Yellow Line
- Blue Line

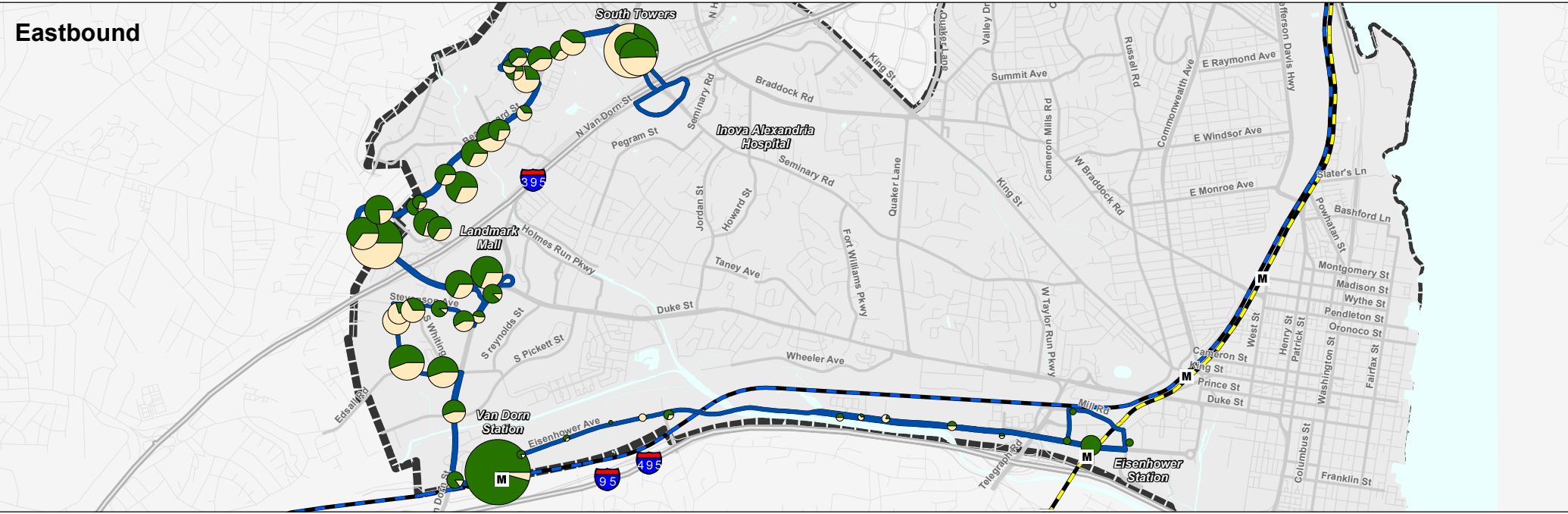
Date Updated: June 2008

Data Sources: DASH 2007

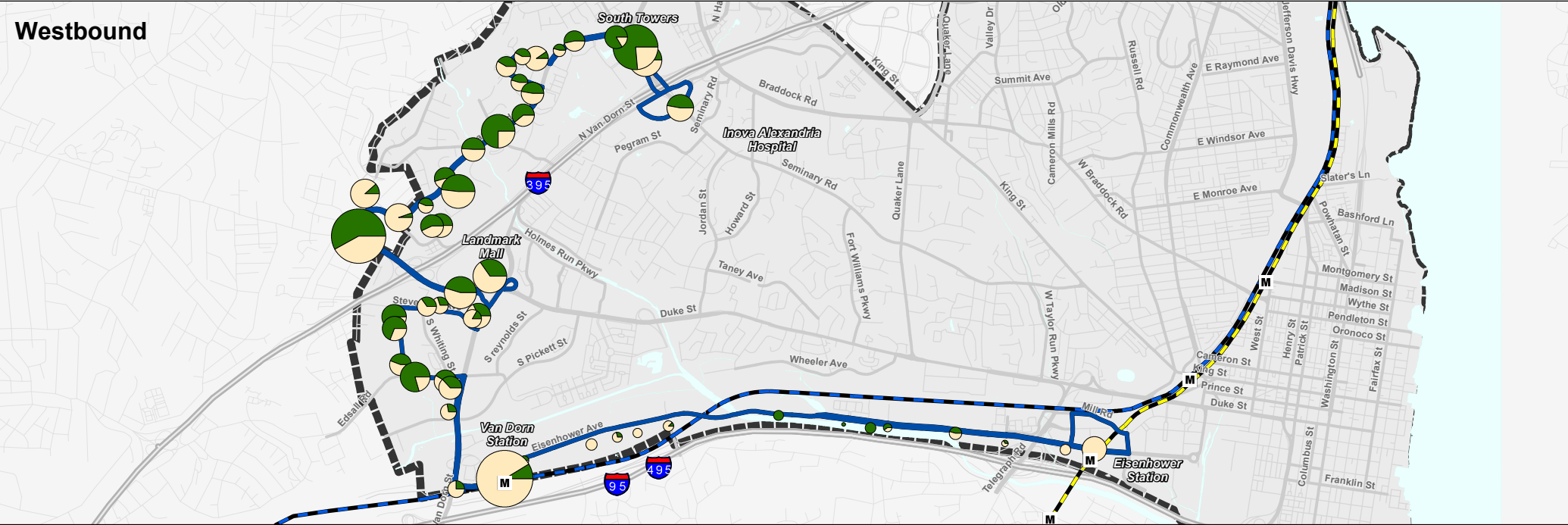


Appendix F – Individual Route Profiles

Eastbound



Westbound

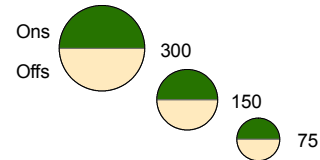


Route 1

Description

ATC Route 1 operates in an east-west direction providing service between the Eisenhower Metro Station and the Alexandria Inova Hospital to the Van Dorn Metro Station and the Landmark Mall. ATC Route 1 originated in a 2007 restructuring that separated ATC Route 2 into two individual routes.

Passenger Activity (2007)

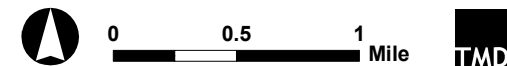


Legend

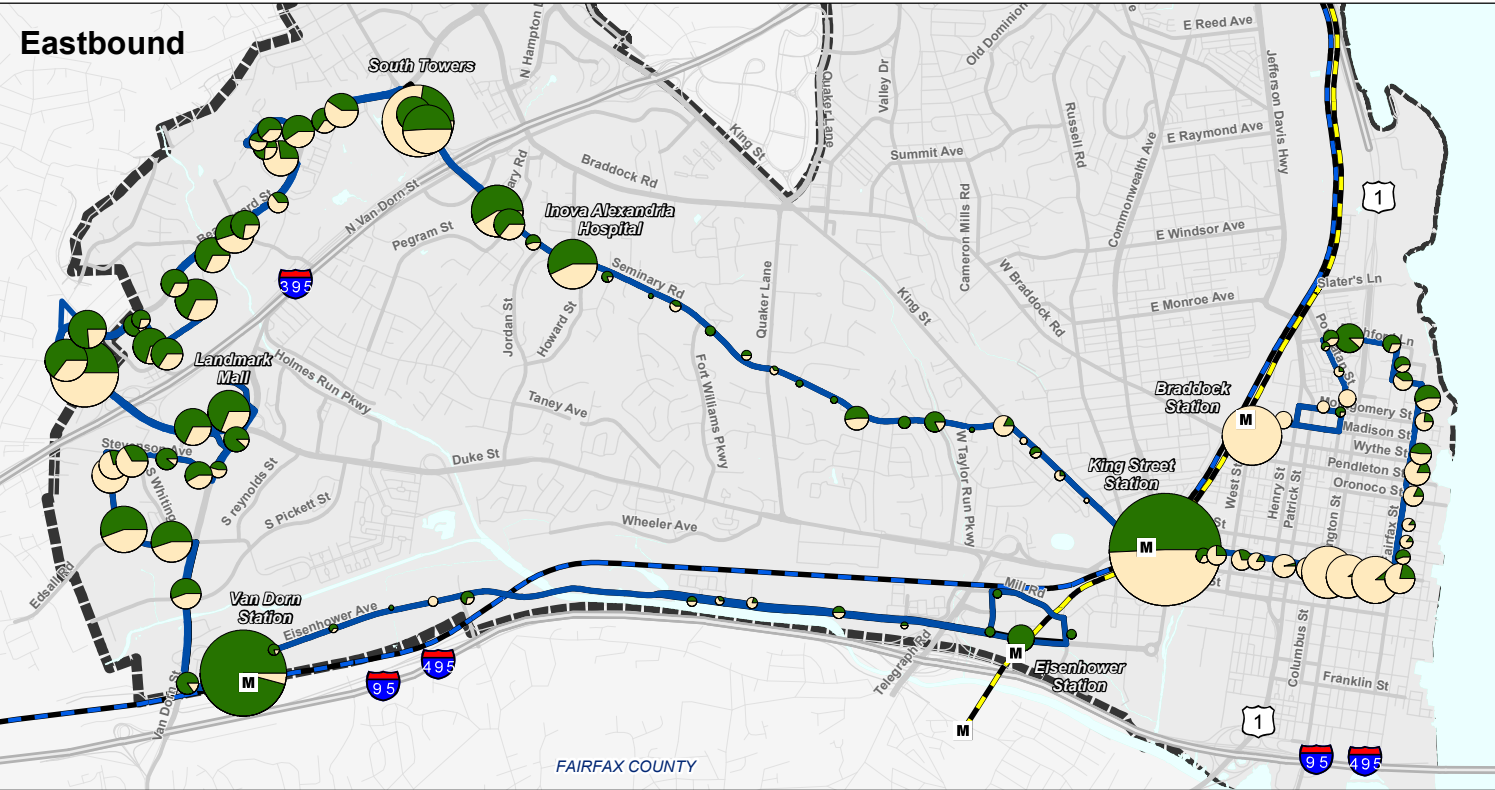
- DASH Route 1
- Metro Station
- Metro Yellow Line
- Metro Blue Line

Data Sources
DASH 2007 Ridecheck

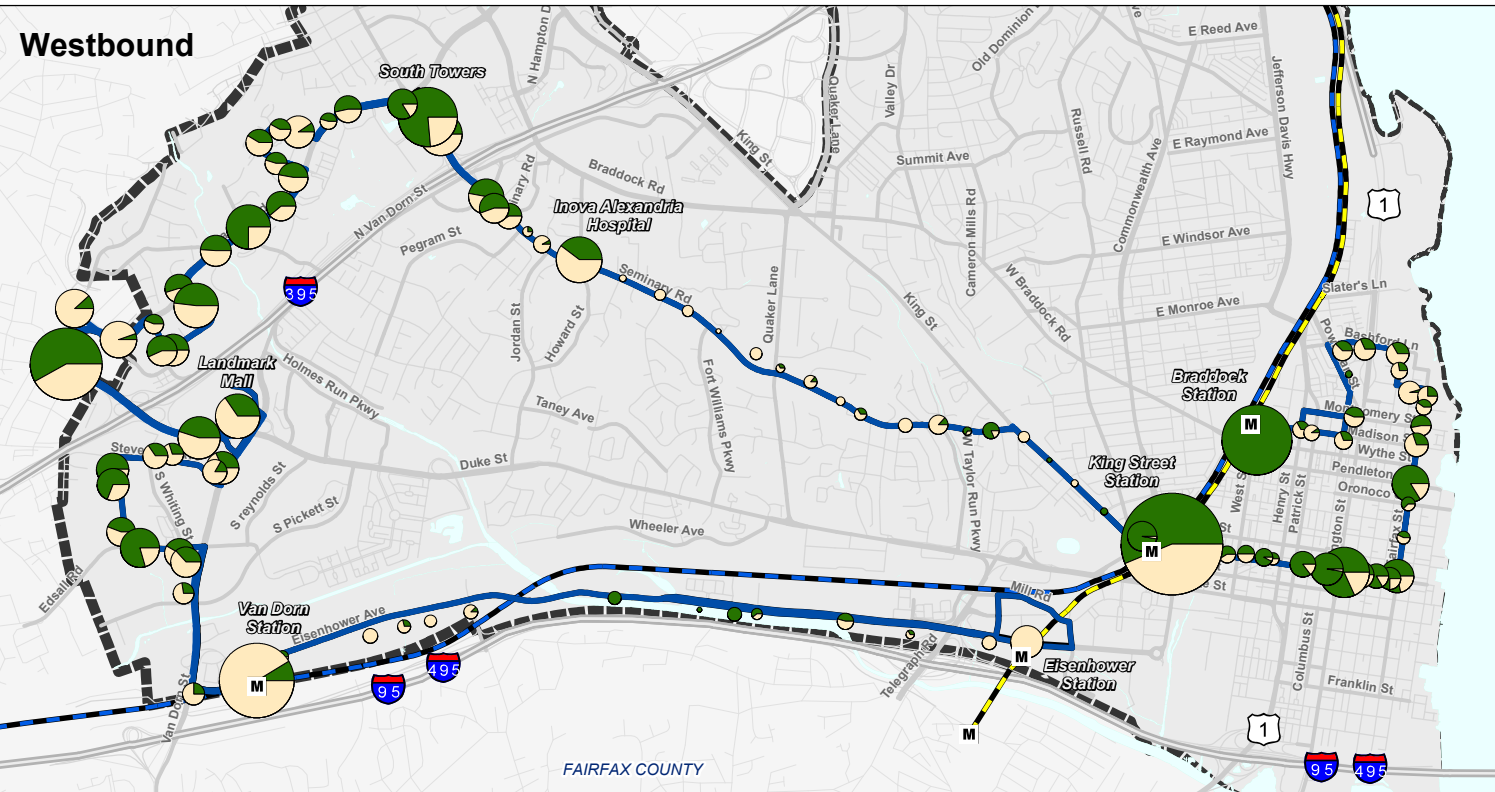
Date Updated
June 2008



Eastbound



Westbound



Route 2

Description

ATC Route 2 operates generally in an east-west direction providing service between Braddock Road Metro Station in Old Town Alexandria to Van Dorn Street Metro Station in western Alexandria, and to Eisenhower Avenue Metro Station during the peak rush periods. The service operates primarily on major arterials including Madison Street, Fairfax Street, King Street, Seminary Road, Beauregard Street, Van Dorn Street and Eisenhower Avenue.

Service Frequencies (Minutes)

2008	Weekday				Sat / Sun
	AM	Mid	PM	EVE	
Eastbound	20	30	30	60	45 / 60
Westbound	25	30	20	60	45 / 60

2005	Weekday				Sat / Sun
	AM	Mid	PM	EVE	
Eastbound	25	30	25	30	50 / 60
Westbound	25	30	25	30	50 / 60

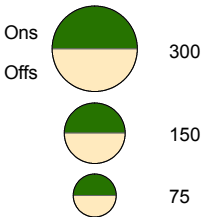
Current Span of Service

	Eastbound	Westbound
Weekday	05:41 - 22:12	05:40 - 23:26
Saturday	07:16 - 23:09	07:04 - 23:20
Sunday	07:59 - 19:35	08:02 - 19:55

Passenger Boarding Per Revenue Hour

2007	Qtr.	1	2	3	4	Year
Weekday		40.1	36.8	31.7	38.4	37.1
Saturday		35.5	33.0	24.4	34.9	32.1
Sunday		31.5	28.4	23.9	29.0	28.8

Passenger Activity (2007)

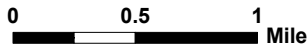


Legend

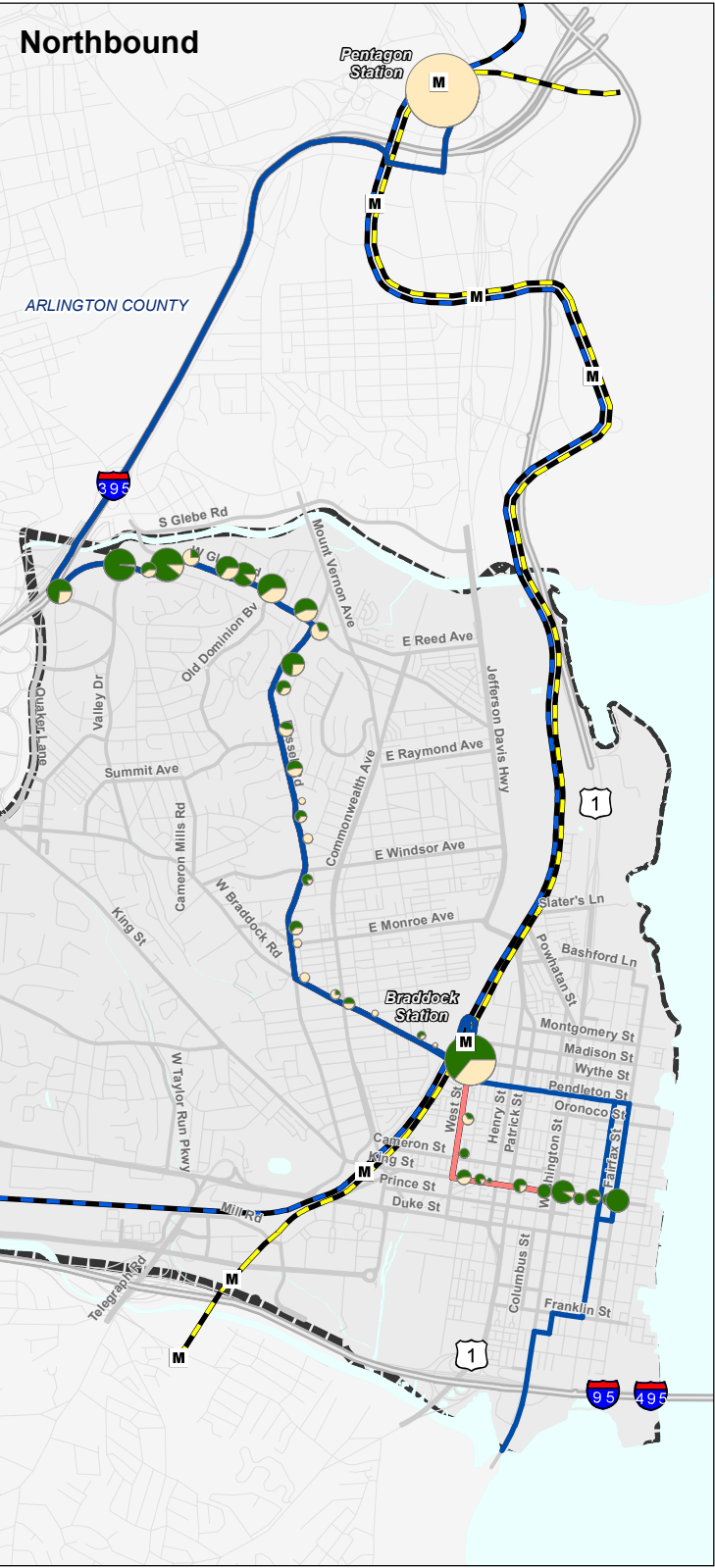
- DASH Routes 1 & 2
- Route 1 - Eisenhower Metro Station to Inova-Alexandria Hospital
- Route 2 - Braddock Metro Station to Landmark Mall
- M Metro Station
- Metro Yellow Line
- Metro Blue Line

Data Sources Date Updated

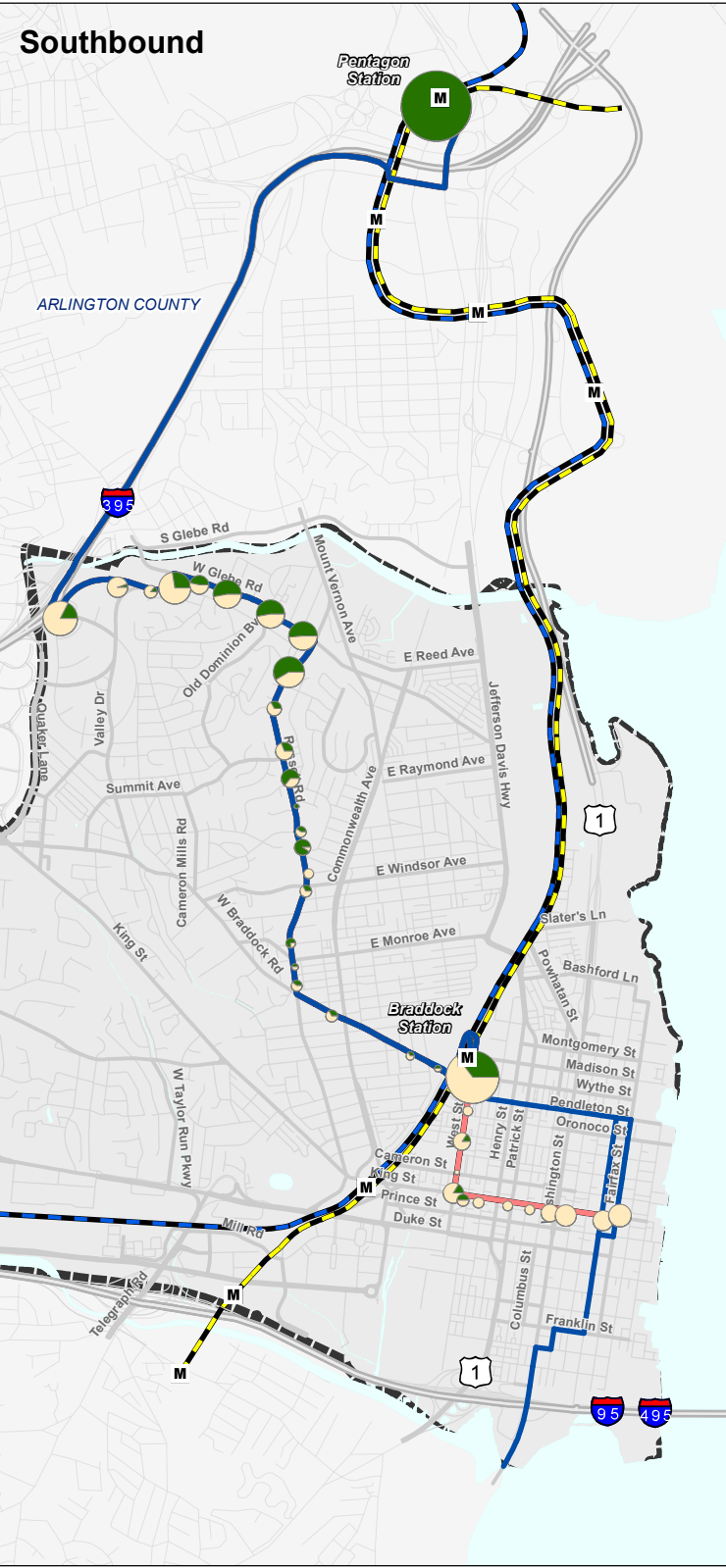
DASH 2007 Ridecheck June 2008



Northbound



Southbound



Route 3

Description

ATC Route 3 operates northwest/southeast between Old Town Alexandria and the Pentagon Metro Station during the peak rush hour periods. The service operates on local arterials and residential streets including King Street, West Street, Braddock Road, Russell Road, West Glebe Road and the Shirley Highway HOV lanes to the Pentagon Metro Station.

Service Frequencies (Minutes)

	2008 Weekday				Sat / Sun
	AM	Mid	PM	EVE	
Northbound	20	X	20	X	X
Southbound	20	X	20	X	X
	2005 Weekday				Sat / Sun
	AM	Mid	PM	EVE	
Northbound	20	X	20	X	X
Southbound	20	X	20	X	X

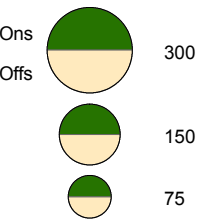
Current Span of Service

	Northbound	Southbound
Weekday	05:32 - 20:09	06:29 - 20:10
Saturday	X	X
Sunday	X	X

Passenger Boarding Per Revenue Hour

2007	Qtr. 1	2	3	4	Year
Weekday	32.0	30.8	31.7	32.8	32.0
Saturday	X	X	X	X	X
Sunday	X	X	X	X	X

Passenger Activity (2007)

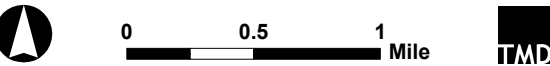


Legend

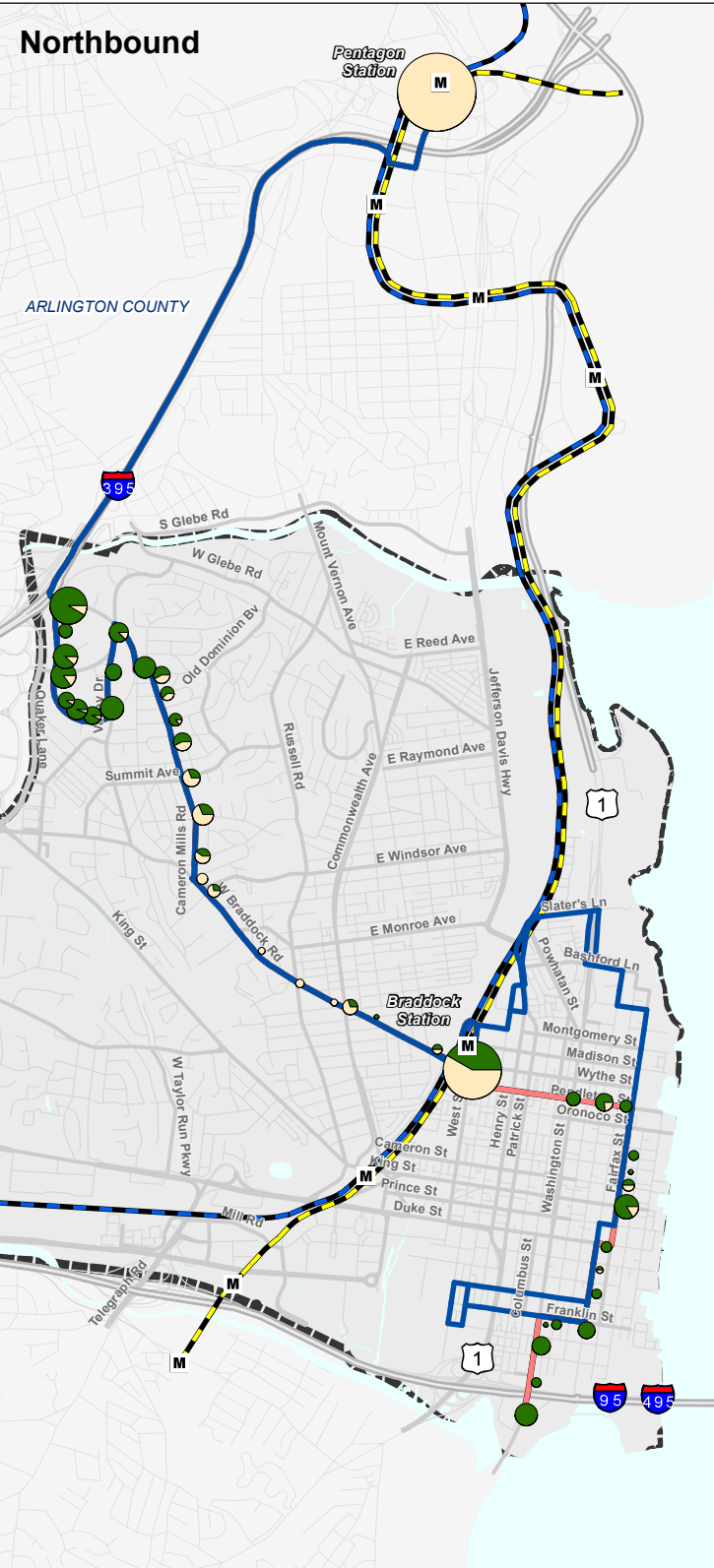
- Current Route Alignment
- 2007 Route Alignment
- Metro Station
- Metro Yellow Line
- Metro Blue Line

Data Sources Date Updated

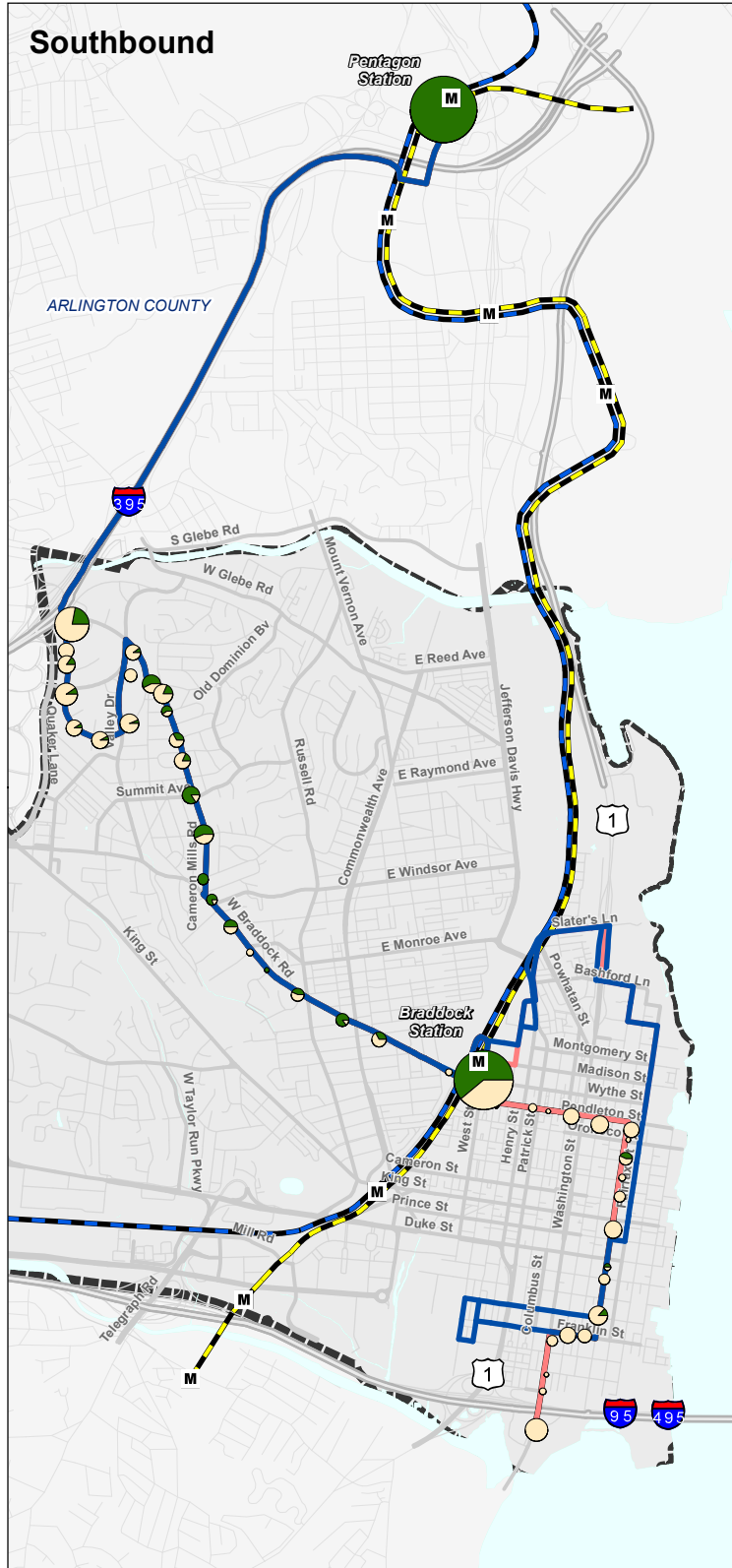
DASH 2007 Ridecheck June 2008



Northbound



Southbound



Route 4

Description

ATC Route 4 operates northwest/southeast between Hunting Towers apartment complex in southeastern Alexandria via Old Town to the Pentagon Metro Station during the peak rush hour periods. The service operates on local arterials and residential streets including Washington Street, Royal/Fairfax one-way pair, Pendleton Street, Braddock Road, Gunston Road, Martha Custis Drive and the Shirley Highway HOV lanes to the Pentagon Metro Station.

Prevailing Service Frequencies (Minutes)

	Weekday				Sat / Sun
	AM	Mid	PM	EVE	
Northbound	20	X	20	X	60/X
Southbound	20	X	20	X	60/X

	Weekday				Sat / Sun
	AM	Mid	PM	EVE	
Northbound	20	X	20	X	X
Southbound	20	X	20	X	X

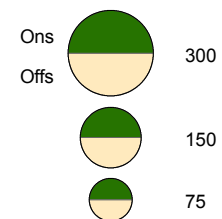
Current Span of Service

	Northbound	Southbound
Weekday	05:50 - 21:10	06:44 - 21:50
Saturday	X	X
Sunday	X	X

Passenger Boarding Per Revenue Hour

2007	Qtr.	1	2	3	4	Year
Weekday		26.9	26.3	27.7	25.3	26.6
Saturday		5.9	6.9	4.3	6.5	5.8
Sunday		X	X	X	X	X

Passenger Activity (2007)



Legend

- Current Route Alignment
- 2007 Route Alignment
- M Metro Station
- Metro Yellow Line
- Metro Blue Line

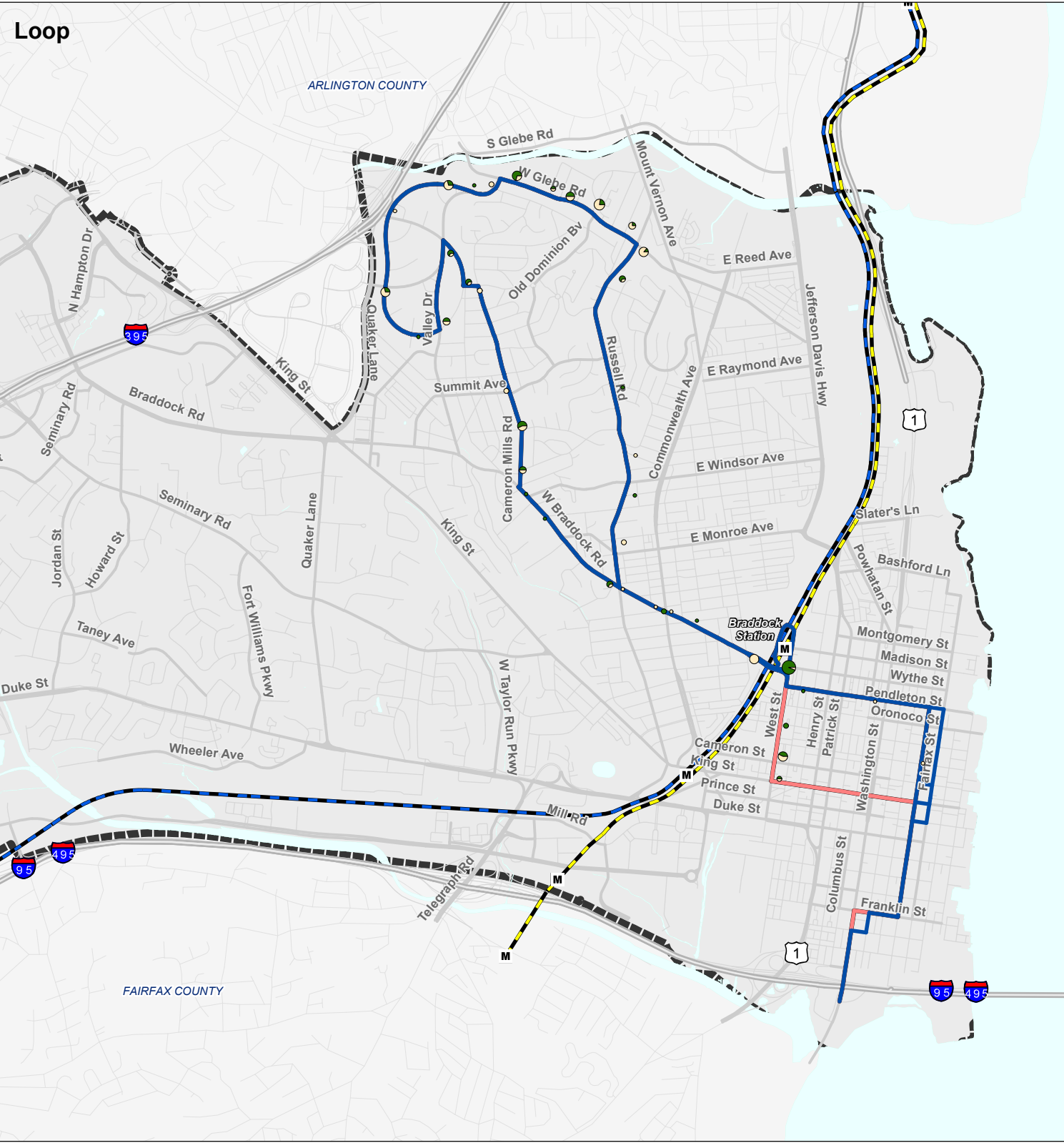
Data Sources

Date Prepared

DASH 2007 Ridecheck June 2008



Loop



Route 3/4 Combination

Description

One-way loop route from City Hall through Braddock Road Metro Station, Russell Road, and Cameron Mills Road.

Current Service Frequencies (Minutes)

2008	Weekday				Sat / Sun
	AM	Mid	PM	EVE	
Loop	X	60	X	55	60/60

2005	Weekday				Sat / Sun
	AM	Mid	PM	EVE	
Loop	X	60	X	60	60/60

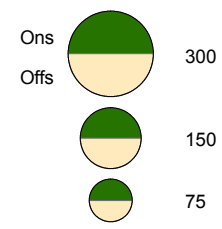
Current Span of Service

	Loop
Weekday	10:26 - 22:27
Saturday	08:38 - 20:02
Sunday	09:07 - 18:51

Passenger Boarding Per Revenue Hour

2007	Qtr.	1	2	3	4	Year
Weekday		11.9	9.9	10.5	11.4	11.0
Saturday		9.2	8.9	9.0	9.9	9.3
Sunday		8.5	8.0	8.4	7.2	8.0

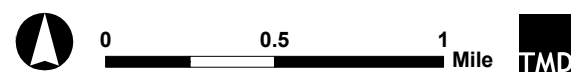
Passenger Activity (2007)



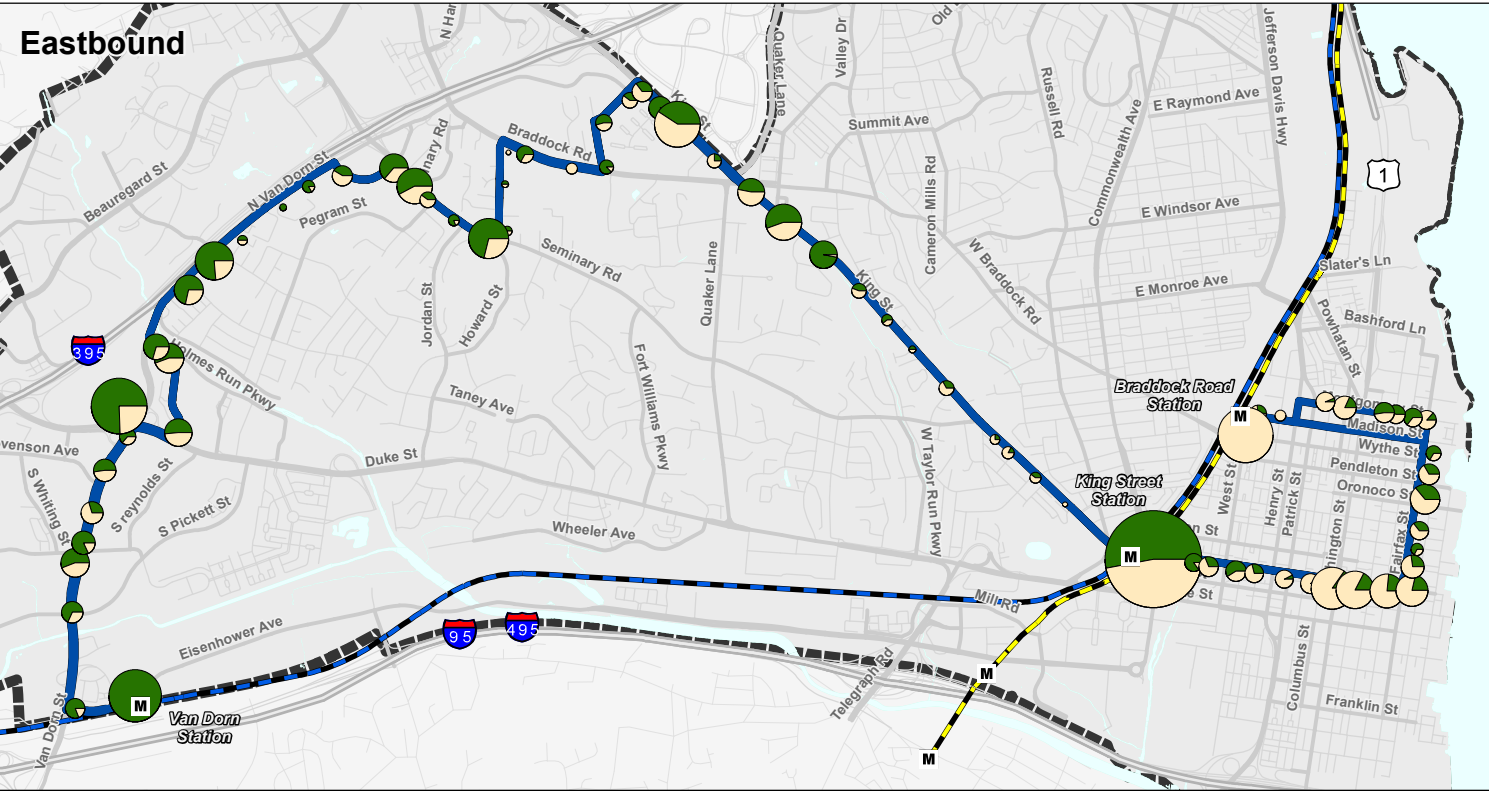
Legend

- Current Route Alignment
- 2007 Route Alignment
- Metro Station
- Metro Yellow Line
- Metro Blue Line

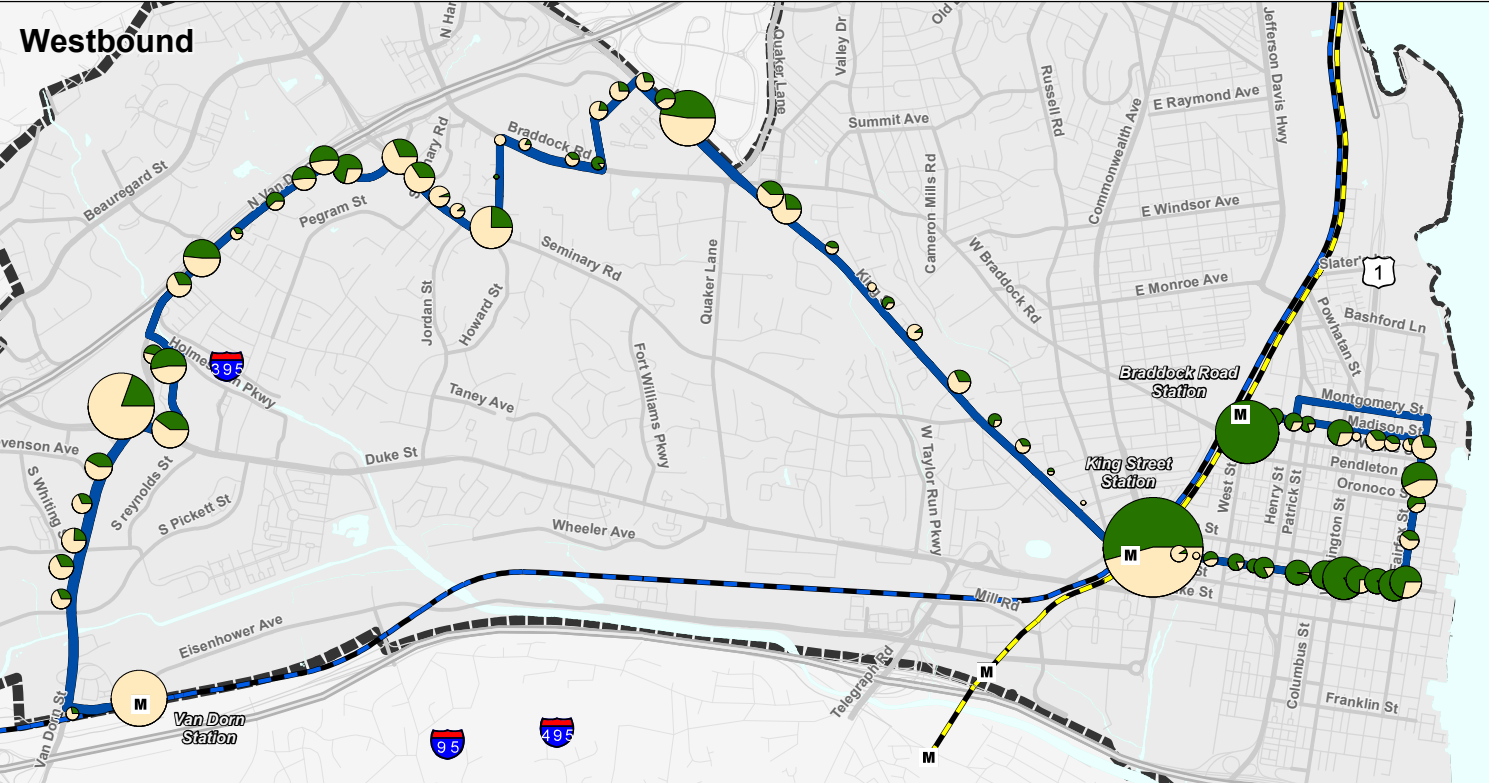
Data Sources **Date Updated**
DASH 2007 Ridecheck June 2008



Eastbound



Westbound



Route 5

Description

ATC Route 5 operates generally in an east-west direction from Braddock Road Metro Station via Old Town Alexandria to Van Dorn Street Metro Station. The service operates primarily on major arterials including the Montgomery/Madison one-way pair, Fairfax Street, King Street, Seminary Road and N. Van Dorn Street to Van Dorn Street Metro Station.

Current Service Frequencies (Minutes)

2008	Weekday				Sat / Sun
	AM	Mid	PM	EVE	
Eastbound	30	30	30	50	30 / 60
Westbound	30	30	30	60	30 / 60
2005	Weekday				Sat / Sun
	AM	Mid	PM	EVE	
Eastbound	30	30	30	60	30 / 60
Westbound	30	30	30	60	30 / 60

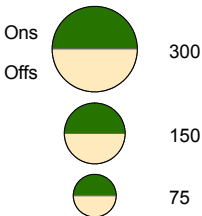
Current Span of Service

	Eastbound	Westbound
Weekday	05:15 - 23:09	05:31 - 23:56
Saturday	06:54 - 22:49	07:07 - 23:37
Sunday	07:44 - 18:31	08:00 - 19:59

Passenger Boarding Per Revenue Hour

2007	Qtr.	1	2	3	4	Year
Weekday		35.4	33.2	34.2	35.6	34.6
Saturday		29.3	27.6	27.1	27.3	27.8
Sunday		30.6	27.0	26.5	28.0	28.2

Passenger Activity (2007)

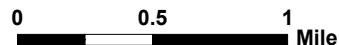


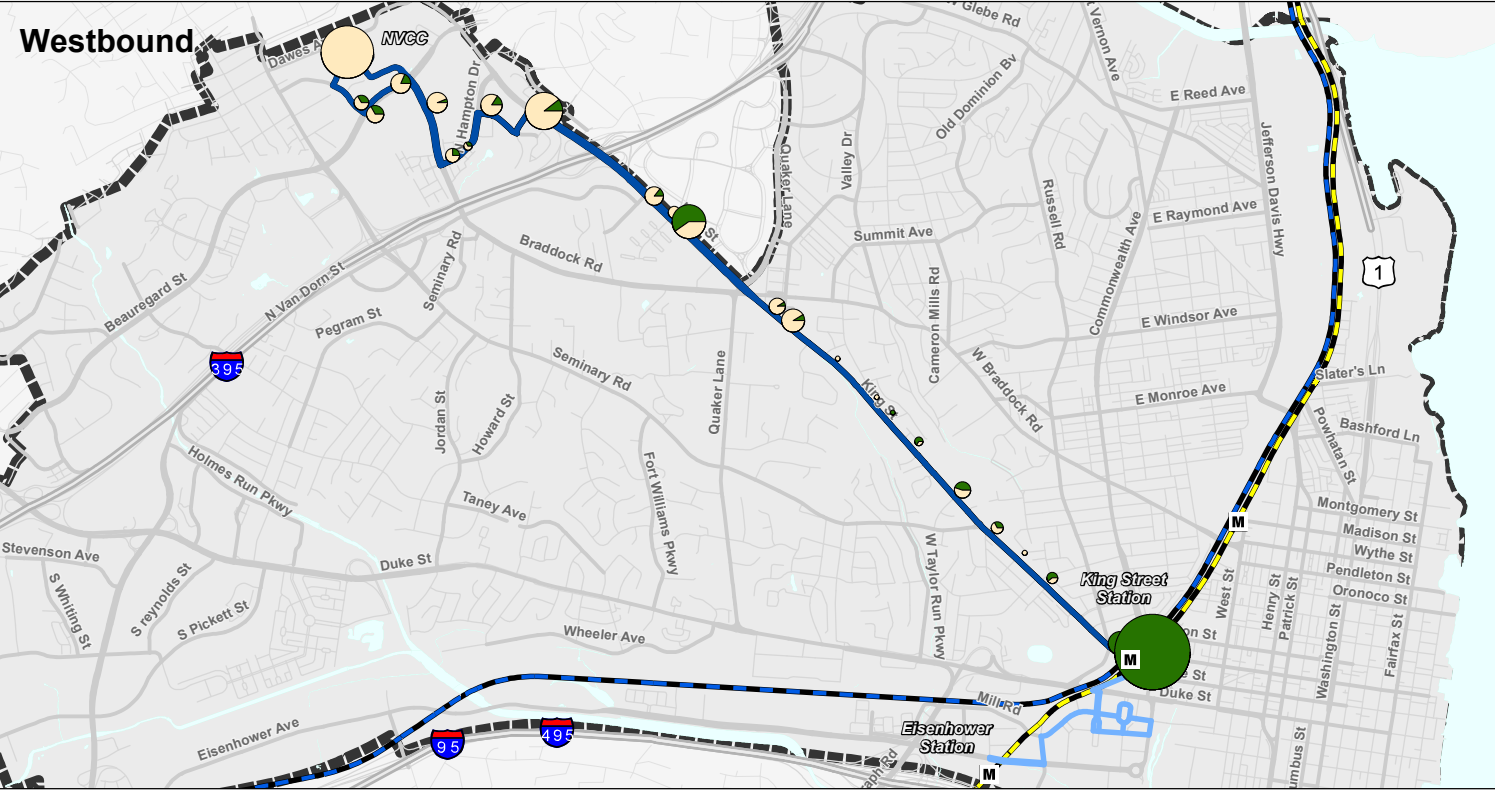
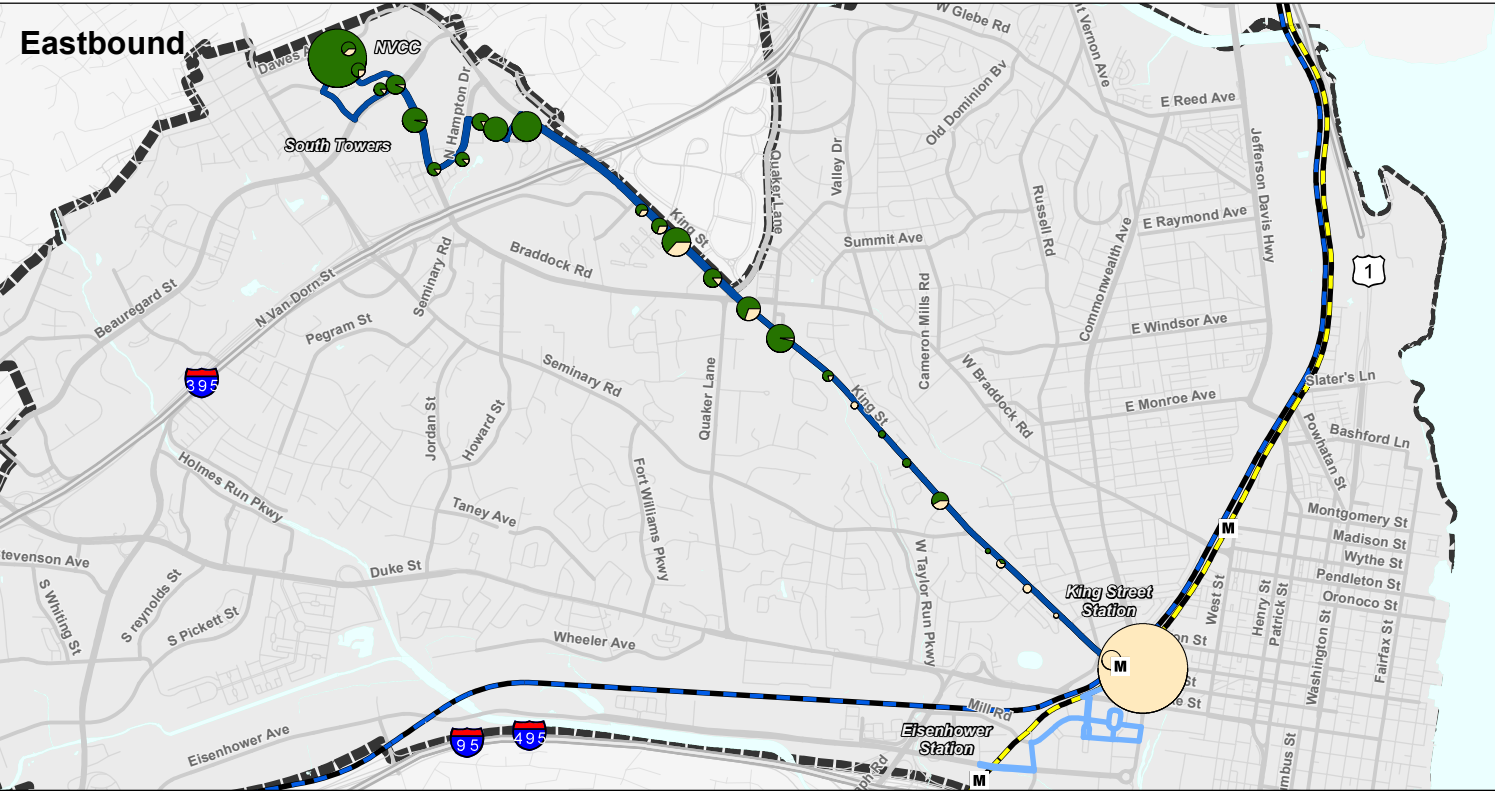
Legend

- 2008 Route Alignment
- Metro Station
- Metro Yellow Line
- Metro Blue Line

Data Sources Date Updated

DASH 2007 Ridecheck June 2008





Route 6

Description

ATC Route 6 operates from King Street Metro Station in Old Town to the campus of North Virginia Community College. The route operates in an east-west direction from the King Street Metro Station via King Street and local streets in Park Center to reach the campus roadways northwest of Beauregard Street and Braddock Road.

Current Service Frequencies (Minutes)

2008	Weekday				Sat / Sun
	AM	Mid	PM	EVE	
Eastbound	25	60	30	30	X
Westbound	30	60	30	40	X

2005	Weekday				Sat / Sun
	AM	Mid	PM	EVE	
Eastbound	30	60	30	60	X
Westbound	30	60	30	60	X

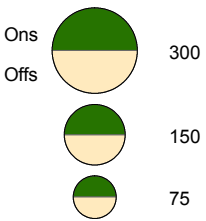
Current Span of Service

	Eastbound	Westbound
Weekday	05:51 - 22:53	05:53 - 22:24
Saturday	X	X
Sunday	X	X

Passenger Boarding Per Revenue Hour

2007	Qtr.	1	2	3	4	Year
Weekday		33.7	32.7	32.7	34.3	33.4
Saturday		X	X	X	X	X
Sunday		X	X	X	X	X

Passenger Activity (2007)

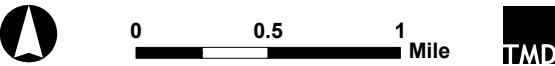


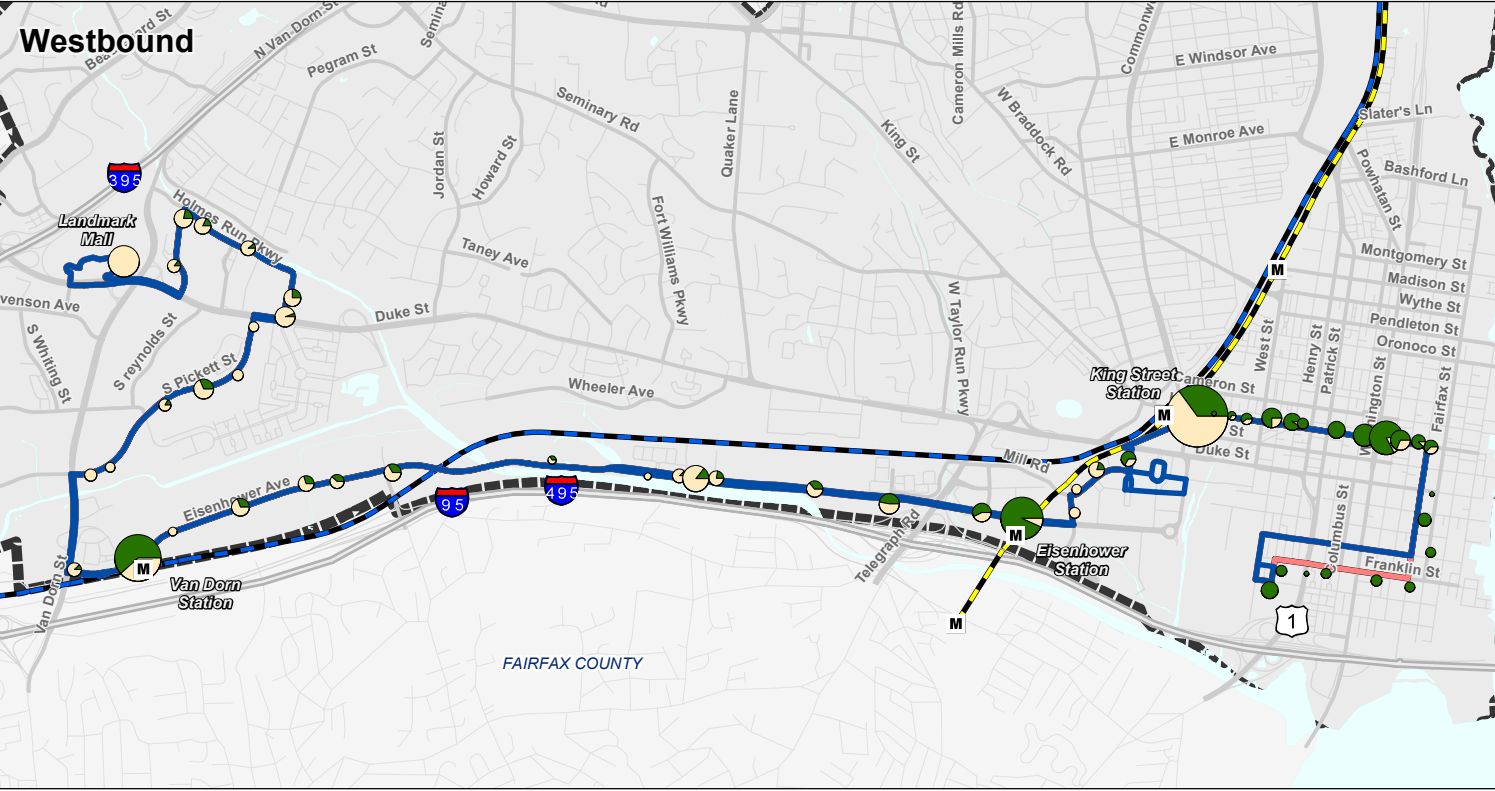
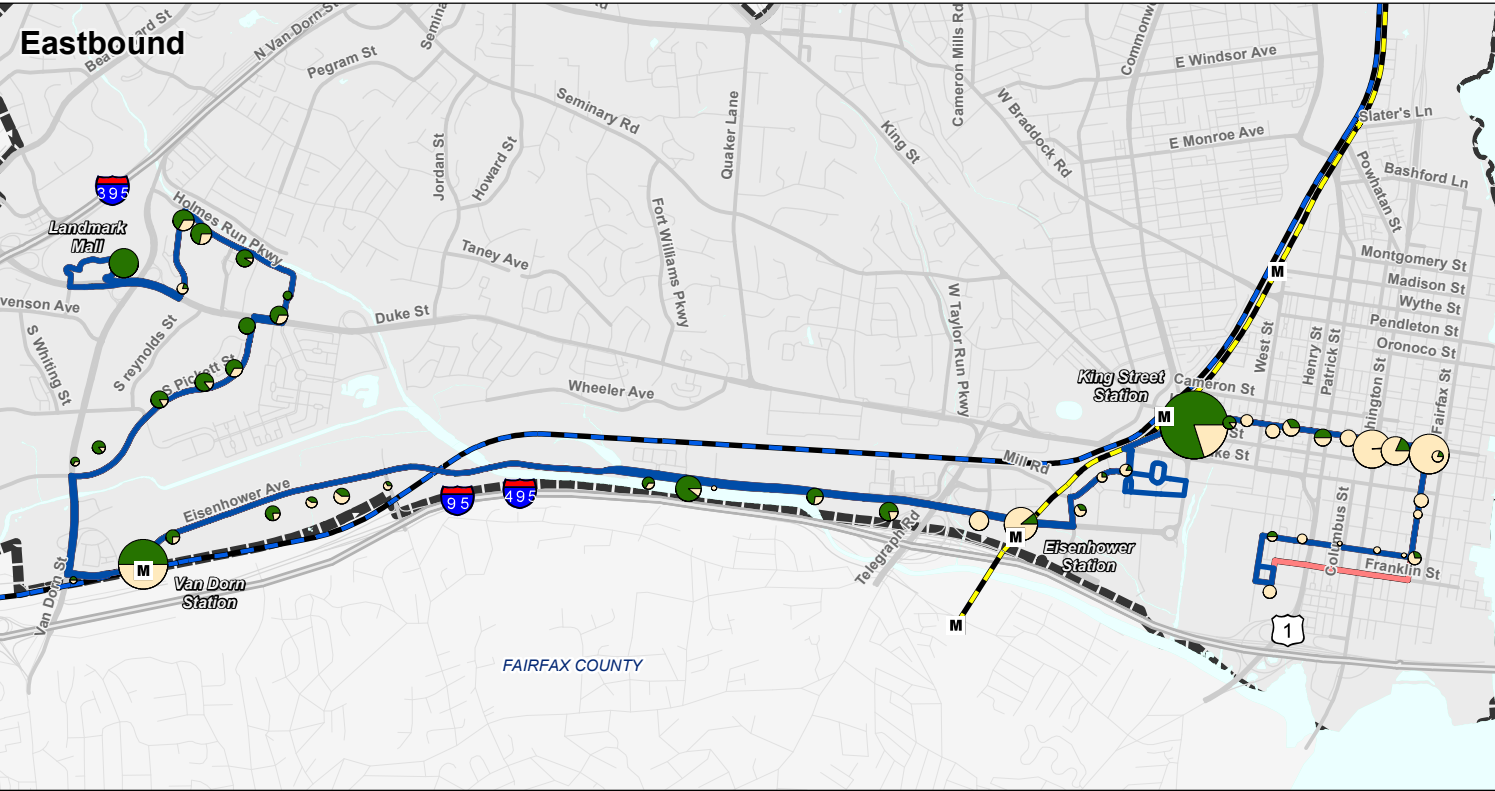
Legend

- 2008 Route Alignment
- Limited Trips to Eisenhower Station
- Metro Station
- Metro Yellow Line
- Metro Blue Line

Data Sources Date Updated

DASH 2007 Ridecheck June 2008





Route 7

Description

ATC Route 7 operates in an east-west direction from Lee Center in southeast Alexandria through Old Town and King Street Metro Station to Van Dorn Metro Street Station and Landmark Mall on Van Dorn Street. The route operates on major roads including Royal Street, King Street, Eisenhower Avenue and Van Dorn Street to the Mall.

Current Service Frequencies (Minutes)

2008	Weekday				Sat / Sun
	AM	Mid	PM	EVE	
Eastbound	30	60	30	X	60 / X
Westbound	30	60	30	X	60 / X
2005	Weekday				Sat / Sun
	AM	Mid	PM	EVE	
Eastbound	30	60	30	60	60 / X
Westbound	30	60	30	60	60 / X

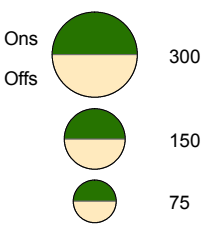
Current Span of Service

	Eastbound	Westbound
Weekday	05:14 - 20:49	05:41 - 20:44
Saturday	07:06 - 19:20	07:47 - 20:02
Sunday	X	X

Passenger Boarding Per Revenue Hour

2007	Qtr.	1	2	3	4	Year
Weekday		27.8	24.2	22.6	27.5	25.5
Saturday		13.5	11.3	10.5	12.9	12.0
Sunday		X	X	X	X	X

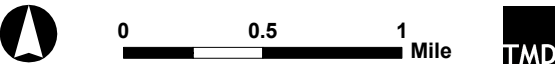
Passenger Activity (2007)

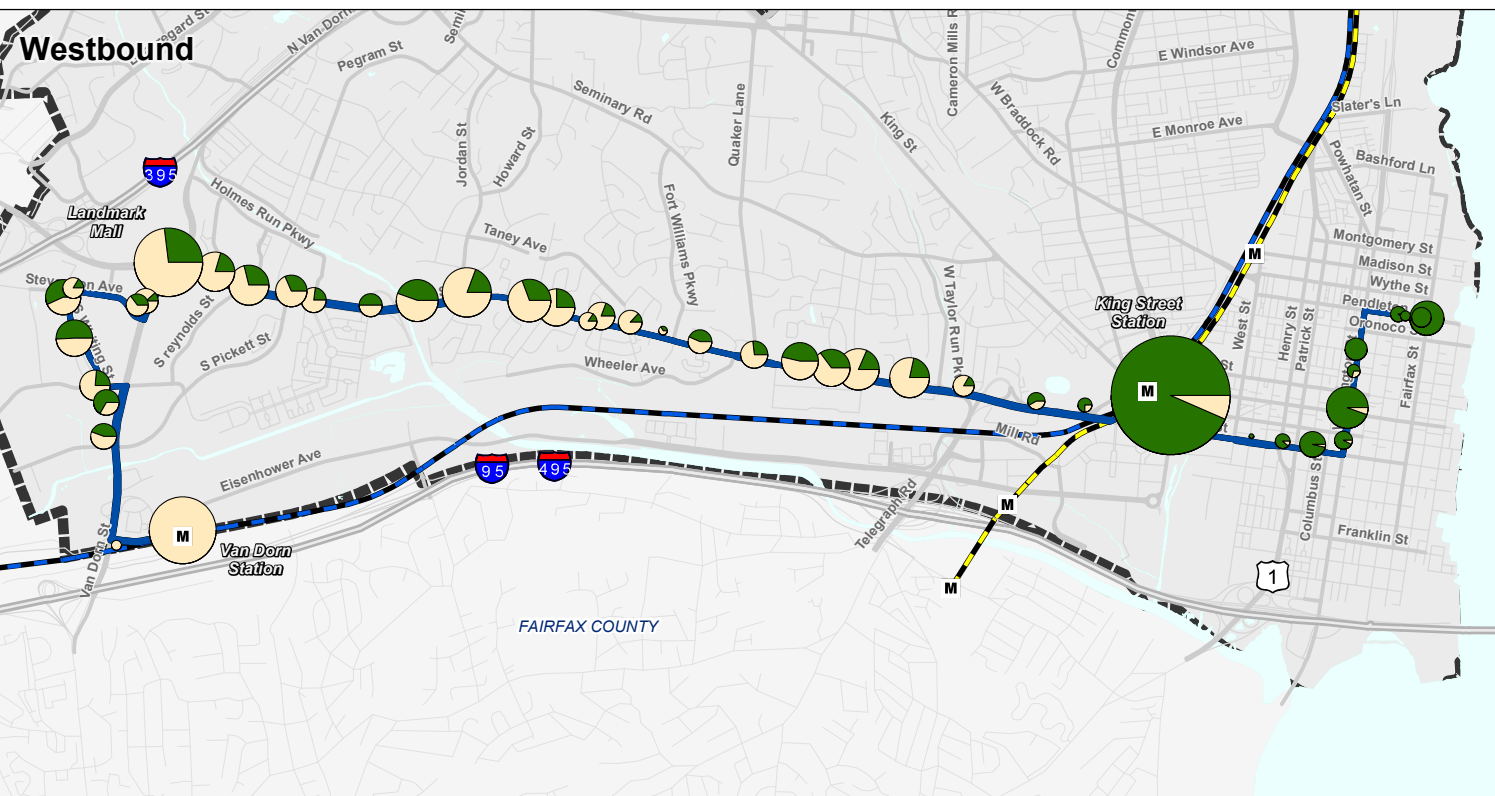
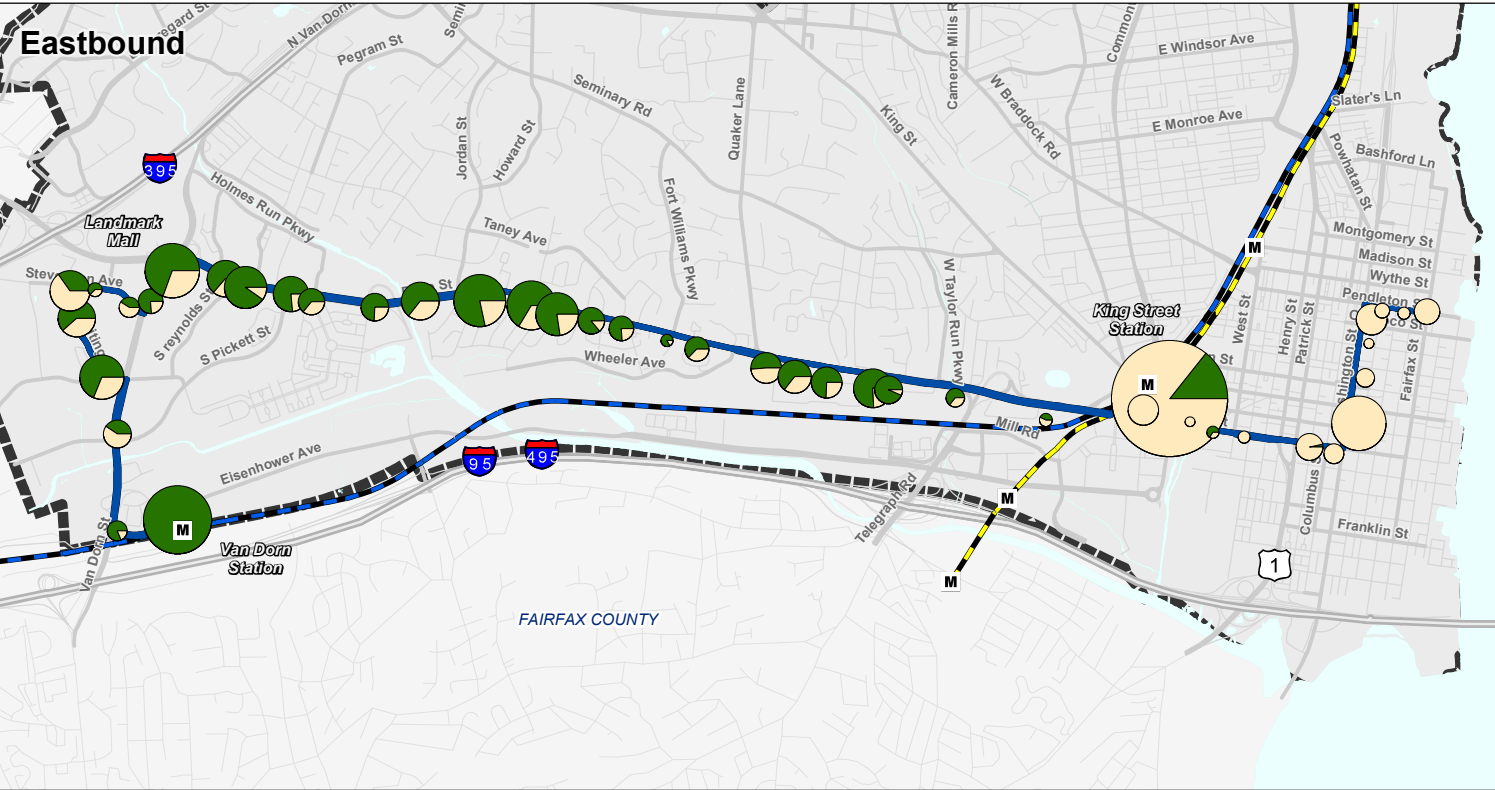


Legend

- 2008 Route Alignment
- 2007 Route Alignment
- Metro Station
- Metro Yellow Line
- Metro Blue Line

Data Sources Date Updated
DASH 2007 Ridecheck June 2008





Route 8

Description

ATC Route 8 operates in an east-west direction from Old Town via Duke Street to Van Dorn Street and Van Dorn Street Metro Station. The route serves Old Town, King Street Metro Station, the Duke Street commercial area, Landmark Mall, Van Dorn Plaza and Van Dorn Street Metro Station.

Current Service Frequencies (Minutes)

	2008				
	Weekday				Sat / Sun
Eastbound	AM	Mid	PM	EVE	
Westbound	15	20	30	45	30/30
	15	30	20	55	30/30
	2005				
	Weekday				Sat / Sun
Eastbound	AM	Mid	PM	EVE	
Westbound	10	20	20	45	60
	15	20	20	55	60

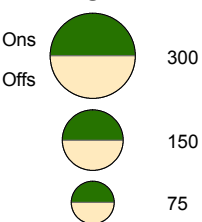
Current Span of Service

	2005	Eastbound	Westbound
Weekday		05:23 - 24:30	04:56 - 24:14
Saturday		06:25 - 23:24	06:27 - 23:46
Sunday		06:52 - 23:20	07:19 - 23:28





Passenger Boarding Per Revenue Hour

	2007	Qtr.	1	2	3	4	Year
Weekday			52.0	48.4	47.3	47.8	48.9
Saturday			48.8	46.5	48.1	44.5	47.0
Sunday			44.5	42.2	47.7	39.5	43.3

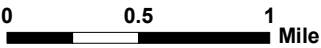
Passenger Activity (2007)



Legend

-  2008 Route Alignment
-  Metro Station
-  Metro Yellow Line
-  Metro Blue Line

Data Sources Date Updated
DASH 2007 Ridecheck June 2008



Route 10

Description

ATC Route 10 operates in an north-south direction from King Street Metro Station. The route provides a link between those residential areas along Commonwealth and Mount Vernon Avenues and King Street Station in the south and Potomac Yard Shopping Center in the north.

Current Service Frequencies (Minutes)

2008	Weekday				Sat / Sun
	AM	Mid	PM	EVE	
Northbound	30	60	30	60	60/60
Southbound	30	60	30	60	60/60
2005	Weekday				Sat / Sun
	AM	Mid	PM	EVE	
Eastbound	10	20	20	45	60
Westbound	15	20	20	55	60

Current Span of Service

	Northbound	Southbound
Weekday	07:13 - 21:04	06:35 - 21:25
Saturday	08:00 - 21:23	08:33 - 21:40
Sunday	09:10 - 18:33	09:38 - 18:55

Employment Density (2010)

Jobs per Commercial Acre

- Above 60
- 40 - 60
- 20 - 40
- Below 20

Population Density (2010)

Persons per Residential Acre

- Above 60
- 40 - 60
- 20 - 40
- Below 20

Legend

- 2008 Route Alignment
- Metro Station
- Metro Yellow Line
- Metro Blue Line

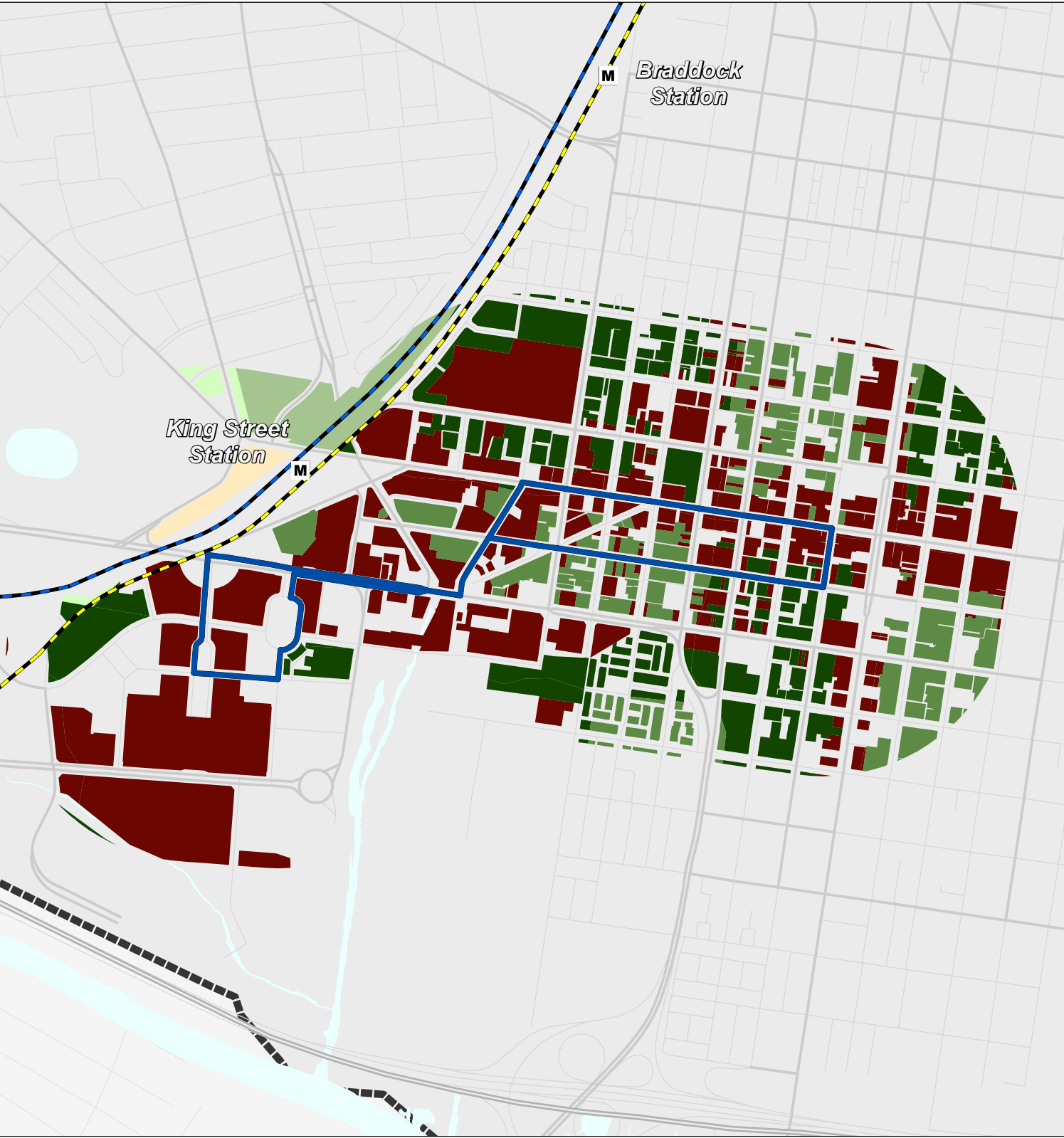
Data Sources

DASH, U.S. Census

Date Prepared

June 2008





Lunch Loop

Description

ATC Lunch Loop operates between the central business district with stops westbound along King Street and the Patent and Trademark Office and Federal Courthouse of Old Town on Dulany and Ballenger Streets.

Current Service Frequencies (Minutes)

2008	Weekday				Sat / Sun
	AM	Mid	PM	EVE	
Northbound	X	10	X	X	X
Southbound	X	10	X	X	X

2005	Weekday				Sat / Sun
	AM	Mid	PM	EVE	
Eastbound	X	X	X	X	X
Westbound	X	X	X	X	X

Current Span of Service

	Northbound	Southbound
Weekday	11:30 - 14:00	11:30 - 14:00
Saturday	X	X
Sunday	X	X

Employment Density (2010)

Jobs per Commercial Acre

- Above 60
- 40 - 60
- 20 - 40
- Below 20

Population Density (2010)

Persons per Residential Acre

- Above 60
- 40 - 60
- 20 - 40
- Below 20

Legend

- 2008 Route Alignment
- Metro Station
- Metro Yellow Line
- Metro Blue Line

Data Sources

DASH, U.S. Census

Date Prepared

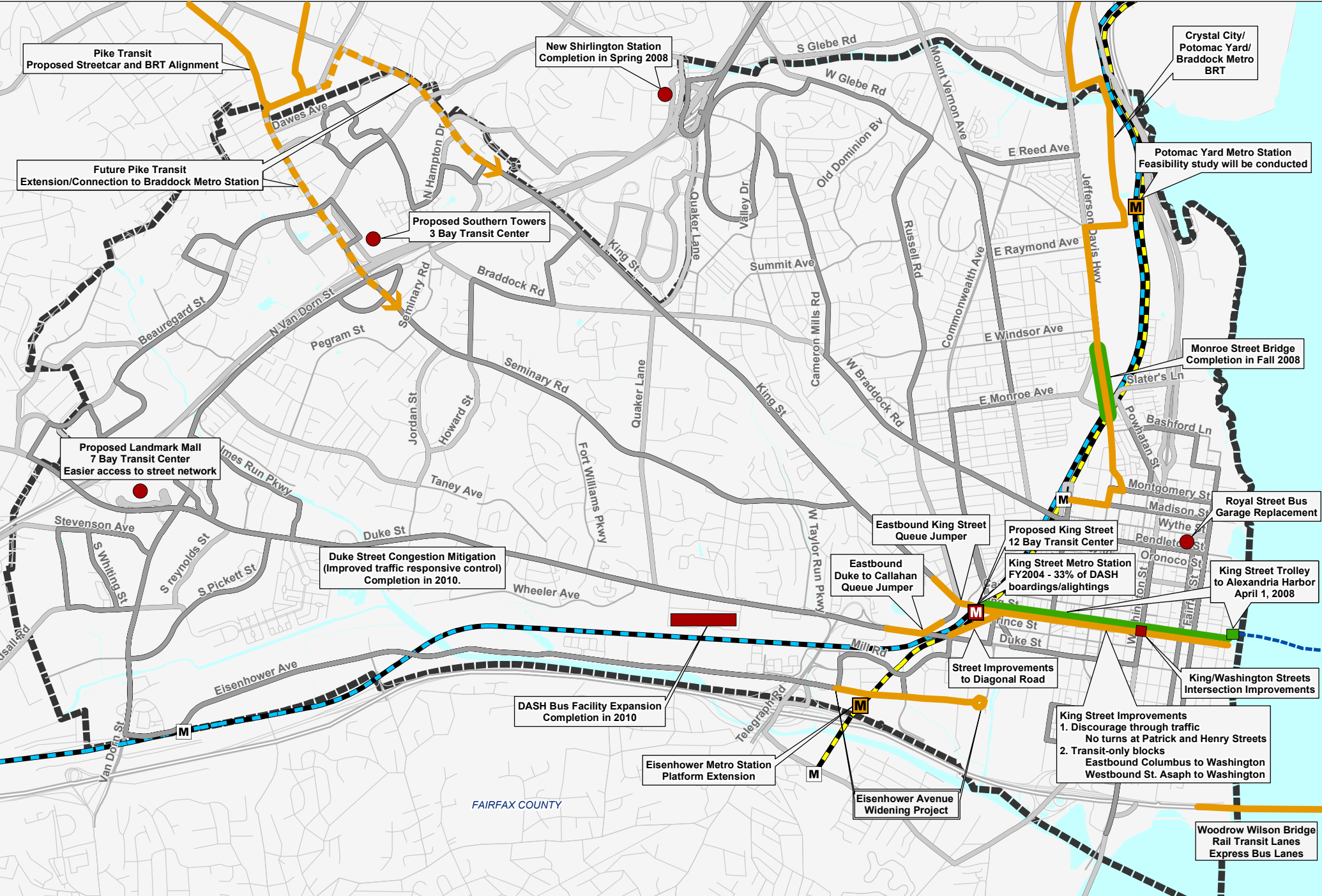
June 2008



0 0.1 0.2 Mile



Appendix G – Network Maps



Capital Improvement Projects in Alexandria, VA