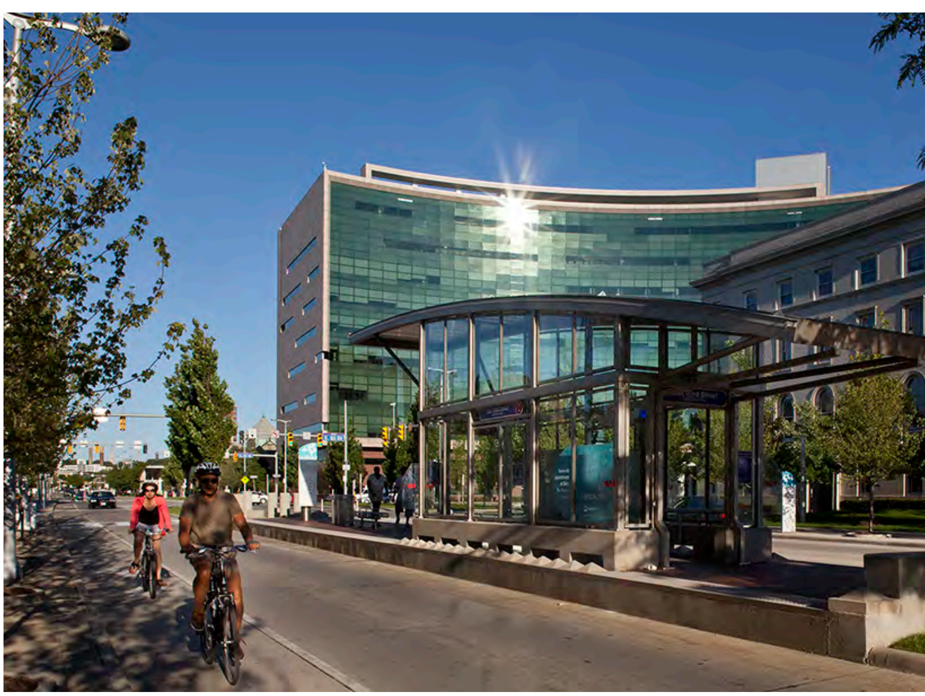
City of Alexandria

Transitway Corridors Feasibility Study



October 2012

Kimley-Horn and Associates, Inc.

CITY OF ALEXANDRIA VIRGINIA

Transitway Corridors Feasibility Study

October 2012

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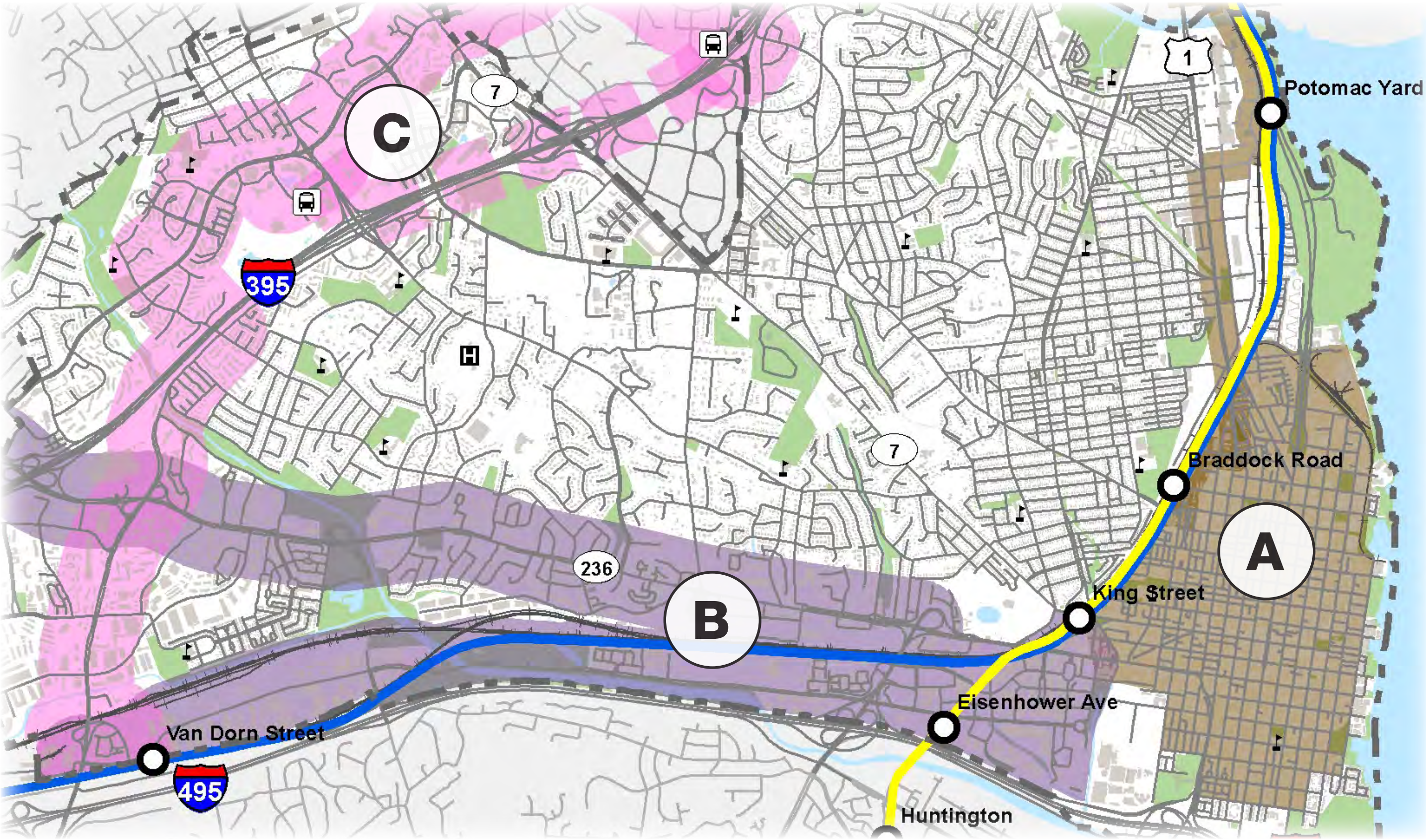

Executive Summary

Traffic congestion is a challenging reality in nearly every urban community in the Washington Metropolitan area. Peak period traffic congestion is rapidly becoming one of the most challenging issues affecting people's quality of life in the region. Alexandria's leaders recognize that a transportation strategy focused on multimodal mobility has the potential to provide significant benefit to the city. High-capacity transit facilities and services would offer Alexandrians an additional reliable travel option and help to meet citywide goals such as sustainability and high quality of life.

Figure E.1: Transportation Master Plan Identified Corridors

Building on Policy

The Alexandria *Transitway Corridor Feasibility Study* is rooted in principles and concepts developed in the city's adopted *Transportation Master Plan* (2008). The goal of the transitway study was to advance the *Transportation Master Plan's* planning and general policy ideas on high-capacity transit in the three corridors. The transitway study further evaluated each corridor and first identified whether high-capacity transit would be appropriate and then, if needed, proceeded to refine the corridor's alignment and transit mode technology recommendation, and identify cost and implementation implications.

Filling a Mobility Need

Metrorail's alignment through the city limits its ability to serve the entirety of Alexandria. Regional bus services augment Metrorail and provide coverage throughout the city; however, they are not able to provide the quality and frequency of service ultimately envisioned by city leaders and desired by the traveling public. The *Transportation Master Plan* identified corridors (Figure E.1) having the potential to fill a vast transit need in the city.

High Capacity Transit Corridor Work Group Meeting

Transportation Master Plan Transitway Goals

The *Transportation Master Plan* states that the implementation of transit facilities and services in these corridors would seek to achieve the following:

- Provide a seamless transit feeder network
- Focus investments on mobility needs
- Integrate key elements with transit plans in surrounding jurisdictions
- Advocate policy to encourage future transit-supportive land use

Study Public Process

Through 15 meetings of the High Capacity Transit Corridor Work Group (Corridor Work Group), which were open to the public, members of the Corridor Work Group and citizens provided input for the study. Corridor Work Group meetings were structured to provide an opportunity for presentations and information sharing from the project team (city staff and consultants) as well as comments, questions, and discussion by the Corridor Work Group and comments and questions from the public.

Corridor Work Group comments were taken into account throughout the study and incorporated into the development of alternatives and final recommendations for all corridors.

Corridor A: North-South

This corridor approximately follows US 1 (Jefferson Davis Highway and Patrick and Henry Streets) from the Fairfax County line on the south to the Arlington County line on the north. There are numerous challenges that affect the ability to locate surface-running high-capacity transit in the study area. General constraints include:

- Peak hour congestion on US 1 (Patrick Street, Henry Street, and Jefferson Davis Highway)
- Peak hour congestion on Washington Street
- Narrow rights-of-way as compared to functional needs of streets such as Patrick Street and Henry Street
- Narrow travel lanes on Patrick Street and Henry Street
- On-street parking
- Narrow sidewalks on portions of some streets where the transitway could run
- High-occupancy vehicle lanes on Patrick Street, Henry Street, and Washington Street
- Historic structures fronting rights-of-way along possible transitway routes

While each of these challenges are significant, the protracted traffic congestion along Patrick Street and Henry Street in the peak hour and direction and accompanying narrow rights-of-way along each of these streets limits potential transit concepts.

The series of Corridor Work Group meetings revealed significant concerns and alternative transportation priorities for the public and other stakeholders along Corridor A. Responding to Corridor Work Group direction and public comments, city staff recognized that the development of a service and infrastructure concept in Corridor A to the south of Braddock Road was a lower priority than transitways in Corridors B and C.

Two circulator starter ideas were developed in-response to Corridor Work Group and public comments. One of these starter ideas is shown in Figures E.2. The DASH Comprehensive Operations Analysis will identify and evaluate possible Old Town circulator services and will provide detailed recommendations.

Corridor B: Duke Street

This corridor follows Duke Street between Fairfax County on the west and the vicinity of the King Street Metrorail station on the east. Challenges and constraints for Corridor B include:

- Significant peak hour traffic congestion on Duke Street and surrounding side streets and ramps
- Generally narrow street rights-of-way
- Land use compatibility
- Residential parking on service roads
- Poor pedestrian and bicycle connectivity

With the array of challenges and constraints in the study corridor, the first focus of the study was on the alignment itself. Initially, the study evaluated alignment concepts along Duke Street and Eisenhower Avenue. Three alignment concepts were considered for the transitway in Corridor B: Duke Street, Eisenhower Avenue, and a combination of Duke Street and Eisenhower Avenue.

The combined Duke-Eisenhower alternative was eliminated from consideration due to the limited connectivity that exists between Duke Street and Eisenhower Avenue and the high costs associated with creating sufficient connections. The Eisenhower Avenue alignment also was eliminated from consideration due to factors that included greater demand for high-capacity transit along

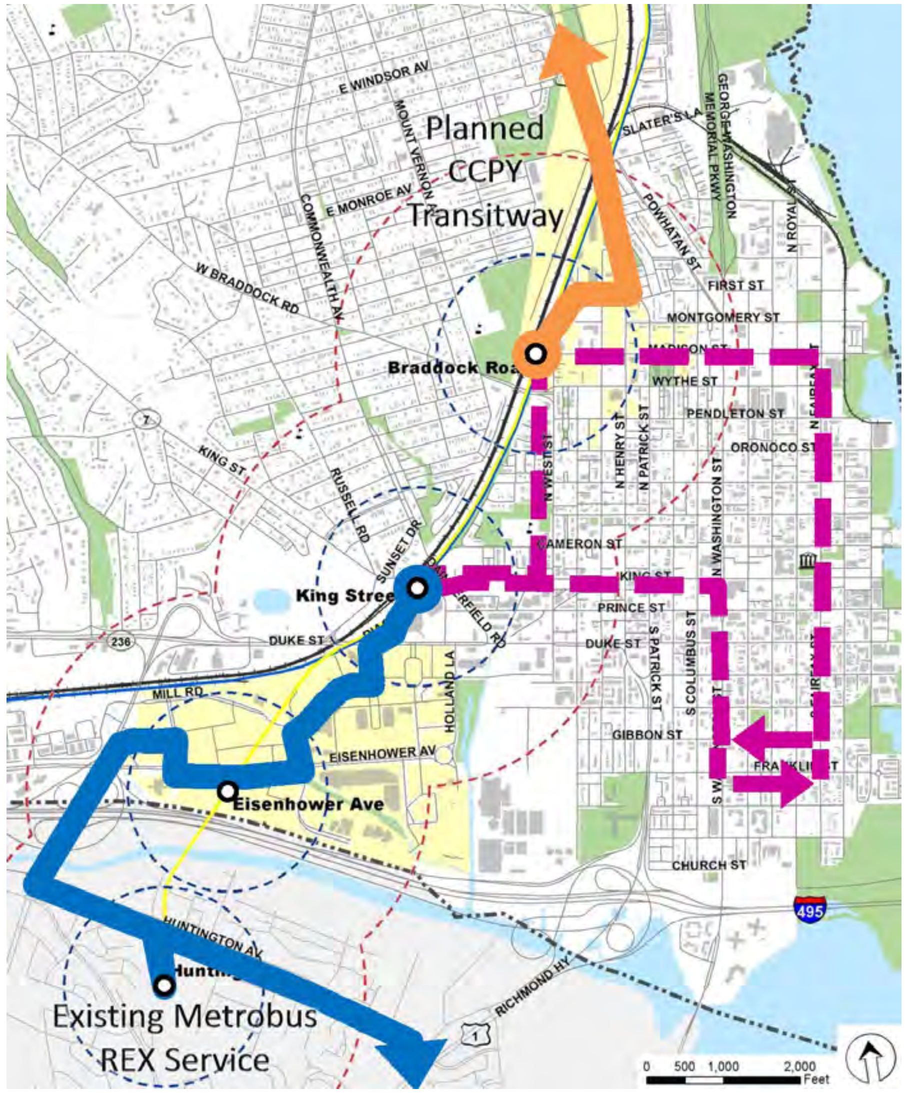

Figure E.2: Bidirectional Circulator Concept Starter Idea for Corridor A Area

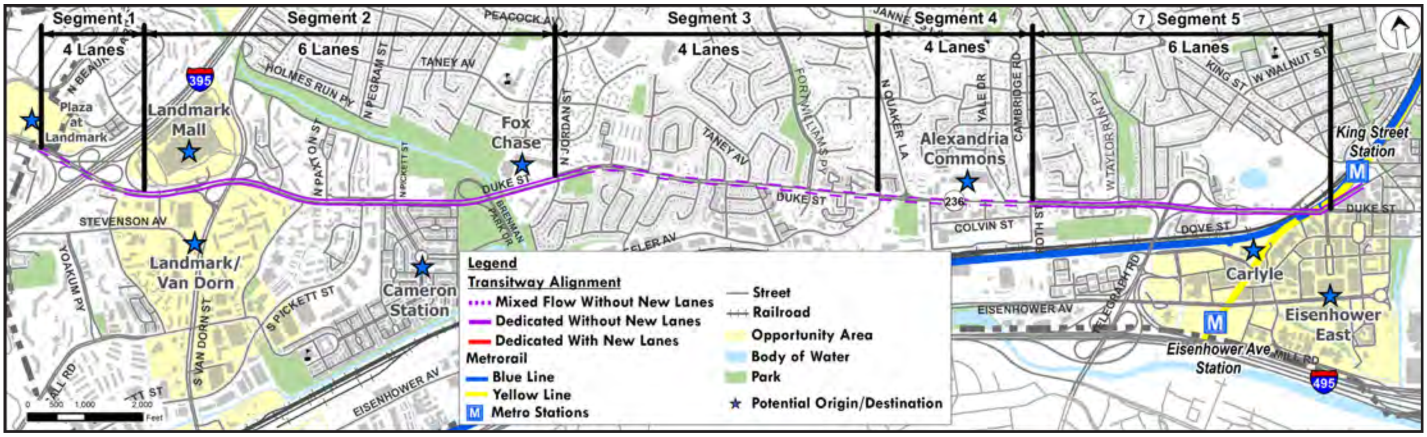

Figure E.3: Alternative 1a (Curb Running in Mixed Flow and Dedicated Lanes)

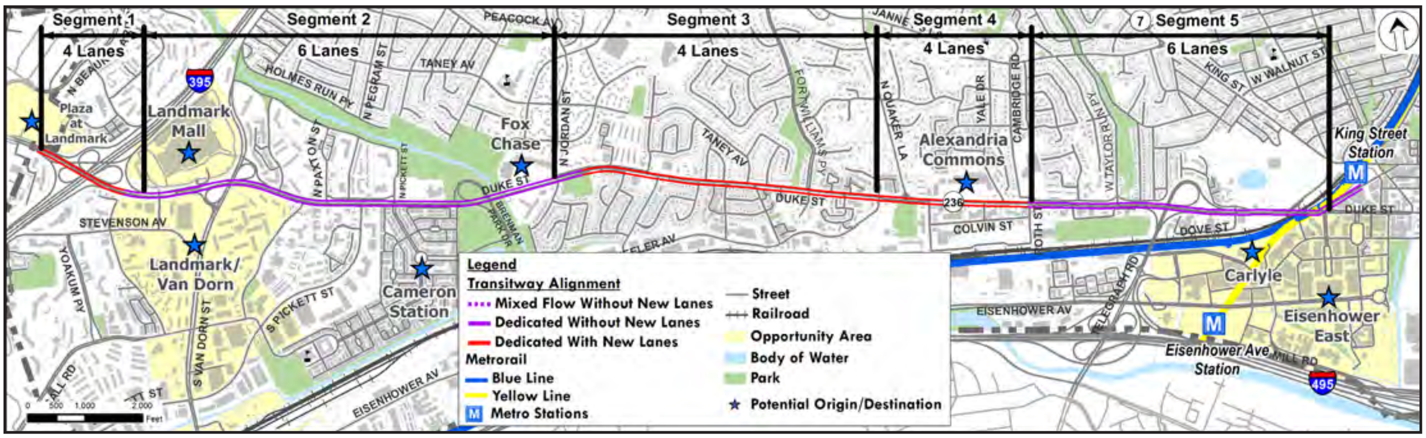

Figure E.4: Alternative 3c (Curb Running in Dedicated Lanes with New Lanes)

Duke Street, physical and natural barriers along Eisenhower Avenue, and duplication of service with Metrorail along the Blue Line. Duke Street was selected as the preferred location for a dedicated transitway.

Following the selection of Duke Street as the preferred alignment, a number of concepts were developed and evaluated for Duke Street. These ranged from fully dedicated median running Bus Rapid Transit (BRT) concepts to mixed flow operation Rapid Bus concepts.

Based on feedback from the Corridor Work Group and the public, as well as additional evaluation of bicycle connectivity options, a preliminary preferred alternative and phasing strategy were identified.

Ultimately, a combination of two concepts (Alternatives 1a and 3c) was the preferred approach for the Corridor B. These concepts are shown in Figures E.3 and E.4. A brief summary of recommended transitway characteristics is below:

- BRT operating in a combination of mixed flow and dedicated lanes
- Dedicated transit lane on Duke Street between Landmark Mall and Gordon Street, between Wheeler Avenue and S. Quaker Lane, and between Roth Street and Diagonal Road
- Reversible travel lane on Duke Street between Gordon Street and Wheeler Avenue and between S. Quaker Lane and Roth Street to facilitate the provision of a dedicated transit lane in the peak direction and peak periods
- Real-time service information at stations and online
- Transit signal priority at signalized intersections
- Queue jump lanes at some intersections
- Substantial station infrastructure
- Service-specific branding
- Special transit vehicles
- Off-board fare collection
- Enhanced streetscape along Duke Street that accommodates pedestrians and bicycles

Recognizing that additional transit service would be beneficial to Eisenhower Avenue, the study recommended that the City pursue conventional transit service and facility enhancements along Eisenhower Avenue.

The formal recommendation for Corridor B, as defined and unanimously approved by the Corridor Work Group on March 15, 2012, is presented below.

> *"Alternative 1a would be the first phase of transitway implementation on Duke Street. It would create dedicated transit lanes in existing six-lane sections of Duke Street between Landmark Mall and Jordan Street and between Roth Street and Diagonal Road. In the remaining section of Duke Street between Jordan Street and Roth Street, transit would operate in mixed flow.*
>
> *A parallel off-corridor bicycle facility should be examined to accommodate bicyclists along Duke Street and improved pedestrian facilities would be provided at intersections and near transit stations. Preliminary implementation should prioritize enhanced pedestrian safety and improvements at Taylor Run Parkway.*
>
> *Alternative 3c would be the subsequent phase of transitway implementation on Duke Street. It would build on Alternative 1a by widening Duke Street to provide a reversible lane between Jordan Street and Roth Street.*
>
> *The reversible lane would be configured to allow Duke Street to accommodate a dedicated transit lane in the peak hour and peak direction of traffic flow during the a.m. and p.m. peak periods along Duke Street.*
>
> *Alternative 3c should continue to examine a bicycle facility along Duke Street along with corridor-wide pedestrian improvements. However, the Work Group believes that bicycles should be accommodated in this corridor if studies demonstrate that the streetscape can still be enhanced."*

The Corridor Work Group recommendation was approved by the City Council on June 14, 2012, following input from the Transportation Commission and Planning Commission, which stressed the need to minimize impacts to businesses and homeowners.

Corridor C: Van Dorn Street/Beauregard Street

This corridor runs along portions of Walter Reed Drive, Beauregard Street, Sanger Avenue, and Van Dorn Street. Like the other corridors studied, there are numerous challenges that affect the ability to locate surface-running high-capacity transit in the corridor such as:

- Peak hour congestion on Van Dorn Street and in the Mark Center vicinity
- Lack of a direct (one-street) route from the beginning to the end of the corridor
- Grade separated interchanges at Van Dorn Street with Metro Road and Duke Street
- Limited rights-of-way with many businesses and residences adjacent to Van Dorn Street
- Proximity to interstate facilities
- Environmental constraints such as Holmes Run and Lucky Run
- Existing streetscape along Beauregard Street
- Limited clearance of the Sanger Avenue underpass at I-395
- Narrow sidewalks on portions of some streets

The existing congestion and travel patterns reinforce the need for transit to operate in a fully or partially dedicated (congestion-free) runningway to achieve its stated purpose. Most of the roadways in the corridor have current geometric configurations which would allow for the creation of dedicated lanes. However, grade-separated interchanges, limited rights-of-ways, and planned roadway improvements challenge the implementation of a dedicated runningway.

Seven preliminary alternatives were developed using a "kit of parts" approach that took into consideration regional connectivity, alternative alignments within the Beauregard/Van Dorn corridor, and several different transit mode technologies. The alternatives also took into account Corridor Work Group and public input regarding origins and destinations, impacts, priorities, and other factors.

A series of potential connections and alignments that were identified and developed to create alternative concepts. Using beneficial and effective combinations of regional connections, alignment alternatives within the Beauregard/Van Dorn corridor, and transit mode technologies, the following seven preliminary alternatives were created:

- Alternative A: Streetcar in Mixed Flow Connecting to Columbia Pike
- Alternative B: Rapid Bus in Mixed Flow Connecting to the Pentagon and Shirlington
- Alternative C: Rapid Bus in Mixed Flow Connecting to the Pentagon and Streetcar in Mixed Flow Connecting to Beauregard Town Center
- Alternative D: BRT Connecting to the Pentagon and Shirlington
- Alternative E: BRT Connecting to the Pentagon and Streetcar in Mixed Flow Connecting to Beauregard Town Center
- Alternative F: BRT Connecting to the Pentagon and Shirlington via the Plaza at Landmark
- Alternative G: Streetcar in Dedicated Lanes Connecting to Columbia Pike

As a result of the detailed analysis and work with the Corridor Work Group, a preferred concept was selected for Corridor C. The concept selected was Alternative D (BRT service in dedicated lanes), as shown in Figure E.5.

Alternative D involves two transit mode technologies. BRT is recommended to operate in mostly dedicated runningway from the Van Dorn Metrorail Station to Mark Center Drive. This section of the corridor would provide direct BRT access to major destinations such as Landmark Mall, current and future development along Van Dorn Street, existing and future development along Sanger Avenue and Beauregard Street, and the Mark Center.

At the Mark Center, the transitway service would branch into two lines. Passengers ultimately destined for the line terminus would not need to transfer since both branches would terminate at Pentagon/Pentagon City.

One branch of the service would run express after stopping at the Mark Center and turn onto Seminary Road and use I-395 to make a direct connection to Pentagon/Pentagon City. During peak hours in the peak direction, this branch would use the I-395 HOV lanes.

The second branch of transitway service would travel across Seminary Road and into Southern Towers. This service would then return to N. Beauregard Street as a Rapid Bus service connecting to Pentagon/Pentagon City through Shirlington.

A brief summary of recommended characteristics of Alternative D is below:

- BRT operating primarily in a dedicated median transitway
- Median-running dedicated transitway on Van Dorn Street Street between Eisenhower Avenue and Stevenson Avenue
- Mixed flow operation on Stevenson Avenue and in the short-term, through Landmark Mall
- Curb-running dedicated lane operation on Van Dorn Street between Landmark Mall and Sanger Avenue
- Median-running dedicated transitway on Sanger Avenue between Van Dorn Street and Beauregard Street
- Median-running dedicated transitway on Beauregard Street between Sanger Avenue and Mark Center Drive
- Mixed flow operation on Mark Center Drive
- Dedicated lane operation through Southern Towers
- Mixed flow operation on Beauregard Street from Southern Towers to Route 7
- Real-time service information at stations and online
- Transit signal priority at signalized intersections
- Queue jump lanes at some intersections
- Substantial station infrastructure
- Service-specific branding
- Special transit vehicles
- Off-board fare collection
- Enhanced streetscaps along Van Dorn Street, Sanger Avenue, and Beauregard Street

It should be noted that implementation of Alternative D does not preclude a future streetcar service at a later phase.

The series of Corridor Work Group meetings ultimately concluded with a final recommendation for Corridor C that confirmed Alternative D as the selected concept with the notion that analysis would continue to study the future implementation of Alternative G (streetcar service). On May 11, 2011, the Corridor Work Group concluded:

> *"Alternative D is the preferred alternative for phased implementation of transit in dedicated lanes in Corridor C until such time as Alternative G becomes feasible and can be implemented. This course of action is consistent with the Council's recent decision to provide dedicated lane transit along the segment of Corridor A that is north of Braddock Road. Evaluation and analysis will continue of Alternative D in preparation for future implementation of Alternative G. Construction of transit in Corridor C shall be the first priority of Alexandria's transportation projects. Each subsequent corridor shall be evaluated separately regarding the need to acquire additional right-of-way for dedicated lanes as discussed in the Transportation Master Plan."*

The Corridor Work Group recommendation was approved by the City Council on September 17, 2011, following input from the Transportation Commission and Planning Commission, which stressed the need to better serve the Northern Virginia Community College.

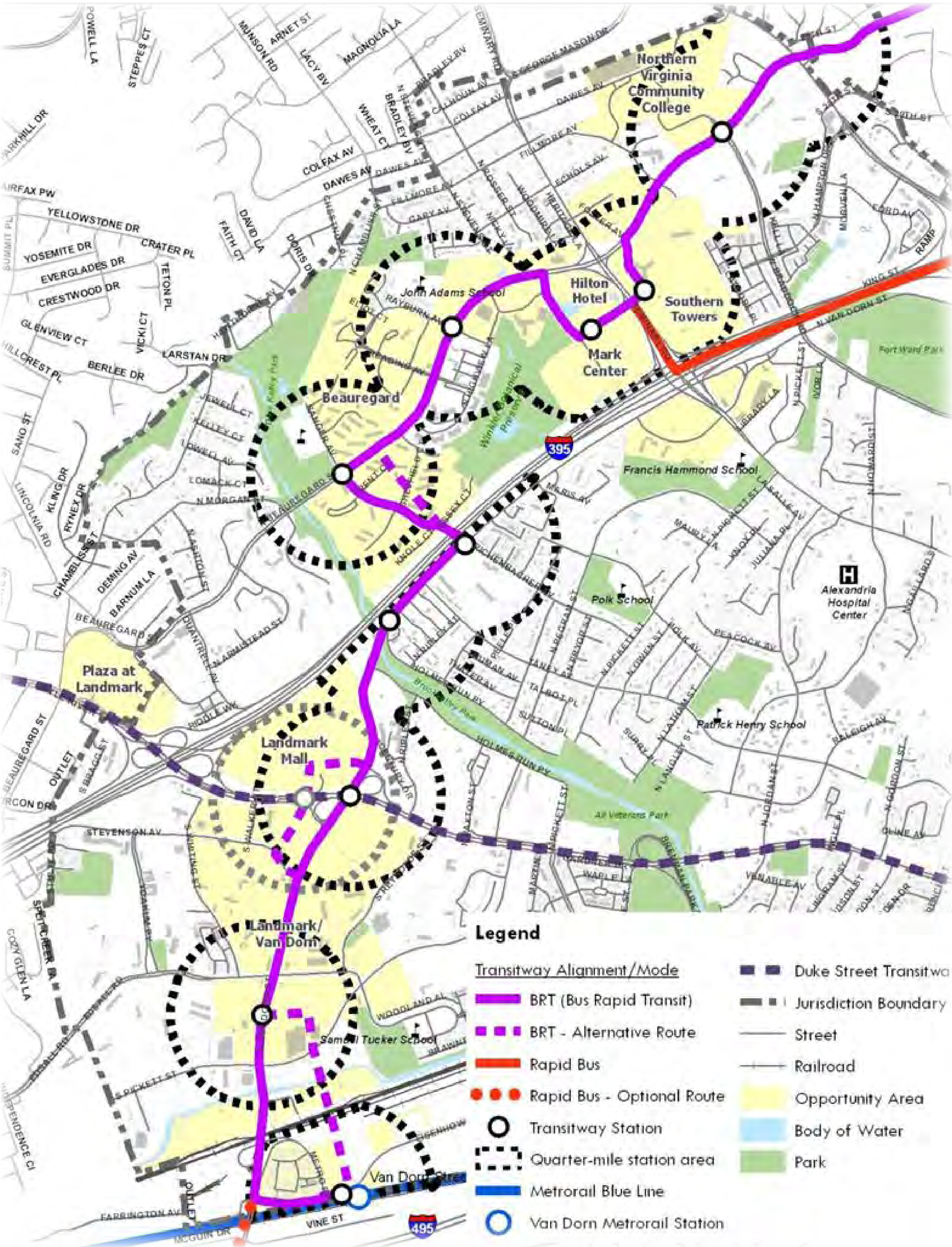

Figure E.5: Preferred Alternative

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chapter 1

King Street Trolley (Old Town, Alexandria)

Background

Traffic congestion is a challenging reality in nearly every urban community in the Washington Metropolitan area. Peak periods extend for multiple hours in the mornings and evenings of typical weekdays. Incidents and special events occur on a regular basis and add to already challenging travel conditions. Alexandria is subject to travel demand from residents and workers within its jurisdictional boundary and by people traveling through the city. Improving people's mobility by solely adding car-carrying capacity along existing transportation corridors is an investment with diminishing returns in Alexandria. The physical, monetary, societal, environmental, and other costs of widening existing streets and building new streets are vastly disproportionate to benefits that would be realized.

Alexandria's leaders recognize that a transportation strategy focused on multimodal mobility has the potential to provide the most significant benefit to the city at a manageable cost. A cornerstone of the city's multimodal approach to transportation is high-quality and high-capacity transit facilities and services. These transit facilities and services have the potential to offer travelers reliable trips, time savings, real-time information, desirable amenities, and an enjoyable travel experience.

Study Purpose and City Planning Context

The Alexandria *Transitway Corridor Feasibility Study* was undertaken to build on principles and concepts developed in the city's adopted *Transportation Master Plan* (2008). The primary purpose of the study was to further evaluate each of the three transitway corridors identified in the city's adopted *Transportation Master Plan* (2008).

Overall, the goal of the study was to advance the *Transportation Master Plan's* planning and general policy ideas on high-capacity transit in each of these corridors. The study scope was developed to determine whether high-capacity transit would be appropriate and needed in each corridor. Where the study identified a need for high-capacity transit, a refined alignment, preferred transit mode technology, operating, capital, right-of-way cost, and implementation steps would be identified. From a policy framework perspective related to high-capacity transit in the city, the *Transportation Master Plan* (2008) envisions the following:

> *"…a transportation system that encourages the use of alternative modes*

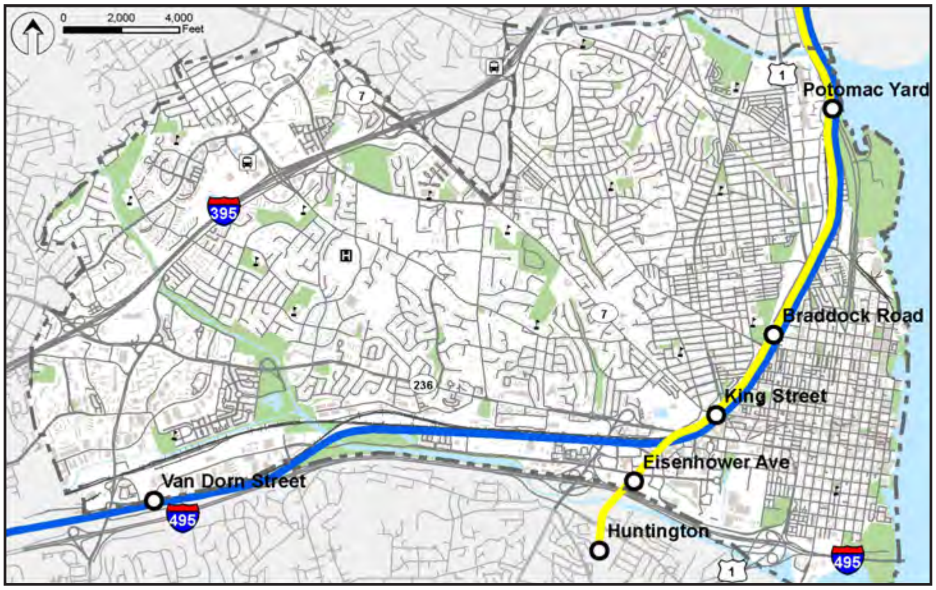


Figure 1.1: Metrorail in Alexandria

of transportation, reducing dependence on the private automobile. This system will lead to the establishment of transit-oriented, pedestrian-friendly village centers, focused on neighborhood preservation and increased community cohesion, forming a more urban, vibrant and sustainable Alexandria. The City will promote a balance between travel efficiency and quality of life, providing Alexandrians with transportation choice, continued economic growth and a healthy environment."

The city's transportation vision, articulated in the *Transportation Master Plan*, is supported by the following guiding transportation principles:

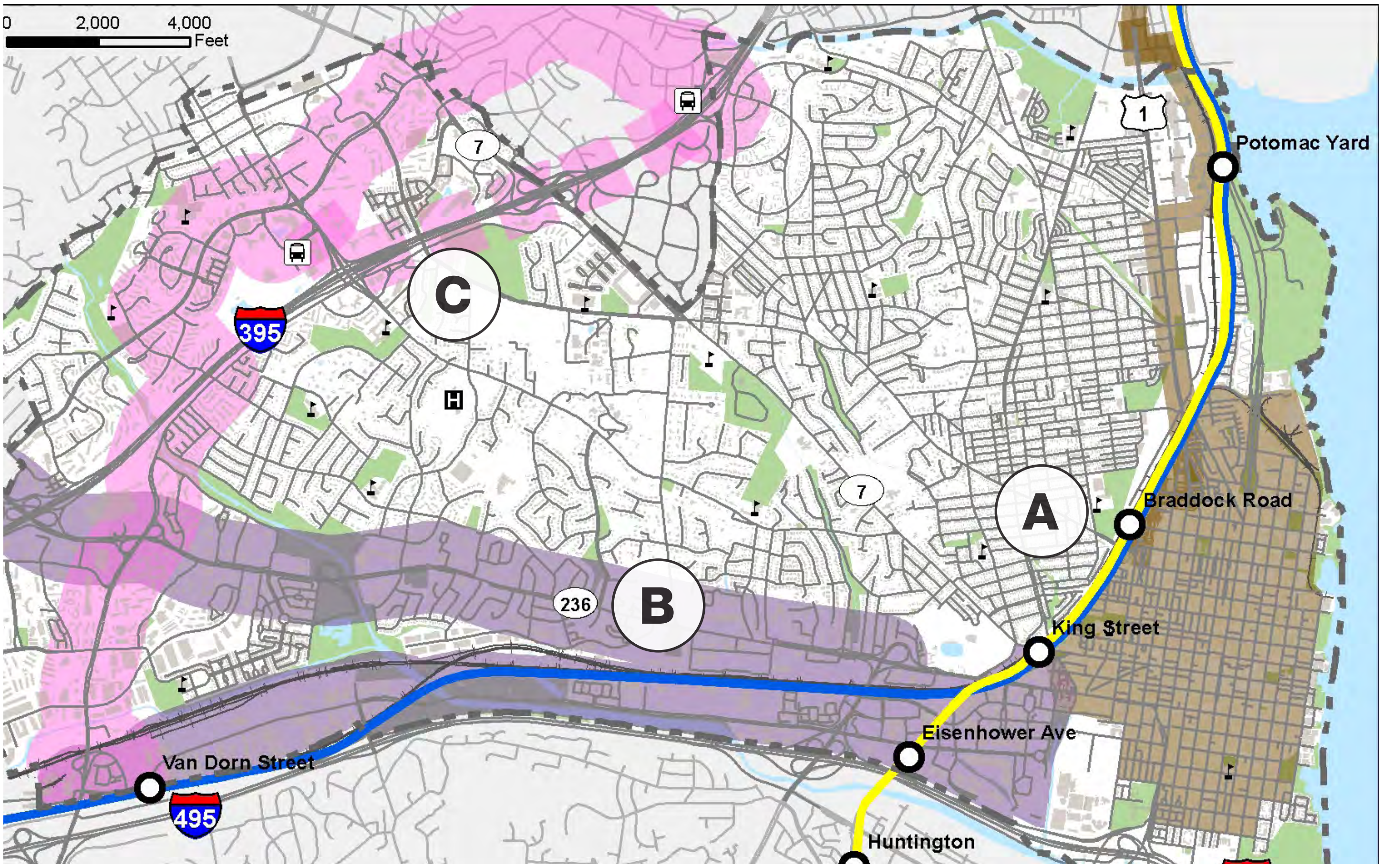
1. *Alexandria will develop innovative local and regional transit options.*
2. *Alexandria will provide quality pedestrian and bicycle accommodations.*
3. *Alexandria will provide all its citizens, regardless of age or ability, with accessibility and mobility.*
4. *Alexandria will increase the use of communications technology in transportation systems.*
5. *Alexandria will further transportation policies that enhance quality of life, support livable urban land use, and encourage neighborhood preservation, in accordance with the City Council Strategic Plan.*
6. *Alexandria will lead the region in promoting environmentally-friendly transportation policies.*
7. *Alexandria will ensure accessible, reliable, and safe transportation for older and disabled citizens.*

Alexandria's citizens are already served by the city's interconnected network of streets; local bus service principally provided by DASH and Metrobus; Metrorail services along the Blue and Yellow lines at the Van Dorn, Eisenhower Avenue, King Street, and Braddock Road stations; and a growing network of sidewalks, trails, and bikeways. The *Transportation Master Plan* provides guidance for the long-term adaptation of the city's transportation system to expand pedestrian and bicycle networks, high-quality transit services and facilities, and the role of streets.

While a valuable asset to the Washington Metropolitan area and Alexandria, Metrorail's alignment through the city limits its ability to serve the entirety of Alexandria (Figure 1.1). Regional bus services augment Metrorail by providing a significant amount of coverage throughout the city; however, they are not able to provide the quality and frequency of service ultimately envisioned by city leaders and desired by the traveling public. To realistically achieve the goal of offering high-quality transit services and facilities in key corridors citywide, the *Transportation Master Plan* identified three corridors (Figure 1.2) for high-quality, frequency, and capacity transit service expansion.

Corridor A: North-South

This corridor would approximately follow US 1 (Jefferson Davis Highway and Patrick and Henry Streets) from the Fairfax County line on the south to the Arlington County line on the north. It could have the potential to seamlessly connect to planned transit corridors in Fairfax and Arlington Counties. Corridor A would provide services to through commuters who currently drive along the US 1 corridor and to residents and employees with origins and destinations along the corridor; would function as an alternative to Metrorail services (Blue and



Yellow lines); and would improve access to key destinations within the city and in Fairfax and Arlington Counties such as Old Town, Potomac Yard, Crystal City, the Pentagon, and Ft. Belvoir.

Figure 1.2: Transportation Master Plan Identified Transitway Corridors

Corridor B: Duke Street/Eisenhower Avenue

This corridor would follow either Duke Street or Eisenhower Avenue between Fairfax County on the west and the vicinity of the King Street Metrorail station on the east. It has the potential to serve the Eisenhower East area, Landmark Mall, Foxchase, Alexandria Commons, the King Street Metrorail station, and portions of Old Town. The alignment of the corridor in an approximate east/west orientation also would allow it to connect to Corridor A at US 1 and to Corridor C at Van Dorn Street.

Corridor C: Van Dorn Street/Beauregard Street

This corridor would run along portions of Walter Reed Drive, Beauregard Street, Sanger Avenue, and Van Dorn Street. On the north, the corridor could extend to the Pentagon area and/or could connect to Shirlington. On the south, the corridor would directly connect to the Van Dorn Street Metrorail station, Corridor B, and eventually into Fairfax County. Key destinations along the corridor include the Van Dorn Street Metrorail station, Landmark Mall/ Van Dorn Street commercial areas, Kingstowne, the Mark Center, Shirlington, and the Pentagon.

Transportation Master Plan Transitway Goals

The *Transportation Master Plan* states that the implementation of transit facilities and services in these corridors would seek to achieve the following:

- Provide a seamless transit feeder network
- Focus investments on mobility needs
- Integrate key elements with transit plans in surrounding jurisdictions
- Advocate policy to encourage future transit-supportive land use

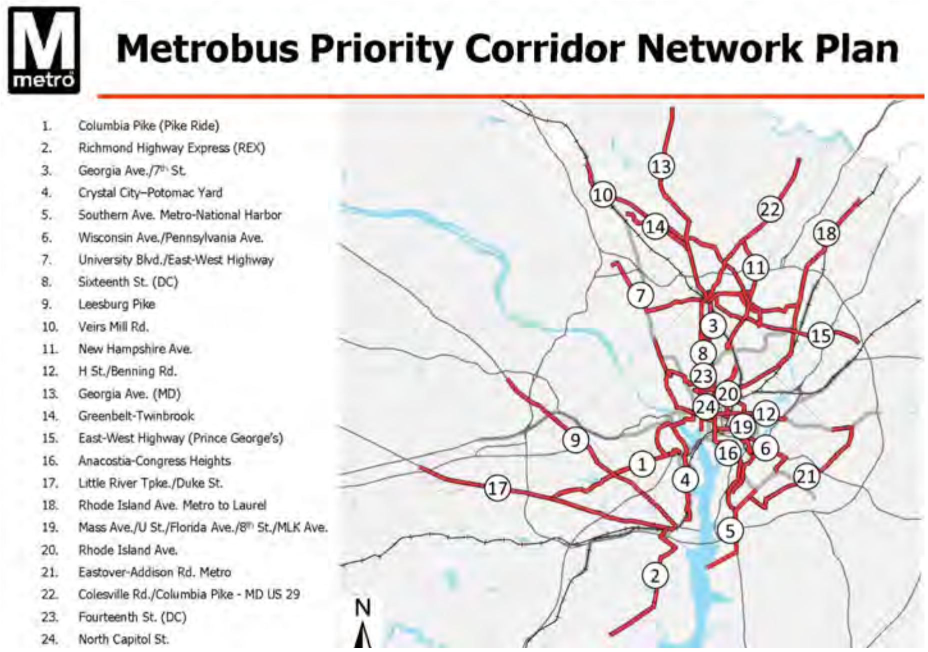
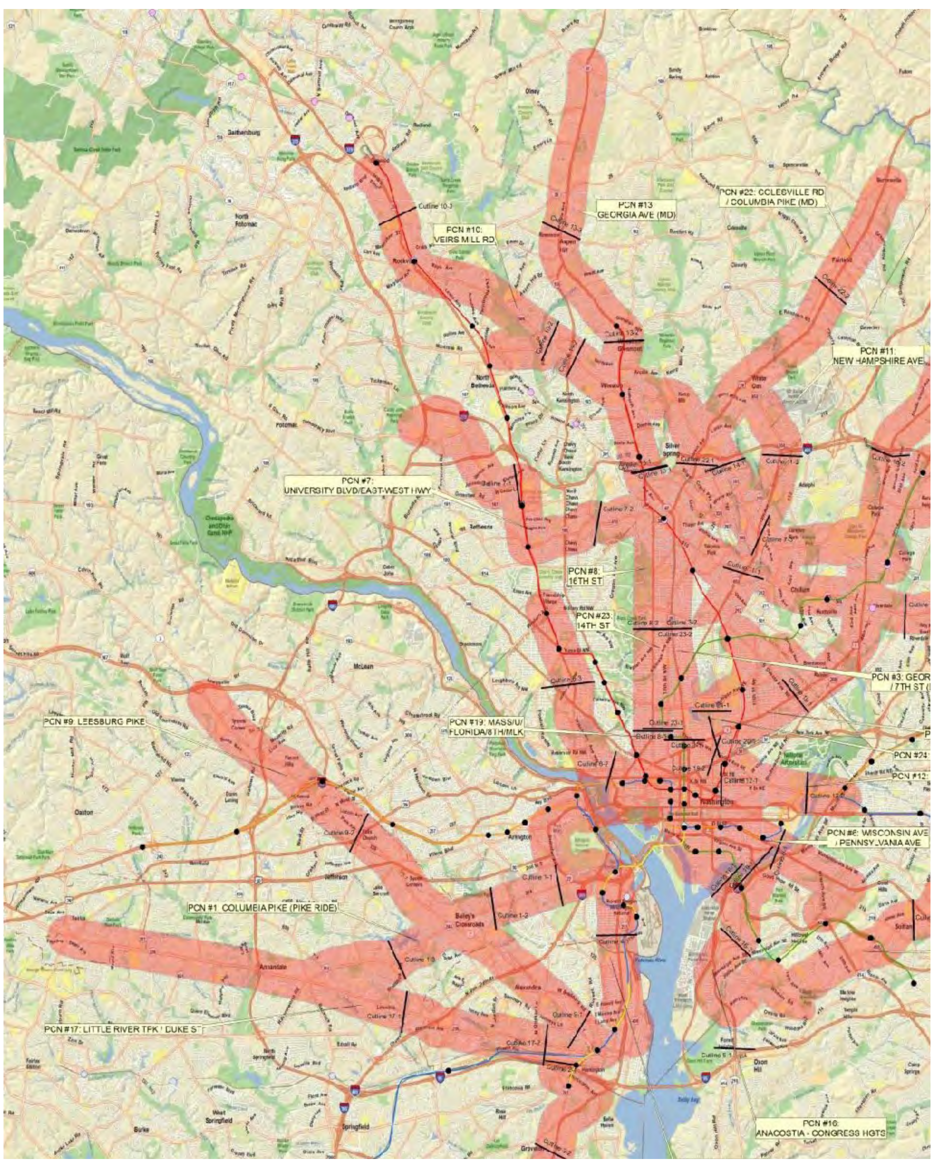


Figure 1.3: WMATA Priority Corridor Network Plan Schematic

Figure 1.4: WMATA Priority Corridor Network Plan Map



Regional Plan Context

Also recognizing the limitations of the existing rail transit and local bus network within the Washington Metropolitan area to serve people's mobility needs today and into the future, the Washington Metropolitan Area Transit Authority (WMATA) and Metropolitan Washington Council of Governments (MWCOG) developed plans for surface-running priority corridor transit services. Figures 1.3 and 1.4 show the designated corridors. Suggesting the benefit of investing in the region's surface transit system, when implemented, WMATA's analyses indicate that regional transit boardings could increase by three to four percent in the service area. WMATA has three goals for its priority corridor network (PCN):

- Improve competitiveness of bus transit
- Support existing and planned land use and economic development
- Improve efficiency of the transportation system

The plan-designated corridors are candidates for improvements to services through measures such as increases in service frequency (decrease in headways), conversion of general purpose travel lanes to bus-only lanes, transit signal priority (TSP), queue jump lanes, off-board fare collection, and branding. WMATA's PCN follows 23 of the most heavily used Metrobus corridors in the region, covering more than 235 miles of roadway and 250,000 unlinked daily trips. The 23 corridors account for more than half of the daily boardings for all Metrobus routes in the region. Three corridors are designated in Alexandria and include the following:

1. US 1 from Pentagon Metrorail station to the Braddock Road Metrorail station
2. Route 7 (Leesburg Pike) from Tysons Corner (West Park) to King Street Metrorail station

3. Little River Turnpike/Duke Street from City of Fairfax (Route 123) to King Street Metrorail station

Corridors 1 and 3 overlap portions of two of Alexandria's transitway corridors. Corridor 1 is the northern portion of Corridor A (North-South) in Potomac Yard and northern US 1. Corridor 3 follows Corridor B (Duke Street/ Eisenhower Avenue) along the Duke Street alignment.

Building on WMATA's PCN is a planned interconnected system of other regional priority corridors designated by individual jurisdictions. Responding to the opportunity for the region to take advantage of economic stimulus funds from the federal government, in 2009 the MWCOG Transportation Planning Board submitted an application on behalf of the region for funding from the Transportation Investments Generating Economic Recovery (TIGER) grant program administered by the U.S. Department of Transportation (USDOT). The application contained a request for funding for 14 priority bus corridors throughout the region, as shown in Figure 1.5. Nine of the corridors in that application were the same as those identified in WMATA's PCN; however, the application also included the following five new corridors:

1. Van Dorn to the Pentagon via Shirlington in Virginia
2. US 1 Transitway from King Street to the Pentagon in Virginia
3. Theodore Roosevelt Bridge to K Street NW in the District of Columbia
4. The Fourteenth Street Bridge from I-395 to K Street in the District of Columbia
5. Express bus on freeways, specifically I-66 and I-95/I-395

Figure 1.5: MWCOG Planned Priority Bus Corridors

Similar to WMATA's PCN, the MWCOG-identified corridors mirror several of those identified in Alexandria's *Transportation Master Plan*. Corridor 1 is largely Corridor C (Van Dorn/Beauregard), while Corridor 2 includes the northern and central portion of Corridor A (North-South).

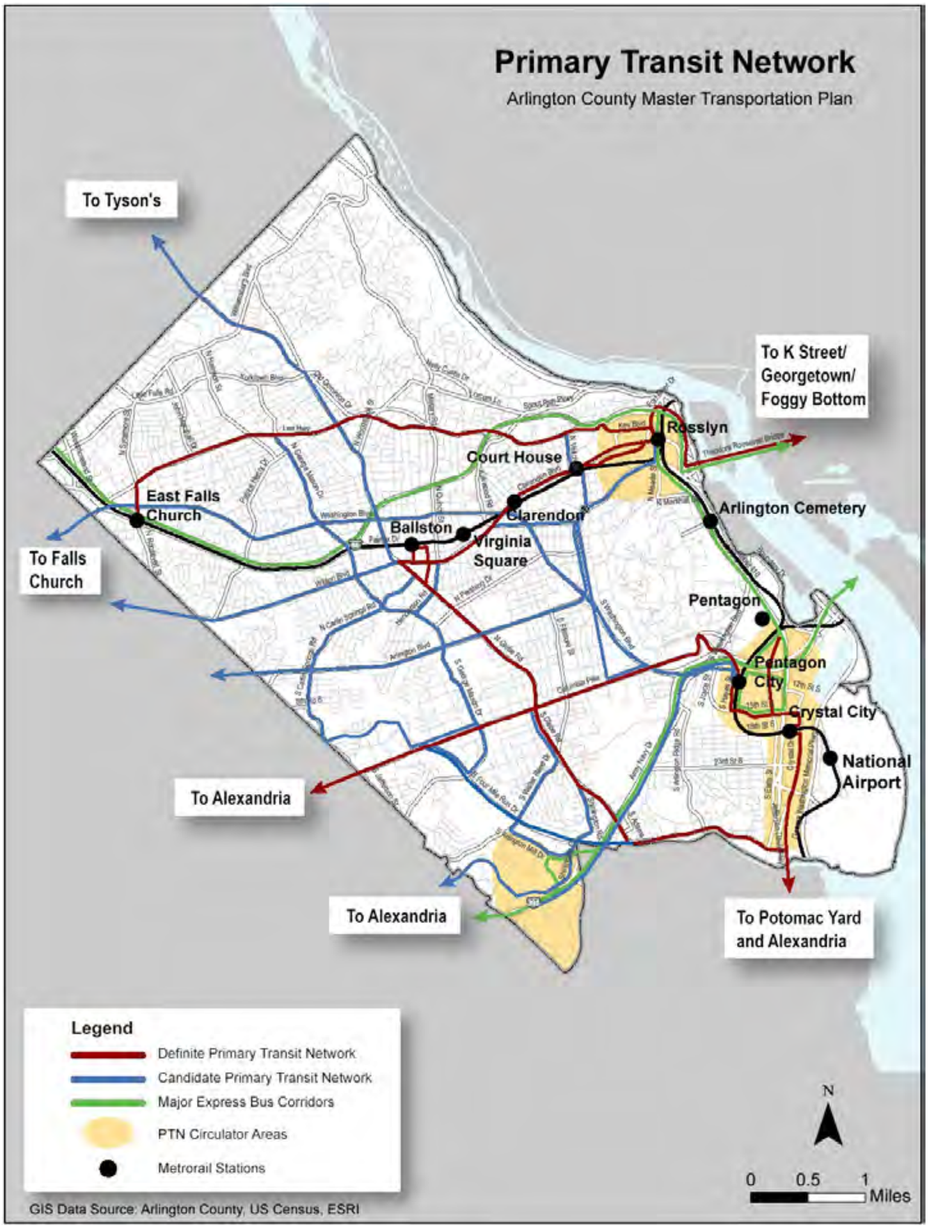


Figure 1.6: Arlington County Planned Primary Transit Network

Neighboring Jurisdiction Plans Context

Arlington County

Arlington and Fairfax Counties each have long-term visions for high-capacity and high-quality transit facility and service expansions. Arlington's primary transit network (PTN) identifies key corridors countywide (Figure 1.6) for the implementation of transit services. The PTN is envisioned by Arlington County as a network of transit lines that operate every 15 minutes or better for at least 18 hours a day, 7 days a week. In addition to Metrorail lines through the county, the PCN includes Metrobus and ART bus as well as future streetcar or bus rapid transit lines. On designated PTN roadways, transit operations will receive priority. Corridors that have the potential to eventually connect to Alexandria include the following definite PTN corridors:

- Crystal City/Potomac Yard Corridor. Active coordination and investment between Arlington County and Alexandria is underway in this corridor. Portions of this corridor were awarded TIGER funds for implementation. This corridor is the northern section of Alexandria's Corridor A (North-South).
- Columbia Pike Corridor. Active coordination is underway between Arlington County, Fairfax County, and Alexandria. The Arlington County and Fairfax County sections currently have a Federal Transit Administration-guided Alternatives Analysis and NEPA effort underway. This corridor has the potential to connect to northern portions of Alexandria's Corridor C (Van Dorn/Beauregard).

Fairfax County

Like Alexandria, Fairfax County will continue to invest in its transportation future. The identification of the Enhanced Public Transportation Corridor (EPTC) network was one approach developed by the county to address pressing mobility concerns. The EPTC concept was initially introduced during the 1990-1991 Planning Horizons update to the Fairfax County Comprehensive Plan. The approximately 132-mile network of nine EPTCs is entirely within Fairfax County. The EPTCs are intended to serve intra- and inter-county trip purposes. The combination of the EPTCs and the high-quality transit network (HQTN) is intended to provide transit service at a level that is competitive with travel by private vehicle while being reliable, safe, and attractive to users. The county is currently conducting a high-capacity transit study of the Comprehensive Plan-identified EPTC corridors as well as new corridors that have emerged as a result of changes in the county since the comprehensive plan was developed.

While Fairfax County already provides and has access to local and express bus services, county leaders recognize that these services are made less attractive and effective by deteriorating traffic conditions and roadway congestion. The following EPTCs, representing general alignments, are identified in Fairfax County's Comprehensive Plan:

- I-66 from Prince William County to Arlington County
- I-95/I-395 from Prince William County to the City of Alexandria
- I-495 from the American Legion Bridge to the Woodrow Wilson Bridge
- US 1 (Richmond Highway) and Route 241 (North Kings Highway) from Prince William County to Huntington Metrorail and the Woodrow Wilson Bridge
- Route 7 (Leesburg Pike) from Tysons Corner to the City of Alexandria
- Route 28 from Route 267 (Dulles Toll Road) to Prince William County
- Route 267 (Dulles Toll Road) from Route 28 to I-66
- Route 286/289 (formerly Route 7100/7900—Fairfax County Parkway/Franconia-Springfield Parkway) from Route 267 (Dulles Toll Road) to Frontier Drive
- Long Branch Railroad (serving Fort Belvoir) from Franconia-Springfield Metrorail Station to Route 1

Relative to Alexandria, the county is also evaluating South Van Dorn Street, which could connect to Corridor C in the future. Fairfax County's US 1, I-95, I-395, I-495, and Route 7 corridors all have the potential to connect with portions of Corridors A (North-South), B (Duke Street/Eisenhower Avenue), and C (Van Dorn/Beauregard) in Alexandria.

Crystal City/Potomac Yard Transit Improvements Project

The Crystal City/Potomac Yard (CCPY) Transit Improvements Project is jointly sponsored by the City of Alexandria and Arlington County in cooperation with WMATA and the Virginia Department of Rail and Public Transportation (DRPT). Figure 1.7 shows Sections A, B, and C of the CCPY project. The project's purpose is to provide high-capacity and high-quality bus service in

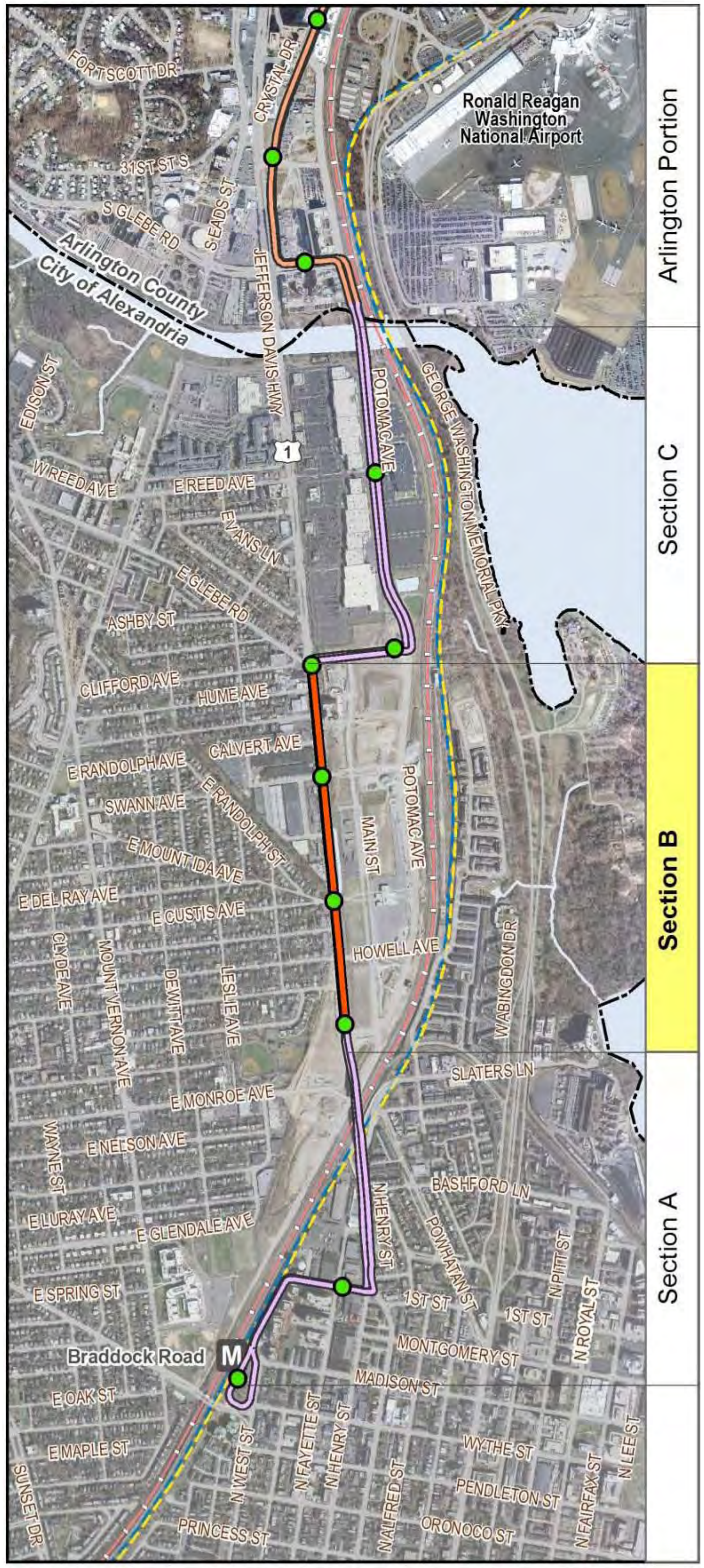


Figure 1.7: Crystal City/Potomac Yard Transit Improvements Project Plan Schematic

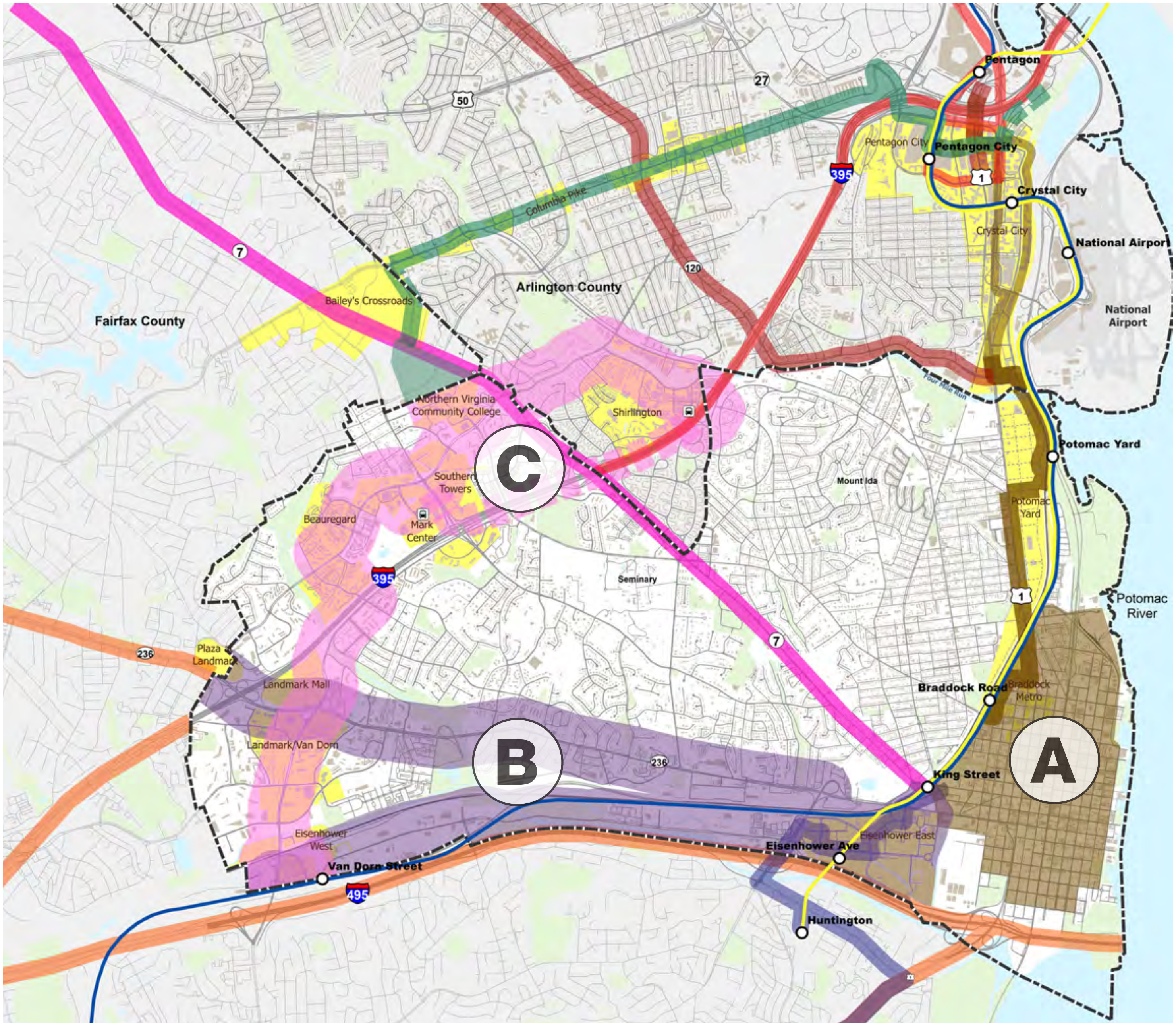


Figure 1.8: Regionally Planned High-Capacity Transit Lines in the Vicinity of Alexandria

Legend

- Metrobus REX

Metrorail

- Blue Line
- Yellow Line
- Metrorail Station

Fairfax County

- Enhanced Public Transportation Corridor

NVTC

- Route 7 Alternatives Analysis

Arlington County Primary Transit Network

- Crystal City/Potomac Yard Transitway
- Columbia Pike Transit
- Other Primary Transit Corridor
- Express Bus Corridor

Alexandria High Capacity Transit Corridors

- Corridor A
- Corridor B
- Corridor C

- Redevelopment Opportunity
- Airport
- Street
- Railroad
- Park
- Body of Water

the five-mile section of the US 1 corridor between the Pentagon in Arlington County and the Braddock Road Metrorail station in Alexandria.

The project is in various stages of project development, ranging from design to construction. In 2010 the City of Alexandria, through MWCOG, received a TIGER grant to build Section B of the Transitway (section from E. Glebe Road to E. Monroe Avenue) in the median of US 1. The city expects that Section C will be built in coordination with the redevelopment of North Potomac Yard. Transit enhancements in Section A will be built in coordination with the redevelopment of properties to the north of the Braddock Road Metrorail station.

Route 7 Alternatives Analysis Study

The Northern Virginia Transportation Commission, in cooperation with Arlington County, Alexandria, Falls Church, and Fairfax County, is undertaking an Alternatives Analysis Study of the Route 7 corridor between Old Town Alexandria and Tysons Corner. This study will seek to identify a feasible and preferred high-capacity transit alternative for the Route 7 corridor. The study is scoped to follow a Federal Transit Administration (FTA) Alternatives Analysis Study process and result in a Locally Preferred Alternative (LPA) for Route 7. The LPA is expected to be supported by each of the participating jurisdictions.

The Route 7 high-capacity transit corridor has the potential to connect to Corridor C at Beauregard Street as well as Corridor B at the King Street Metrorail Station or in the vicinity of Quaker Lane, depending on the preferred alignment identified. Overall, the study will identify the preferred transit mode technology, runningway configuration, and corridor alignment, as well as other preferred characteristics and potential impacts of high-capacity transit in the corridor.

Purpose of Dedicated Transit Corridors

Local and regional planning studies indicate that maintaining people's mobility in the future will require a diverse transportation system and significant multimodal network investments. The region will need to continue to improve its vehicular transportation network, but also will need to heavily invest in pedestrian and bicycle networks and transit facilities and services in a coordinated manner. While congestion is unlikely to be substantially affected by multimodal investments, people will benefit significantly through the increased number of real choices in the way they travel.

The implementation of WMATA's PCN, MWCOG's additional priority transit corridors, Fairfax County's EPTCs, Arlington County's PTN, and Alexandria's transitway corridors will create the next generation high-capacity transit network in the region. Figure 1.8 shows each of the plan designated corridors in the context of the City of Alexandria.

This transit network will be coordinated with other transit services and facilities regionally and will have the ability to independently serve inter- and intra-jurisdictional trips. When interconnected, this network will offer currently unserved or underserved transit travel demand with attractive, competitive transit services, helping to increase transit ridership, manage vehicular demand on major travel corridors, and increase mobility in a sustainable manner.

In the context of Alexandria, Corridors A (North-South), B (Duke Street/Eisenhower Avenue), and C (Van Dorn/Beauregard) will provide access to the city's existing and planned major population

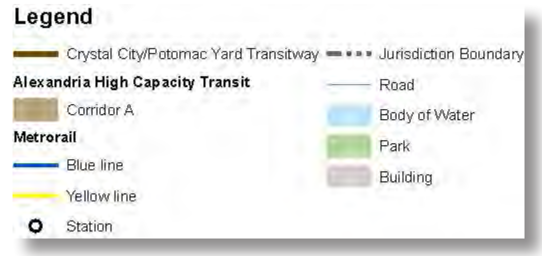


Figure 1.9: Corridor A Study Area

and activity centers; connectivity to neighboring Arlington and Fairfax Counties and their planned transit corridors; and access to local and regional transportation facilities and services. The corridors also will increase the number of residents and employees in and traveling through Alexandria with convenient access to attractive reliable transit services. Figure 1.8 shows the planned transit corridors in relation to existing and planned development in Alexandria and adjacent areas of Arlington and Fairfax Counties.

Corridor A (North-South)

The section of Corridor A examined as part of the High-Capacity Transit Corridor Feasibility Study extends south from the terminus of the CCPY Transit Improvement Project to the Fairfax County border, as shown in Figure 1.9. Corridor A follows an important local and regional commute route for people traveling to and from areas south of Alexandria. Corridor A provides connectivity to existing and planned development in Potomac Yard (Arlington County and Alexandria), Crystal City, Pentagon City, and the Pentagon. Corridor A also has the potential to coordinate and integrate with service provided by Fairfax County to Fort Belvoir as well as future transit connections to Maryland using the Woodrow Wilson Bridge. As previously described, sections of Corridor A are included in WMATA's PCN and MWCOG's priority transit corridor plan. In addition, Corridor A is the extension of the Crystal City/Potomac Yard transitway and Fairfax County's Route 1 EPTC.

Providing high-quality and high-capacity transit service through Corridor A could create a much needed resource for through commuters as well as underserved areas of east Old Town. Much of the vehicular traffic currently traveling through Corridor A has few mode choices and little incentive to use transit.

The purpose of Corridor A is to accommodate north/south trips currently traveling through Alexandria in the US 1 corridor and to provide increased access to high-quality and high-capacity transit services for Alexandrians in the east end of the city. With potential connectivity to King Street, Braddock Road, and Potomac Yard Metrorail stations; Virginia Railway Express; and Amtrak as well as future connections to the CCPY transitway and Fairfax County's Route 1 EPTC, Corridor A has the potential to carry trips within Alexandria as well as between origins and destinations well beyond the city's boundaries. Potential benefits it could provide include:

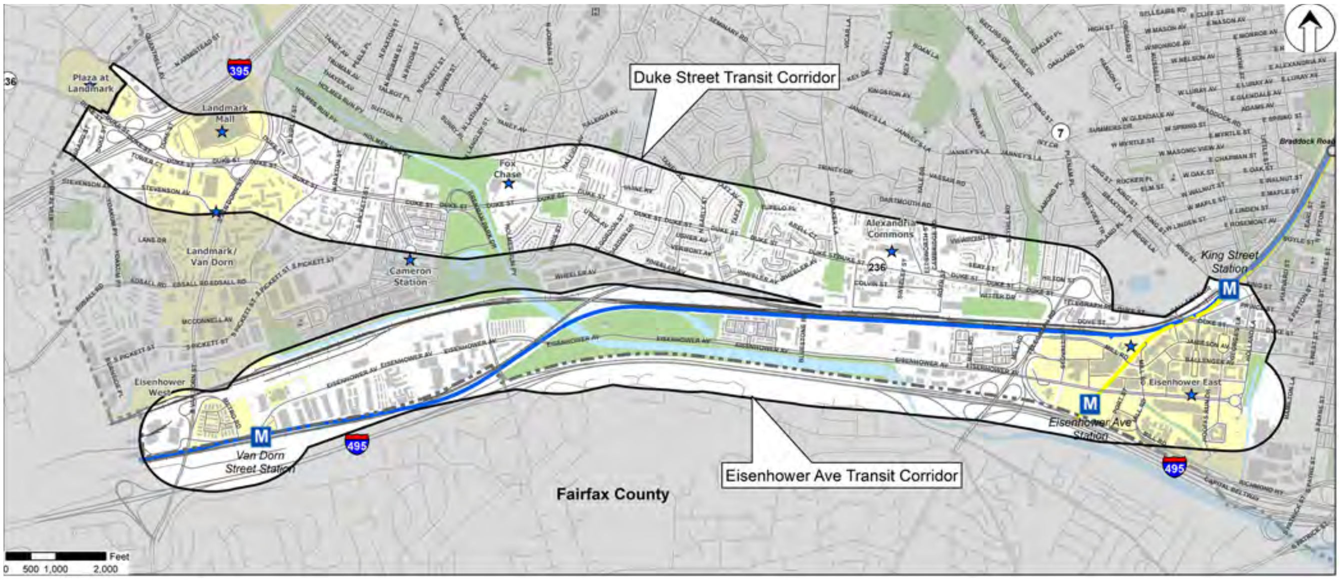


Figure 1.10: Corridor B Study Area

- Direct service to destinations along US 1 corridor not served by Metrorail
- Better access to destinations in between Metro stations along the Blue and Yellow lines
- Increased high-capacity and high-quality transit coverage for east Alexandria
- Increased number of travel choices for trips along the US 1 corridor
- Increased connectivity to Metrorail and Virginia Railway Express

Corridor B (Duke Street/Eisenhower Avenue)

The section of Corridor B examined as part of the High-Capacity Transit Corridor Feasibility Study extends along Duke Street and Eisenhower Avenue for approximately four miles from Landmark Mall to the King Street Metro Station, as shown in Figure 1.10.

Corridor B follows an important local and regional route for commuters traveling east and west, through the southern section of Alexandria. Corridor B is particularly critical for providing direct and indirect connections to major destinations in the area including:

- Eisenhower East
- Landmark Mall
- Cameron Station
- Fox Chase
- Alexandria Commons
- Old Town
- Van Dorn Metro
- King Street Metro
- Eisenhower Avenue Metro

As previously described, sections of Corridor B are included in WMATA's PCN and MWCOG's priority transit corridor plan. Improving the capacity and quality of transit service through Corridor B would create a much needed resource for through commuters as well as underserved areas of Alexandria that lack high-capacity and high-quality transit. Corridor B presently offers few mode choices and travelers have little incentive to use transit.

The purpose of Corridor B is to improve the accommodation of east/west trips and provide increased access to high-capacity and high-quality transit services. Corridor B would provide potential benefits including:

- Direct service to destinations along the corridor not served by Metrorail
- Increased high-capacity and high-quality transit coverage for southern Alexandria
- Increased number of travel choices for trips along the Duke Street/Route 236 corridor
- Increased connectivity to Metrorail

Corridor C (Van Dorn/ Beauregard)

The section of Corridor C Transportation Master Plan (TMP) alignment examined as part of the High-Capacity Transit Corridor Feasibility Study extends from the Van Dorn Metrorail station to Beauregard Street, northeast of the Northern Virginia Community College, as shown in Figure 1.11. Corridor C follows an important local and regional commute route for people traveling to and from western Alexandria. Running primarily on Van Dorn Street, Sanger Avenue, Beauregard Street, and Walter Reed Drive, Corridor C is particularly critical with regard to its connectivity to existing and planned development at major destinations such as:

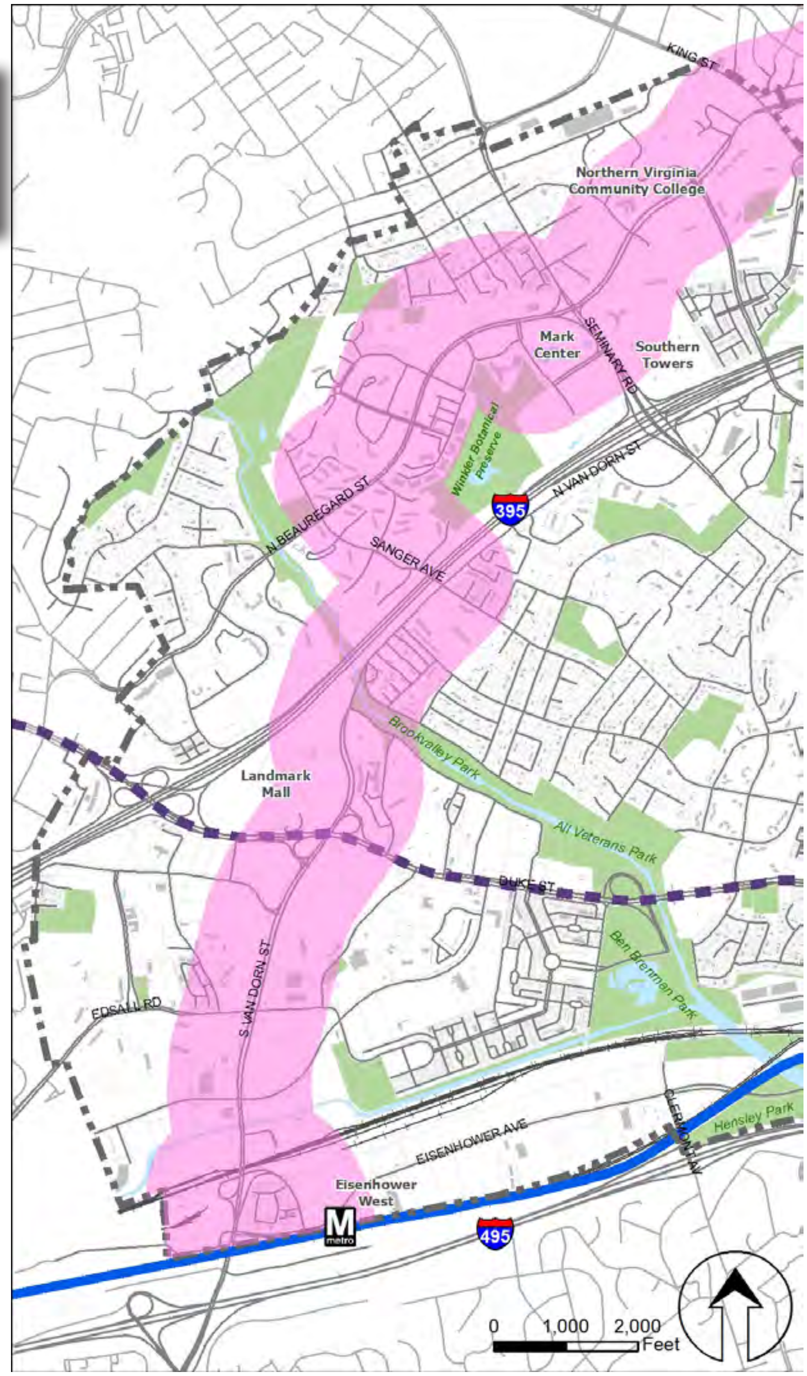
- Eisenhower West
- Van Dorn Metrorail Station
- Landmark Mall/Van Dorn Street
- Beauregard Town Center
- Mark Center
- Southern Towers
- Northern Virginia Community College (NVCC)
- Shirlington
- Pentagon/Pentagon City

Corridor C also has the potential to coordinate with services provided by Fairfax County at the southern terminus and Arlington County at the northern terminus. Corridor C's close proximity to Shirley Highway (I-395) and the Capital Beltway (I-495) as well as its terminus at the Van Dorn Metrorail station allows for regional connectivity to and from Washington, D.C., Maryland, and northern Virginia.

Providing high-quality and high-capacity transit service through Corridor C would create a much needed resource for residents and commuters to access areas in western Alexandria currently underserved by transit. Persons currently traveling through Corridor C have few mode choices and little incentive to use transit.

The purpose of Corridor C is to accommodate trips that currently originate or end in the corridor; planned and approved developments and land use changes; and to connect to other transit systems in the region. Corridor C has the potential to carry trips within Alexandria as well as between origins and destinations well beyond the city's boundaries. Potential benefits it could provide include:

Figure 1.11: Corridor C Study Area



- Direct service to local destinations along the Van Dorn/Beauregard corridor not served by Metrorail
- Increased high-capacity and high-quality transit coverage for western Alexandria
- Increased number of travel choices for trips along the Van Dorn/Beauregard corridor
- Increased connectivity to Metrorail and I-395 transit options
- Potential connection to Columbia Pike transit system

Corridor C, Corridor Work Group Meeting

Public Process

The City of Alexandria conducted a public process in coordination with the evaluation of transportation conditions and the development of potential transit concepts for the study. Through regular meetings of the High Capacity Transit Corridor Work Group (Corridor Work Group), which were open to the public, members of the Corridor Work Group and citizens provided input for the study. Corridor Work Group members and the public provided input on existing transportation conditions; transit opportunities and constraints; transit service and runningway concepts; transit mode technologies; community considerations; transportation priorities; and financial elements. Each Corridor Work Group meeting was structured to provide an opportunity for presentations and information sharing from the project team (city staff and consultants) as well as comments, questions, and discussion by the Corridor Work Group and comments and questions from the public.

Membership on the Corridor Work Group represented a wide range of interests and geography within the City of Alexandria. It included two members of Council (non-voting), one representative from the Planning Commission, one representative of the Transportation Commission, one representative of the Budget and Fiscal Affairs Advisory Committee, one representative of the Chamber of Commerce, two representatives appointed by the Alexandria Federation of Civic Associations, and one citizen with transit industry expertise.

A total of 15 Corridor Work Group meetings were held over the course of the study.

Corridor Work Group Membership

- Rob Krupicka, Councilman
- Paul Smedberg, Councilman
- John Komoroske, Planning Commission Representative
- Donna Fossum, Transportation Commission Representative
- Dak Hardwick, Budget & Fiscal Affairs Advisory Committee Representative
- Bill Denton, Chamber of Commerce Representative
- Poul Hertel, Alexandria Federation of Civic Associations Representative
- Nancy Jennings, Alexandria Federation of Civic Associations Representative
- Anna Bentley, Transportation Industry Representative

Corridor Work Group for Corridor A

In addition to a field walk conducted with the West Old Town Citizens Association on May 19, 2011, the following three Corridor Work Group meetings were held to focus on or discuss Corridor A:

- May 19, 2011. Overview of study goals and objectives, expected outcomes, and review of existing conditions—Corridor Work Group and public discussion
- July 21, 2011. Review of existing conditions and general framework for future concepts—Corridor Work Group and public discussion
- September 15, 2011. Additional existing conditions information and review of general future concepts—Corridor Work Group and public discussion
- December 15, 2011. Recommendation for Corridor A—Corridor Work Group and public discussion

Corridor Work Group for Corridor B

The following seven Corridor Work Group meetings involved discussion on Corridor C:

- May 19, 2011. Overview of study goals and objectives, expected outcomes, and review of existing conditions—Corridor Work Group and public discussion
- July 21, 2011. Preliminary transitway concepts and screening—Corridor Work Group and public discussion
- August 18, 2011. Review of existing conditions and land use, and consideration of alignment, runningway, and mode—Corridor Work Group and public discussion
- November 17, 2011. Evaluation of traffic and discussion of runningway and mode—Corridor Work Group and public discussion
- January 19, 2012. Secondary screening of alternatives—Corridor Work Group and public discussion
- February 16, 2012. Summary of secondary screening and additional impacts investigation—Corridor Work Group and public discussion
- March 15, 2012. Options for bicycle connectivity and preliminary recommendation—Corridor Work Group and public discussion

Corridor Work Group for Corridor C

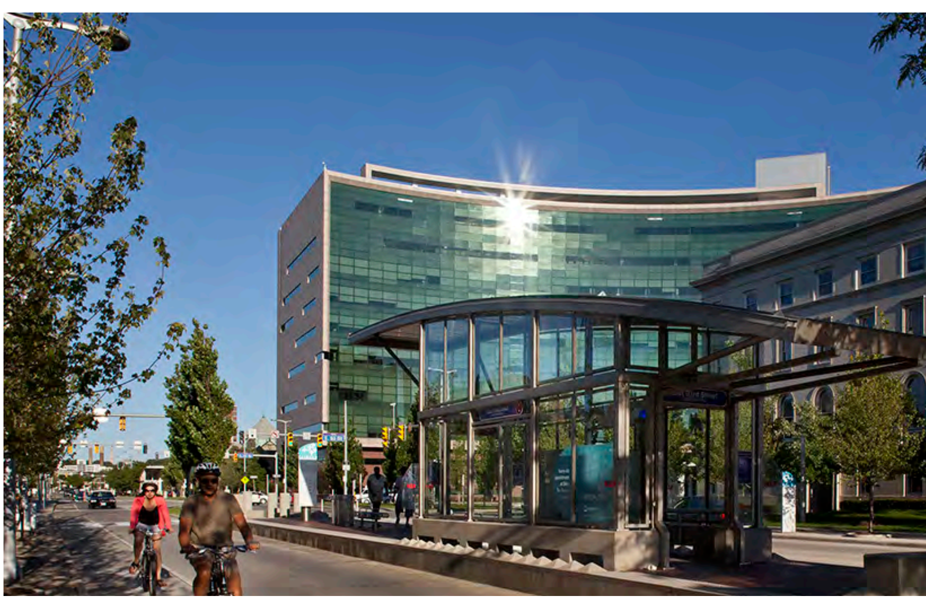
The following four Corridor Work Group meetings involved discussion on Corridor C:

- November 18, 2010. Overview of Existing Conditions and Study Process—Corridor Work Group and public discussion
- January 20, 2011. Overview of Preliminary Alignment Alternatives—Corridor Work Group and public discussion
- March 17, 2011. Secondary Alternative Screenings—Corridor Work Group and public discussion
- May 5, 2011. Work session to review secondary alternatives—Corridor Work Group and public discussion
- May 19, 2011. Recommendation for Corridor C —Corridor Work Group and public discussion

Corridor Work Group comments were taken into account throughout the study and incorporated into the development of alternatives and final recommendations for all corridors. Specific comments and concerns brought forth at the Corridor Work Group meetings are detailed in the following chapters.

CORRIDOR A

chapter 3



existing conditions

DASH AT8 along Washington Street (Old Town, Alexandria)

Introduction

Providing high-quality and high-capacity transit services within Corridor A is not without challenges. The study section of Corridor A is defined by the area bounded by the Blue and Yellow Metrorail lines on the west, the Fairfax County line on the south, the Alexandria waterfront on the east, and the Arlington County line on the north. In the north-south direction, the corridor is approximately two miles in length. The study area is generally designated as Old Town Alexandria and contains the Old and Historic Alexandria historic district and Parker-Gray historic district.

For the purposes of this study, Corridor A analysis focused on the area south of Braddock Metrorail station since the alignment and mode north of Braddock Metrorail station has been determined and design and construction is underway.

The Old and Historic district contains many historic landmarks and has 35 buildings of more than 100 years in age. The Parker-Gray historic district is a historically African-American neighborhood in Alexandria that was a haven for escaped slaves and freedmen during and after the Civil War. The Old and Historic and Parker-Gray districts each have boards of architectural review that must approve a certificate of appropriateness for all new construction and exterior alterations for structures that are visible for the public way.

With the aforementioned as general context, there are numerous challenges that affect the ability to locate surface-running high-capacity transit in the study area. General constraints include:

- Historic districts and buildings
- Land use compatibility
- Significant peak hour traffic congestion on Patrick, Henry, and Washington Streets
- Narrow street rights-of-way
- On-street parking
- Limited number of appropriate (functional classification) north-south streets

The following sections provide additional information on several of these challenges as well as summarize general existing transportation (multimodal) and land use and development conditions.

Travel Patterns and Activity Centers

Alexandria's location adjacent to Washington, D.C., and Arlington County subjects many of its major streets to regional through traffic, in addition to being a destination in its own right. Many commuters travel north to Washington, D.C., and Arlington County in the morning peak period and return south in the evening using important city roadways within the Corridor A area such as Duke Street, US 1 (Patrick and Henry Streets), Washington Street, and King Street. In addition, tens of thousands of transit trips traverse the city each day using a myriad of bus services as well as Metrorail and Virginia Railway Express (VRE) trains.

Major destinations outside of Corridor A within Alexandria include Eisenhower East, the Landmark/Van Dorn area, and the Mark Center area. Destinations in the study area include the King Street corridor, Braddock Road Metrorail station, King Street Metrorail station, the Waterfront, Canal Center, the Slater's Lane District, and southern Old Town.

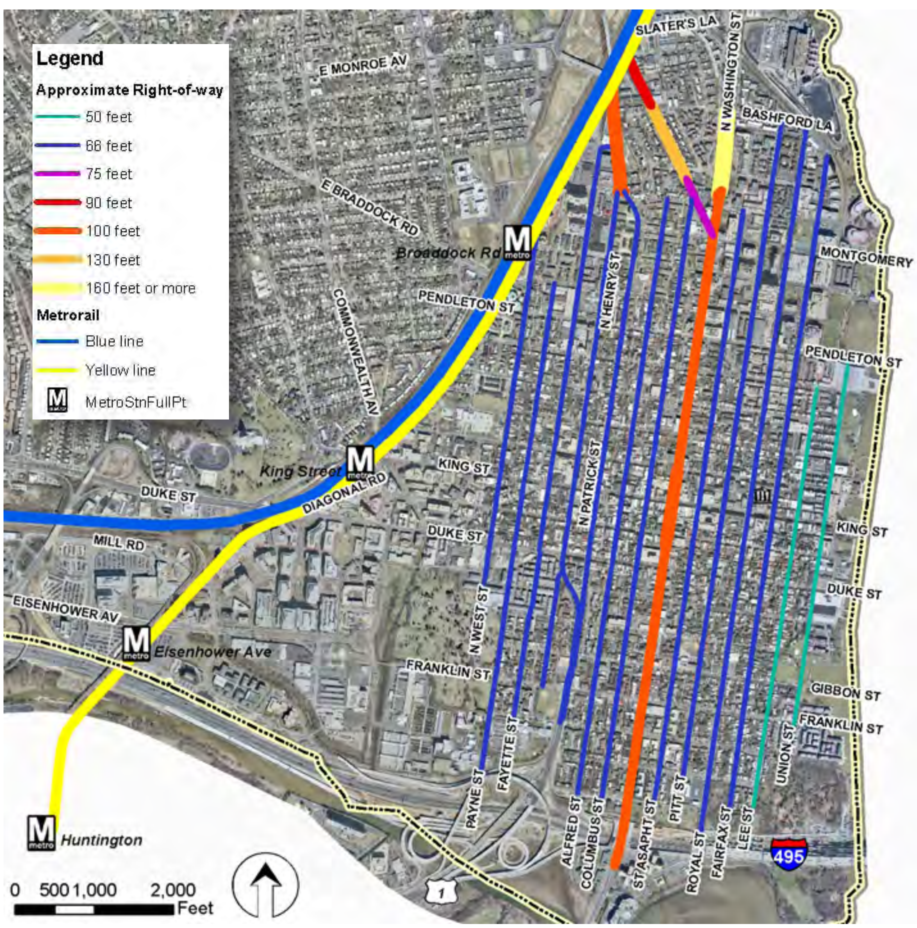


Figure 3.1: North-South Street Rights-of-Way

Transportation Conditions

Metropolitan Washington Council of Governments's (MWCOG) fiscally constrained long-range plan does not include any major north-south roadway capacity increases in the study area during the next 20 years. MWCOG's travel demand forecasts show that peak period travel demand on US 1 and Washington Street will increase during the next 20 years and that these routes will continue to have travel demand that outpaces their capacity.

Regional Traffic Influences

Regional congestion is a major influence on travel conditions in Alexandria. Congestion on the Capital Beltway (I-495) and Shirley Highway (I-395) divert some longer through trips onto arterial facilities such as US 1 and Washington Street as well as other routes in Alexandria. Traffic diverting to local streets increases significantly during special events and incidents on the region's major freeway links. Regional through trips diverted to local routes limit capacity available to Alexandrians for shorter distance trips and contribute to the substantial peak period congestion that exists on routes such as US 1 and Washington Street in the city.

Local Transportation Conditions

Street Rights-of-Way

Most street rights-of-way in the study area date to the original layout of the city. Within Corridor A, the right-of-way of most streets is defined by opposing faces of buildings lining streets.

The majority of major north-south streets in the study area have 66-foot rights-of-way. Only Washington Street has a more expansive right-of-way. Figure 3.1 shows north-south street rights-of-way in the study area.

Functional Classification

Street classifications typically help to describe and define a street's purpose. A street with a higher functional classification—arterial or major collector—is traditionally intended to carry longer distance trips and offer a higher level of mobility. These streets often have few individual driveways and single-user points of access. Streets with lower functional classifications—minor collectors and locals—typically serve more access-oriented roles. They are the more typical locations for loading and driveways. Figure 3.2 shows designated functional classes for streets in the study area.

For the most part, streets within the study area perform their functions, as classified; however, streets like Patrick Street, Henry Street, and Washington Street carry a considerable number of local and property access-oriented trips as well as city and regionally-oriented trips. At a general level, arterials and collectors are more appropriate for the location of transitways and transit service.

Street Cross Sections

On-street parking is permitted on the majority of streets in the study area. Attributed to the age of most of the development in the study area, there is typically minimal off-street parking for most residential and commercial uses. As a result, on-street parking is a critical resource to the majority of the study area.

With a few exceptions, north-south streets in the study area are one travel lane in each direction with some provision (casual or marked) for

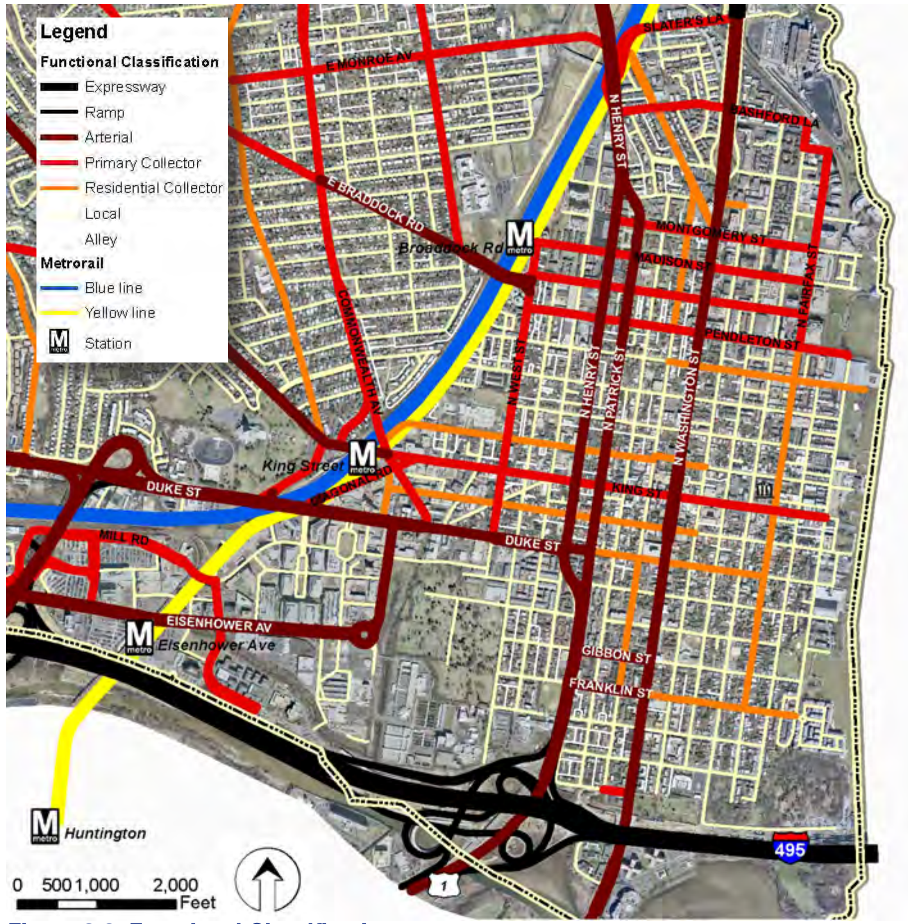
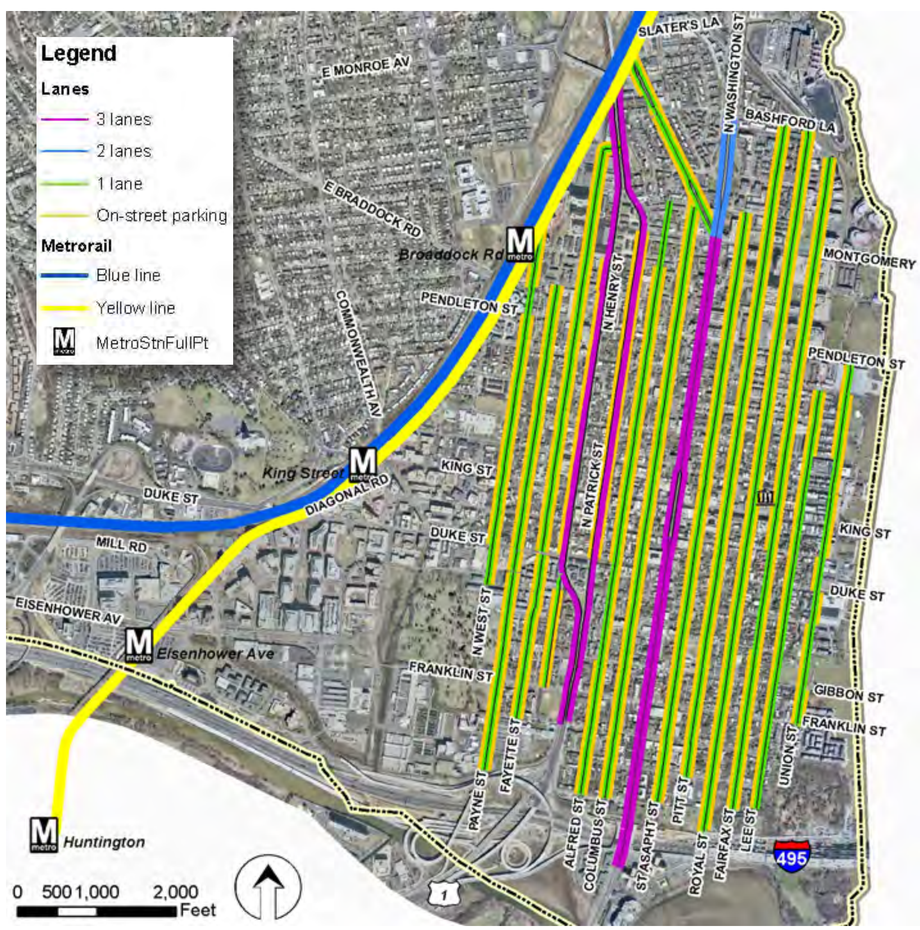


Figure 3.2: Functional Classifications

Figure 3.3: Street Cross Sections



turn lanes at intersections and have on-street parking on both sides of the street. Figure 3.3 shows generalized street cross sections in the study area. For the most part, simply dimensioning one travel lane and on-street parking in each direction within the available right-of-way leaves in some cases nominal sidewalks and tree buffers between the curb and face of buildings. In the most challenging locations (some along Patrick Street), sidewalks are as narrow as four feet, taking into account obstructions such as signs, trees, and other street features.

In Old Town, US 1 is a one-way pair—Patrick Street northbound and Henry Street southbound. Each street has three through lanes, one of which is designated for high-occupancy vehicles during a specific peak period. Washington Street is the local segment of the George Washington Memorial Parkway. In Alexandria, Washington Street has three through lanes in each direction. The outer lane is designated for high-occupancy vehicles in the peak direction and peak periods (northbound 7–9 a.m. and southbound 4–6 p.m.) and is used for parking at other times of the day.

Daily Traffic

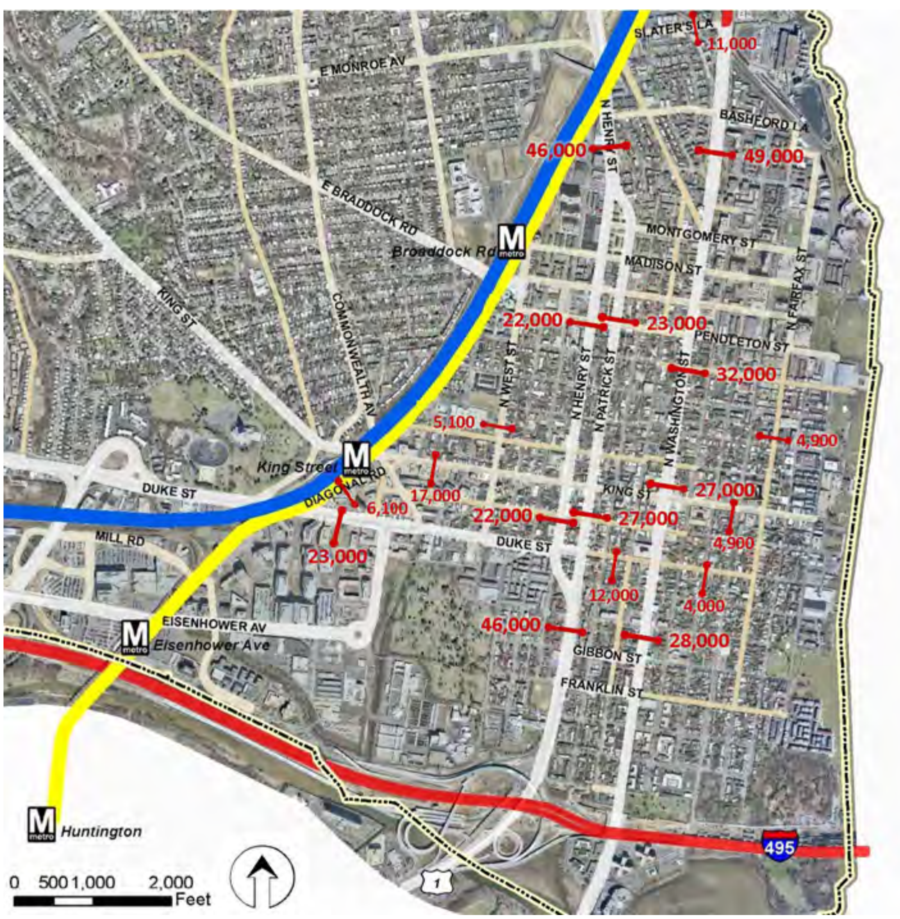
Existing average daily traffic volumes on study area streets are shown in Figure 3.4. As shown in the figure, Patrick Street and Henry Street, as a one-way pair, carry between 44,000 and 49,000 vehicles per day in their combined six-lane cross section. Meanwhile, Washington Street carries approximately 28,000 to 49,000 vehicles per day in four to six lanes. The traffic volumes on Patrick Street and Henry Street are reflective of a capacity-constrained condition. This condition is the result of a combination of the street cross section, close traffic signal spacing, traffic signal timing, and several major intersections. During peak periods in peak directions, traffic congestion is significant on each of these streets.

Traffic conditions on Washington Street also are constrained by signal spacing and timing as well as the number of travel lanes. During peak periods in the peak direction, traffic back-ups are frequent and can be extensive.

Traffic Flow

While level of service is a good measure of unsaturated traffic conditions, it is less useful when traffic is effectively metered by congestion. To better understand general traffic flow conditions in the US 1 and Washington Street corridors, weekday peak period travel time runs were conducted on each. The travel time runs (conducted multiple times in each

Figure 3.4: Average Daily Traffic Volumes (2009)



direction of the peak period) measured travel speed and delay. A summary of average travel speeds on segments of the US 1 corridor in Old Town during the weekday peak periods are shown in Figures 3.5 and 3.6. The following summarizes peak travel speeds and time for the segments of US 1 surveyed:

- Patrick Street/Jefferson Davis Highway (northbound)
  - AM Peak Hour: 12.8 mph, 7:15 minutes
  - PM Peak Hour: 17.6 mph, 5:06 minutes
- Henry Street/Jefferson Davis Highway (southbound)
  - AM Peak Hour: 19.7 mph, 4:42 minutes
  - PM Peak Hour: 3.6 mph, 25:18 minutes

Washington Street speed and delay summaries are below:

- Washington Street (northbound)
  - AM Peak Hour: 6.6 mph, 10 minutes
- Washington Street (southbound)
  - PM Peak Hour: 8.3 mph, 8 minutes

Figure 3.5: AM Peak Hour Travel Speeds on Patrick Street and Henry Street

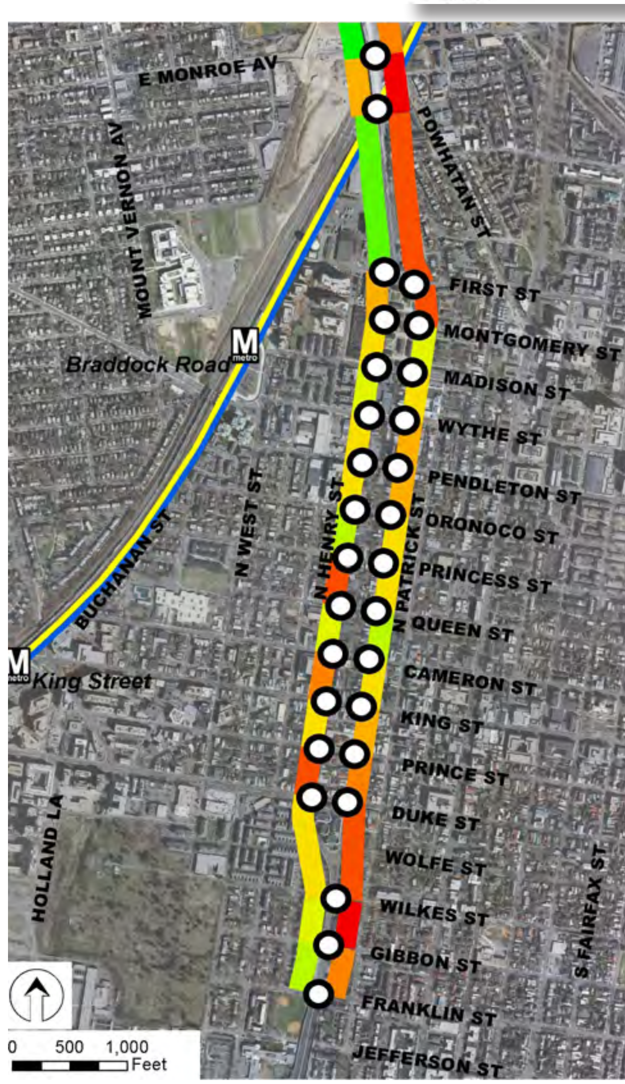


Figure 3.6: PM Peak Hour Travel Speeds on Patrick Street and Henry Street

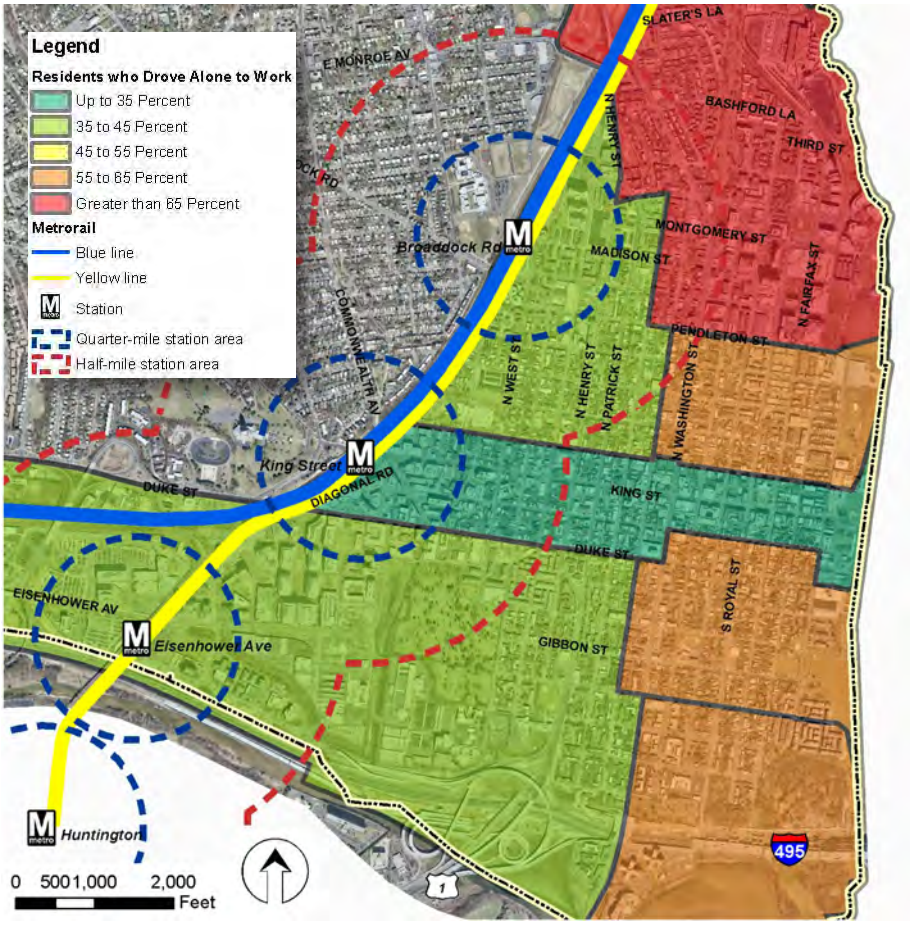


Figure 3.7: Journey to Work Mode Split

Transit Use

Old Town is served by Metrorail's Blue and Yellow lines at the King Street and Braddock Road Metrorail stations. VRE provides service to Alexandria at the King Street station. The area also is served by the King Street Trolley, Metrobus, and DASH.

Based on data available from the U.S. Census (2010) at the Tract level, many Old Town Alexandria residents commute by a mode other than single-occupant vehicle. It might be expected, as distance from Metrorail increases, the single-occupant work trip share also increases. Despite this, many people outside the traditional quarter- and half-mile walk zones (shown in Figure 3.7) of the area's two Metrorail stations are traveling by a mode other than a single-occupant vehicle. A summary of single-occupant vehicle use for work trips for the census divisions representing the study area is shown in Figure 3.7.

Many Old Town residents and employees live outside what is considered to the traditional walk-shed of a rail transit system (one half mile radius). 60 percent of households, 55 percent of the population, and 48 percent of employees live more than one-half mile from a Metrorail station in the study area. As seen in the figure, census divisions beyond a half-mile distance from the metro stations have a higher percentage of residents who drive alone to work. For many of these people, DASH and Metrobus service provide local as well as feeder service to Metrorail. Service and route varies from line to line and is viewed by some as confusing and unreliable.

The King Street trolley also provides transit services in Old Town, as shown in Figure 3.8. It runs from the King Street station to the waterfront, carrying more than 2,000 people each day, fare-free, at 15-minute headways.

Metrobus 11Y provides service in Alexandria along Washington Street and the Metrobus Richmond Express (REX) provides express bus service from areas south along US 1 to the Eisenhower Avenue and King Street Metrorail stations. Existing transit services in the study are shown in Figure 3.9. Table 3.1 provides a summary of transit ridership for services running through the study area.

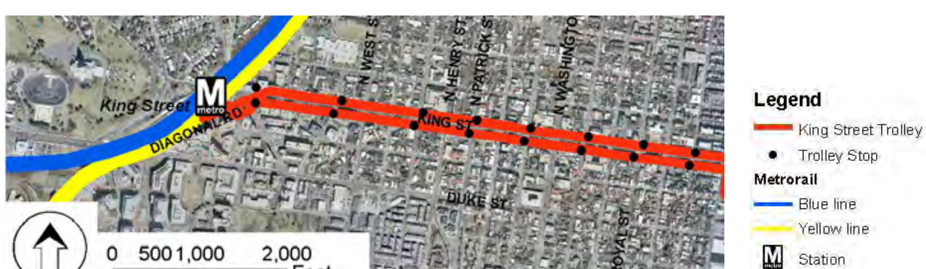


Figure 3.8: King Street Trolley

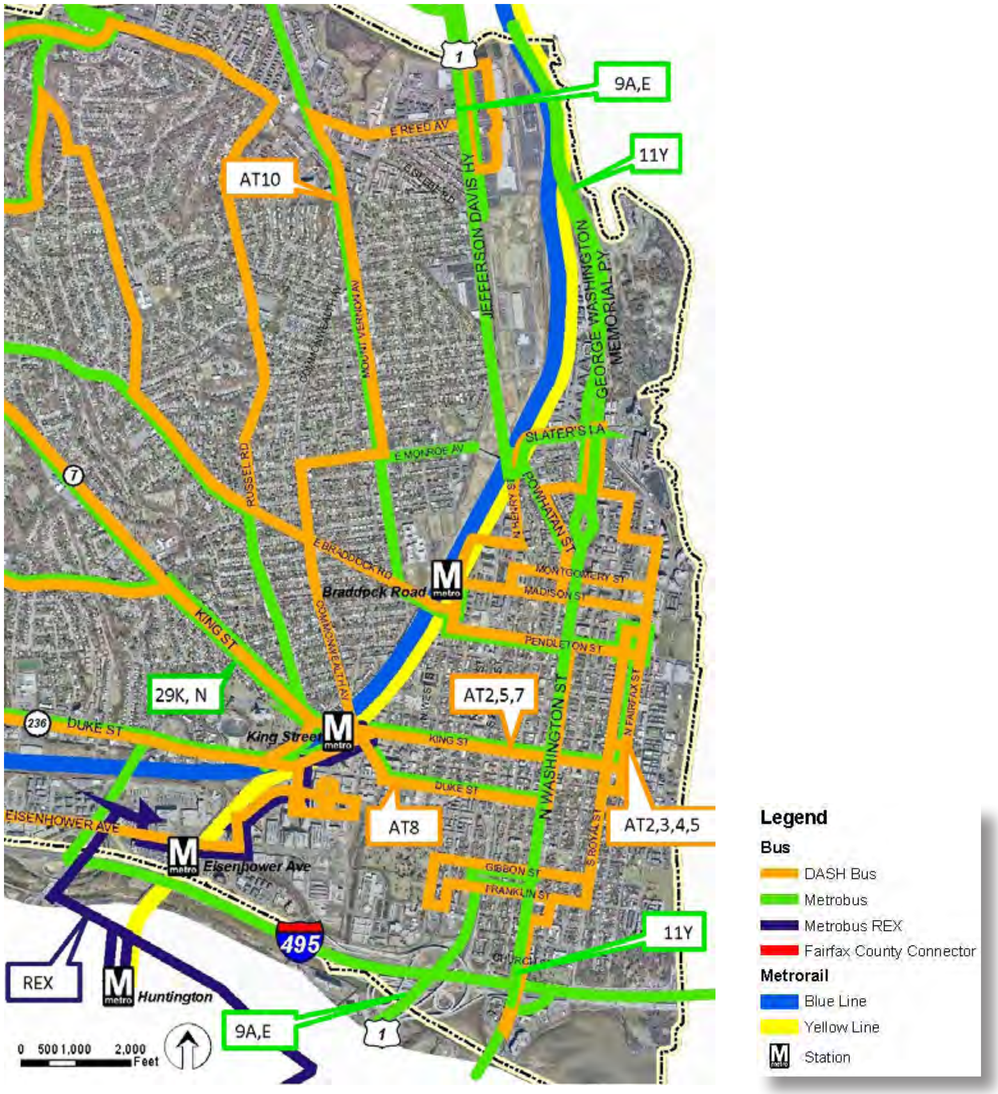


Figure 3.9: Existing Transit Services

Table 3.1: Existing Transit Ridership for Services Operating in Corridor A

Service/Route	Peak Period Headway (minutes)	Average Weekday Ridership
Metrorail	3 to 6	9,306 (Boardings)
VRE	10 to 30	650
DASH Route AT2	20 to 30	2,035
DASH Route AT3	20	976
DASH Route AT4	20	912
DASH Route AT5	20 to 20	2,063
DASH Route AT7	30	1,015
DASH Route AT8	20 to 30	2,628
DASH Route AT10	30	731
Metrobus Route 9A-E	10 to 20	1,788
Metrobus Route 10A	30	2,452
Metrobus Route 10B	30	2,589
Metrobus Route 11Y	15	378
Metrobus Routes 29K, N	30	2,272
Metrobus REX	12	3,685
Source: DASH, WMATA, and VRE		

Bicycle and Pedestrian Networks

The majority of the study area benefits from a robust network of sidewalks on both sides of nearly every street. Some sidewalks are wider than others and there are documented challenges to sidewalk width along streets such as Patrick Street and Henry Street in Old Town.

In addition to the area's interconnected sidewalk network, there are numerous on-street bicycle routes in the study area. Existing bicycle facilities are shown in Figure 3.10.

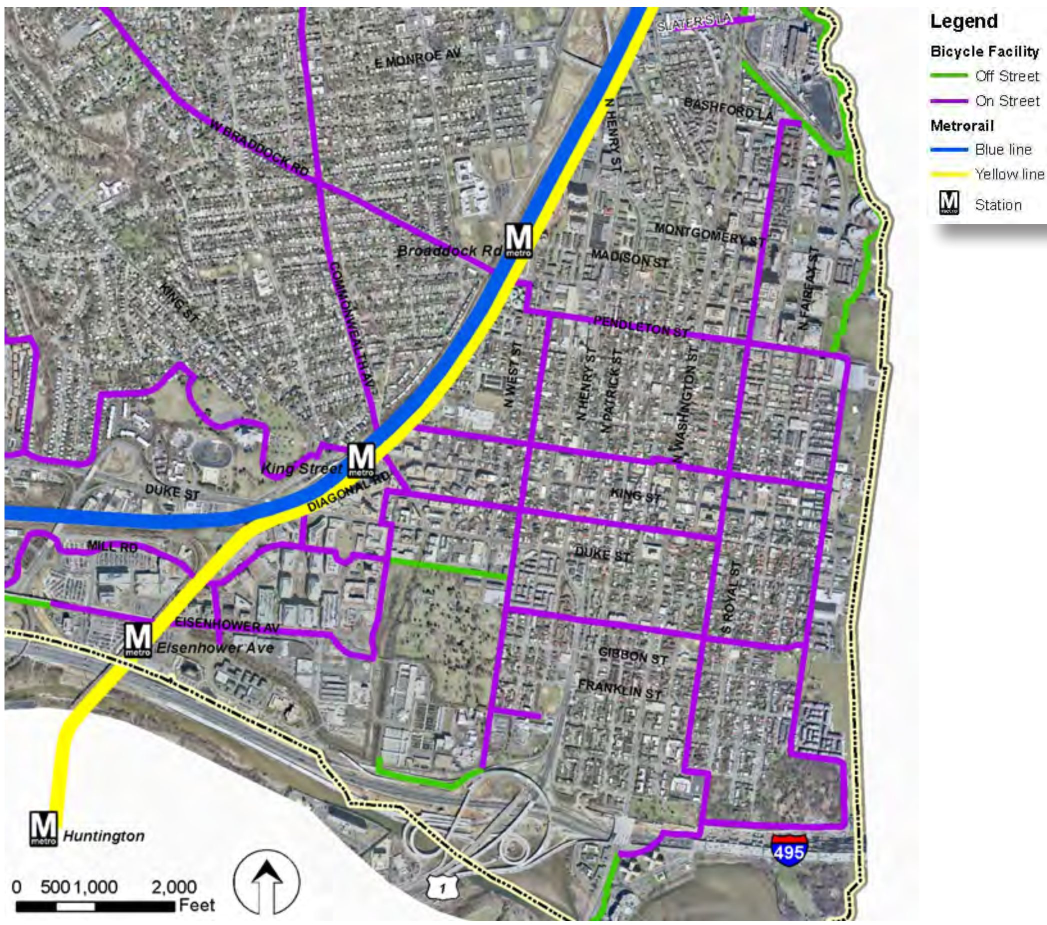


Figure 3.10: Existing Bicycle Facilities

Land Use and Development

General

The urban form of the Corridor A area varies considerably. Old Town is the oldest part of Alexandria and among the oldest in the region. In Old Town, existing development varies in character, size, scale, and use.

While uses along King Street and Washington Street are primarily commercially oriented, many other streets in the study area are residentially focused. The age and materials used in buildings in Old Town vary widely. These variances contribute to some areas of Old Town being more susceptible to impacts from traffic noise and vibration than others. Figure 3.11 shows existing zoning in the study area.

Figure 3.11: Existing Zoning

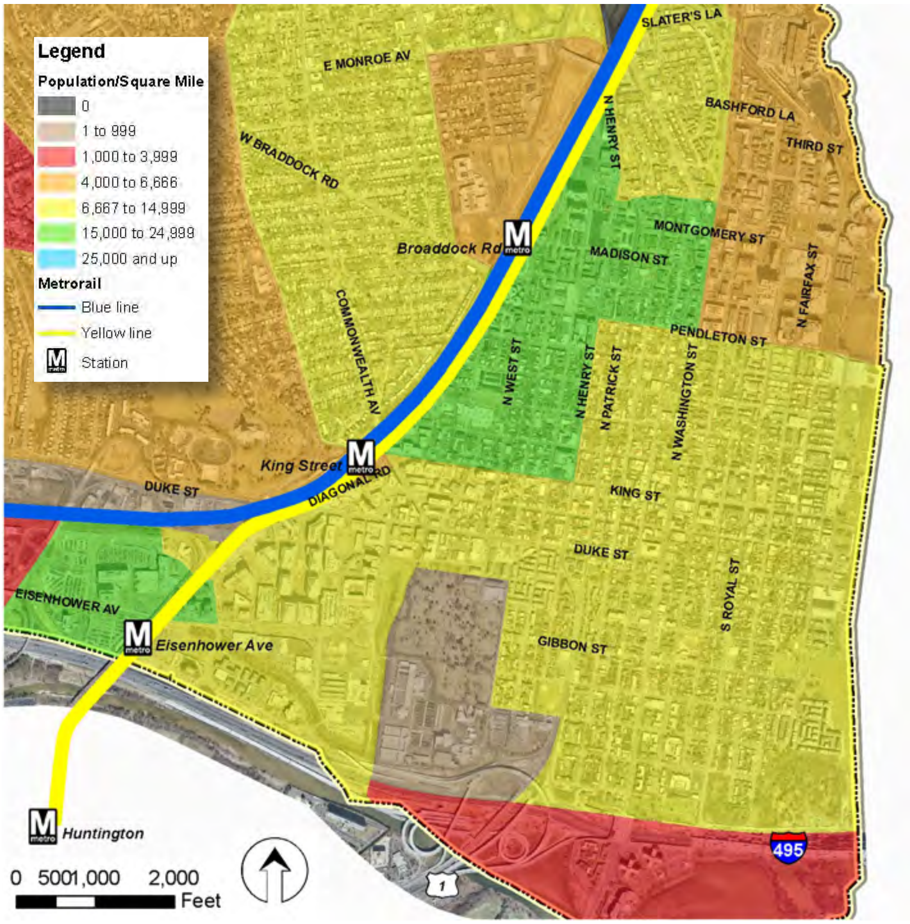
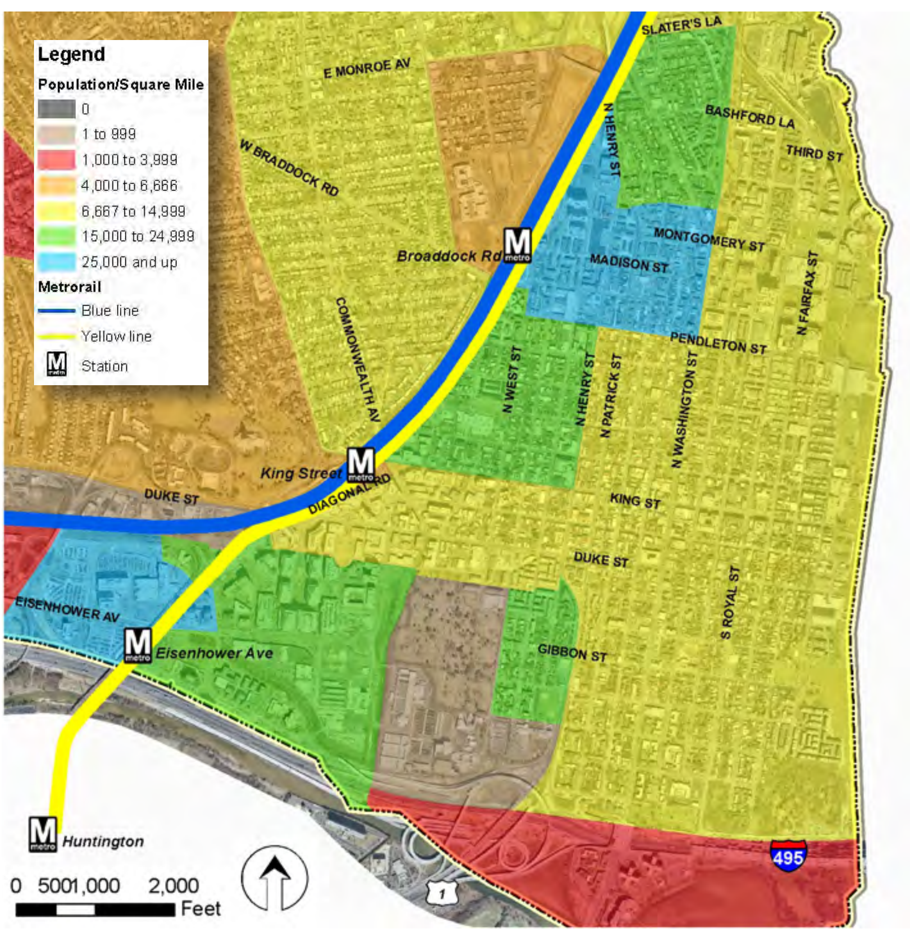


Figure 3.12: Existing Population Density (2000)

Figure 3.13: Projected Population Density (2030)



Population and Employment

The study area has relatively high population and employment density. Based on forecast data available from MWCOG, which is provided by each local jurisdiction, population and employment is forecast to increase in the study area. Table 3.2 summarizes general population and employment conditions for the study area in 2000 and 2030.

Within the study area, the area with the highest population density is adjacent to the Braddock Road Metrorail station. The highest employment density is in the vicinity of the Braddock Road Metrorail station and in Eisenhower East.

Population

Based on information from the MWCOG regional travel demand model, population in the study area is forecast to grow by 2030. Based on this data, growth will be more pronounced in the vicinity of the Braddock Road Metrorail station, Eisenhower East, and the northeast corner of Old Town. Figures 3.12 and 3.13 show existing (2000) and projected (2030) population density. At the time of this study, 2010 U.S. Census data was not available at the tract, block group, or block levels.

Table 3.2: Population and Employment Summary

Measure	2000	2030
Population	15,850	21,157
Population Density (ppl./sq. mi.)	7,304	9,705
Employment	18,405	30,479
Employment Density (emp./sq. mi.)	8,443	13,980

Source: MWCOG Travel Demand Model, Version 2.2, Round 8 Socioeconomic Data Forecasts

Employment

Using the same data from MWCOG, the number of jobs in the study area also is forecast to increase by the year 2030. Employment growth appears to be most evident in Eisenhower East and the northeast part of Old Town. Figures 3.14 and 3.15 show existing (2000) and projected (2030) employment density. At the time of this study, MWCOG's regional population and employment data for 2010 that accompanies Version 2.3 of the regional travel demand model was not available.

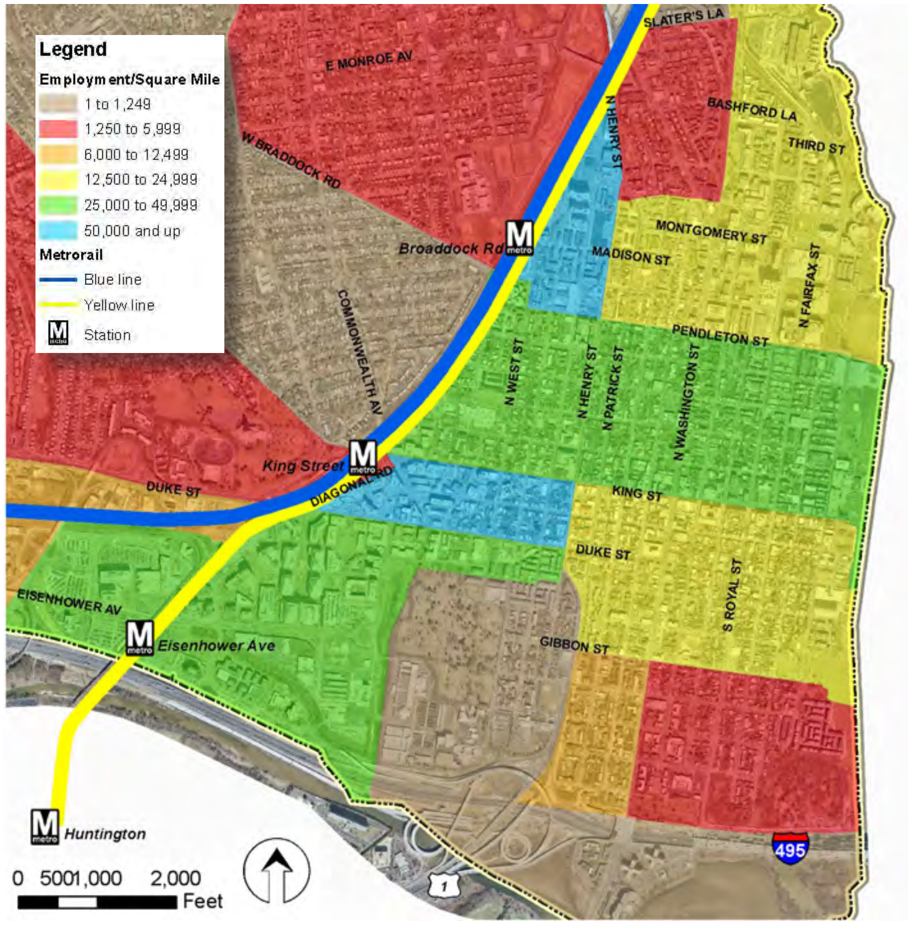
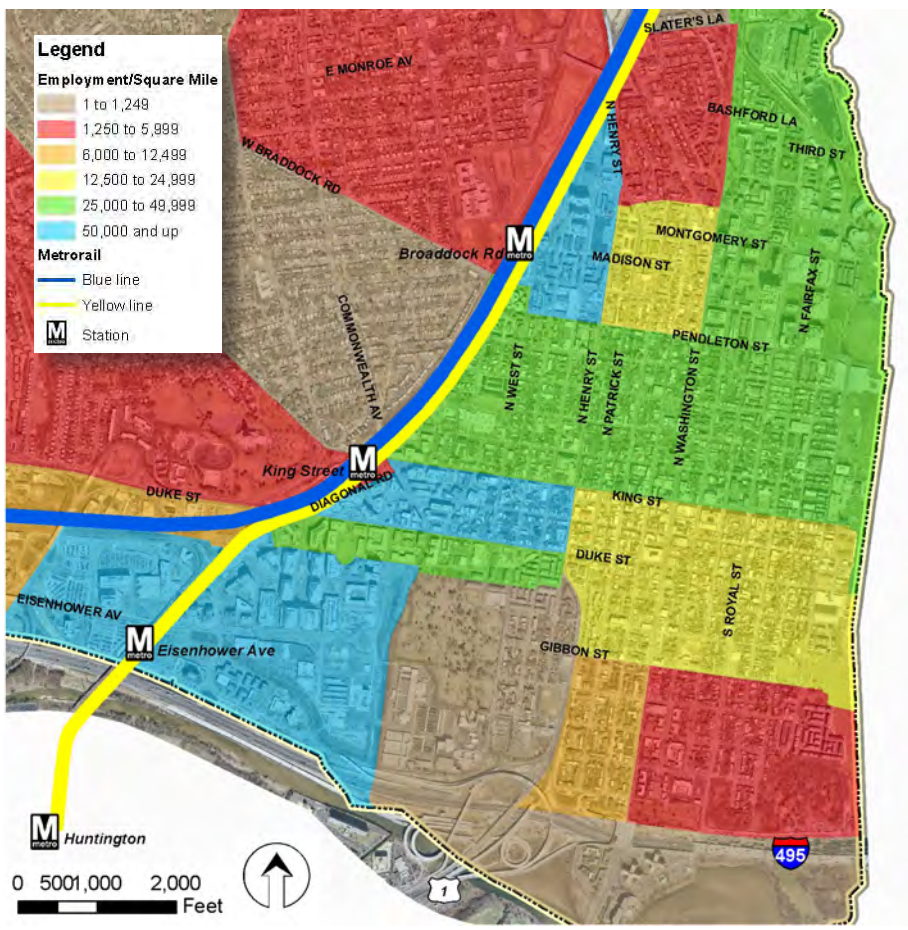


Figure 3.14: Existing Employment Density (2000)

Figure 3.15: Projected Employment Density (2030)



Summary of Existing Conditions

In the context of planning a new surface-running high-capacity transit service in Corridor A, there are a number of particularly evident challenges within the existing transportation system. These include:

- Peak hour congestion on US 1 (Patrick Street, Henry Street, and Jefferson Davis Highway)
- Peak hour congestion on Washington Street
- Narrow rights-of-way as compared to functional needs of streets such as Patrick Street and Henry Street
- Narrow travel lanes on Patrick Street and Henry Street
- On-street parking
- Narrow sidewalks on portions of some streets where the transitway could run
- High-occupancy vehicle lanes on Patrick Street, Henry Street, and Washington Street
- Historic structures fronting rights-of-way along possible transitway routes

While each of these challenges are significant, the protracted traffic congestion along Patrick Street and Henry Street in the peak hour and direction and accompanying narrow rights-of-way along each of these streets limits potential transit concepts. At a conceptual level, the existing congestion reinforces the need for transit to operate in a fully- or partially-dedicated (congestion-free) runningway to achieve its stated purpose. Creating a dedicated transit lane from an existing travel lane would require approximately 11 feet of lane width (ideally 11.5 feet). Along many sections of Patrick Street and Henry Street, existing general purpose lanes are less than 11 feet in width, with no opportunity for expansion without impacts to already minimum-width on-street parking lanes.

Without the opportunity to expand the existing right-of-way, concepts are limited to reconfiguring street cross sections within the existing right-of-way and, more accurately, within the existing dimension of the street between curb faces. Providing a dedicated runningway for transit has the potential to require the consideration of one or more of the following:

- Running transit in mixed flow (not meeting the general *Transportation Master Plan* goal for operating high-capacity services in dedicated lanes) with some opportunity for queue jump lanes through the displacement of parking
- Displacing an existing general purpose travel lane for transit (thereby reducing general vehicle throughput) and narrowing adjacent travel lanes where needed to meet minimum transit lane width requirements
- Repurposing a high-occupancy vehicle (HOV) lane for exclusive or shared (HOV and transit) use and narrowing adjacent travel lanes to meet minimum transit-lane width requirements
- Displacing an existing parking lane for transit use (likely not physically feasible due to available width within the cross section)
- Displacing an existing parking lane in combination with a shared (HOV/transit) use of the existing HOV lane and streetscape improvements (widened sidewalks, etc.)

Concepts relying on some of the aforementioned and in consideration of existing conditions are described in the next section.

AC Transit Rapid Bus (Bay Area, California)

Preliminary Transitway Concepts

A number of different concepts were developed for Corridor A for discussion purposes. Concepts varied in terms of runningway treatment, service alignment, service extent, and general operations. Concepts were developed along Patrick and Henry Streets, Washington Street, the Crystal City Potomac Yard (CCPY) alignment, and portions of the existing REX route. The following were general elements used to create concepts:

Route/Alignment (General)

- Washington Street
- Patrick and Henry Streets
- Other (including railroad right-of-way and other north-south streets)

Operational Configuration

- Mixed flow
- Partial mixed flow (some sections dedicated lane)
- Dedicated lane

Runningway Accommodation

- None (mixed flow)
- Shared HOV/transit lane
- Displacement of general purpose travel lane

Northern Terminus

- Braddock Road Metrorail station
- King Street Metrorail station

Southern Terminus

- Braddock Road Metrorail station
- King Street Metrorail station
- Huntington Metrorail station
- US 1 in Fairfax County

Mode/Service

- Express bus
- Rapid bus
- Bus rapid transit
- Streetcar

Using these elements, several basic concepts were created to begin the discussion on route, operational configuration, runningway, and terminus. While transit mode was an element of concept development, it was not specifically discussed due to the limited concept development performed. The following is a brief description of each concept developed for Corridor A.

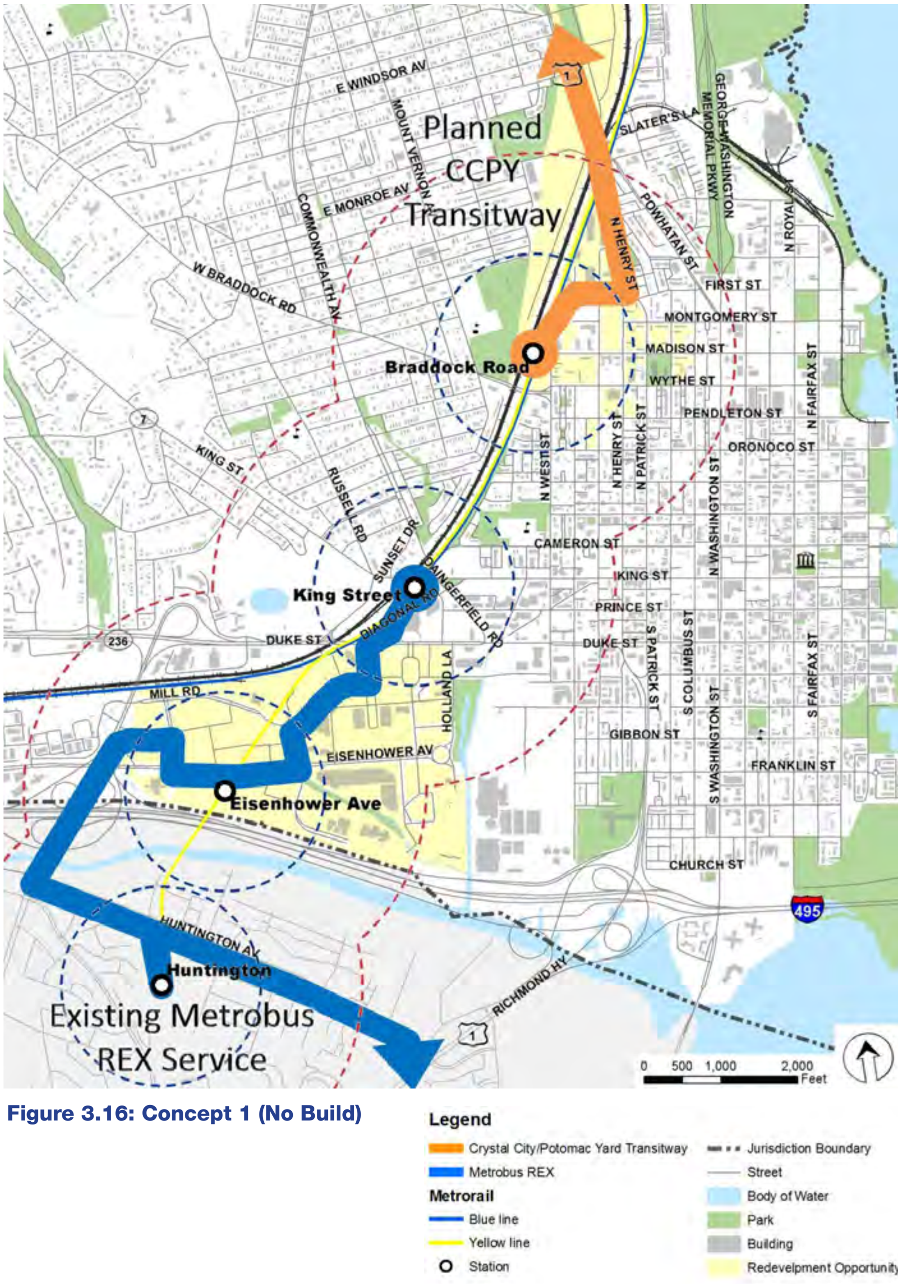


Figure 3.16: Concept 1 (No Build)

Concept 1 (No Build)

This concept is comprised of the adopted CCPY alignment to the Braddock Road Metrorail station and the existing REX route through Eisenhower East, terminating at the King Street Metrorail station. Figure 3.16 shows this concept. An on-street dedicated transit service and runningway would not be established to connect the CCPY alignment and REX service. Principal advantages and disadvantages of this concept include:

Advantages

- Status quo—no right-of-way, travel lane, parking, or streetscape impacts
- No additional capital and operating cost
- Direct connectivity to the King Street Metrorail station from the south and Braddock Road Metrorail station from the north
- Connectivity with VRE and Amtrak via the existing REX service at King Street

Disadvantages

- Would require two transfers to travel between REX and CCPY
- Does not increase availability and convenience to high-capacity transit services for east Old Town
- Indirect route for through trips

Concept 2 (West Street)

This concept is comprised of the adopted CCPY alignment to the Braddock Road Metrorail station, the existing REX route through Eisenhower East terminating at the King Street Metrorail station, and a new dedicated transitway connection using portions of King Street and West Street. Figure 3.17 shows this concept. This concept has the potential to accommodate rail and bus transit technologies depending on the ultimate build-out of CCPY. Differing from the No Build concept, an on-street transit service benefit from transit signal priority and potentially queue jump lanes would be established to connect the CCPY alignment at the Braddock Road Metrorail station and REX service at the King Street Metrorail Station. Several effective service structures could be used to operate this concept including:

- Extension of CCPY service to the King Street Metrorail station and a coordinated transfer to REX service at the King Street Metrorail station. One transfer would be required between REX and CCPY services in this scenario.
- Extension of REX service to the Braddock Road Metrorail station and a coordinated transfer to CCPY service at the Braddock Road Metrorail station. One transfer would be required between REX and CCPY services in this scenario.
- Integration of REX and CCPY services throughout the entire route. No transfers would be required to travel from northern and southern route termini of the entire corridor.

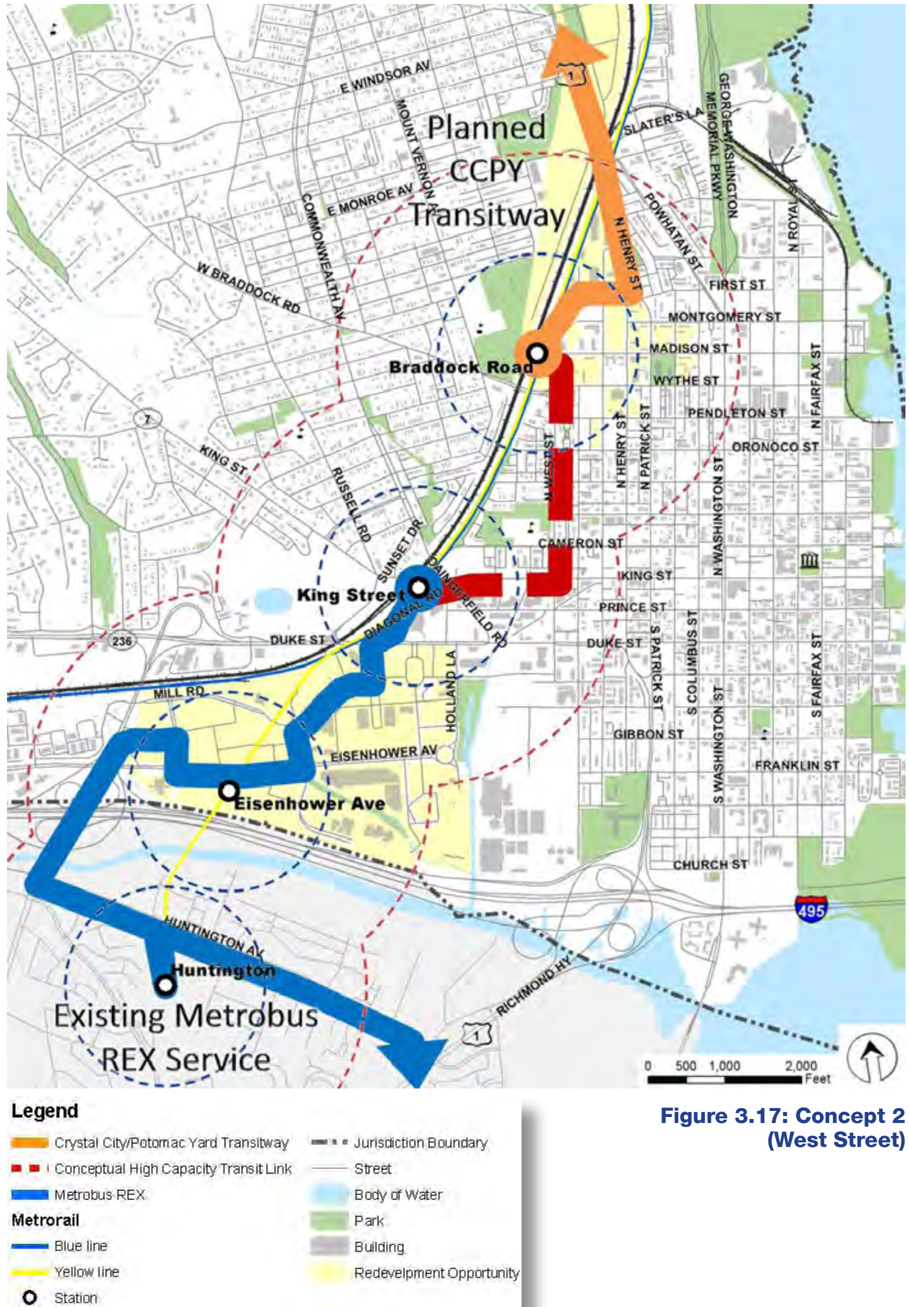


Figure 3.17: Concept 2 (West Street)

Principal advantages and disadvantages of this concept include:

Advantages

- Minimizes transfers
- Uses existing and adopted plans for the majority of its route
- Limited impact to traffic operations along Old Town streets
- Relatively low capital cost to implement
- Direct connectivity to Metrorail at three locations in Alexandria
- Direct connectivity to VRE and Amtrak at King Street

Disadvantages

- Potential impacts to traffic operations on King Street and West Street
- Potential noise and vibration impacts to West Street
- Minimally increases availability and convenience to high-capacity transit services for east Old Town
- Indirect route for through trips
- Higher cost than No Build

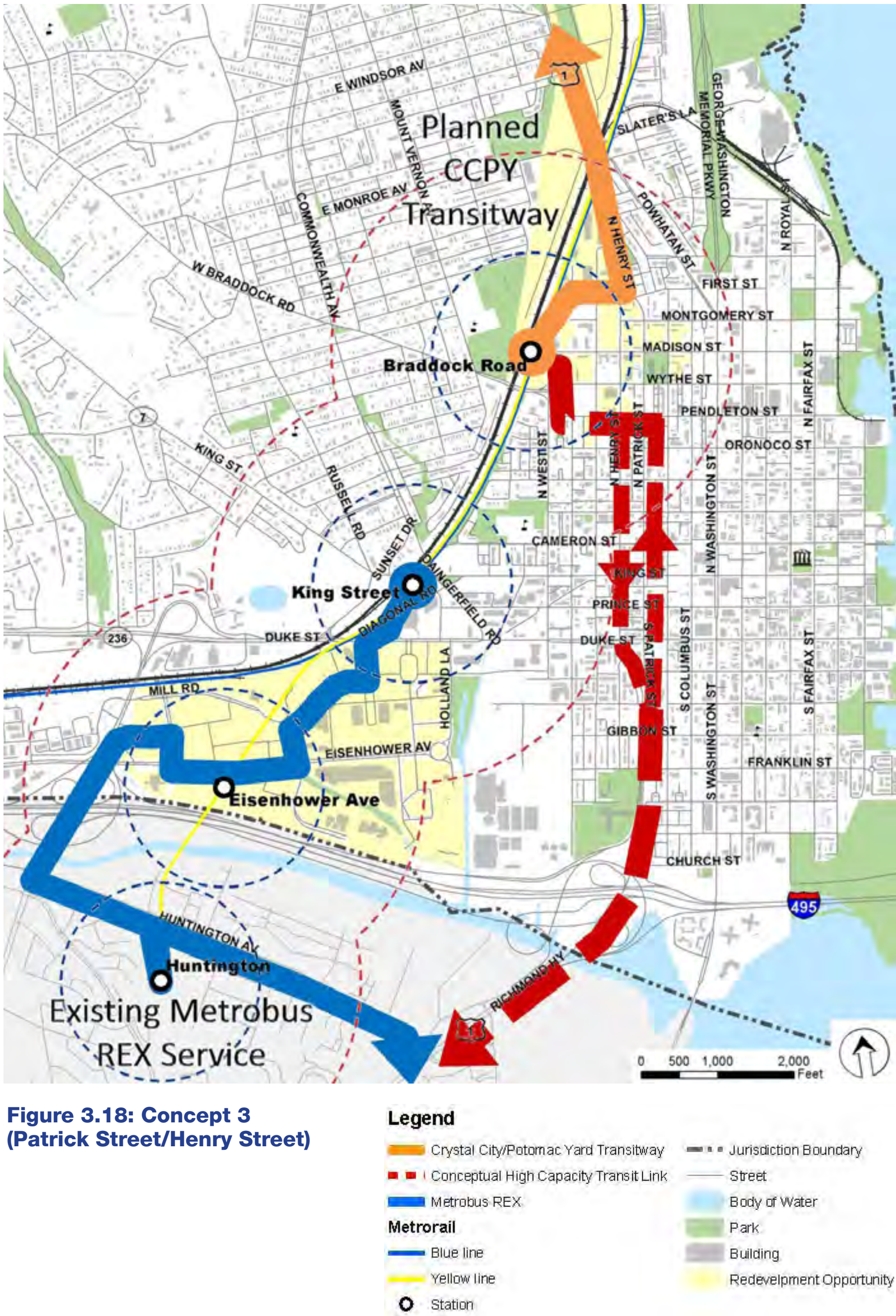


Figure 3.18: Concept 3 (Patrick Street/Henry Street)

Concept 3 (Patrick Street/Henry Street)

This concept is comprised of the adopted CCPY alignment to the Braddock Road Metrorail station and a new alignment primarily using existing Patrick and Henry Streets (US 1) through Old Town, with a transition to Richmond Highway south of Alexandria. Figure 3.18 shows this concept. This concept has the potential to accommodate rail and bus transit technologies. An interim terminus of the transitway could be at Duke Street. Within this concept, several runningway configurations could support the transitway operation through Old Town including:

- Conversion of the existing HOV lanes to transit and HOV lanes
- Conversion of the existing HOV lanes to transit only
- Several effective service structures could be used to operate this concept including:
  - Extension of CCPY service to the southern terminus of the transitway in Fairfax County
  - Spur service of REX to connect to the Braddock Road Metrorail station

Principal advantages and disadvantages of this concept include:

Advantages

- Minimizes transfers
- Direct route for through trips
- Potential for high quality of operation for transit service
- Increases availability and convenience to high-capacity transit services for east Old Town
- Direct connectivity to Metrorail at two locations in Alexandria
- Potential for phased implementation

Disadvantages

- Indirect connectivity to VRE and Amtrak
- Impacts traffic operations on Richmond Highway, Patrick Street, and Henry Street
- Potential noise and vibration impacts to Old Town
- Narrow existing lane widths along Patrick Street and Henry Streets could require adjustment to accommodate frequent transit service adequately
- Higher cost than Concepts 1 and 2

Concept 4 (Washington Street)

This concept is comprised of the adopted CCPY alignment to the Braddock Road Metrorail station and a new alignment primarily using existing Washington Street through Old Town, with a transition to South Patrick Street in south Old Town and to Richmond Highway in Fairfax County. Figure 3.19 shows this concept. This concept has the potential to accommodate rail and bus transit technologies. An interim terminus of this concept could be at Franklin Street and Gibbon Street. Within this concept, several runningway configurations could support the transitway operation through Old Town including:

- Conversion of the existing HOV lanes to transit and HOV lanes
- Conversion of the existing HOV lanes to transit only
- Several effective service structures could be used to operate this concept including:
  - Extension of CCPY service to the southern terminus of the transitway in Fairfax County
  - Spur service of REX to connect to the Braddock Road Metrorail station

Principal advantages and disadvantages of this concept include:

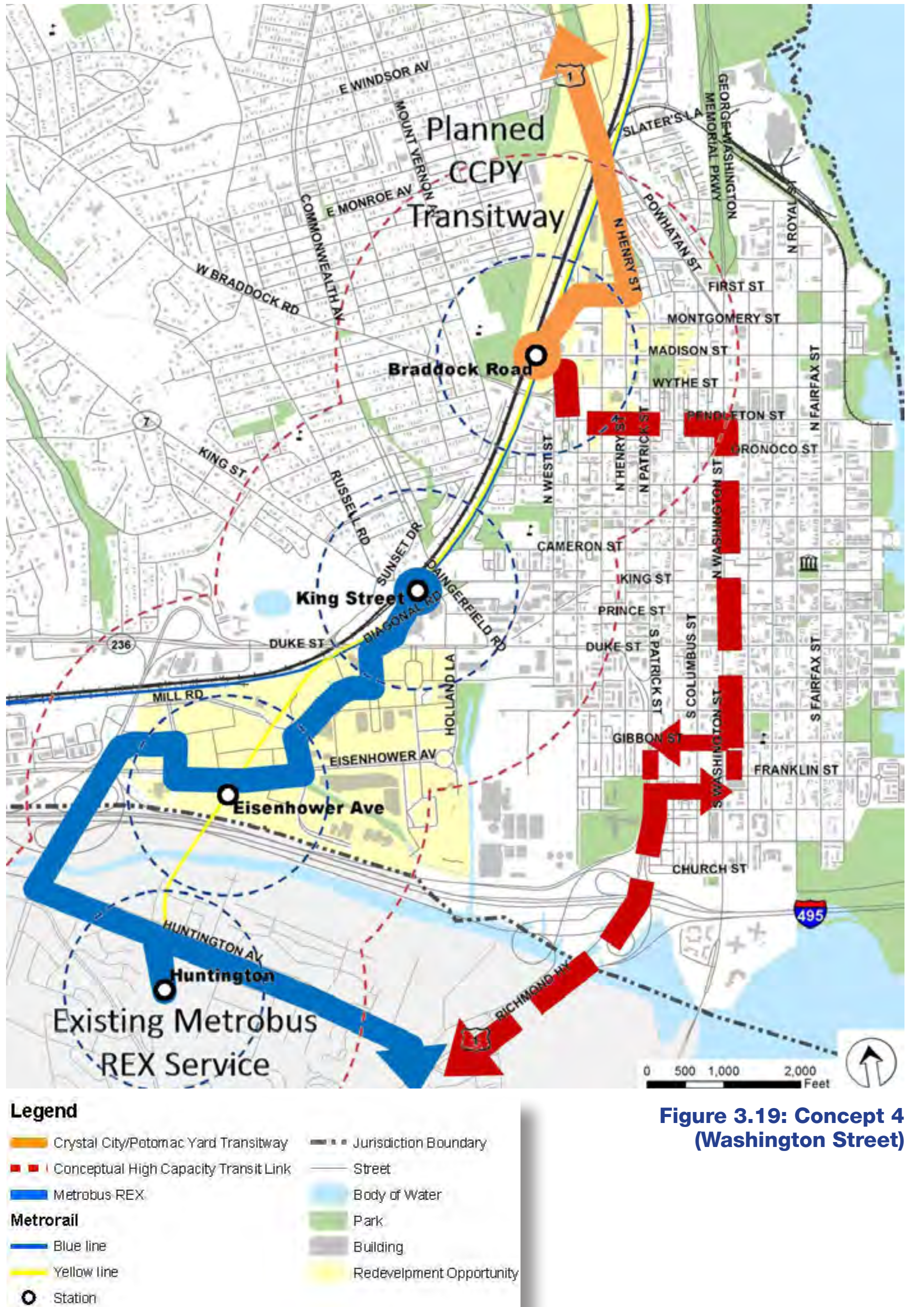


Figure 3.19: Concept 4 (Washington Street)

Advantages

- Minimizes transfers
- Potential for high quality of operation for transit service
- Significantly increases availability and convenience to high-capacity transit services for east Old Town
- Direct connectivity to Metrorail at two locations in Alexandria
- Operates along a potentially more compatible route (Washington Street) from a residential impacts perspective
- Potential for phased implementation

Disadvantages

- Less direct route for through trips than Concept 3 due to transitions at north and south ends of the route through Old Town
- Indirect connectivity to VRE and Amtrak
- Impacts traffic operations on Richmond Highway, S. Patrick Street, and Washington Street
- Has potential National Park Service impacts
- Potential noise and vibration impacts to Old Town
- Higher cost than Concepts 1 and 2

Discussion

During High Capacity Transit Corridor Work Group (Corridor Work Group) meetings, discussion ranged from current transportation issues and neighborhood concerns to future transitway concepts and Old Town transportation priorities. A brief summary of paraphrased public and Corridor Work Group comments from the meetings is provided below:

Public Comments

Connectivity and Service to Destinations & Population

- Study needs to define travel patterns and potential users of the future transitway within the identified corridor—some concern was noted as to the corridor mostly serving non-Alexandrians
- A distinction between destination types within the study corridor should be made
- Perception that Old Town is already well-served by Metrorail and would not benefit from a new transitway in the location proposed
- REX service passengers' destination is Metrorail at Eisenhower Avenue and King Street
- Improvements should focus on serving local residents before serving regional users
- Focus on connectivity to Metro, not trips through Old Town
- Question the need for surface transit connectivity between Braddock Road and King Street Metrorail stations

Community

- Travel lanes are very narrow on Patrick and Henry Streets—concern that adding transit to these lanes will make conditions worse for residents
- Concern that investing in high-capacity transit could create new development pressure in Old Town
- Do not widen any streets in Old Town or remove parking along Patrick or Henry Streets
- Preservation of streetscape and neighborhood character is critical
- Noise and vibration of historic and old structures along Patrick and Henry Streets is a major concern
- Inadequate rights-of-way already constrain sidewalk, tree buffers, and parking—these need to be improved before transit modifications should be considered
- Consider reducing vehicular capacity on Patrick and Henry Streets to reduce traffic volumes
- Old Town already benefits from DASH, Metrobus, VRE, and Metrorail services
- Concepts should protect Old Town and divert traffic around it; consider using the right-of-way along the freight railroad or limiting new routes through Old Town by routing services to Eisenhower Avenue to/from the south

Alignment/Route

- Minimal community support for a transitway alignment through Old Town
- Priority in Old Town is on a local transit circulator to improve connectivity to Metrorail
- Any future system should be continuous to avoid mode transfer penalties
- Future transit service should cross the Woodrow Wilson Bridge into Maryland
- Consider extending the Yellow line to Fort Belvoir instead of extending transit through Old Town
- Consider a transit connection using the rail spur to the waterfront
- Evaluate the opportunity to continue dedicated lanes from the Route 1 section of Crystal City-Potomac Yard to Braddock Metro using the railroad right-of-way
- Connection through Old Town and to Fairfax County is desirable; there has been a lot of discussion about congestion in Old Town and something needs to be done
- Washington Street alignment may be more desirable than an alignment on Patrick and

Henry Streets; however, there also is opposition to high-capacity transit along Washington Street

- King Street trolley service is desirable
- Additional east-west connectivity is desirable
- Significant support for the No Build option

Corridor Work Group Comments

Existing Conditions

- Limited right-of-way along Patrick and Henry Streets
- Significant congestion already exists within the US 1 corridor
- Transit service does not currently operate along Patrick and Henry Streets due to community concerns with neighborhood compatibility
- Significant rate of HOV violations in arterial HOV lanes on Patrick and Henry Streets—little enforcement
- 33.5 million square feet of development (Potomac Yard, Crystal City, and other developments) are coming to the Route 1 corridor and Route 1 is already at saturation
- DASH services and amenities are inconsistent in Old Town
- Headways vary from route to route and during different times of the day
- Routes are indirect
- Headways and travel times are long enough that in some cases it is easier to walk
- Service has low ridership

Future Conditions

- Do no harm to Old Town
- Protect neighborhoods from existing and future through traffic
- Consider removing a general purpose through lane on Patrick and Henry Streets
- Coordinate with neighboring jurisdictions to take advantage of opportunities such as Fairfax County's Route 1 project and the Huntington Metrorail station
- Evaluate population and employment at the U.S. Census Block level
- Examine travel pattern information
- Transit travel must be competitive with auto travel

Future Services

- Service needs to be reliable, fast, and convenient
- Real solution to traffic problems is to provide a reliable circulator system
- Provide additional east-west transit connections and coordinate with Corridor B
- Need to coordinate with neighboring jurisdictions
- Consider a concept with high-capacity transit operating in mixed flow
- Provide services in Old Town that increase connectivity of existing services
- Need to factor King Street and Braddock Metrorail stations into the options
- Improve branding of DASH services and have Old Town specific branding of transit services
- Enhance the existing REX service and connect it to the future Route 9X service
- Consider more service to connect to the Crystal City/Potomac Yard transitway 1) with dedicated lanes; 2) without dedicated lanes; and 3) with marginal physical improvements
- Consider an extension of the Yellow line into southern Fairfax County & Ft. Belvoir
- Look to create a partnership with adjacent jurisdictions to fund Corridor A improvements
- Consider using transit signal priority (TSP) to improve transit travel speeds

Euclid Avenue, Healthline BRT at Cleveland Clinic (Cleveland, Ohio)

Process Conclusions

The series of Corridor Work Group meetings revealed significant concerns and alternative transportation priorities for the public and other stakeholders along Corridor A. From the Corridor Work Group meetings and other interactions with the public, the study team recognized that the development of a transit service and infrastructure plan for additional north-south transit service was not a priority. Instead, the public and Corridor Work Group expressed a desire to focus on transportation solutions to enhance local mobility and connectivity within Old Town and existing Metrorail stations at Braddock Road and King Street through the following general concepts:

- Completion of the adopted CCPY transitway project from the Arlington County line to the Braddock Road Metrorail station
- Reconfiguration of existing DASH services within Old Town to simplify route structure, schedules, and frequency of service
- Potential Old Town circulator transit service

Responding to Corridor Work Group direction and public comments, city staff recognized that the development of a service and infrastructure concept in Corridor A to the south of Braddock Road was not a priority of the city. Other transit studies, focused on local mobility and circulation, were requested by the Corridor Work Group and public within the Corridor A area. Consistent with public and Corridor Work Group comments, the DASH Comprehensive Operations Analysis anticipated to begin in Fall 2012 will closely examine DASH services within Old Town and evaluate potential circulator service alternatives for Old Town. In general, alternatives for the Old Town circulator should consider the following:

- Transit service and facility coordination. The service should connect directly to the King Street and Braddock Road Metrorail stations. It also should connect to significant transfer locations for DASH.
- Appropriate frequency and duration of service. The service should be sufficiently frequent—minimum of 15-minute headways, preferably less based on the relatively compact service area—so that people do not need to rely on a schedule when using the service. Headways should be consistent to the extent possible. The service should be provided for a period complementary of operating hours of area destinations and transportation services (Metrorail, DASH, VRE, and Metrobus).
- Direct, simple routing. The service should be oriented in a logical, predictable route, free of unnecessary deviations. Loop alternatives should operate bidirectional services to reduce trip lengths for passengers. Linear alternatives should operate along easily recognizable and

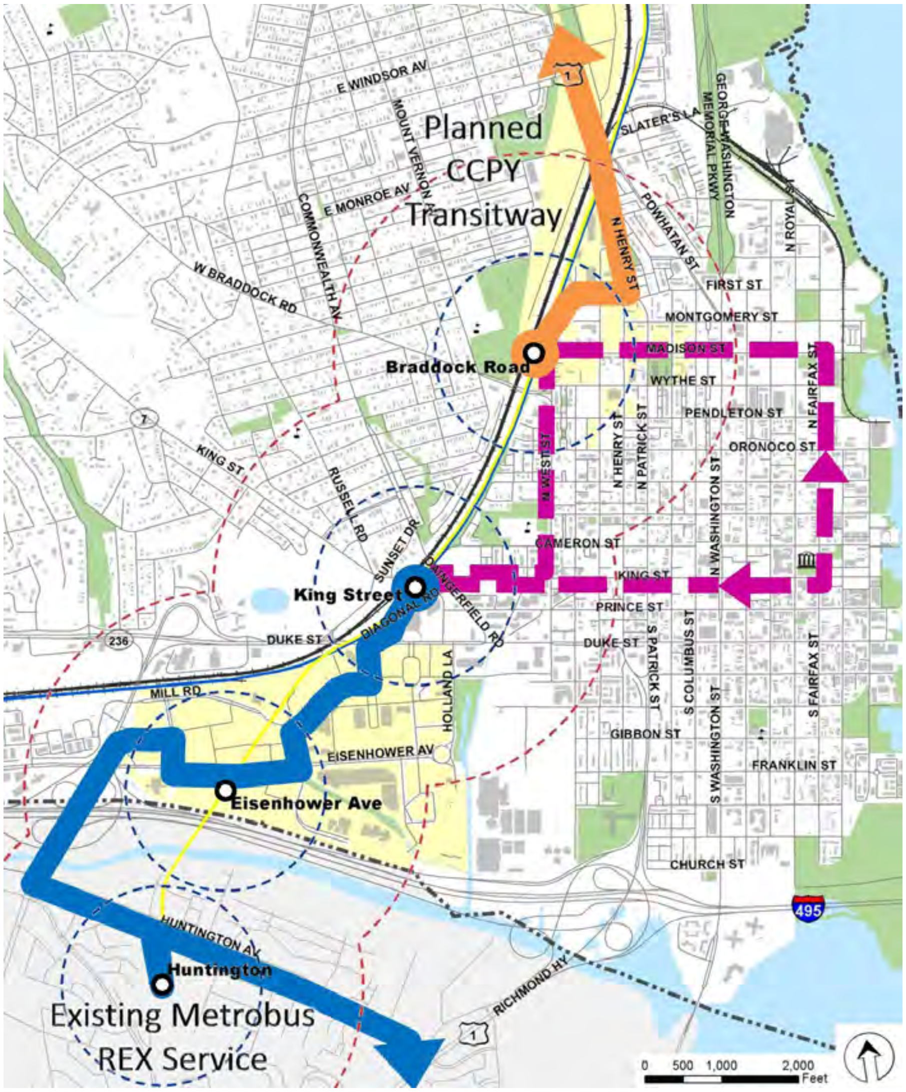


Figure 3.20: Bidirectional Circulator Concept 1 Starter Idea

easy-to-understand routes (e.g., King Street to Commonwealth Avenue).

- Recognizable brand. The service should have a distinct and attractive brand that is easily recognizable by residents as well as visitors and others traveling within the area.
- Appropriate vehicle type and size. The circulator vehicle should be of an appropriate size and propulsion type to minimize negative impacts on the neighborhood, while providing transit patrons a comfortable and convenient travel experience. Ideally, the vehicle should be easy to board and alight—low-floor vehicle with nearly level boarding at stops—to improve accessibility and reduce dwell time at stops.
- Fare structure. Both fare and fare-free services should be considered. Each has advantages and disadvantages which should be weighed carefully. The collection of fares aids in the recovery of operating cost; however, it may discourage use of the service and increase dwell times at stops.
- Amenities (facilities). Appropriate facilities should be provided at circulator stops. All stops should be identified clearly through service-specific branding. All stops also should provide a route map highlighting significant destinations and other landmarks, information on how to access real-time arrival information, service frequency and duration information, fare information, lighting, and convenient access to a trash can. Some stops should provide real-time information, shelters, and benches.

Circulator Starter Ideas

Two circulator starter ideas were developed in-response to Corridor Work Group and public comments. These starter ideas are shown in Figures 3.20 and 3.21. Each of these concepts has the potential to incorporate features and operations described in the aforementioned summary points.

Figures 3.20 and 3.21 are intended to illustrate general concepts for circulators. The DASH Comprehensive Operations Analysis will identify and evaluate possible Old Town circulator services in detail and will provide detailed recommendations.

The concept illustrated in Figure 3.20 shows a bidirectional circulator operating along Madison Street, Fairfax Street, King Street, and West Street. The circulator would connect to the King Street and Braddock Road Metrorail stations and also would connect to City Hall, where many of DASH's existing services stop. The service would operate bidirectionally to minimize travel time and distance for patrons.

The concept illustrated in Figure 3.21 also shows a bidirectional circulator. The route is slightly longer than the concept shown in Figure 3.20. To extend the reach of the circulator to south Old Town, the circulator would extend south of King Street on Washington Street, to Franklin Street and Gibbon Street (depending on direction), and then onto Fairfax Street. Like the first concept, this circulator would connect to the Braddock Road and King Street Metrorail stations as well as City Hall. Differing from the first concept, this concept would better serve south Old Town and the neighborhood commercial area of south Washington Street.

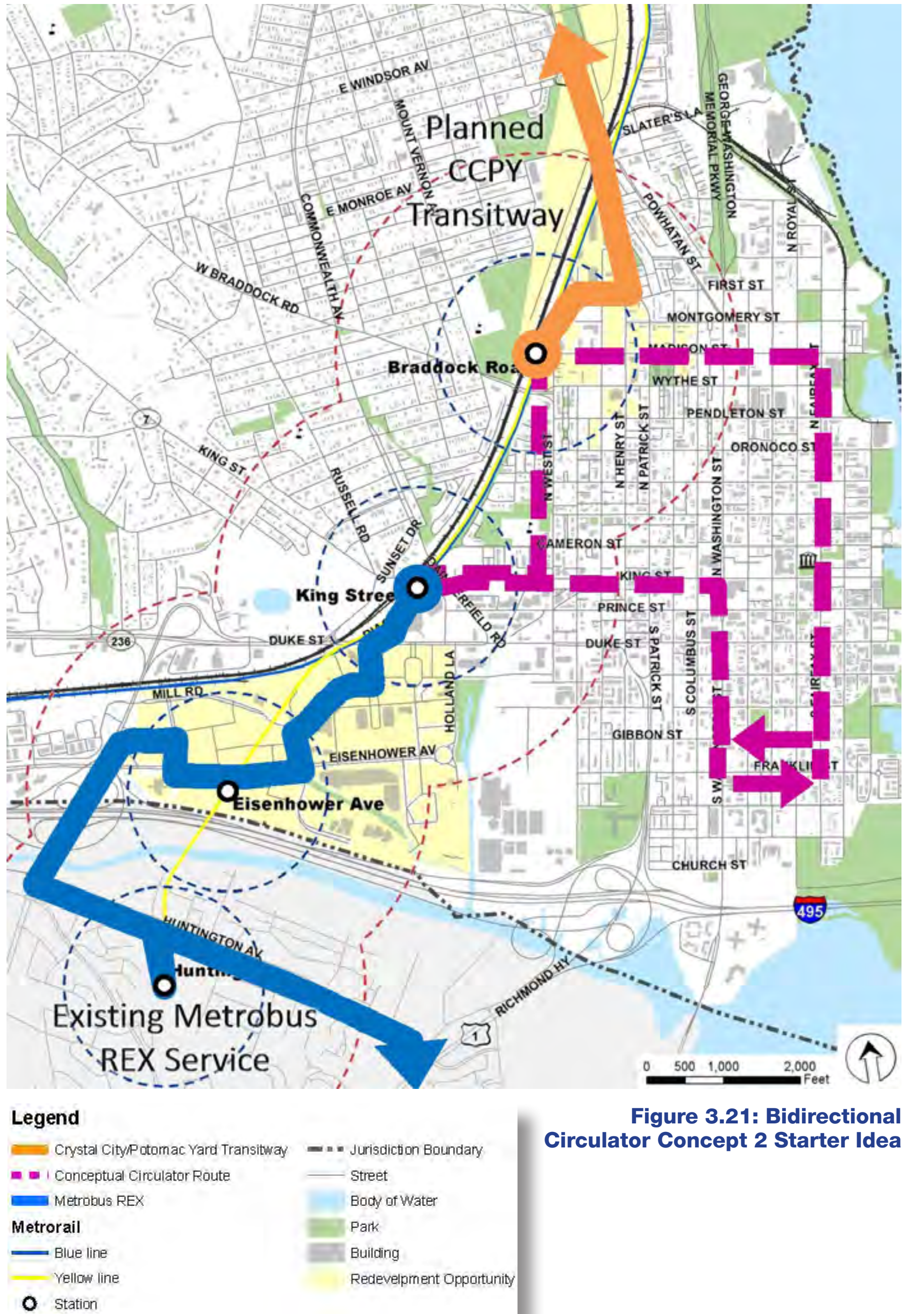


Figure 3.21: Bidirectional Circulator Concept 2 Starter Idea

Future Considerations

Currently, planning and implementation of high-capacity transit in Corridor A south of the Braddock Road Metrorail station is not a priority for Alexandria. Planning of new high-capacity and high-quality surface transit is not being pursued further for Corridor A at this time. In the long-term, Corridor A (north-south) may become an important link in the region's high-capacity and high-quality surface transit network. MWCOG, WMATA, Fairfax County, and Arlington County have adopted plans to develop transit facilities and services to connect to Corridor A at its north and south termini. Reliable, continuous, convenient, and direct transit between Crystal City and southern Fairfax County has the potential to provide an additional travel mode choice for travelers in the US 1 corridor and has the potential to help manage through travel demand on Patrick and Henry Streets in Old Town Alexandria. Alexandria will continue to monitor transportation, land use and development, and regional planning and policy conditions as they relate to Corridor A.

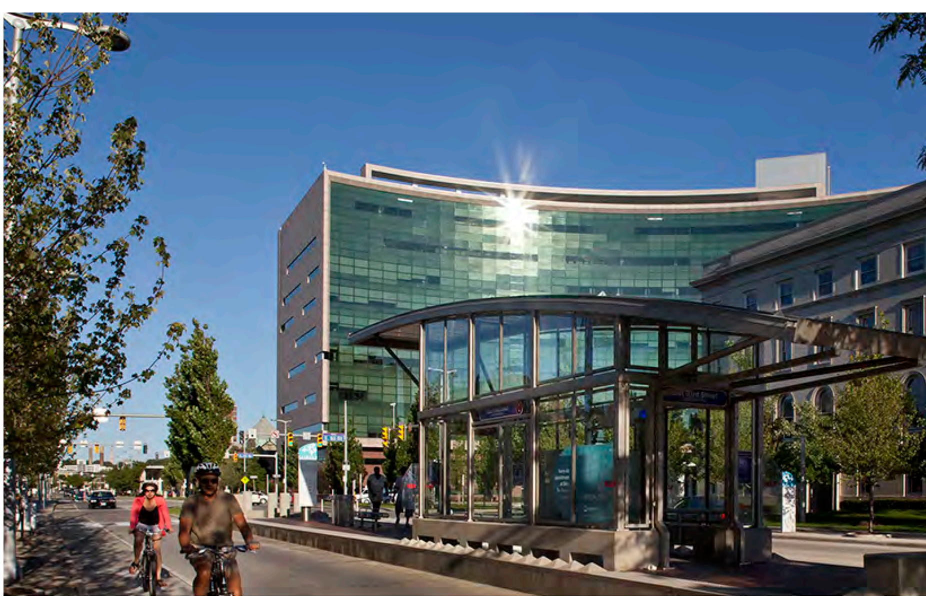
Corridor Work Group Recommendation

The formal recommendation for Corridor A, as defined and approved by the Corridor Work Group on December 15, 2011, is presented below.

> *"Whereas the Alexandria Comprehensive Transportation Master Plan conceptually envisioned the eventual location of high capacity transit in dedicated lanes in the portion of Corridor A south of Braddock METRO Station; and*
>
> *Whereas the High Capacity Transit Corridor Work Group was appointed to recommend methods for implementing the Alexandria Comprehensive Transportation Master Plan to City Council;*
>
> *Be it hereby resolved that the High Capacity Transit Corridor Work Group recommends that there be no dedicated-lane high capacity transit on the portion of Corridor A south of Braddock METRO Station. Instead, the High Capacity Transit Corridor Work Group recommends that resources be used to explore the possibility of putting circulator buses/ trolleys or other forms of conventional and scale appropriate transit in this portion of the City."*

The Corridor Work Group recommendation was approved by the City Council on June 13, 2012, following input from the Transportation Commission and Planning Commission.

CORRIDOR B
chapter 4



Duke Street near Cameron Station

existing conditions

Introduction

The Corridor B study area is bounded to the west by the Alexandria city line and to the east by the King Street Metrorail station. The study corridor is approximately four miles long and has existing bus service operating along its full length.

Duke Street and Eisenhower Avenue are classified as arterials within the study area. The study area includes several parks, stream crossings, and residential and commercial areas.

Providing high-capacity and high-quality transit services in Corridor B will be challenging. Challenges and constraints for Corridor B include:

- Significant peak hour traffic congestion on Duke Street and surrounding side streets and ramps
- Generally narrow street rights-of-way
- Varying road geometry and number of lanes
- Land use compatibility
- Residential parking on service roads
- Poor pedestrian and bicycle connectivity

The following sections provide additional information on these challenges and summarize general existing multimodal transportation, land use, and development conditions.

Travel Patterns and Activity Centers

Alexandria's location adjacent to Washington, D.C. and Arlington County creates an environment where regional traffic passes through the community and is destined for locations within the community. Many area commuters travel east to Old Town and/ or north to Washington, D.C. and Arlington County. Corridor B serves as the area's primary east-west travel corridor via important city roadways such as Duke Street and Eisenhower Avenue. In addition, tens of thousands of transit trips traverse Alexandria each day using bus services as well as Metrorail and Virginia Railway Express (VRE).

Major destinations outside of Corridor B within Alexandria include Old Town, Potomac Yard, and the Mark Center area. Destinations within the study area include Landmark Mall and the Van Dorn corridor, Eisenhower East, Cameron Station, Carlyle, and Alexandria Commons.

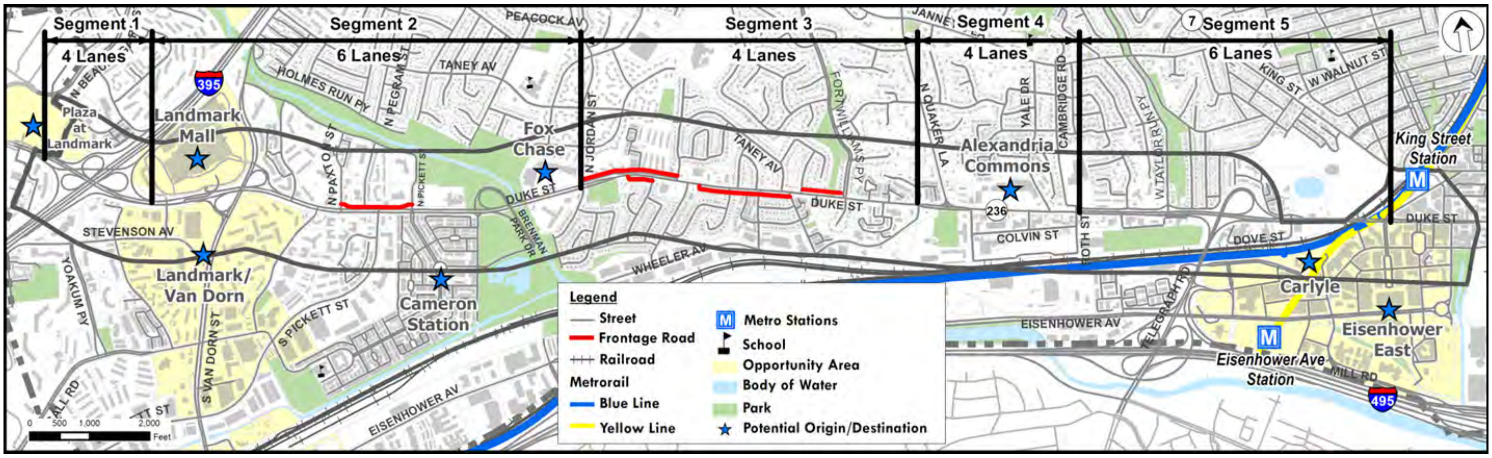


Figure 4.1: Duke Street Sections

Transportation Conditions

Metropolitan Washington Council of Governments' (MWCOG) fiscally constrained long-range plan includes limited east-west roadway capacity increases in the study area during the next 20 years. MWCOG's travel demand forecasts show that peak period travel demand on Duke Street and Eisenhower Avenue will increase during the next 20 years. These routes will continue to have travel demand that outpaces their capacity in part because they effectively parallel the Capital Beltway, which is predicted to be significantly over-capacity in the future.

Regional Traffic Influences

Regional congestion is a major influence on travel conditions in Alexandria. Congestion on the Capital Beltway (I-95/I-495) and Shirley Highway (I-395) divert some longer through trips onto arterial facilities such as Duke Street and Eisenhower Avenue as well as other routes in Alexandria. Traffic diverting through the city streets increases significantly during incidents on the region's major freeway links. Regional through trips diverted to local routes limit capacity available to Alexandrians for shorter distance trips and contribute to the substantial congestion that exists within the study corridor.

Local Transportation Conditions

Duke Street

The Duke Street corridor was divided into five segments (Figure 4.1) between the west city limit and King Street station to the east. The following briefly describe characteristics within each section evaluated.

Segment 1

- Oasis Drive to Landmark Mall - 0.5 miles
- Four lanes with a raised-curb landscaped median
- Curb-to-curb width of 90 feet
- Right-of-way width varies due to I-395

This section was later dropped from consideration for this study. When Fairfax County begins consideration of the Route 236 corridor for high-capacity transit services, coordination should be undertaken to ensure that a seamless transitway is implemented between Fairfax County and the City of Alexandria.

Segment 2

- Landmark Mall to Jordan Street - 1.5 miles
- Six lanes with a median or left-turn lane
- Curb-to-curb width varies from 90 feet to 130 feet
- Right-of-way width varies from 110 to 180 feet

Segment 3

- Jordan Street to west of Quaker Lane - 1 mile
- Four-lane undivided section
- Service roads on varying sections to the north and south sides
- Curb-to-curb width varies from 46 feet to 100 feet
- Right-of-way width varies from 60 feet and 120 feet

Segment 4

- Quaker Lane to Roth Street - 1 mile
- Four lanes with left-turn lanes
- Curb-to-curb width varies from 60 feet to 82 feet
- Right-of-way width varies from 80 feet to 110 feet

Segment 5

- Roth Street to Diagonal Road - 1 mile
- Six lanes with a raised-curb landscaped median or left-turn lane
- Curb-to-curb width varies from 66 feet to 90 feet
- Right-of-way varies from 90 feet to 190 feet

There is no on-street parking along Duke Street, with the exception of service roads that provide parking between N. Jordan Street and Wheeler Avenue.

Figure 4.2: Eisenhower Avenue Sections

Eisenhower Avenue

The Eisenhower Avenue study corridor was divided into six segments (Figure 4.2) between Van Dorn Street to the west and John Carlyle Street to the east.

Segment 1

- Van Dorn Street to the Police Department Range - 0.4 miles
- Four-lane undivided section with left-turn lanes at intersections
- Curb-to-curb width varies from 52 feet to 60 feet with a right-of-way width of 80 feet

Segment 2

- Police Department Range to Clermont Avenue - 0.8 miles
- Four lanes with a two-way left-turn lane
- Curb-to-curb width is 52 feet and the right-of-way is 80 feet

Segment 3

- Clermont Avenue to the railroad bridge - 0.2 miles
- Four lanes with a raised-curb landscaped median and left-turn lanes
- Curb-to-curb width of 88 feet
- Right-of-way width of 120 feet

Segment 4

- Railroad bridge to the driveway at 3965 Eisenhower Avenue - 1.5 miles
- Four-lane undivided cross section
- Curb-to-curb width of 48 feet
- Right-of-way of 70 feet

Segment 5

- Driveway at 3965 Eisenhower Ave to Telegraph Road - 0.3 miles
- Four-lane median-divided with left-turn lanes
- Curb-to-curb width varies from 64 feet to 88 feet
- Right-of-way width varies from 98 feet to 120 feet

Source: 2009 VDOT AADT, *Daily traffic on Eisenhower Avenue between Van Dorn Street and Telegraph Road estimated

Figure 4.3: Average Daily Traffic Volumes (2009)

Segment 6

- Telegraph Road to John Carlyle Street - 0.8 miles
- Four lanes with a raised-curb landscaped median and left-turn lane
- Curb-to-curb width varies from 60 feet to 74 feet
- Right-of-way varies from 80 feet to 115 feet

Eisenhower Avenue is bordered by a number of residential, commercial, and industrial use areas, all of which have off-street parking.

Daily Traffic

Existing (2009) average daily traffic volumes on the study area streets are shown in Figure 4.3. Duke Street carries the following daily traffic:

- 66,000 vehicles per day (vpd) between S. Van Dorn Street and I-395
- 39,000 vpd between Van Dorn Street and N. Pickett Street
- 33,000 vpd between N. Pickett Street and Telegraph Road
- 23,000 vpd between Telegraph Road and Diagonal Road

Traffic along Eisenhower Avenue varies between 9,500 vpd and 21,700 vpd.

Traffic Flow

To better understand general traffic flow conditions along the major east-west routes in Corridor B, weekday peak-period travel time runs were conducted on Duke Street and Eisenhower Avenue. The travel time runs were conducted multiple times in each direction during the peak period and measured the travel speed and delay. Peak-period travel times along Duke Street were collected in Fall 2010 and are summarized in Table 4.1. The travel time runs were conducted between Beauregard Street to the west and S. Washington Street to the east, a distance of 4.5 miles. A summary of the average travel speeds during the weekday peak periods are shown on Figures 4.4 and 4.5. Eisenhower Avenue data is not shown since the travel speeds were relatively consistent and generally representative of free-flow conditions throughout the corridor.

Table 4.1: Duke Street Peak Period Travel Times

Direction	AM Travel Time	PM Travel Time
Eastbound	21 minutes	23 minutes
Westbound	19 minutes	24 minutes

Figure 4.4: AM Peak Period Travel Speeds on Duke Street

Legend
- Signaled Intersection

Corridor Travel Speed Range
- Low (5 mph or Less)
- Moderate
- High (More than 35 mph)

Figure 4.5: PM Peak Period Travel Speeds on Duke Street

Legend
- Signaled Intersection

Corridor Travel Speed Range
- Low (5 mph or Less)
- Moderate
- High (More than 35 mph)

Transit Use

Several transit providers operate service along Duke Street and Eisenhower Avenue. Existing services within the study corridor include DASH, Metrobus, Metrorail, and Fairfax Connector. There is considerable demand for these existing services, which is one of the reasons high-capacity transit services are being studied in this corridor. Existing transit routes are shown on Figure 4.6. Although the Blue line of the Metrorail parallels the study corridor, there is limited access to stations due to its location and the limited connectivity between Duke Street and Eisenhower Avenue.

The Yellow line of the Metrorail serves the eastern portion of the study corridor running north to south with stops at Eisenhower Avenue and King Street. Existing Metrorail ridership is summarized in Table 4.2.

DASH services run along Duke Street and Eisenhower Avenue. Metrobus runs east-west along Duke Street and runs north-south on surrounding side streets. The Fairfax County Connector provides north-south service in the western part of the corridor and connects to the Van Dorn Metrorail Station; however, service does not extend east of the Van Dorn Metrorail station or along Duke Street east of Van Dorn Street. Existing bus ridership is summarized in Table 4.3.

Table 4.2: Existing Metrorail Ridership

Station	Average Weekday Boarding
Van Dorn	3,653
Eisenhower Avenue	2,094
King Street	9,306

Source: WMATA 2011

Table 4.3: Existing Bus Ridership

Service Provider	Bus Route	Average Weekday Boardings	Headway Peak / Off-peak
DASH	Route AT1	1,765	20 min / 30 min
	Route AT7	1,015	20 min / 30 min
	Route AT8	2,628	15 min / 30 min
WMATA	Route 29K	2,272	30 min / 60 min
	Metrobus REX	3,685	30 min / 30 min
Fairfax County Connector	#109	811	30 min / 30 min
	#231	294	30 min / 30 min
	#232	310	30 min / 60 min
	#306	201	60 min / 60 min
	#321	1,099	30 min / 60 min
	#322	1,079	30 min / 60 min

Source: WMATA and DASH

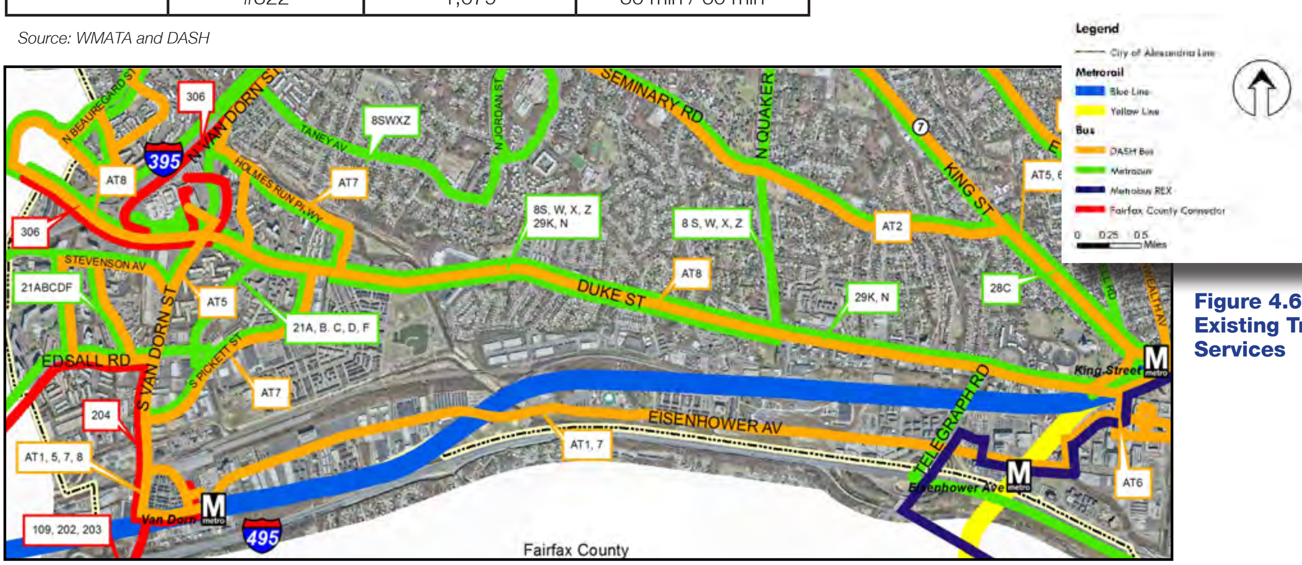


Figure 4.6: Existing Transit Services

Figure 4.7: Existing Bicycle Facilities

Pedestrian Network

The study area along Duke Street and Eisenhower Avenue contains a somewhat disconnected network of sidewalks that flank either one or both sides of the roadways. Sidewalks are located along Duke Street through the corridor.

The condition of the sidewalks is generally poor. They are narrow, in deteriorating condition, and do not meet Americans with Disabilities Act (ADA) requirements.

The existing sidewalk along Eisenhower Avenue is relatively continuous along the corridor; however, there are locations where sidewalk is missing and worn paths exhibit the need for sidewalks. Many sections of sidewalk and features within the sidewalk do not meet ADA requirements. Specific examples include:

- Horizontal clear way inadequate at protruding utilities
- Pedestrian ramps without detectable warning surfaces
- Tree roots creating trip hazards and an uneven surface

There are also many residential and business entrances located along the corridors that intersect the sidewalk. Many of these entrances have characteristics that contribute to them not meeting minimum requirements for accessibility.

Bicycle Networks

There are numerous on-street and off-street bicycle routes in the study area; however, many are in poor condition and do not connect well with one another. Existing bicycle facilities are shown in Figure 4.7.

Off-street bikeways are also located throughout the study area. Beginning at the western terminus of the study area, the off-street bike path approximately follows Holmes Run, connecting many area parks. The path crosses the Metrorail tracks and then runs adjacent to the south side of Eisenhower Avenue to the Eisenhower Avenue Metrorail station.

Currently, there are limited bike path connections to streets parallel to Duke Street. While there are bike routes along nearby parallel streets, the connections to Duke Street are indirect via Eisenhower Avenue, Taney Avenue, and Wheeler Avenue.

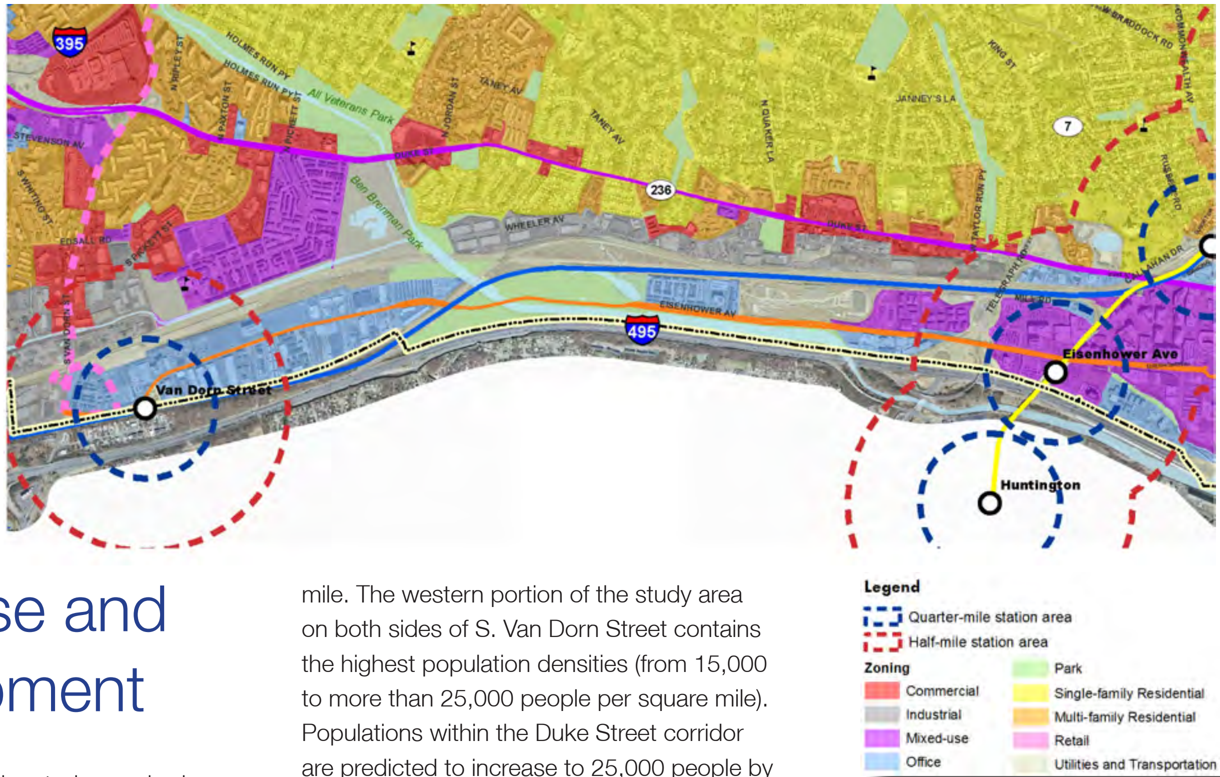


Figure 4.8: Existing Zoning

Land Use and Development

General

Land use (zoning) in the study area is shown in Figure 4.8. Along the Duke Street corridor, land use is primarily commercial and residential with the commercial uses concentrated at the eastern and western limits of the corridor. The land uses along the Eisenhower Avenue corridor are primarily industrial and utility/transportation with some public open space just north of I-495 and some residential. The Eisenhower Avenue corridor also contains several areas designated for office use. Major redevelopment and planning initiatives are concentrated on both ends of the study corridors surrounding the Landmark Mall/Van Dorn area to the west and the Eisenhower East/Carlyle area to the east.

Population and Employment

The study area has relatively high population and employment density. The approximate population within one quarter mile of the project corridor along Duke Street is 21,500 people (2010). The approximate population within one quarter mile of the Eisenhower Avenue corridor is 7,300 (2010).

Population

According to MWCOG, the approximate population density surrounding the two corridors ranges from zero people per square mile (centered in the industrial areas) to over 25,000 people per square mile. The majority of the study area has a population density of between 4,000 to 14,999 people per square mile. The western portion of the study area on both sides of S. Van Dorn Street contains the highest population densities (from 15,000 to more than 25,000 people per square mile). Populations within the Duke Street corridor are predicted to increase to 25,000 people by 2030, an increase of approximately 16 percent. Populations within the Eisenhower Avenue corridor are predicted to grow by nearly 50 percent, reaching a population of 10,900 people by 2030. Figures 4.7 and 4.8 show existing and currently forecasted population densities within the project corridor. Table 4.4 shows population trends.

Employment

Figure 4.11 shows existing employment density. Projected employment density data for 2030 follows a similar trend as population growth with significant increases around the Eisenhower Avenue Station and also north and west of the Van Dorn Station (see Figure 4.12). Employment is expected to rise between 31% and 54% in the project study area between 2010 and 2030. Table 4.5 summarizes employment trends.

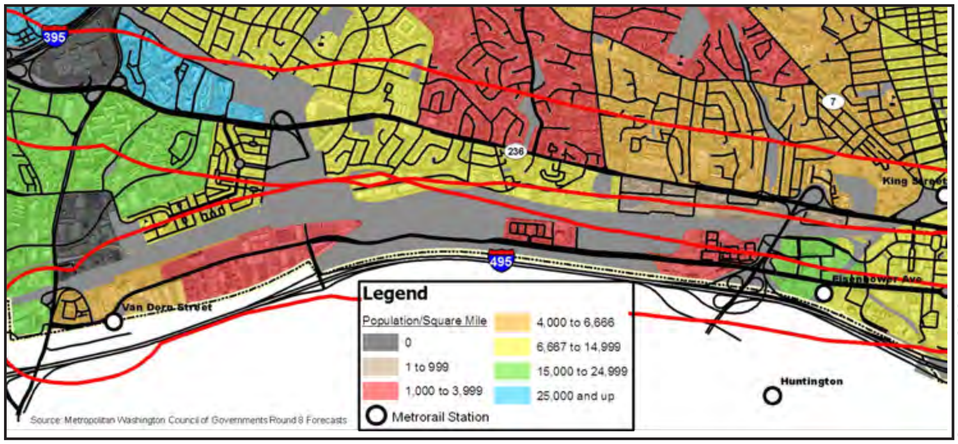
Table 4.4: Population Summary

Corridor	2010	2030	Percent Increase
Duke Street	21,500	25,000	16%
Eisenhower Avenue	7,300	10,900	49%

Table 4.5 Employment Summary

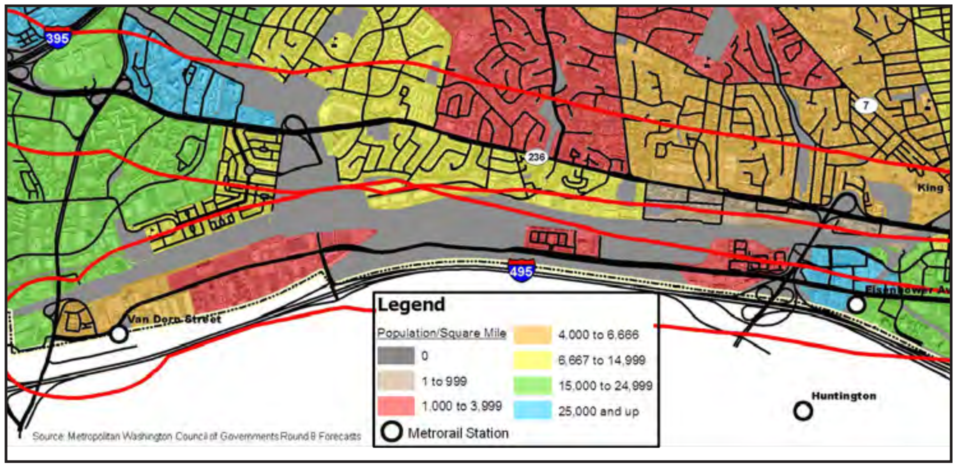
Corridor	2010	2030	Percent Increase
Duke Street	17,900	23,400	31%
Eisenhower Avenue	20,000	30,700	54%

Source: MWCOG and U.S. Census



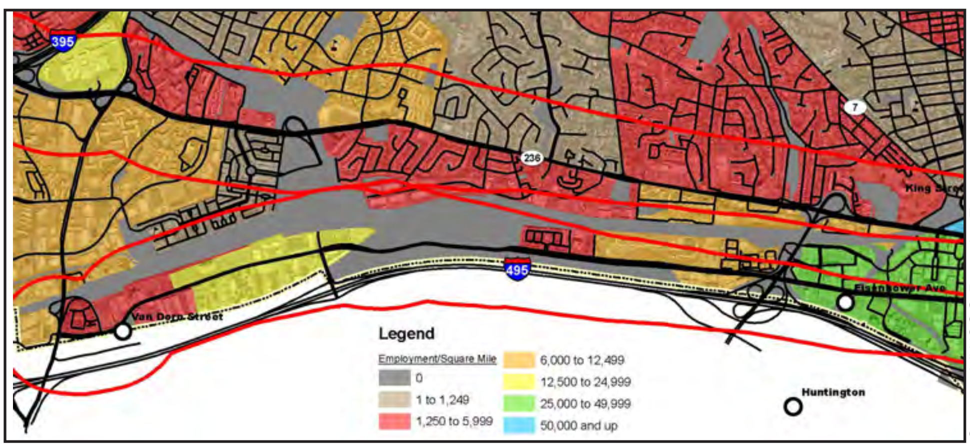
Source: MWCOG Round 8 Forecasts

Figure 4.9: Existing Population Density (2010)



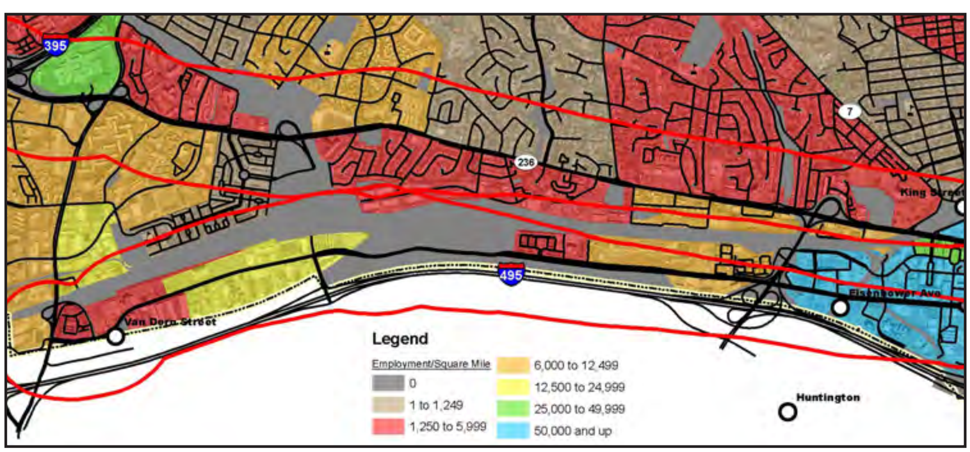
Source: MWCOG Round 8 Forecasts

Figure 4.10: Projected Population Density (2030)



Source: MWCOG Round 8 Forecasts

Figure 4.11: Existing Employment Density (2010)



Source: MWCOG Round 8 Forecasts

Figure 4.12: Projected Employment Density (2030)

Duke Street near Sweeley Street

Alignment Concepts

With the array of challenges and constraints in the study corridor, the first focus of the study was on the alignment itself. Initially, the study evaluated alignment concepts along both Duke Street and Eisenhower Avenue. Following the alignment evaluation, the study turned its attention to the Preliminary Screening, Secondary Screening, Refined Alternatives, and the Recommended Alternative for Duke Street.

Three alignment concepts were considered for the transitway in Corridor B: Duke Street, Eisenhower Avenue, and a combination of Duke Street and Eisenhower Avenue.

The three alignment concepts were evaluated using the following criteria:

- Service/connectivity to local population, employment, and other destinations
- Service/connectivity to regional population, employment, and other destinations
- Connections to other transit services
- Operational quality of transit service
- Quality of roadway operations in the corridor

The combined Duke-Eisenhower alternative was eliminated from consideration due to the limited connectivity that exists between Duke Street and Eisenhower Avenue and the high costs associated with creating sufficient connections.

The preliminary evaluation showed a greater demand for high-capacity transit along Duke Street due to higher population density and a higher concentration of destinations within the corridor, as detailed in the previous section. Additionally, the highest density areas along Eisenhower Avenue are currently served by Metrorail, limiting the potential to capture new transit ridership. Finally, Eisenhower Avenue is restricted by various natural and built environment barriers such as Cameron Run, I-495, the Metrorail tracks, freight and passenger railroad tracks, and park land. Eisenhower Avenue has the potential to serve as an express east-west route connecting to metro on both ends of the corridor, but that potential did not justify high-capacity transit service within the corridor.

Based on the results of the preliminary evaluation, feedback from the Corridor Work Group, and public input, Duke Street was selected as the preferred location for a dedicated transitway. It also was recommended that existing transit service along Eisenhower Avenue be improved through expanded service and enhanced passenger amenities.

Preliminary Transitway Concepts

Six preliminary transitway alternatives were developed for the Duke Street alignment. The six preliminary alternatives were created from various combinations of three possible design elements. The design elements consisted of lane operations (mixed-flow versus dedicated-lane); footprint impacts (right-of-way impacts versus auto lane impacts); and runningway location (curb-running versus median-running). Median running transit was not considered for scenarios with mixed flow because left turning vehicles would impede transit flow.

Figure 4.13 outlines the process of combining the elements into six alternatives. Primary characteristics of each alternative are summarized on the following pages.

Design Elements

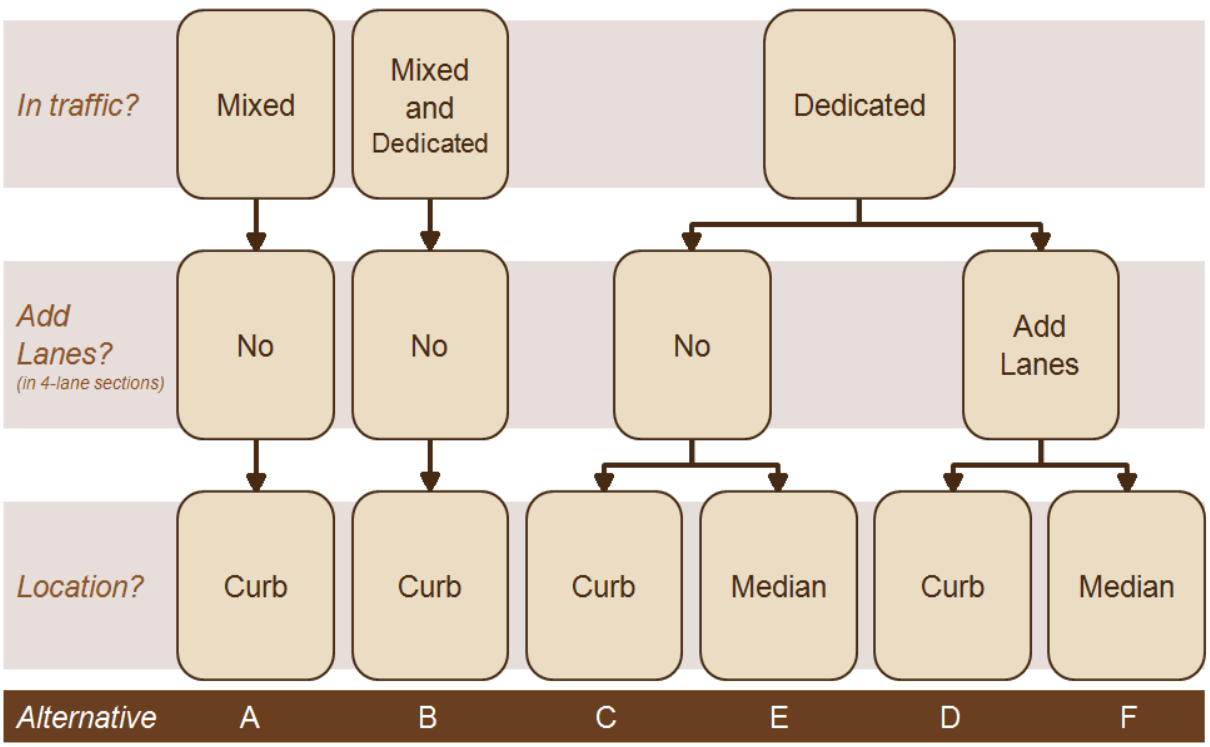


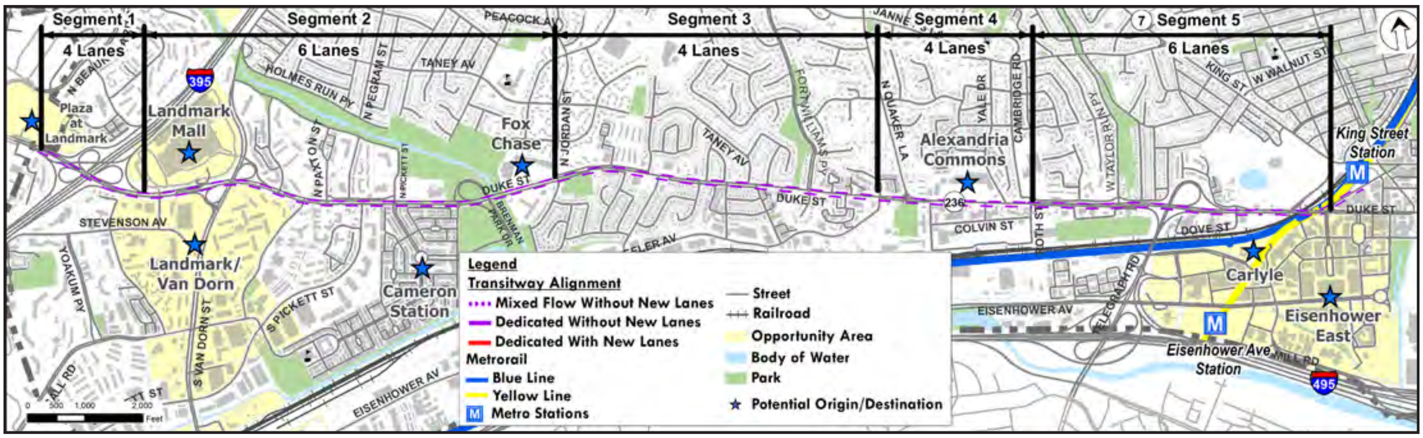
Figure 4.13: Preliminary Alternatives Development

Alternative A: Curb Running in Mixed Flow without New Lanes

Alternative A is shown in Figure 4.14 and summarized below:

- Transit operates in mixed flow for full length of corridor
- Transit operates along existing curb and shares the lane with right turns in most locations
- Concept uses queue jumps and transit signal priority (TSP) at intersections
- Improvements impact property and service roads to accommodate queue jumps (complete street impacts, such as improved sidewalks and bike facilities, were not accounted for in this level of screening and were studied in later rounds of screening)

Figure 4.14: Alternative A (Curb Running in Mixed Flow without New Lanes)

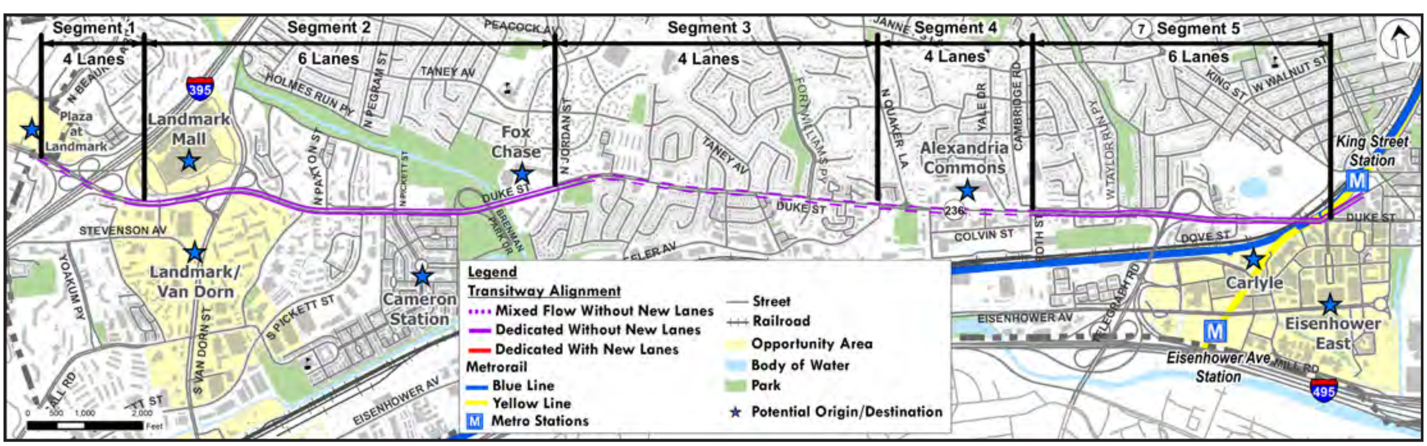


Alternative B: Curb Running in Mixed Flow and Dedicated Lanes without New Lanes

Alternative B is shown in Figure 4.15 and summarized below:

- Transit operates in mixed flow on four-lane segments (2 miles total) and in dedicated lanes on six-lane segments (2.5 miles total) to reduce property impacts
- Transit operates along existing curb and shares the lane with right turns in most locations
- Concept uses queue jumps and TSP at intersections
- Improvements impact property and service roads to accommodate queue jumps (complete streets impacts were not accounted for in this level of screening and were studied in later rounds of screening)

Figure 4.15: Alternative B (Curb Running in Mixed Flow and Dedicated Lanes without New Lanes)

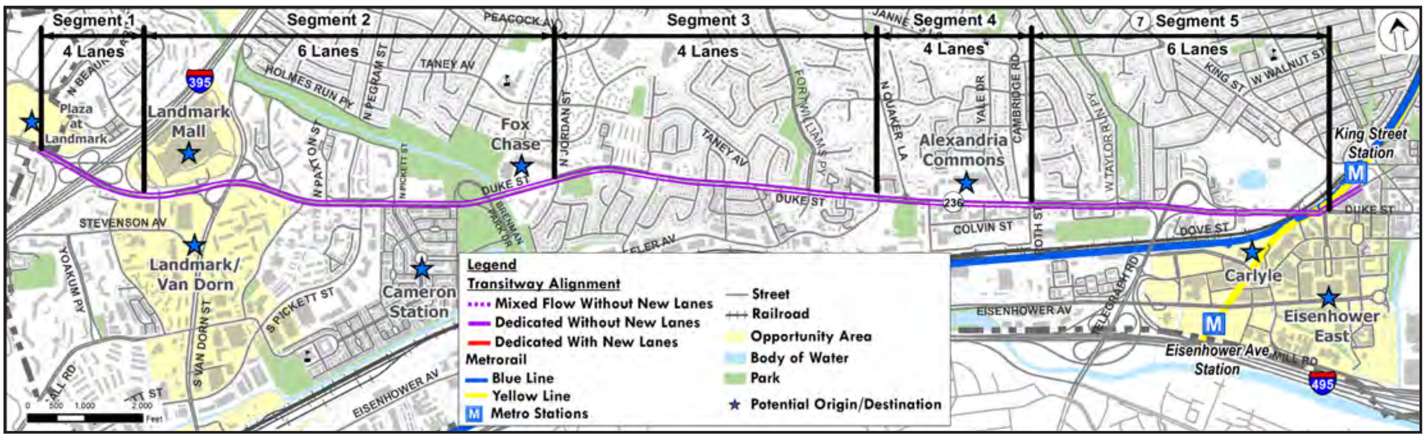


Alternative C: Curb Running in Dedicated Lanes without New Lanes

Alternative C is shown in Figure 4.16 and summarized below:

- Transit operates in dedicated lanes for full length of corridor
- Curb lane on six-lane sections to become a dedicated transit lane
- Duke Street is reduced to one lane in each direction for general purpose traffic in four-lane segments (2 miles total)
- Transit operates along the existing curb and shares the lane with right turns in most locations
- Improvements have minimal impact to property and service roads (complete streets impacts were not accounted for in this level of screening and were studied in later rounds of screening)

Figure 4.16: Alternative C (Curb Running in Dedicated Lanes without New Lanes)

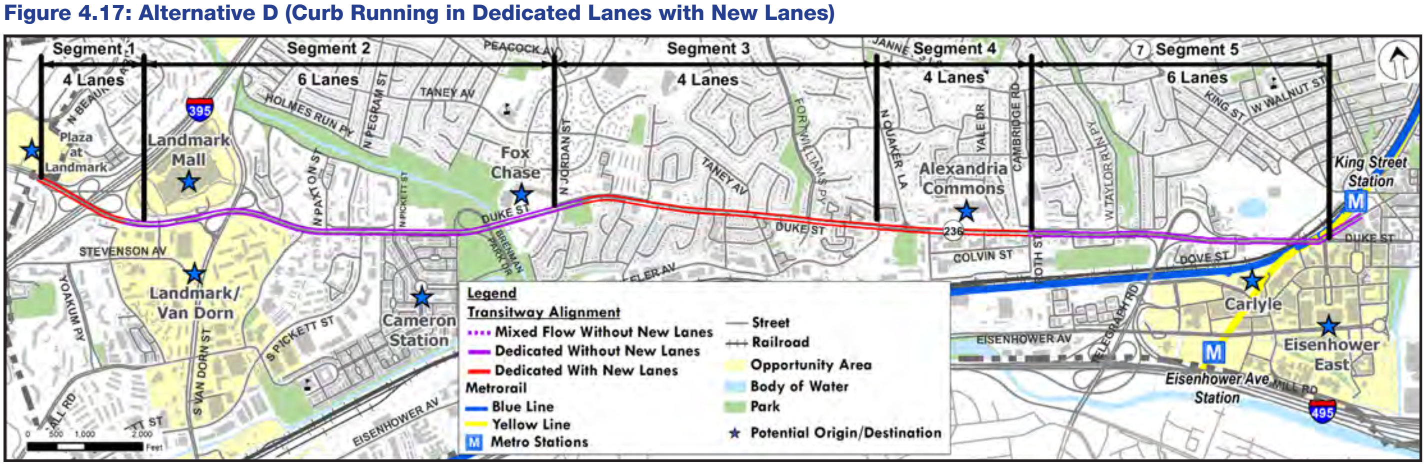


Alternative D: Curb Running in Dedicated Lanes with New Lanes

Alternative D is shown in Figure 4.17 and summarized below:

- Transit operates in dedicated lanes for full length of corridor
- Duke Street is widened in four-lane segments (2 miles total)
- Transit operates along curb and shares the lane with right turns in most locations
- Improvements impact property and service roads (complete streets impacts were not accounted for in this level of screening and were studied in later rounds of screening)

Figure 4.17: Alternative D (Curb Running in Dedicated Lanes with New Lanes)

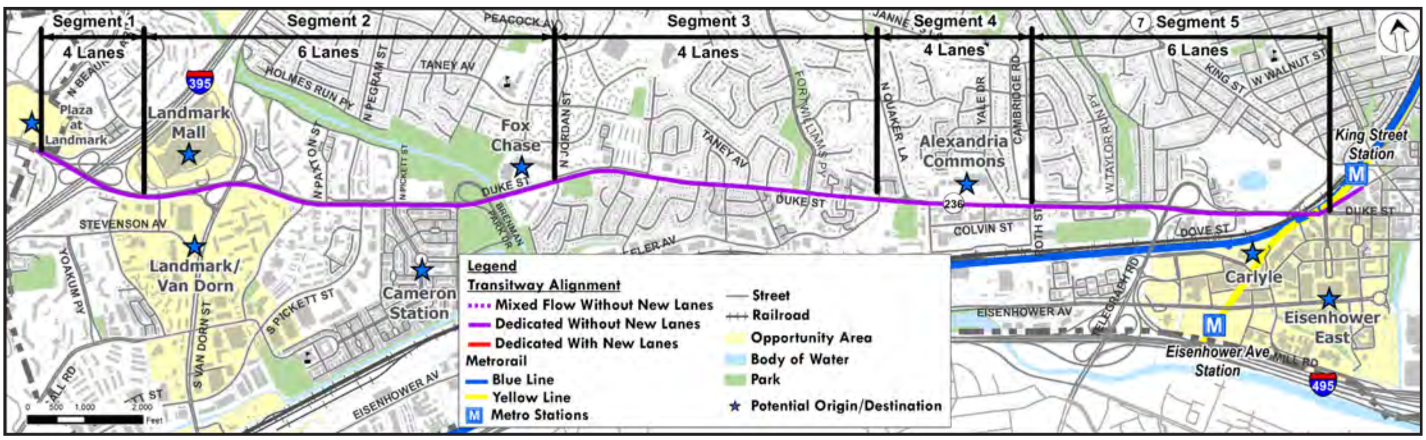


Alternative E: Median Running in Dedicated Lanes without New Lanes

Alternative E is shown in Figure 4.18 and summarized below:

- Transit operates in dedicated lanes for full length of corridor
- Duke Street is reduced to one lane in each direction for general purpose traffic in four-lane segments (2 miles total); six-lane sections would provide two general purpose lanes in each direction
- Transit operates in dedicated lanes within the median for the full length of the corridor
- Improvements have minimal impact to property and service roads (complete streets impacts were not accounted for in this level of screening and were studied in later rounds of screening)

Figure 4.18: Alternative E (Median Running in Dedicated Lanes without New Lanes)

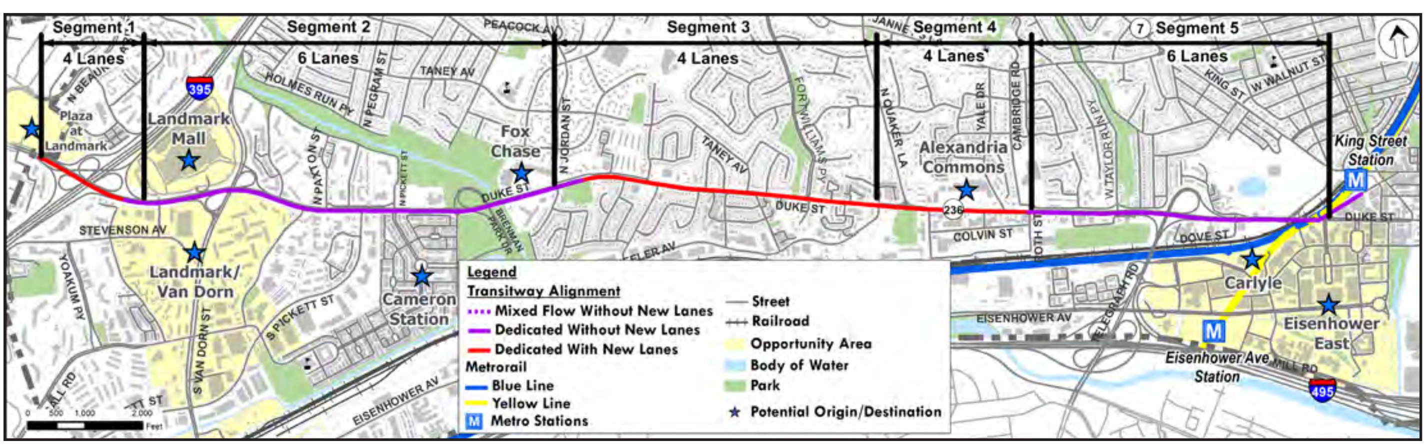


Alternative F: Median Running in Dedicated Lanes with New Lanes

Alternative F is shown in Figure 4.19 and summarized below:

- Transit operates in dedicated lanes within the median for the full length of corridor
- Duke Street is widened in four-lane segments (2 miles total)
- Maintains two general purpose lanes in each direction
- Improvements impact property and service roads (complete streets impacts were not accounted for in this level of screening and were studied in later rounds of screening)

Figure 4.19: Alternative F (Median Running in Dedicated Lanes with New Lanes)



Preliminary Screening

The six alternatives were screened using an initial set of evaluation criteria (described in Figure 4.20) that reflected Corridor Work Group and public priorities, as well as were measures suitable for comparing the alternatives. The preliminary screening, Figure 4.21, presents these criteria and the results for the alternatives.

The alternatives and associated screening were presented to the Corridor Work Group and public on November 17, 2011. Based on the feedback from the Corridor Work Group and public input, two alternatives were eliminated from further consideration and four were retained for further analysis as summarized in Table 4.6.

General Evaluation Criteria Grouping	Criteria Sub-Group	Evaluation Criteria	Preliminary Screening	Measurement Method
Effectiveness - Addresses stated transportation issues in the corridor	Coverage	Transit Connectivity	✓	Access to other transit services (existing and planned)
	Operations	Avoidance of Congestion	*	Number and locations of LOS E/F intersections avoided
		Transit Travel Time	*	Transit travel time
		Intersection Priority	✓	Percent of intersections where TSP is needed and can be implemented successfully - notation of where it cannot be implemented successfully
	Alignment	Runningway Status	o	Percent of corridor to be located on new or realigned roadway
	Phasing	Phasing	✓	Identification of ability to phase operations and implementation
Impacts - Extent to which economics, environment, community, transportation are affected	Natural Environmental	Natural Environment	o	Summary of key environmental conditions affected (wetlands, floodplains, T&E, streams, and similar)
	Neighborhood and Community	Property	✓	Number, use type, and quantity of properties impacted with anticipated level of impact (ROW only, partial take, total take)
		Streetscapes	*	Impact to existing streetscapes
		Noise and Vibration	o	Summarize relative noise and vibration impacts of different mode types and corridor configurations
	Transportation	Traffic Flow Impact	*	Effect of transit implementation on vehicular capacity of corridor
		Multimodal Accommodation	✓	Impacts to, and ability to accommodate bicycles and pedestrians
		Parking	✓	Impacts to parking
Cost Effectiveness - Extent to which the costs are commensurate with their benefits	Cost	Capital cost	✓	Order of magnitude capital cost for corridor (stations, runningway, etc.)
		Operating cost	✓	Order of magnitude operating cost
		Cost Per Rider	✓	Order of magnitude operating cost per rider
Financial Feasibility - Extent of funding is driven by cost	Funding	Funding	✓	Availability to specific funding sources

Screening Criteria Legend:	*	Highest Importance	✓	Normal Importance	o	Lesser Importance

Figure 4.20: Preliminary Screening Criteria Descriptions

	Preliminary Screening Criteria	Alternative A	B	C	D	E	F
	In traffic? / Add lanes? / Location?	Mixed / No / Curb	Both / No / Curb	Dedicated / No / Curb	Dedicated / Add a lane / Curb	Dedicated / No / Median	Dedicated / Add a lane / Median
Effectiveness	Transit Connectivity	◑	◑	◑	◑	◑	◑
Effectiveness	Avoidance of Congestion	○	◑	●	●	●	●
Effectiveness	Transit Travel Times	○	◑	●	●	●	●
Effectiveness	Intersection Priority	○	◑	●	●	●	●
Effectiveness	Runningway Status (Percent already in place)	◑	◑	●	○	●	○
Effectiveness	Runningway Configuration (Percent dedicated)	○	◑	●	●	●	●
Effectiveness	Phasing	●	●	◑	○	◑	○
Impacts	Natural Environment Impacts	◑	◑	●	○	●	○
Impacts	Property Impacts	◑	◑	●	○	●	○
Impacts	Impacts to Existing Streetscape	◑	◑	●	○	●	○
Impacts	Noise and Vibration	◑	◑	◑	○	●	●
Impacts	Traffic Flow Impact	◑	◑	○	●	○	●
Impacts	Pedestrian Accommodation	●	●	●	●	◑	◑
Impacts	Bicycle Accommodation	○	○	◑	◑	●	●
Impacts	Parking Impacts	◑	◑	●	○	●	○
Cost	Capital Cost	◑	◑	●	○	◑	○
Cost	Operating Cost	○	○	●	●	●	●
Cost	Funding	◑	◑	●	○	◑	○

NOTE: Data to evaluate Cost Per Rider is not available at this time.

Rating: ● Best ◑ Fair ○ Poor

Figure 4.21: Preliminary Evaluation Summary

Table 4.6: Alternatives Analysis Summary

Alternative	Justification	Result
A: Curb Running in Mixed Flow	• Offers no benefit over Alternative B	Eliminated from consideration
B: Curb Running in Mixed Flow and Dedicated Lanes	• Preferred by CWG due to minimal extent of impacts to property and traffic • Viewed as base alternative for implementation within existing footprint • Consider modified Alternative B with dedicated lanes at narrowest segment utilizing service road right-of-way (coined B+)	Consider alternative and a variation (B+) using service roads for further analysis
C: Curb Running in Dedicated Lanes without New Lanes	• Fewer impacts to property and environment, but adverse impact on traffic • Should be modified to consider reversible lane configuration	Consider alternative for further analysis in combination with Alternative D by implementing a reversible lane
D: Curb Running in Dedicated Lanes with New Lanes	• Preferred by some members of CWG due to uniformity and improved operations • Viewed as efficient and effective • Would reduce congestion, but result in greater impacts to property and environment • Should be modified to consider reversible lane configuration in order to use auto lane in off-peak direction	Consider alternative for further analysis in combination with Alternative C by implementing a reversible lane
E: Median Running in Dedicated Lanes without New Lanes	• Fewer impacts to property and environment, but extensive adverse impact on traffic	Eliminated from consideration
F: Median Running in Dedicated Lanes with New Lanes	• Viewed as worst-case scenario from property and environment impact perspective • Should be analyzed further since this alternative would provide the best transit operations	Consider alternative for future analysis

Secondary Transitway Concepts

Subsequent to the preliminary screening, the remaining alternatives were restructured and renamed, as depicted in Figure 4.22. The four retained alternatives were defined in more detail during the secondary screening. Due to comments received from the Corridor Work Group and the public, bike lanes and complete street considerations were added to each of the alternatives in order to be consistent with Alexandria's complete streets policy adopted by City Council in April 2011. Typical sections and key features of each retained alternative are presented on the following pages.

Figure 4.22 Alternatives Retained

Alternative 1

The existing lane configuration is shown in Figure 4.23 and consists of the following:

- Transit operates along curb
- Transit operates in mixed flow on existing four-lane segments (2 miles total) and in dedicated lanes on existing six-lane segments (2.5 miles total)
- Concept uses existing lanes for transit and widens Duke Street to accommodate bicycle facilities and improved sidewalks
- Concept uses queue jumps where there are no dedicated lanes
- Improvements impact property and service roads to accommodate queue jumps and bike lanes
- Includes bike lanes or shared outside lane

Principal advantages and disadvantages of this alternative include:

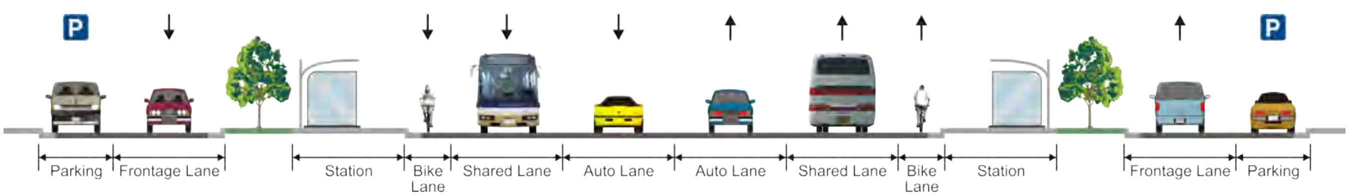
Advantages

- Fewest negative impacts (including property)
- Maintain service roads
- Lowest capital cost
- Easy to phase

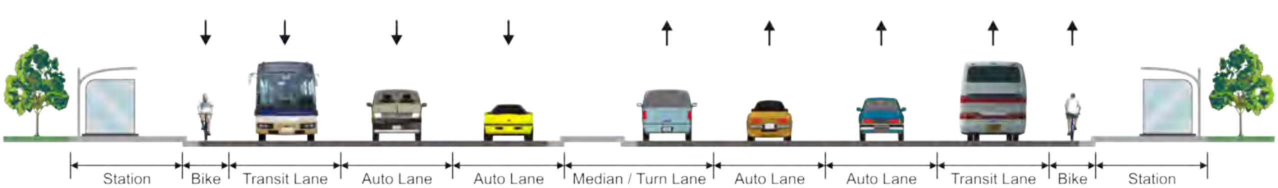
Disadvantages

- Worst transit operation due to shared lanes
- Highest operating cost
- Highest fleet cost
- May be impacted by congestion on Duke Street
- Longest transit travel time
- Lowest ridership potential

Figure 4.23: Alternative 1 (Existing Lane Configuration)



Duke Street Typical (current 4-lane section)
Alternative 1 – No Widening
(Ingram Street to Wheeler Avenue)



Duke Street Typical (current 6-lane section)
Alternative 1 – No Widening
(Landmark Mall to Jordan Street)

Alternative 2

Alternative 2 uses service road right-of-way. Details of this alternative are shown in Figure 4.24 and listed below:

- Transit operates along curb
- Transit operates in dedicated lanes for full corridor length (right turns for general traffic are permitted using the transit lane at intersections)
- Typical section adds one lane per direction in existing four-lane segments (2 miles total)
- Concept reduces impacts to property by shifting roadway centerline to make use of service roads
- Concept provides on-street parking in some locations to replace service road parking losses
- Includes bike lanes or shared outside lane

Principal advantages and disadvantages of this alternative include:

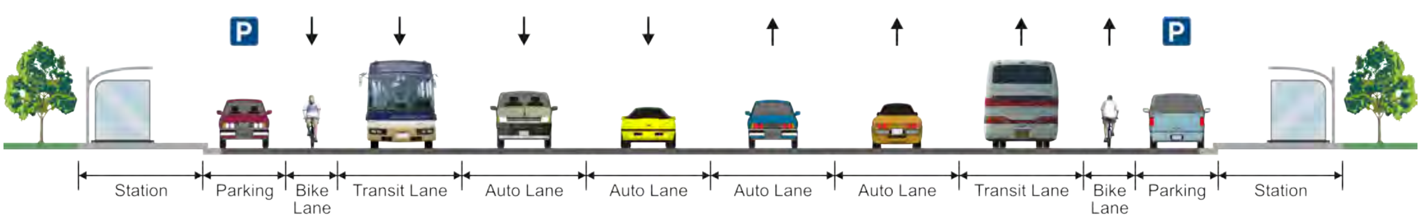
Advantages

- Minimal impact to traffic flow
- High quality transit operation
- Moderate capital, fleet, and operating cost
- Some avoidance of congestion for transit

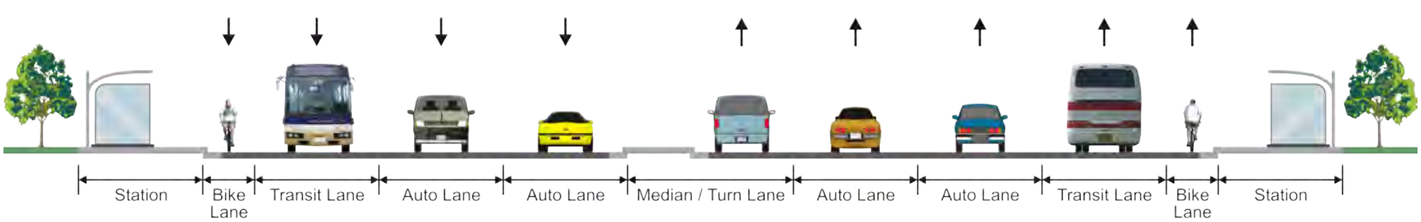
Disadvantages

- Curvilinear alignment
- On-street parking could disrupt transit operations
- Impacts service roads and streetscape as a result

Figure 4.24: Alternative 2 (Service Road Right-of-Way)



Duke Street Typical (current 4-lane section)
Alternative 2 – Curbside Dedicated
(Ingram Street to Wheeler Avenue)



Duke Street Typical current (6-lane section)
Alternative 2 – Curbside Dedicated
(Landmark Mall to Jordan Street)

Alternative 3

Alternative 3 uses a reversible lane to accomodate transit in sections of the corridor where there is significant right-of-way constraint. It is shown in Figure 4.25 and consists of the following:

- Transit operates along curb
- Transit operates in dedicated lanes for full corridor length in peak period, peak direction (right turns for general traffic are permitted using the transit lane at intersections)
- Typical section adds one-half lane in each direction (one lane total) in existing four-lane segments (2 miles total)
- Center lane functions as reversible lane for general purpose traffic during peak periods
- Center lane acts as a turn-lane during off-peak periods
- Reversible lane transitions at Jordan Street and Wheeler Avenue
- Improvements impact property and existing streetscape
- Concept maintains service roads
- Includes bike lanes or shared outside lane

Principal advantages and disadvantages of this alternative include:

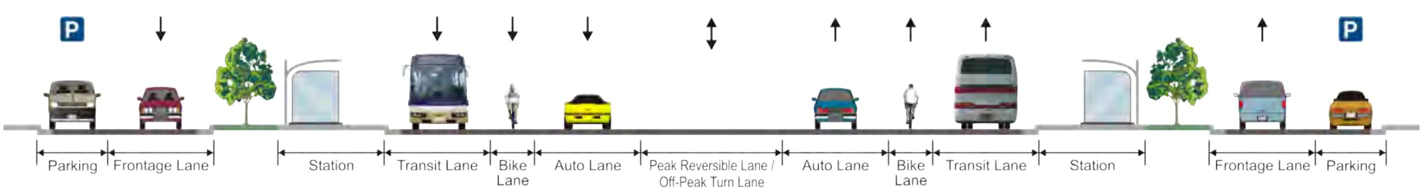
Advantages

- Provides peak direction, peak period transit lane
- Maintains most service roads
- Moderate capital, operation and fleet cost
- Provides turn lanes at some new locations to help traffic flow

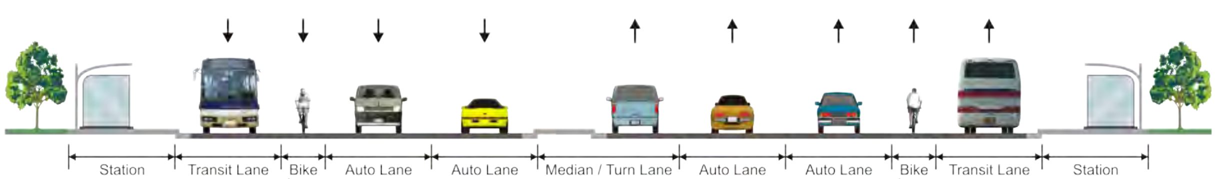
Disadvantages

- No dedicated lanes off-peak time and direction
- Property impacts
- Requires overhead gantries to control reversible condition
- May be confusing to drivers due to changing lane use condition

Figure 4.25: Alternative 3 (Reversible Lane)



Duke Street Typical (current 4-lane section)
Alternative 3 – Curbside Dedicated with Reversible Lane
(Ingram Street to Wheeler Avenue)



Duke Street Typical (current 6-lane section)
Alternative 3 – Curbside Dedicated with Reversible Lane
(Landmark Mall to Jordan Street)

Alternative 4

Alternative 4 uses the median for transit. Details are shown in Figure 4.26 and listed below:

- Transit operates in median
- Transit operates in dedicated lanes for full corridor length
- Typical section adds two lanes in each direction in existing four-lane segments (2 miles total)
- Improvements impact property significantly
- Concept removes service roads and driveways would be accessed directly from Duke Street
- Includes bike lanes or shared outside lane

Principal advantages and disadvantages of this alternative include:

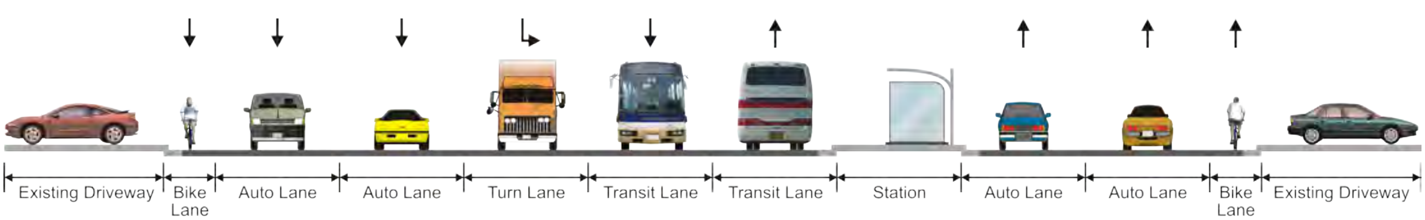
Advantages

- Best transit operation by eliminating conflicts with driveways and traffic
- Lowest fleet and operating cost
- Avoids impacts from traffic congestion
- Highest ridership potential

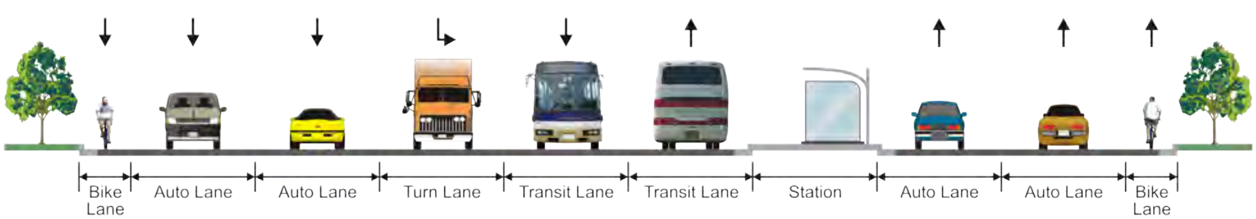
Disadvantages

- Largest property impact
- Eliminates service roads and parking (impact to 28 homes)
- Highest capital cost
- Highest right-of-way cost and impacts

Figure 4.26: Alternative 4 (Median Running)



Duke Street Typical (current 4-lane section)
Alternative 4 – Median Dedicated
(Ingram Street to Wheeler Avenue)



Duke Street Typical (current 6-lane section)
Alternative 4 – Median Dedicated
(Landmark Mall to Jordan Street)

Secondary Screening Summary

The four refined alternatives were screened using a set of detailed evaluation criteria. The secondary screening criteria and results are presented in Figure 4.27.

In addition to the relative comparison provided by the screening process, preliminary impacts, potential ridership estimates, and costs were developed for each of the four alternatives and are provided in Tables 4.7 and 4.8, respectively.

Figure 4.27: Secondary Screening Criteria and Results

Evaluation Criteria		Description	Alternative 1: Existing Configuration	Alternative 2: Uses Service Road ROW	Alternative 3: Reversible Lane	Alternative 4: Median Running
Effectiveness	Coverage	Service to Regional Destinations	◑	◑	◑	◑
		Service to Population, Employment & Retail in the Corridor	●	●	●	●
		Transit Connectivity	●	●	●	◑
	Operations	Running-way Configuration(s)	◑	●	●	●
		Corridor Length	●	●	●	●
		Capacity	●	●	●	●
		Interoperability	●	●	●	●
		Avoidance of Congestion	○	◑	◑	●
		Transit Travel Times	○	◑	◑	●
		Ridership	○	◑	◑	●
		Intersection Priority	◑	●	●	●
	Align-ment	Alignment Quality	●	◑	●	●
		Runningway Status	●	◑	◑	○
		Phasing	●	◑	◑	○
Impacts	Econ-omic	Development Incentive	●	●	●	●
	Natural Enviro-nment	Natural Environment	●	◑	◑	○
		Parks and Open Space	●	◑	◑	○
	Neighborhood and Community	Property	●	●	◑	○
		Existing Streetscapes	●	○	◑	○
		Community Resources	●	◑	◑	○
		Demographics	●	◑	◑	○
		Noise and Vibration	◑	○	○	●
	Transportation	Traffic Flow Impact	◑	●	○	●
		Traffic Signals	○	◑	◑	○
		Multimodal Accommodation – Pedestrian	●	●	●	◑
		Multimodal Accommodation – Bike	◑	◑	◑	●
		Parking	●	◑	●	○
Cost	Cost Effectiveness	Capital Cost	●	◑	◑	○
		Right-of-Way Cost	●	◑	◑	○
		Operating Cost	○	◑	◑	●
		Order of Magnitude Cost Per Rider	○	◑	◑	●

Rating: ● Best ◑ Fair ○ Poor

Table 4.7: Preliminary Impacts and Ridership

Alternative	1	2	3	4
Description	Existing Configuration	Uses Service Rd ROW	Reversible Lane	Median Running
Park Impact	<0.25 acres	<0.25 acres	<0.25 acres	<0.5 acres
Water Impact	<0.1 acres	<0.1 acres	<0.1 acres	<0.1 acres
Property Impact	1.75 acres	3.5 acres	4 acres	7 acres
Potential Ridership	6,000 to 9,000 riders/day	8,000 to 12,000 riders/day	9,000 to 13,000 riders/day	12,000 to 16,000 riders/day
Notes: All property impacts are slivers. Potentially impacted parks include Ewald, Ben Brenman, and Schuyler Hamilton Jones.				

Table 4.8: Preliminary Planning – Level Cost Estimates

Alternative	1	2	3	4
Description	Existing Configuration	Uses Service Rd ROW	Reversible Lane	Median Running
Capital Cost Estimate *(exclusive of vehicles, based on cost per mile within the City)*	$22 M	$27 M	$26 M	$37 M
25-year Fleet Cost Estimate	$20 M	$16 M	$16 M	$13 M
Right-of-Way Cost Estimate	$5 M	$21 M	$22 M	$33 M
25-year Operating Costs	$67 M	$60 M	$60 M	$47 M
Preliminary Planning – Level Cost Estimates	*$114 M*	*$124 M*	*$124 M*	*$130 M*

Notes:

1. Planning level cost estimates are shown in year 2012 dollars and do not include additional contingency or escalation to a future year mid-point of construction. Estimates do not include costs for major utility relocations/new service, or the capital costs for roadway/streetscape improvements that may be implemented concurrently, but are not required for the transit project.
2. Though mode selection had been deferred during this study, Bus Rapid Transit (BRT) was assumed for the purpose of producing costs.

Table 4.9: Alternatives Analysis Summary

Alternative	Justifications	Result
1: Use Existing Lanes for Transit	• Low transit efficiency because dedicated transit lanes would not be provided between Wheeler Avenue and Roth Street • Preferred by some because it would protect neighborhoods by minimizing impacts to residential and commercial property and parking • Consider alternative for further analysis	Selected for further analysis
2: Use Service Road Right-of-Way	• Increased width of street for pedestrians to cross and would not provide adequate refuges for pedestrians • Moderate to high property impacts • Eliminated from consideration	Eliminated from further consideration
3: Reversible Lane	• Preferred by some because of the flexibility to retain service roads while providing dedicated transit lanes • Consider alternative for further analysis	Selected for further analysis
4: Median Running	• Service roads and residential parking would be significantly impacted or eliminated • High property impacts, especially between Jordan Street and Roth Street • Eliminated from consideration	Eliminated from further consideration

The retained alternatives, secondary screening, impacts, and costs were presented to the Corridor Work Group and the public on January 19, 2012. The comments focused primarily on maintaining left-turn lanes; providing adequate pedestrian paths and refuges; and minimizing impacts to residences and small business. The Corridor Work Group and public expressed concern that the inclusion of bike lanes may require more right-of-way than anticipated. Consequently, Alternatives 1 and 3 were selected for further evaluation and Alternatives 2 and 4 were eliminated from further consideration. Table 4.9 provides a summary of the evaluation and alternatives for further consideration and refinement.

Refined Transitway Concepts

Alternatives 1 and 3 were evaluated in greater detail with and without on-street bike lanes to determine property impacts. In addition, off-street bike facilities along adjacent or nearby roads, such as Wheeler Avenue, were examined. The typical sections and descriptions for these refined alternatives are summarized on the following pages.

Alternative 1 Refined

Alternative 1 (refined) is shown in Figure 4.28 and includes the following design elements:

- Transit operates in mixed flow on existing four-lane segments and in dedicated lanes on existing six-lane segments
- Concept uses queue jump lanes to avoid congestion and reduce disruption to Duke Street traffic
-
- Alignment reconfigures the existing eastbound entrance ramp at Telegraph Road and access to adjacent property to accommodate a dedicated transit lane
- Alternative 1a would not have on-street bike lanes
- Alternative 1b would include on-street bike lanes

Principal advantages and disadvantages of Alternative 1a include:

Advantages

- Fewest property impacts
- Maintains service roads

Disadvantages

- Worst transit operation due to shared lanes
- No Duke Street bicycle facility

Principal advantages and disadvantages of Alternative 1b include:

Advantages

- Maintains service roads
- Provides bike lanes

Disadvantages

- Worst transit operation due to shared lanes
- Large property impacts due to bike lanes and streetscape enhancements

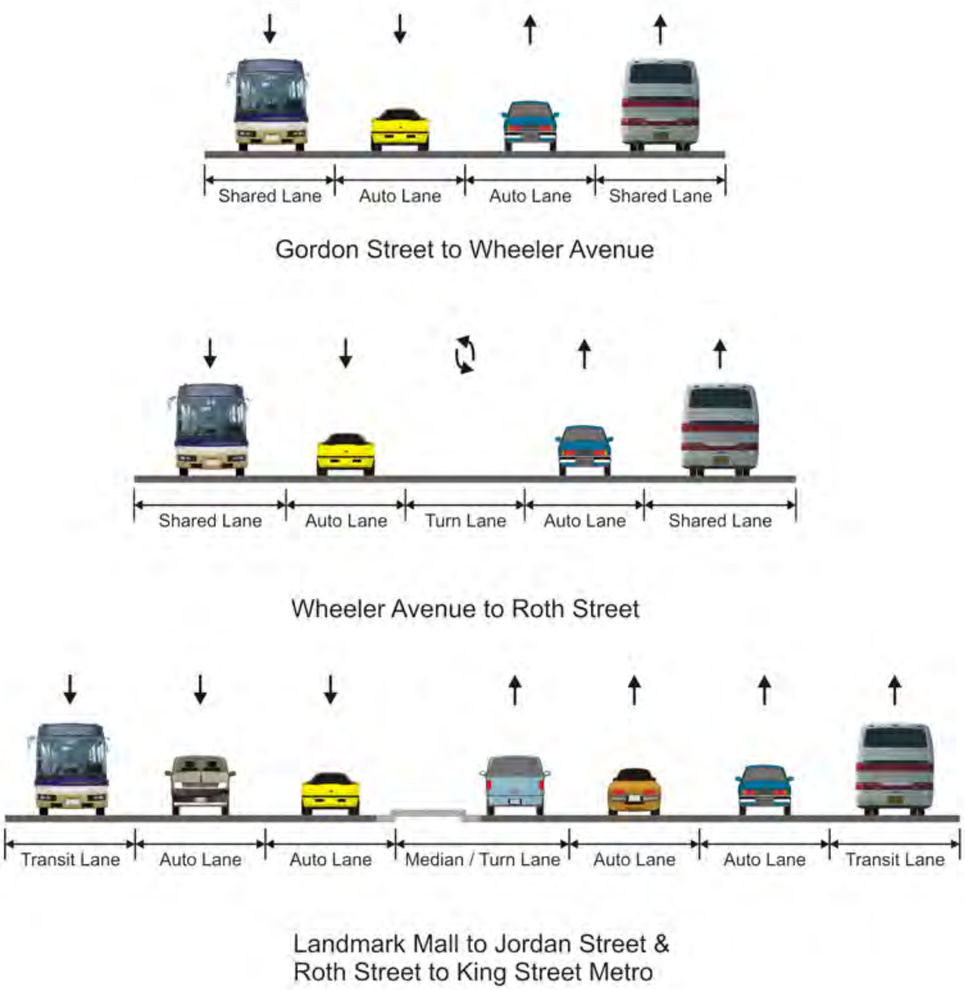


Figure 4.28: Alternative 1 Refined

Alternative 3 Refined

Alternative 3 (refined) is shown in Figure 4.29 and includes the following design elements:

- Identical to Alternative 1 between Landmark Mall and Gordon Street, between Roth Street and Taylor Run Parkway, and between Callahan Drive and King Street Metrorail
- Typical section adds an eastbound lane at Telegraph Road
- Typical section adds one-half lane in each direction (one lane total) between Gordon Street and Wheeler Avenue to provide reversible lane
- Typical section adds one lane adjacent to westbound roadway between Wheeler Avenue and Roth Street to accommodate heavy traffic flow between N. Quaker Lane and Telegraph Road
- Left-turn lane provided during off peak periods between Jordan Street and Wheeler Avenue
- Two center lanes between Wheeler Avenue and Roth Street could include optional two-way turn lane and/or additional auto lane(s)—further detailed traffic analysis needed
- Alternative 3a would not have on-street bike lanes
- Alternative 3b would include on-street bike lanes

Principal advantages and disadvantages of Alternative 3a include:

Advantages

- Quality transit operation
- Maintains service roads

Disadvantages

- Off-peak auto impact from Gordon to Wheeler

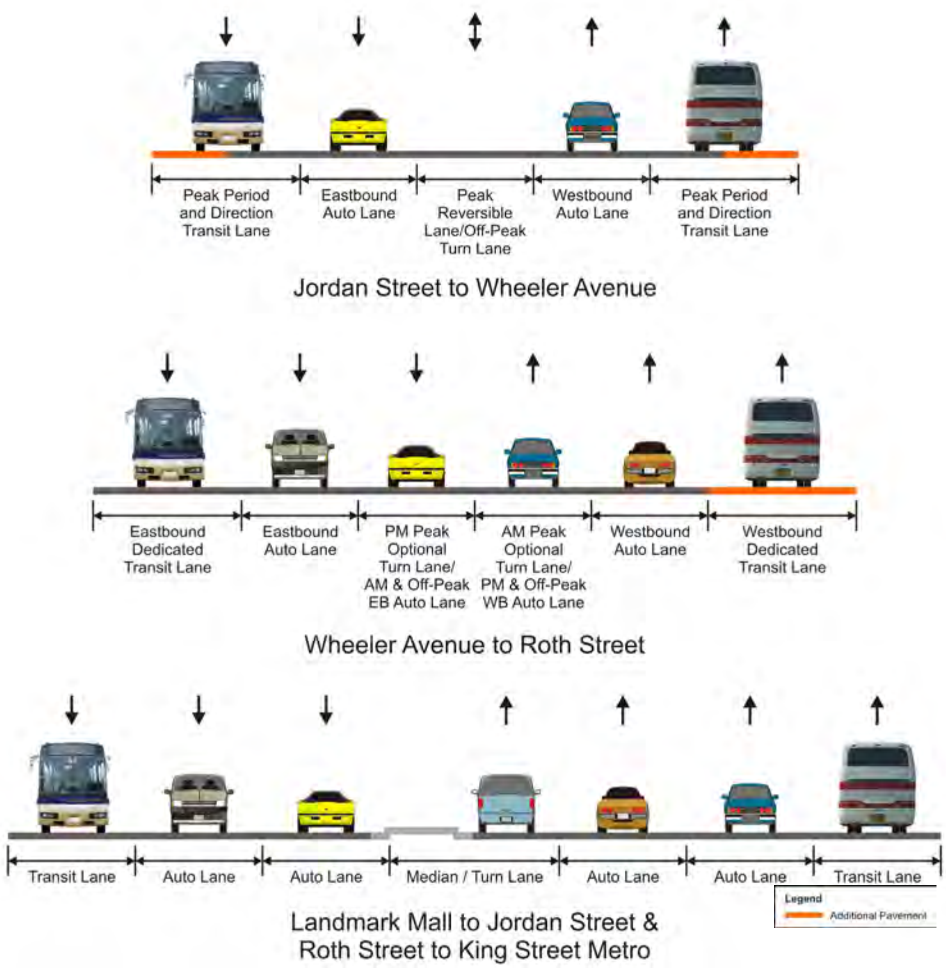


Figure 4.29: Alternative 3 Refined

- No Duke Street bicycle facility
- Lane control gantries
- Potentially confusing to drivers

Principal advantages and disadvantages of Alternative 3b include:

Advantages

- Quality transit operation
- Maintains service roads
- Provides bike lanes

Disadvantages

- Off-peak auto impact from Gordon to Wheeler
- Large property impacts due to bike lanes and streetscape enhancements
- Lane control gantries
- Potentially confusing to drivers

Refined Concepts Evaluation

Transit travel times were forecasted using methodology from the Transit Cooperative Research Program's *Report 100: Transit Capacity and Quality of Service Manual, Second Edition.* Under Alternatives 1 and 3, the one-way peak period travel times from Landmark Mall to the King Street Metrorail Station would be 22 minutes and 19 minutes, respectively.

Potential impacts and preliminary planning-level cost estimates for these alternatives are shown in Tables 4.10 and 4.11.

Table 4.10: Planning-Level Impacts

Alternative	1a	1b	3a	3b
Description	Use Existing Lanes for Transit	Use Existing Lanes for Transit	Reversible Lane	Reversible Lane with Bike Lanes
Park Impact	<0.15 acres	0.20 acres	<0.15 acres	0.25 acres
Property Impact	1.0 acres 65 parcels	2.5 acres 100 parcels	1.5 acres 75 parcels	3.5 acres 160 parcels
Commercial Parking Impact	53 spaces	121 spaces	66 spaces	159 spaces
Residential Parking Impact	2 spaces	12 spaces	4 spaces	13 spaces
Notes: All property impacts are slivers. Potentially impacted parks include Ewald, Ben Brenman, and Schuyler Hamilton Jones.				

Table 4.11: Planning–Level Cost Estimates

Alternative	1a	1b	3a	3b
Description	Use Existing Lanes for Transit	Use Existing Lanes for Transit	Reversible Lane	Reversible Lane with Bike Lanes
Capital Cost Estimate *(exclusive of vehicles, based on cost per mile within the city)*	$20 M	$40 M	$28 M	$53 M
25-year Fleet Cost Estimate	$20 M	$20 M	$16 M	$16 M
Right-of-way Cost Estimate	$3.5 M	$8 M	$4 M	$12 M
25-year Operating Costs	$67 M	$67 M	$60 M	$60 M
Preliminary Planning – Level Cost Estimates	*$111 M*	*$135 M*	*$108 M*	*$141 M*

Notes:

1. Planning level cost estimates are shown in year 2012 dollars and do not include additional contingency or escalation to a future year mid-point of construction. Totals listed do not include costs for major utility relocations/new service, or the capital costs for roadway/ streetscape improvements that may be implemented concurrently, but are not required for the transit project.
2. BRT was the preferred mode for the purpose of producing costs.

The purpose of the Corridor Work Group meetings held on February 16, 2012 and March 15, 2012 was to review the refined analysis for the Duke Street alternatives and to receive a recommendation for a preferred alternative from the Corridor Work Group.

The following significant comments were provided by the Corridor Work Group and the public at the meetings:

- Bike lanes on Duke Street are not desired in section between Jordan Street and Telegraph Road due to property impacts
- Bike facility on Duke Street should be included near Landmark Mall to take advantage of planned redevelopment
- Include a bicycle/pedestrian connection to Eisenhower Avenue
- Pedestrian safety and accommodation along and across Duke Street is important
- Consider a phased approach to transit implementation—Alternative 1 to Alternative 3 with a bike facility
- Improved transit on Eisenhower Avenue should be part of the overall corridor strategy
- Minimize impacts to residences and small businesses
- Concern with cut-through traffic in adjacent neighborhoods
- Some preference expressed for Alternative 1a and Alternative 3 with a modified approach to bicycle configuration in the central portion of the corridor where right-of-way is most constrained—renamed "3c" (further described in the "Preferred Alternative" section)

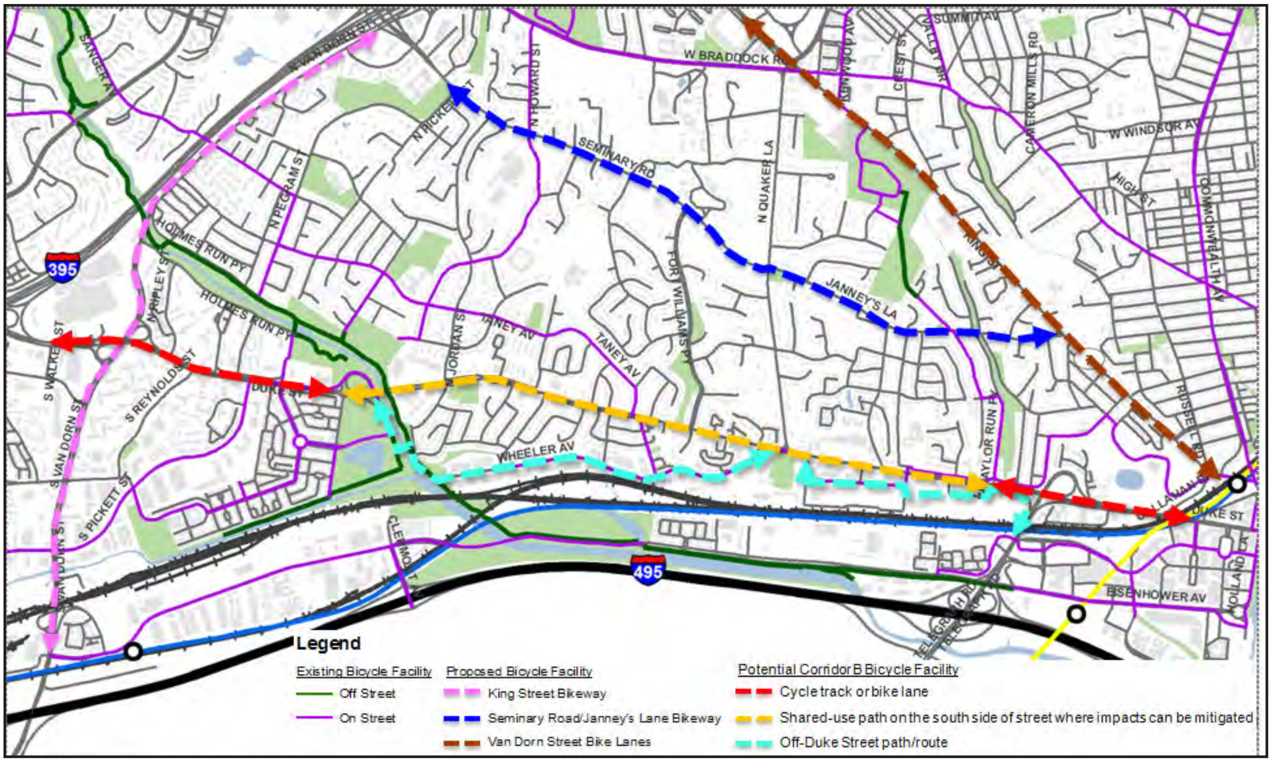


Figure 4.30: Proposed Continuous Bicycle Facility

Preferred Alternative

Based on feedback from the Corridor Work Group and the public, as well as additional evaluation of bicycle connectivity options, a preliminary preferred alternative and phasing strategy were identified.

Physical Characteristics

A combination of Alternatives 1a and 3c was the preferred approach for the Corridor B study. Together, these improvements would provide the opportunity to maximize the performance of the transitway, while minimizing property impacts along the corridor. While the most direct bike route would be along Duke Street, as shown in the alternative 3b analysis, there would be significant property impacts if this were instituted—approximately one additional acre of right-of-way would be needed for the bike lanes.

Therefore, the combination of Alternatives 1a and 3c would provide flexibility to accommodate a continuous bicycle facility along Duke Street in the short- and long-term. The proposed continuous bicycle facility along the Duke Street corridor is shown in Figure 4.30. As shown, the bike component would include a combination of a parallel corridor (off Duke Street) and a multi-use path along one side of Duke Street.

It is likely that in the near-term and prior to redevelopment of selected properties along Duke Street, the parallel off-Duke Street facility would be pursued and constructed. Over time, right-of-way for the Duke Street bike facility could be secured through direct acquisition or as a part of larger infrastructure projects.

The city would continue to pursue transit service and facility enhancements along the Eisenhower Avenue corridor to provide frequent, high-quality services along Eisenhower Avenue.

Operational Characteristics

The preferred long term alternative will feature transit signal priority and/or queue jump lanes at some intersections, a new reversible general purpose travel lane in one section of Duke Street, and real-time service information. Transit signal priority allows for extended green time or shortened red time to assist transit vehicles in maintaining their schedule. Queue jump lanes will be provided at some intersections in the four-lane segments of Duke Street. The lanes allow a transit vehicle to bypass stopped traffic at an intersection and progress through a signal ahead of general traffic. For a section of Duke Street (Jordan Street to Wheeler Avenue), a reversible general purpose travel lane will allow for a dedicated peak direction transit lane during peak periods of travel. In the off-peak direction and off-peak hours, the transit vehicle will travel in mixed traffic in the general purpose lane. Real-time service allows riders at stations to know when vehicles will be arriving in addition to allowing for development of mobile phone applications. Table 4.12 provides the headways and hours of service anticipated for the preferred alternative.

Table 4.13: Alternative 3c Planning-Level Impacts

Description	Impact
Park Impact	0.20 acres
Property Impact	2.0 acres 89 parcels
Commercial Parking Impact	75 spaces
Residential Parking Impact	6 spaces

Table 4.14: Alternative 3c Planning-Level Cost Estimates

Description	Cost Estimate
Capital Cost Estimate *(exclusive of vehicles, based on cost per mile within the City)*	$45 M
25-year Fleet Cost Estimate	$16 M
Right-of-Way Cost Estimate	$8 M
25-year Operating Costs	$60 M
Preliminary Planning – Level Cost Estimates	*$129 M*

Notes:

1. Planning level cost estimates are shown in year 2012 dollars and do not include additional contingency or escalation to a future year mid-point of construction. Totals listed do not include costs for major utility relocations/new service, or the capital costs for roadway/streetscape improvements that may be implemented concurrently, but are not required for the transit project.
2. Though mode selection had been deferred during this study, BRT was assumed for the purpose of producing costs.

Impacts and Cost Estimate

Preliminary impacts and costs associated with the ultimate build of Alternative 3c are summarized in Tables 4.13 and 4.14.

Table 4.12: Alternative 3c Anticipated Headways and Hours of Services

Day of Week		Headway	Duration	Total Duration of Operation
Weekdays	Peak	7.5 min	8 hours	18 hours
	Off-Peak	15 min	10 hours	
Saturdays		15 min	18 hours	18 hours
Sundays/ Holidays		20 min	12 hours	12 hours

Right-of-way along Duke Street is limited and can accomodate either a narrow (5’) sidewalk/streetscape or narrow multi-use path (8’). If future studies seek to implement a combination of standard width streetscape and multi-use path, then additional right-of-way would be needed.

The impacts shown in Table 4.13 reflect a reduced roadway cross sectional width for the majority of the corridor east of Jordan Street. This change from the standard typical section was proposed to reduce impacts to residential and commercial properties in this section.

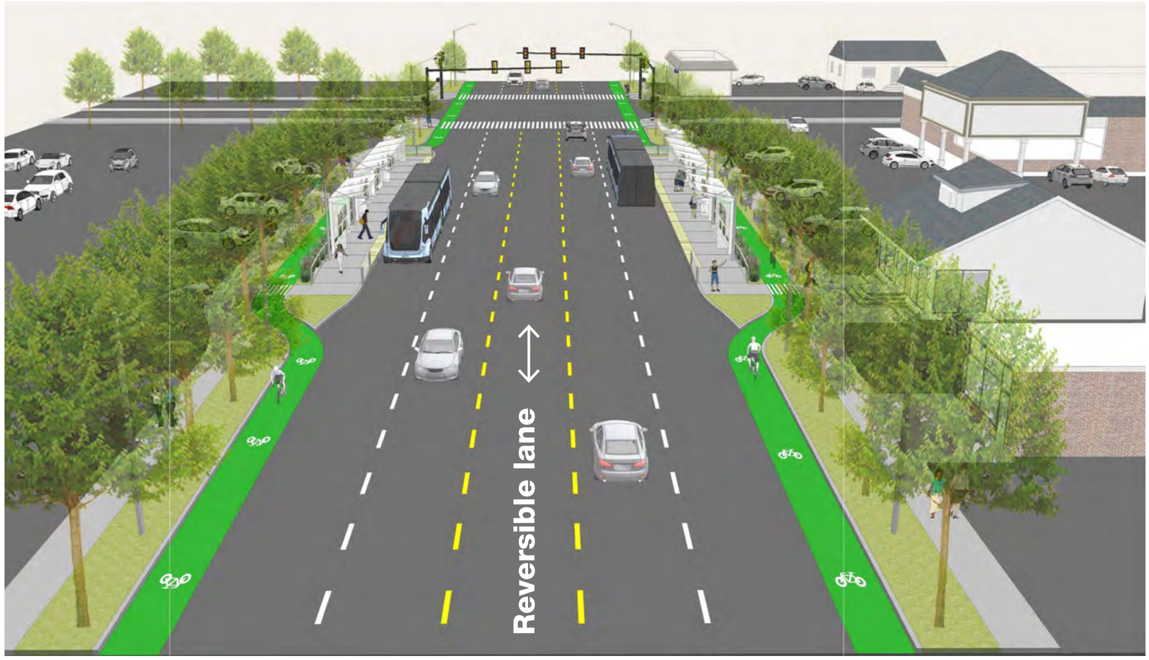


Figure 4.31: Reversible Lane Concept with On-Street Bicycle Facility

Though the original intent of this study was to develop a recommended alignment that could accommodate either BRT or streetcar, BRT is a more effective option and more desirable choice due to lower capital cost, fewer right-of-way requirements, and fewer system control elements. If the streetcar option were selected in the future, the right-of-way impacts may increase.

Corridor Work Group Recommendation

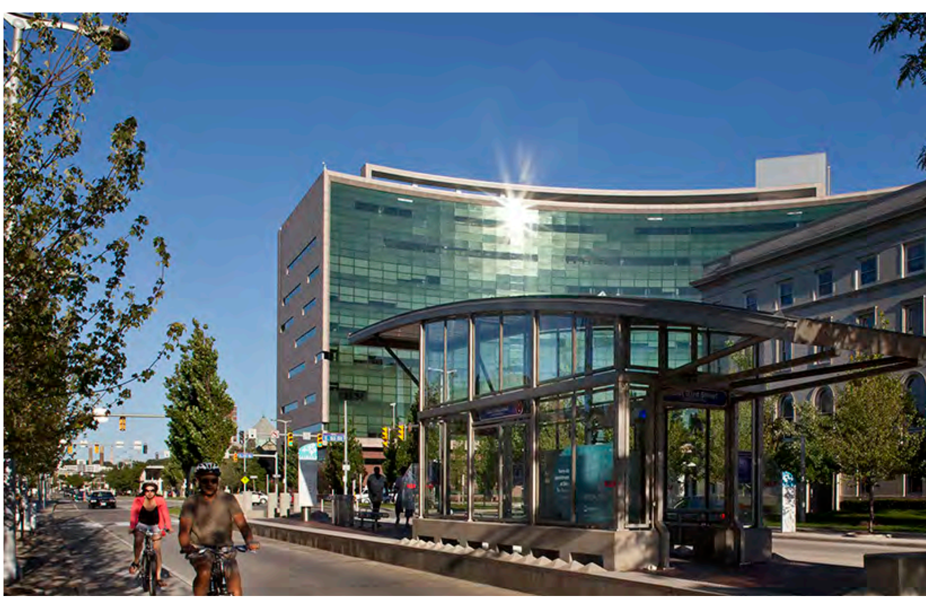
The formal recommendation for Corridor B, as defined and unanimously approved by the Corridor Work Group on March 15, 2012, is presented below.

> *"Alternative 1a would be the first phase of transitway implementation on Duke Street. It would create dedicated transit lanes in existing six-lane sections of Duke Street between Landmark Mall and Jordan Street and between Roth Street and Diagonal Road. In the remaining section of Duke Street between Jordan Street and Roth Street, transit would operate in mixed flow.*
>
> *A parallel off-corridor bicycle facility should be examined to accommodate bicyclists along Duke Street and improved pedestrian facilities would be provided at intersections and near transit stations. Preliminary implementation should prioritize enhanced pedestrian safety and improvements at Taylor Run Parkway.*
>
> *Alternative 3c would be the subsequent phase of transitway implementation on Duke Street. It would build on Alternative 1a by widening Duke Street to provide a reversible lane between Jordan Street and Roth Street.*
>
> *The reversible lane would be configured to allow Duke Street to accommodate a dedicated transit lane in the peak hour and peak direction of traffic flow during the a.m. and p.m. peak periods along Duke Street.*
>
> *Alternative 3c should continue to examine a bicycle facility along Duke Street along with corridor-wide pedestrian improvements. However, the Work Group believes that bicycles should be accommodated in this corridor if studies demonstrate that the streetscape can still be enhanced."*

The Corridor Work Group recommendation was approved by the City Council on June 13, 2012, following input from the Transportation Commission and Planning Commission, which stressed the need to minimize impacts to businesses and homeowners.

CORRIDOR C

chapter 5



Van Dorn Street near Metrorail station

Introduction

Providing high-quality and high-capacity transit services within Corridor C does involve some challenges. Corridor C runs on portions of Eisenhower Avenue, Van Dorn Street, Sanger Avenue, and N. Beauregard Street between the southern border of Alexandria and Fairfax County and the northeast border with Arlington County. The corridor within Alexandria is approximately four miles in length and runs primarily on arterial roadways, ultimately reaching the Pentagon.

Western Alexandria is an activity center for residential, commercial, and mixed-use development that is projected to experience even more growth in the next twenty years. Many roadway facilities that are vital to the city and region's transportation network also run through this area of the city.

With this as general context, there are challenges that affect the ability to locate surface-running high-capacity transit in the study area. General constraints include:

- Land use compatibility
- Significant peak hour traffic congestion on Van Dorn Street and Beauregard Street in the vicinity of Mark Center
- Connectivity to Shirley Highway (I-395) and the Capital Beltway (I-495)
- Right-of-way impacts to businesses and residences
- Existing infrastructure such as bridges and grade separated interchanges

The following sections provide additional information on several of these challenges as well as summarize general existing transportation (multimodal), land use, and development conditions.

Travel Patterns and Activity Centers

Alexandria's location adjacent to Washington, D.C., and Arlington County subjects many of its major streets to regional through traffic, in addition to being a destination in its own right. Corridor C serves as a link between these roadways, serving major centers of growth and development along the way. In addition, tens of thousands of transit trips traverse the city each day using bus services as well as Metrorail and Virginia Railway Express (VRE) trains.

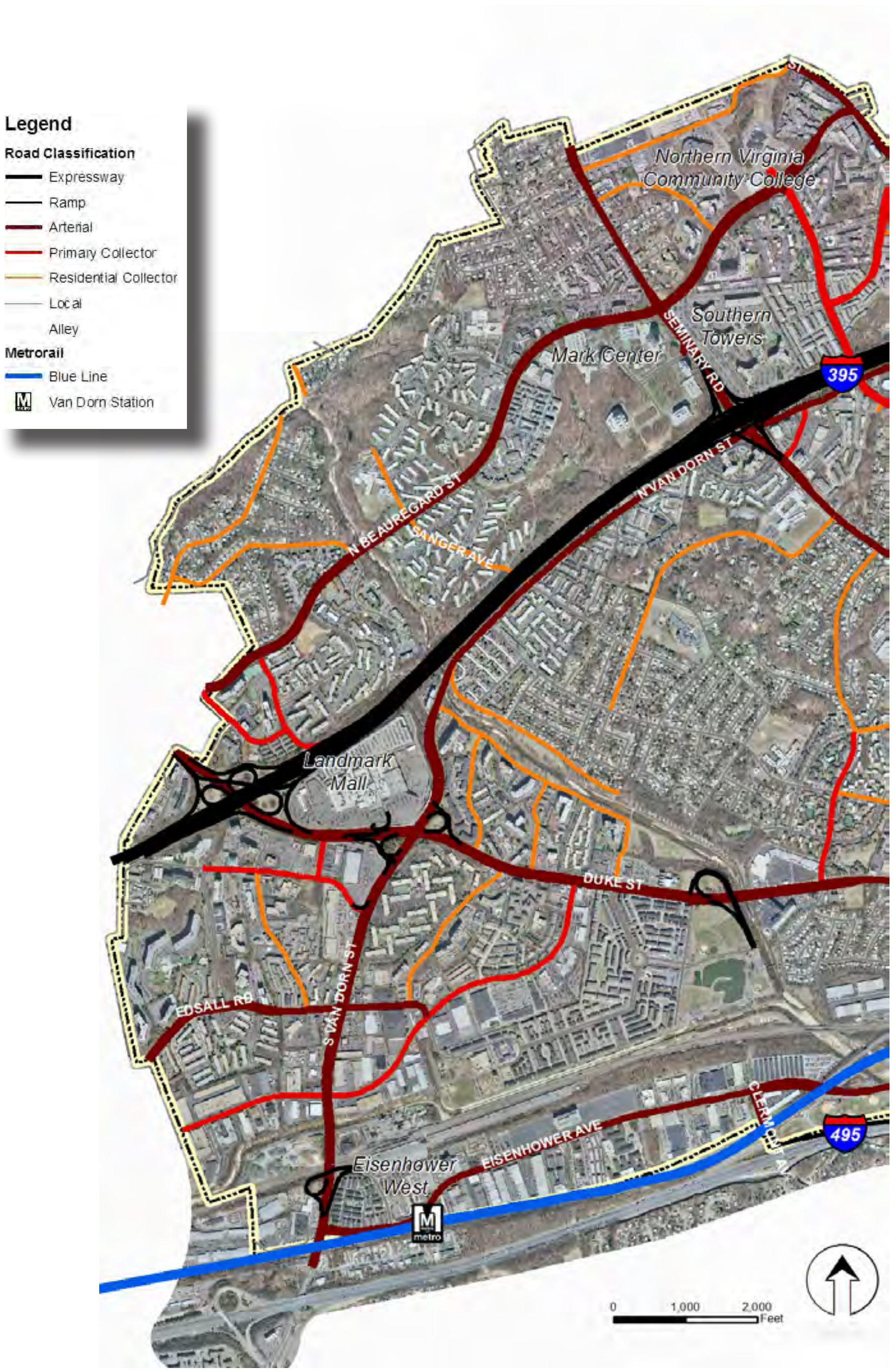


Figure 5.1: Functional Classifications

Major destinations outside of Corridor C within Alexandria include the King Street corridor, Braddock Road Metrorail station, King Street Metrorail station, the Waterfront, Old Town, Eisenhower East, and Alexandria Commons. Destinations that are served by Corridor C are Eisenhower West, Van Dorn Metrorail station, Landmark/Van Dorn development, Beauregard Area development, Landmark Mall, Mark Center, Southern Towers, and Northern Virginia Community College (NVCC).

Transportation Conditions

Metropolitan Washington Council of Governments' (MWCOG) fiscally constrained long-range plan includes a limited number of major capacity increases in the proximity of Corridor C during the next 20 years. MWCOG's travel demand forecasts show that peak period travel demand on Van Dorn Street and Beauregard Street will increase during the next 20 years and that these routes will continue to have travel demand that outpaces their capacity.

Regional Traffic Influences

Regional congestion is a major influence on travel conditions in Alexandria. Congestion on the Capital Beltway (I-495) and Shirley Highway (I-395) divert some longer through trips onto arterial facilities such as Van Dorn Street and Beauregard Street as well as other routes in Alexandria. Traffic diverting to arterial and collector streets increases significantly during special events and incidents on the region's major freeways. Regional through trips diverted to local routes limit capacity available to Alexandrians for shorter distance trips and contribute to the substantial peak period congestion that exists along routes such as Van Dorn Street and Beauregard Street.

Local Transportation Conditions

Functional Classification and Configuration

Street classifications typically help to describe and define a street's purpose. A street with a higher functional classification—arterial or major collector—is traditionally intended to carry longer distance trips and offer a higher level of mobility. These streets often have few individual driveways and single-user points of access. Streets with lower functional classifications—minor collectors and locals—typically serve in more access-oriented roles. The majority of streets on which Corridor C runs are classified as arterials. The only exception is Sanger Avenue, which is classified as a residential collector. Figure 5.1 shows the functional classification of surrounding streets. At a general level, arterials and collectors are more appropriate for the location of transitways.

Street Cross Sections

The streets on which Corridor C runs are primarily four-lane facilities with turn lanes at intersections and a median of varying width. Additional characteristics of the existing roadway configurations are presented below and summarized in Figure 5.2:

Segment 1

Segment 1 extends one-half mile on Eisenhower Avenue between Van Dorn Metro Station and Van Dorn Street. This segment includes:

- Existing right-of-way of approximately 80 feet
- Rail tracks run along the southern edge

Segment 2

Segment 2 extends one mile on South Van Dorn Street between Eisenhower Avenue and Duke Street. This segment includes:

- Existing right-of-way of approximately 100 feet
- Bridge over railroad tracks—approximately 275 feet long and 90 feet wide
- Grade-separated interchanges at Metro Road and Duke Street

Segment 3

Segment 3 extends three-quarters of a mile on North Van Dorn Street between Duke Street and Sanger Avenue. This segment includes:

- Existing right-of-way of approximately 80 feet
- A one-way northbound residential access road located immediately east of and curb-separated from Van Dorn Street between Holmes Run Parkway and Sanger Avenue with on-street and back-in parking
- I-395 runs parallel to the north

Segment 4

Segment 4 extends one-half mile on Sanger Avenue between N. Van Dorn Street and Beauregard Street. This segment includes:

- Undivided cross section (no median)
- Existing right-of-way of approximately 60 feet
- Crossing under I-395 just north of N. Van Dorn Street
- On-street parking during restricted periods

Segment 5

Segment 5 extends three-quarters of a mile on N. Beauregard Street between Sanger Avenue and Mark Center Drive. This segment includes:

- Existing right-of-way of approximately 80 feet

Segment 6

Segment 6 extends one-quarter mile on Mark Center Drive between N. Beauregard Street and Seminary Road and through the Southern Towers apartment complex, connecting to N. Beauregard Street. This segment includes:

- Existing right-of-way of approximately 65 feet on Mark Center Drive

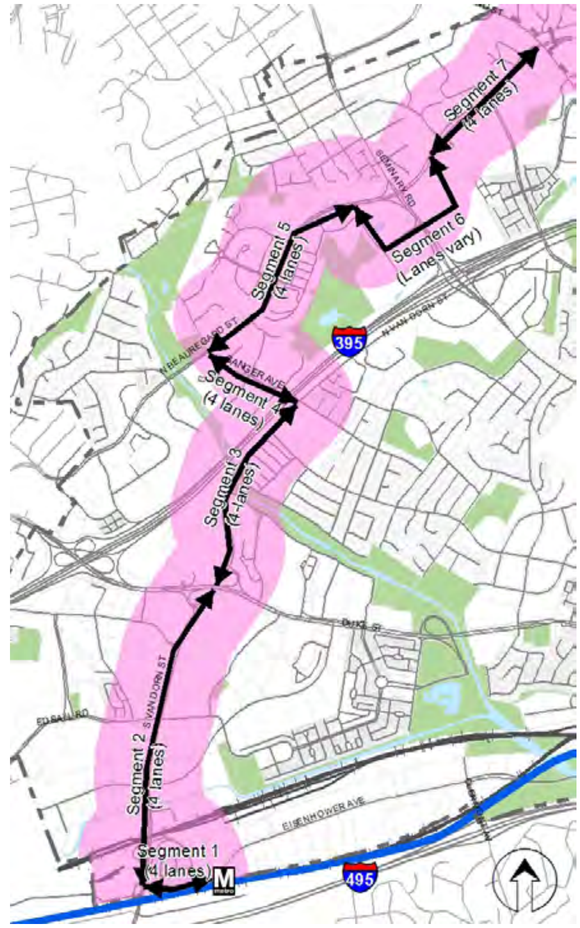


Figure 5.2: Corridor Sections

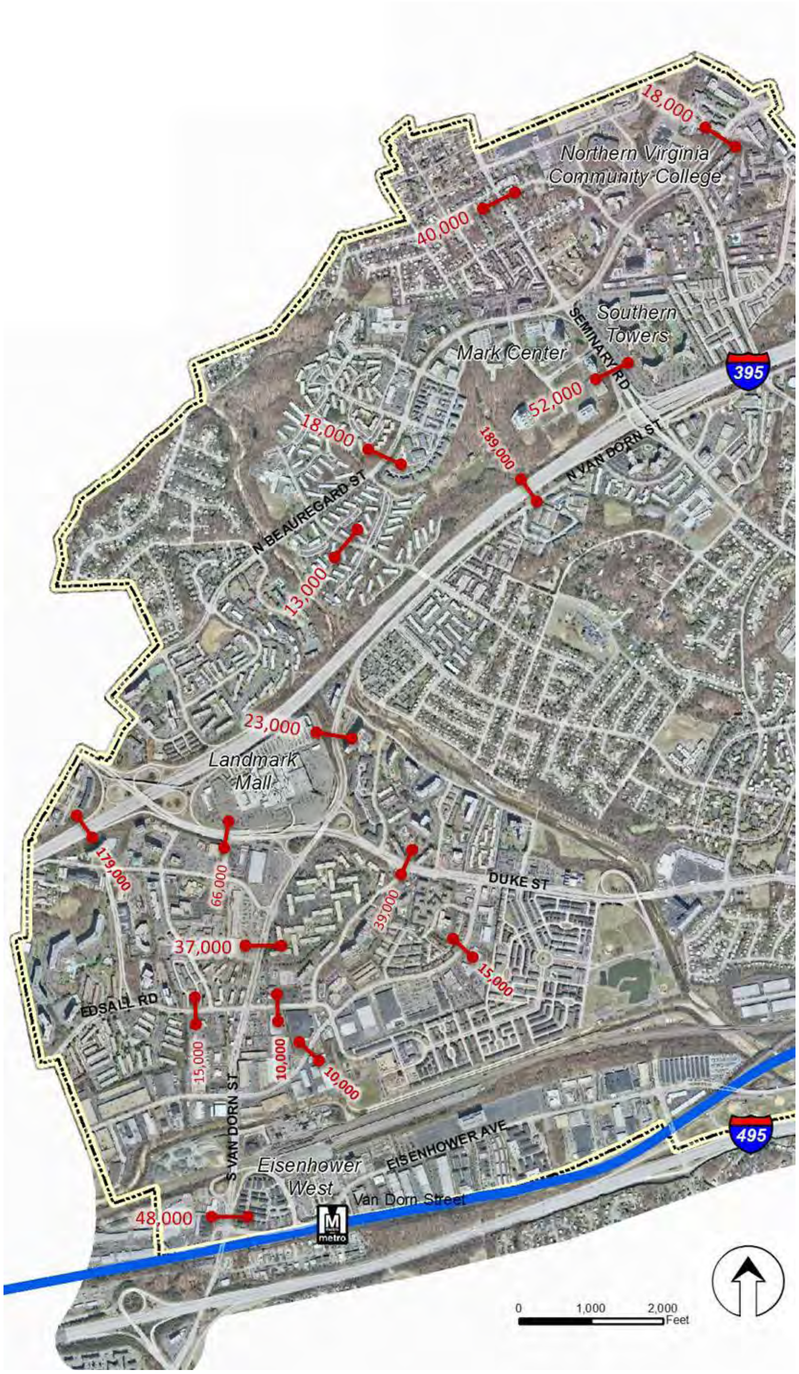


Figure 5.3: Average Daily Traffic Volumes (2009)

- Mark Center bus facility located southwest of Seminary Road
- Parking lot for Southern Towers development located across from Mark Center Drive

Segment 7

Segment 7 extends three-quarters of a mile on N. Beauregard Street between Southern Towers and King Street.

- Existing right-of-way in this segment varies between 100 and 130 feet

These segments are based on the ultimately chosen alignment for Corridor C. Alternative alignments also were initially evaluated.

Daily Traffic

Existing (2009) average daily traffic volumes on study area streets are shown in Figure 5.3. The portions of the corridor that contain the highest volumes and most peak hour congestion serve as access points to the commercial development along Van Dorn Street as well as access to I-495, Duke Street, and the Van Dorn Metrorail station. As shown in the figure, existing volumes on Corridor C are:

Van Dorn Street

- 48,000 vehicles per day (vpd) between Eisenhower Avenue and Edsall Road
- 37,000 vpd between Edsall Road and Duke Street
- 23,000 vpd between Duke Street and Seminary Road

Sanger Avenue

- 13,000 vpd between Van Dorn Street and Beauregard Street

Beauregard Street

- 18,000 vpd between the western boundary of the City of Alexandria and King Street

Traffic Flow

To better understand general traffic flow conditions in the Corridor C area, weekday peak period travel time runs were conducted. The travel time runs (conducted multiple times in each direction of the peak period) measured travel speed and delay. A summary of average travel speeds on segments of Corridor C during the weekday peak periods are shown in Figures 5.4 and 5.5. The following summarizes peak travel speeds and time for the sections surveyed of Corridor C between Eisenhower Avenue and King Street:

- Van Dorn Street/Sanger Ave/Beauregard Street (northbound)
  - A.M. Peak Hour: 10.6 mph, 19:59 minutes
  - P.M. Peak Hour: 15.6 mph, 13:07 minutes
- Beauregard Street/Sanger Ave/Van Dorn Street (southbound)
  - A.M. Peak Hour: 23.0 mph, 8:35 minutes
  - P.M. Peak Hour: 17.9 mph, 10:56 minutes

Figure 5.4: AM Peak Hour Travel Speeds on Van Dorn Street and Beauregard Street

Figure 5.5: PM Peak Hour Travel Speeds on Van Dorn Street and Beauregard Street

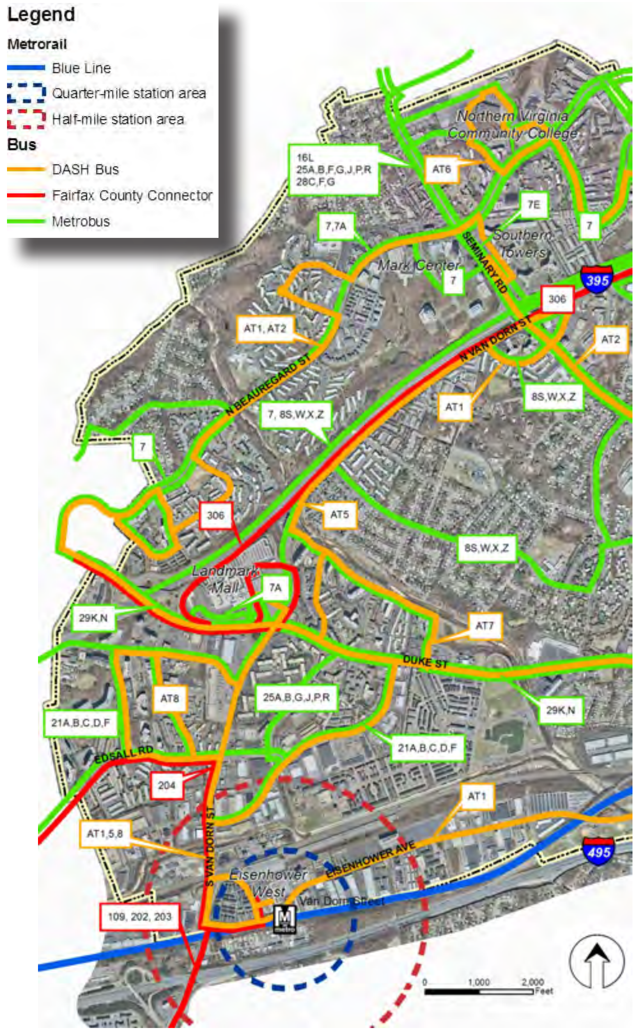


Figure 5.6: Existing Transit Services

Transit Use

Corridor C and the surrounding areas are currently served by transit operated by multiple jurisdictions. The southern terminus of the corridor is served by Metrorail's Blue line at the Van Dorn station. The area also is served by bus by DASH, Metrobus, and the Fairfax County Connector. Express bus and shuttle service on I-395 is also an option for those commuting to Washington, D.C. and the Pentagon Area. Service and route varies from line to line and is viewed by some as confusing and unreliable. The demand for these services is high and there is no single line that runs the entirety of Corridor C. Existing transit services in the study are shown in Figure 5.6. Table 5.1 provides a summary of transit ridership for services running through the study area.

Table 5.1: Existing Transit Ridership

Service/Route	Average Weekday Ridership
DASH Route AT1	1,765
DASH Route AT2	2,035
DASH Route AT5	2,063
DASH Route AT6	2,063
DASH Route AT7	1,015
DASH Route AT8	2,628
Fairfax County Connector Route 306	201
Fairfax County Connector Routes 109/202/203	811
Metrobus Route 16L	196
Metrobus Routes 25A,B,F,G,J,P,R	1,453
Metrobus Routes 28A,B	5,493
Metrobus Routes 28F,G	783
Metrobus Routes 29K,N	2,272
Metrobus Routes 7A-F, H,P,W,X	4,712
Metrobus Routes 8S,W,X,Z	1,521
Metrorail	3,653 (boardings)

Source: WMATA and DASH

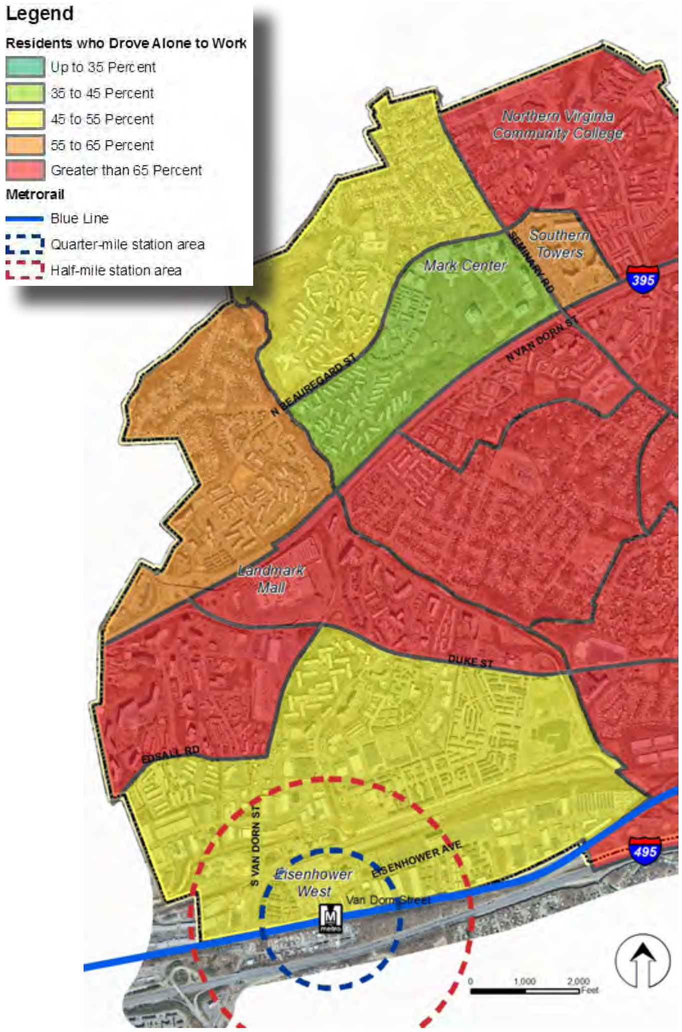


Figure 5.7: Journey to Work Mode Split

Figure 5.8: Existing Bicycle Facilities

Based on data available from the U.S. Census (2010), many residents in the areas surrounding Corridor C commute to work by a mode other than single-occupant vehicle. A summary of single-occupant vehicle use for work trips for the Census Tract-level divisions representing the study area is shown in Figure 5.7. The tracts with the lowest percentages of residents making single-occupant trips are located in close proximity to the Van Dorn Metrorail station and the Mark Center. As distance from Metrorail increases, the single-occupant work trip share also increases. Much of the middle portion of Corridor C runs through census tracts in which over 65% of the residents are commuting to work in single-occupant vehicles.

Bicycle and Pedestrian Networks

Almost the entirety of Corridor C benefits from a network of sidewalks on both sides of the major streets. While some of the adjacent roadways to Corridor C do have accommodations for bicyclists, the majority of the corridor is not equipped with on-street bicycle routes. The Holmes Run off-street bicycle route intersects Corridor C near the intersection of Van Dorn Street and Holmes Run Parkway. Figure 5.8 shows existing bicycle facilities.

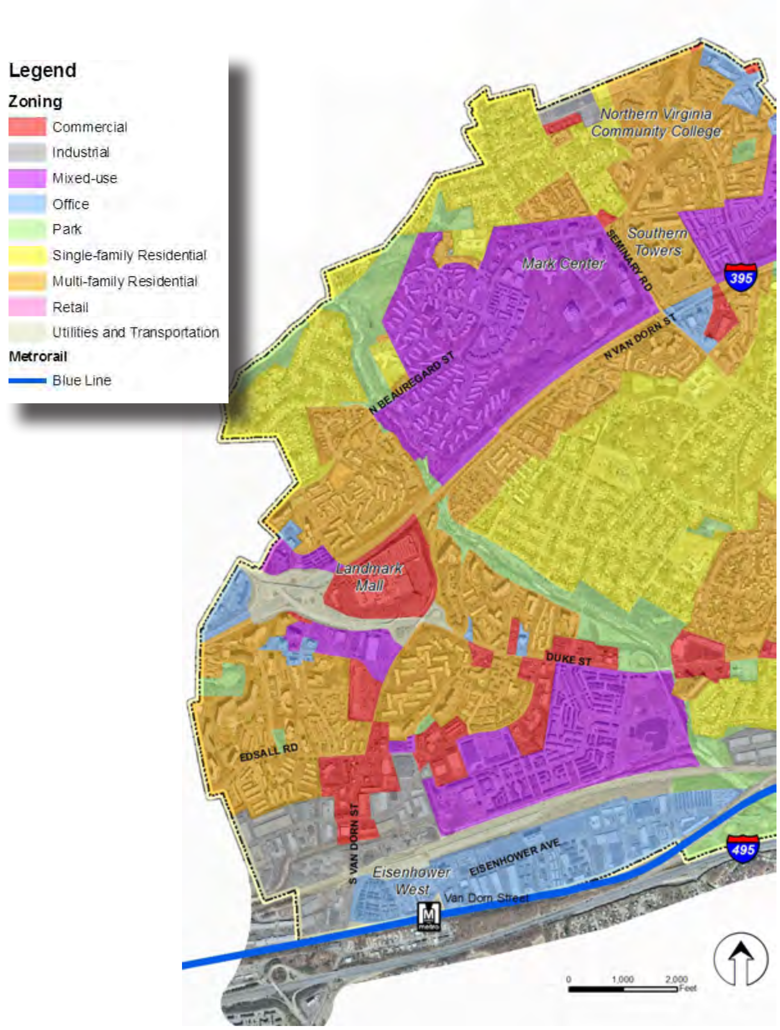


Figure 5.9: Existing Zoning

Land Use and Development

General

Much of Corridor C is surrounded by mixed land use or high-density, multi-family residential development. Specific points of existing high concentrations of people include Southern Towers, Mark Center, and Northern Virginia Community College. In the southern portion of the corridor, Van Dorn Street is mainly commercially-oriented, with Landmark Mall as the main destination. Office use is primarily concentrated near the Van Dorn Metrorail station. Figure 5.9 shows existing zoning in the study area.

The Landmark/Van Dorn Corridor Plan (adopted June 2009) and the Beauregard Small Area Plan (approved May 2012) outline land use and transportation visions for two areas which make up almost the entirety of Corridor C. Both plans contain transformative visions that will enhance the quality of life for residents and visitors by providing convenient activity centers, residential development, and public open spaces. It is vital to the functioning of the city that land use and transportation plans continue to be developed and implemented in coordination.

Table 5.2: Quarter-Mile Area – Population and Employment Forecast Summary

	2010	2030
Population	29,200	38,200
Population Density (People/Square Mile)	14,000	18,400
Employment	15,400	28,600
Employment Density (Jobs/Square Mile)	7,400	13,800

Source: MWCOG and U.S. Census

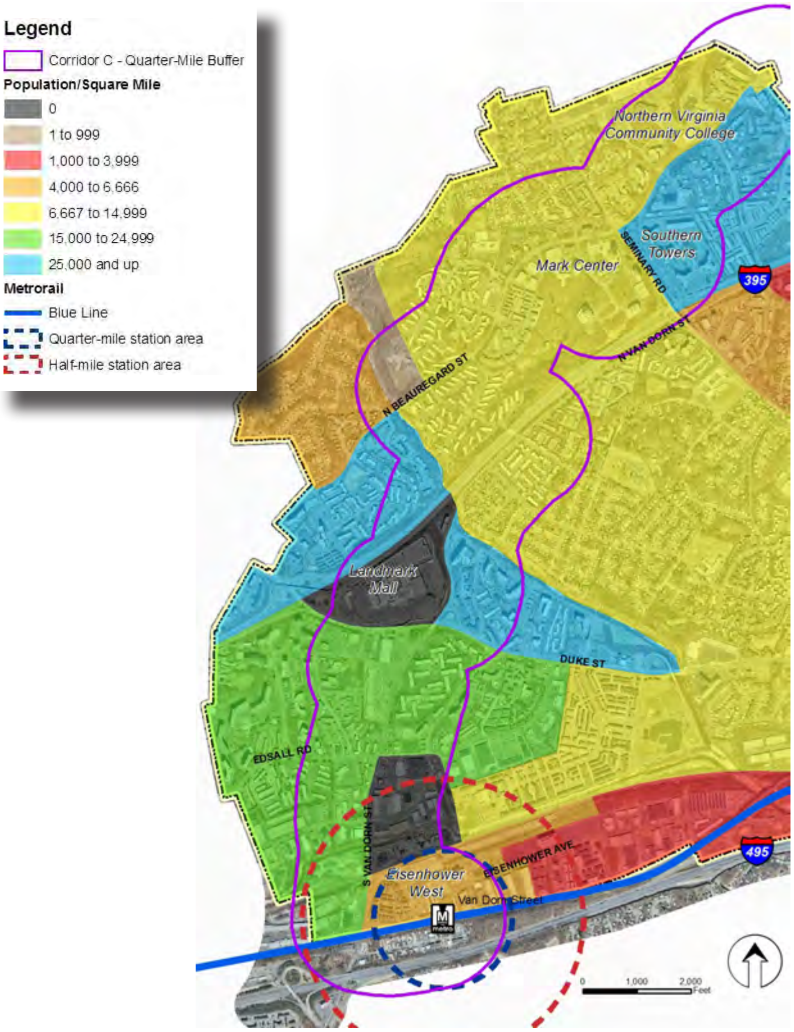


Figure 5.10: Existing Population Density (2010)

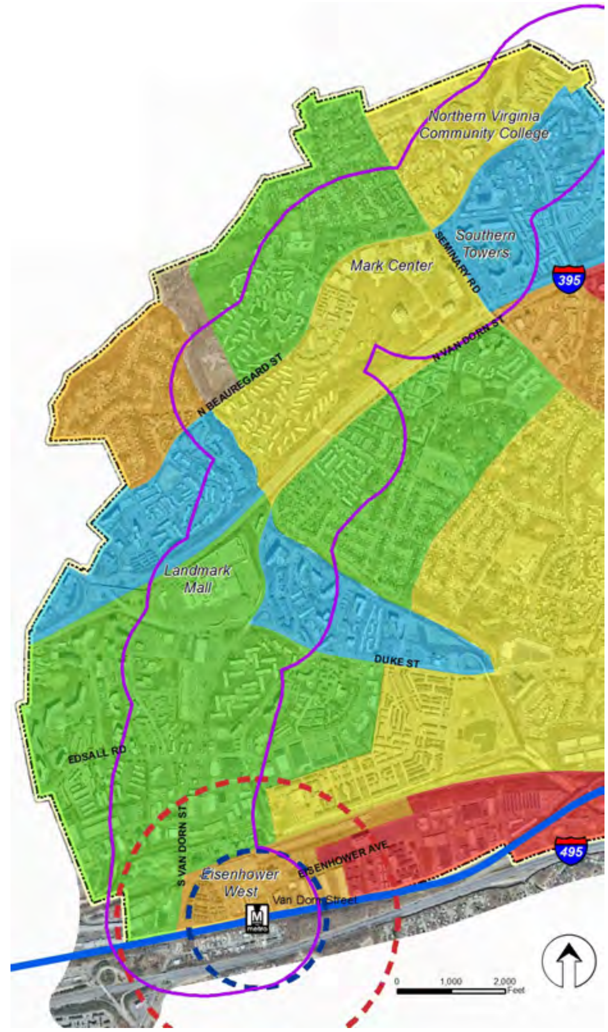


Figure 5.11: Projected Population Density (2030)

Population and Employment

Corridor C has relatively high population and employment density. MWCOG uses data provided by individual jurisdictions to provide forecast information for future population and employment estimates. These forecasts were tabulated for traffic analysis zones located within a quarter-mile of Corridor C. Table 5.2 summarizes these results. Population in the quarter-mile area is expected to grow about 31% while employment is projected to increase by 86% by 2030.

Population

Within the study area, the areas with the highest existing population density are those containing the Southern Towers in the northeast portion of the corridor and the residential developments bordering Landmark Mall. Future growth is forecast to be more pronounced in the residential areas north of Beauregard Street and south of N. Van Dorn Street and I-395. Additionally, new high-density residential development is projected to occur in the area currently occupied by Landmark Mall as part of the Landmark/Van Dorn Corridor Plan Vision. Figures 5.10 and 5.11 show existing (2000) and projected (2030) population density.

Employment

The areas with the highest existing employment density are those containing Mark Center and Landmark Mall. Forecast employment growth is most prominent in the same relative area. The area east of S. Van Dorn Street is also projected to increase in employment. Figures 5.12 and 5.13 show existing (2010) and projected (2030) employment density.

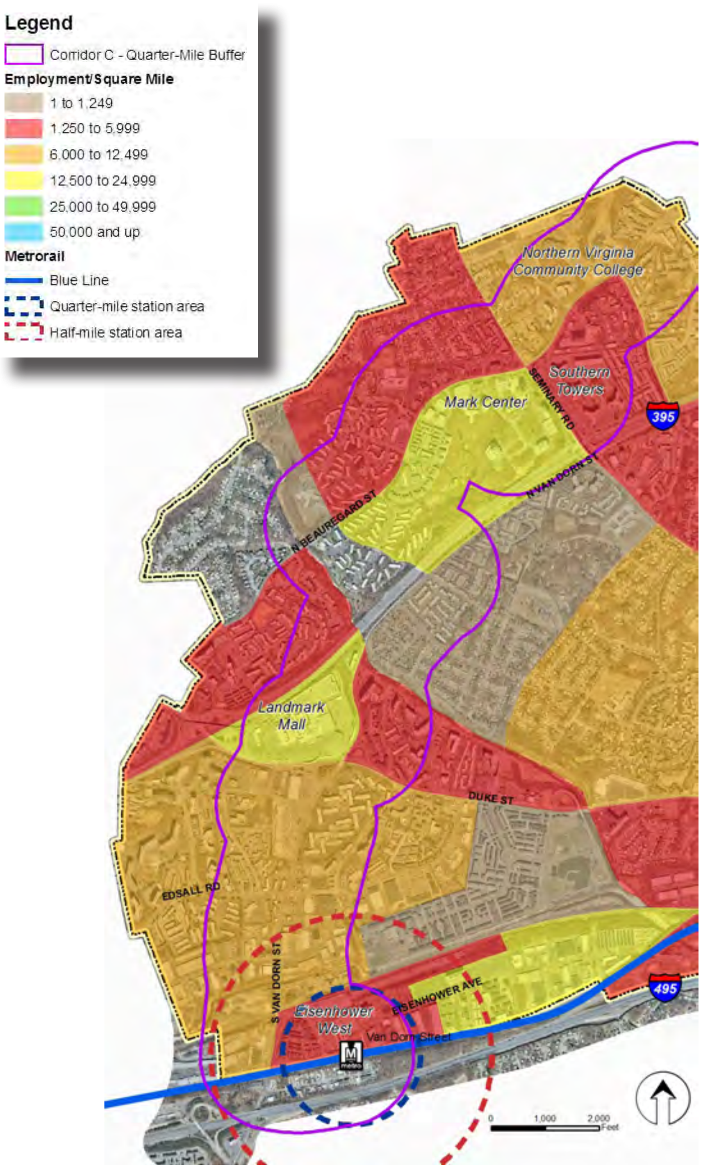


Figure 5.12: Existing Employment Density (2010)

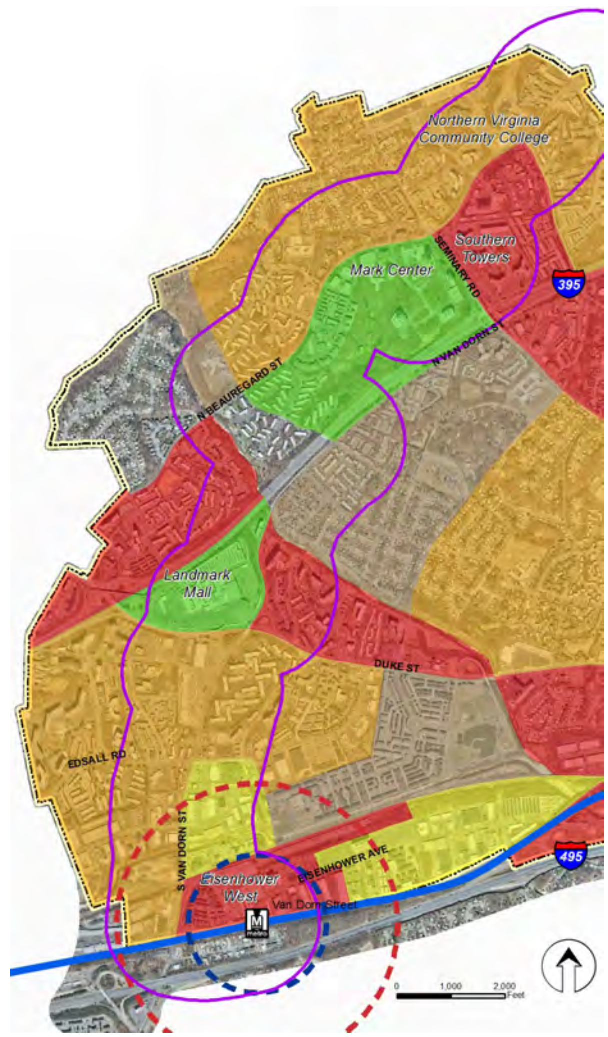


Figure 5.13: Projected Employment Density (2030)

Summary of Existing Conditions

In the context of planning a new, surface-running high-capacity transit service in Corridor C, there are a number of challenges within the existing transportation system. These include:

- Peak hour congestion on Van Dorn Street and in the Mark Center vicinity
- Lack of a direct (one-street) route from the beginning to the end of the corridor
- Grade separated interchanges at Van Dorn Street with Metro Road and Duke Street
- Limited rights-of-way with many businesses and residences adjacent to Van Dorn Street
- Proximity to interstate facilities
- Environmental constraints such as Holmes Run and Lucky Run
- Existing streetscape along Beauregard Street
- Limited clearance of the Sanger Avenue underpass at I-395
- Narrow sidewalks on portions of some streets

The existing congestion and travel patterns reinforce the need for transit to operate in a fully- or partially-dedicated (congestion-free) runningway to achieve its stated purpose. Most of the roadways in the corridor have current geometric configurations which would allow for the creation of dedicated lanes. However, grade-separated interchanges, limited rights-of-way, and planned roadway improvements challenge the implementation of a dedicated runningway. If such a runningway were to be provided, there is the potential to require the consideration of one or more of the following:

- Running transit in mixed flow (not meeting the general Transportation Master Plan goal for operating high-capacity services in dedicated lanes) with some opportunity for queue jump lanes through the displacement of parking
- Displacing an existing general purpose travel lane for transit (thereby reducing general vehicle throughput) and narrowing adjacent travel lanes where needed to meet minimum transit lane width requirements
- Displacing an existing parking lane for transit use
- Running transit through an alternate or phased route until roadway improvements are implemented

Concepts for Corridor C, developed in consideration of existing conditions, are described in the next section.

Preliminary Transitway Concepts

Seven preliminary alternatives were developed using a "kit of parts" approach that took into consideration regional connectivity, alternative alignments within the Beauregard/Van Dorn corridor, and several different transit mode technologies. The alternatives also took into account Corridor Work Group and public input regarding origins and destinations, impacts, priorities, and other factors.

Connection & Alignment Options

The potential connections and alignments that were used to create alternative concepts are listed below and displayed in Figure 5.14. The numbers below correspond to the respective location on the figure.

Northern Connection Options

1. Columbia Pike via NVCC—Would connect Corridor C with Arlington County's proposed Columbia Pike Streetcar project
2. Shirlington/Pentagon via Beauregard Street—Would connect Corridor C with additional areas of population and employment
3. Pentagon via I-395—Would provide a direct connection to the Pentagon via HOV lanes

Alignment Alternatives

4. Mark Center/Southern Towers—Would serve the high densities of employment and population at these sites
5. New High Street (Landmark Mall)—Would allow Corridor C to directly serve Landmark Mall (as identified in the Landmark/Van Dorn Plan)
6. New High Street/Quantrell Avenue—Would serve the portion of Beauregard Street west of the existing Sanger Avenue
7. Landmark Plaza/Beauregard Street—Would serve the Plaza at Landmark and the western portions of N. Beauregard Street
8. Multimodal Bridge to Van Dorn Metrorail Station—Would provide direction connection from Landmark/Van Dorn development area (part of Landmark/Van Dorn Plan)

Southern Connection Option

9. Kingstowne via Van Dorn Street—Would provide connection to mixed-use development in southern Alexandria

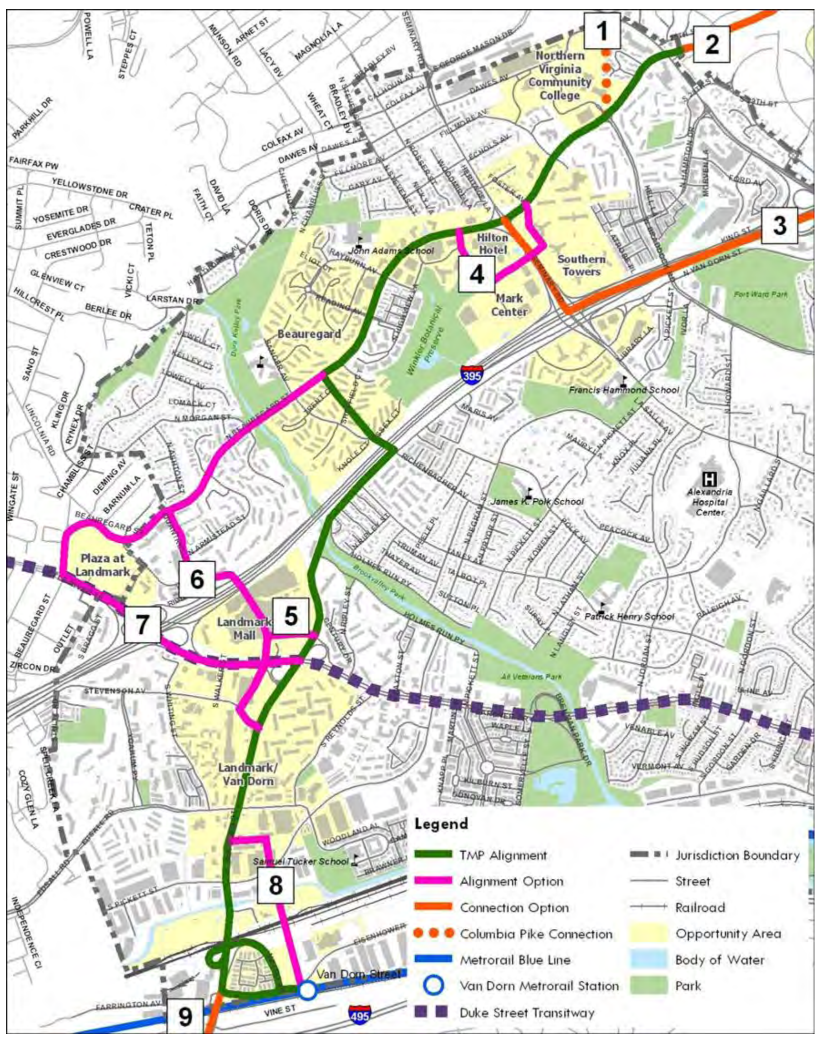


Figure 5.14: Connection and Alignment Options

Operational Options

Mode/Service

- Rapid bus
- Bus rapid transit (BRT)
- Streetcar

Physical Configuration

- Mixed flow
- Partial mixed flow (some sections dedicated lane)
- Dedicated lane
- Quarter-mile station-spacing
- Half-mile station-spacing

Preliminary Transitway Alternatives

Using beneficial and effective combinations of regional connections, alignment alternatives within the Beauregard/Van Dorn corridor, and transit mode technologies, the following seven preliminary alternatives were created:

- Alternative A: Streetcar in Mixed Flow Connecting to Columbia Pike
- Alternative B: Rapid Bus in Mixed Flow Connecting to the Pentagon and Shirlington
- Alternative C: Rapid Bus in Mixed Flow Connecting to the Pentagon and Streetcar in Mixed Flow Connecting to Beauregard Town Center
- Alternative D: BRT Connecting to the Pentagon and Shirlington
- Alternative E: BRT Connecting to the Pentagon and Streetcar in Mixed Flow Connecting to Beauregard Town Center
- Alternative F: BRT Connecting to the Pentagon and Shirlington via the Plaza at Landmark
- Alternative G: Streetcar in Dedicated Lanes Connecting to Columbia Pike

The key features of each alternative are summarized in Table 5.3.

Table 5.3: "Kit of Parts" Screening Options

Feature	Alternative						
	A	B	C	D	E	F	G
Northern Connections							
1. Columbia Pike via NOVA	✓		✓	☐	✓	☐	✓
2. Shirlington/Pentagon via Beauregard		✓		✓		✓	
3. Pentagon via I-395 HOV		✓	✓	✓	✓	✓	
Alignments							
4. Mark Center/Southern Towers	✓	✓	✓	✓	✓	✓	✓
5. New High St (Landmark Mall)	☐	☐	☐	☐	☐		☐
6. New High St/Quantrell Ave						☐	
7. Landmark Plaza/Beauregard St						✓	
8. Multimodal Bridge to Van Dorn Metrorail Station	☐	☐	☐	☐	☐	☐	☐
Southern Connections							
9. Kingstowne via Van Dorn	☐	☐	☐	☐	☐	☐	☐
Transit Mode							
Rapid Bus		✓	✓				
BRT				✓	✓	✓	
Streetcar in mixed flow	✓		✓		✓		
Streetcar in dedicated lanes							✓
Station Spacing							
1/4-mile station-spacing	✓	✓	✓		✓		
1/2-mile station-spacing				✓	✓	✓	✓
Legend: ✓ Alternative contains feature ☐ Optional long-term alignment							

Preliminary Screening

In order to compare the strengths and weaknesses of each alternative, a set of eight preliminary screening criteria was developed. These criteria looked at operations, potential impacts, and probable cost. Table 5.4 describes these criteria.

Each of the seven alternatives was given a comparative score of 1 (Poor), 2 (Fair), or 3 (Best) for each of the criteria and the scores were summed to create a total score. Additionally, a preliminary opinion of probable cost* was prepared for each alternative. A summary table of the data for each alternative is shown in Table 5.5.

Public Input Summary

These preliminary alternatives were presented to the Corridor Work Group and public on January 20, 2011, for discussion and to gain input from the Corridor Work Group and the general public. A brief summary of input obtained at this meeting and follow-up comments is presented below.

Corridor Work Group Comments

- Alternative B had some degree of preference due to its low initial cost and shorter time period for implementation
- Streetcar and higher-level investment alternatives were liked due to their ability to operate with less traffic-related delay and the ability to tie to the regional streetcar network
- Connectivity to the Pentagon and Shirlington was encouraged

Table 5.4: Preliminary Screening Criteria

Preliminary Screening Criteria	Description
Service to Regional Destinations	Key destinations served
Service to Population, Employment, and Retail in the Corridor	Population, employment, retail, and key destinations served
Transit Connectivity	Access to other transit services (existing and planned)
Transit Travel Time	Relative speed of transit along the Van Dorn/Beauregard corridor
Alignment Quality	Geometric quality of alignment
Property Impacts	Number, use type, and quantity of properties impacted with anticipated level of impact (ROW only, partial take, total take)
Traffic Flow Impact	Effect of transit implementation on general vehicle flow (non-transit) in corridor
Capital Cost	Comparative capital cost for initial system construction

Table 5.5: Preliminary Screening Ratings

Preliminary Screening Criteria	Alternative						
	A	B	C	D	E	F	G
Transit Mode:	Streetcar (mixed)	Rapid Bus (mixed)	Streetcar (mixed) & Rapid Bus (mixed)	BRT (mixed & dedicated)	Streetcar (mixed) & BRT (mixed & dedicated)	BRT (mixed & dedicated)	Streetcar (dedicated)
Northern Connection:	Columbia Pike	Shirlington & Pentagon	Columbia Pike & Pentagon	Shirlington & Pentagon	Columbia Pike & Pentagon	Shirlington & Pentagon	Columbia Pike
Service to Regional Destinations	◑	◑	●	◑	●	◑	◑
Service to Population, Employment, & Retail in the Corridor	●	●	●	◑	◑	○	◑
Transit Connectivity	◑	◑	●	◑	●	◑	◑
Transit Travel Times	○	◑	◑	●	●	●	●
Alignment Quality	◑	◑	◑	◑	◑	○	◑
Property Impacts	●	●	●	◑	◑	◑	○
Traffic Flow Impact	○	◑	◑	●	●	●	●
Capital Cost	○	●	◑	◑	◑	◑	○
Preliminary Cost Estimate* (capital cost, based on modal cost per-mile within the City)	$90M	$15M	$40M	$50M	$65M	$55M	$180M

Rating: ● Best ◑ Fair ○ Poor

**Opinions of probable cost were prepared in year 2010 dollars and do not include additional contingency or escalation to a future year midpoint of construction. Totals listed do not include costs for initial (or programmed replacement) vehicle purchases, maintenance facilities, right-of-way acquisition (including any condemnation, damages, or relocation costs), major utility relocations/new service, or roadway/streetscape improvements that may be implemented concurrently, but are not required for the transit project. Alignments designated as "optional" are not included in the cost.*

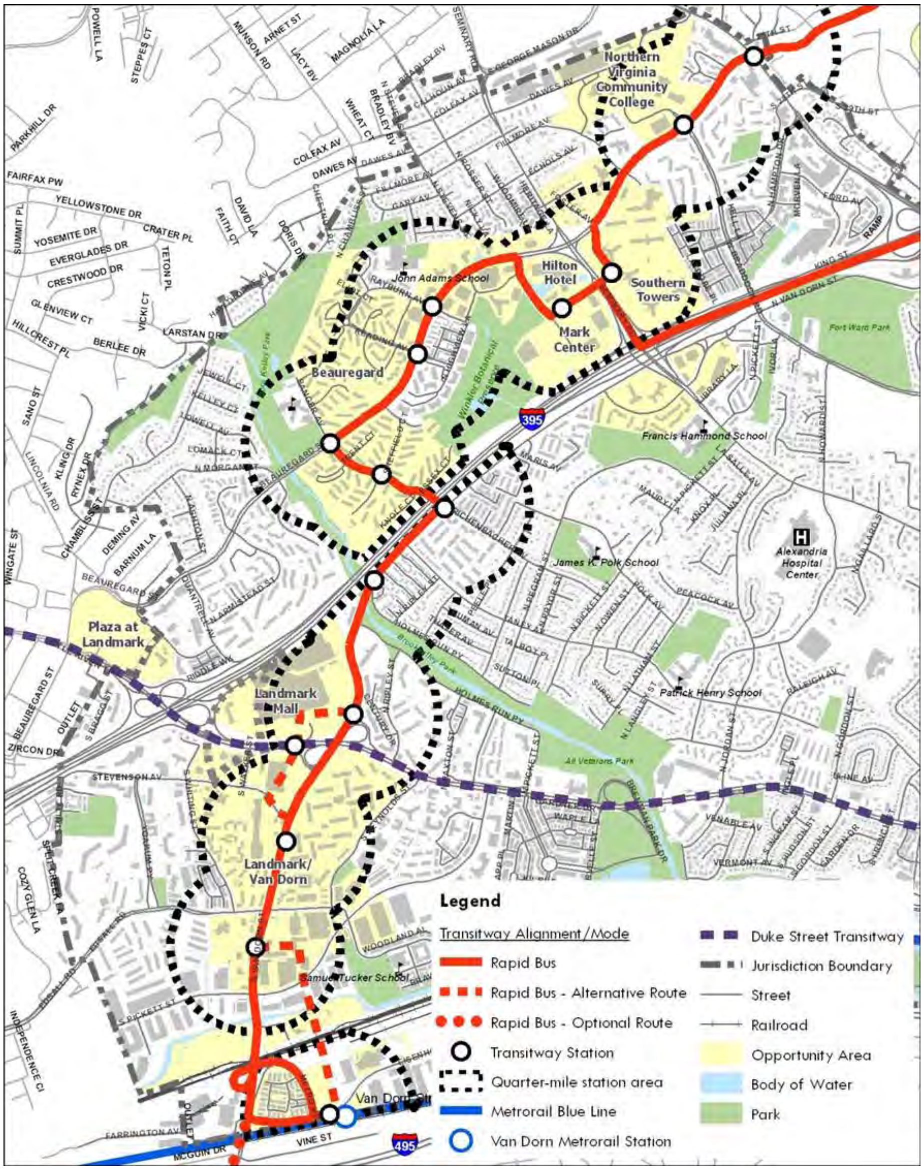


Figure 5.15: Alternative B (Baseline)

Public Comments

- Need for a multi-phased approach to implementing the transitway
- Start out with something smaller, such as a shuttle service or Rapid Bus, not high-capacity transit
- Need something that is permanent, like streetcars that will attract visitors and development
- Concern over negative impacts to the existing Beauregard Street streetscape
- Need dedicated lanes for system effectiveness
- Need to know the ridership estimates before dismissing streetcars
- Sanger Avenue cannot handle a transitway due to existing physical and operational constraints
- Potential environmental impacts to Holmes Run
- Why are we trying to serve/connect to the Pentagon?
- Need to serve local residents over regional trips and provide connectivity to local activity centers
- Need to include access to activity and transit centers in Arlington and Fairfax
- Need to serve more destinations than just along Beauregard/Van Dorn

Based on this data and discussions with city staff, the following three alternatives were removed from consideration:

- Alternative A (Streetcar in mixed-flow with connection to Columbia Pike)—Eliminated due to disproportionate cost to benefit ratio
- Alternative C (Streetcar in mixed-flow and BRT in mixed-flow and dedicated lanes with connections to Columbia Pike & Pentagon)—Eliminated due to disproportionate cost to benefit ratio
- Alternative F (Streetcar in dedicated lane with connection to Columbia Pike)—Eliminated due to deviation from Transportation Master Plan Alignment

Build Alternatives D, E, and G were identified for further analysis. Alternative B was considered as the baseline condition and a potential phase of any alternative. This was in part due to the city's TIGER Grant-funded investment in transit improvements such as queue jump lanes, transit signal priority, and enhanced transit stops along Van Dorn Street and Beauregard Street. Similarly, Alternative C was considered as an optional phase of the three build alternatives.

Secondary Transitway Concepts

The four remaining alternatives that were not eliminated through preliminary screening were retained for further study. This section provides more detailed descriptions of each of the alternatives.

Alternative B (Baseline)

This alternative represents the baseline conditions for the corridor. It would provide Rapid Bus service with stations every quarter-mile. Figure 5.15 shows this alternative. Rapid Bus connections would be available to Shirlington via Beauregard Street and to the Pentagon via I-395 HOV. Alternative B also allows for a future alternative, long-term alignment along a multimodal bridge to the Van Dorn Metrorail station and an optional Rapid Bus extension to Kingstowne in Fairfax County. Principal advantages and disadvantages of this concept include:

Advantages

- Easy to implement/short timeframe for implementation
- Portions of this alternative are funded through an existing TIGER grant
- Negligible impact on right-of-way, natural environment, communities, existing streetscape, etc.
- Low capital cost
- Would improve transit travel speeds in the corridor, but not as much as other alternatives
- Could be a first phase of any of the other alternatives

Disadvantages

- Travels in mixed flow, would be affected by congestion at some locations
- Higher operating cost than other options
- May be less attractive to riders than more capital-intensive alternatives
- Would create delay for traffic due to stopping

Alternative D

This alternative is comprised of BRT service for the entirety of the corridor with stations located every half-mile. The BRT would travel in dedicated lanes where conditions permit. Other aspects of BRT service would be incorporated such as enhanced bus stations and off-board fare collection. Connections would be available to Shirlington via Beauregard and to the Pentagon via I-395 HOV. Alternative D also directly connects to Mark Center and Southern Towers. Figure 5.16 shows Alternative D. Principal advantages and disadvantages of this concept include:

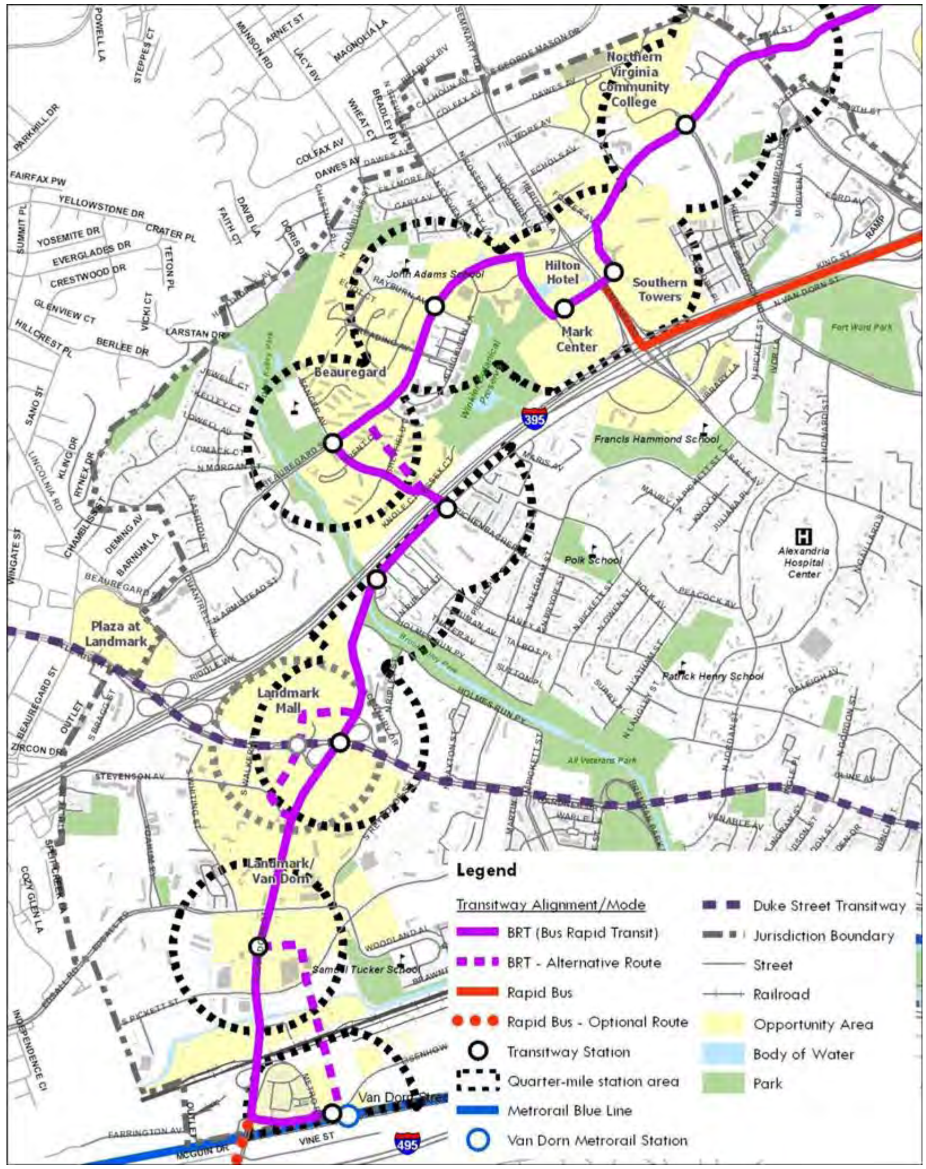


Figure 5.16: Alternative D

Advantages

- Serves multiple regional destinations
- Moderate capital cost—less than streetcar and mixed mode options
- Significant improvement in transit travel speeds between termini
- Relatively efficient from an operations perspective
- Could be an earlier phase of a streetcar alternative

Disadvantages

- May be less attractive to developers to incentivize redevelopment
- Has right-of-way and other physical impacts
- Transfer required to connect to Columbia Pike streetcar if implemented to NVCC campus

Other

- Less total capacity than streetcar; however, has more seated capacity than streetcar (assumes similar headways)

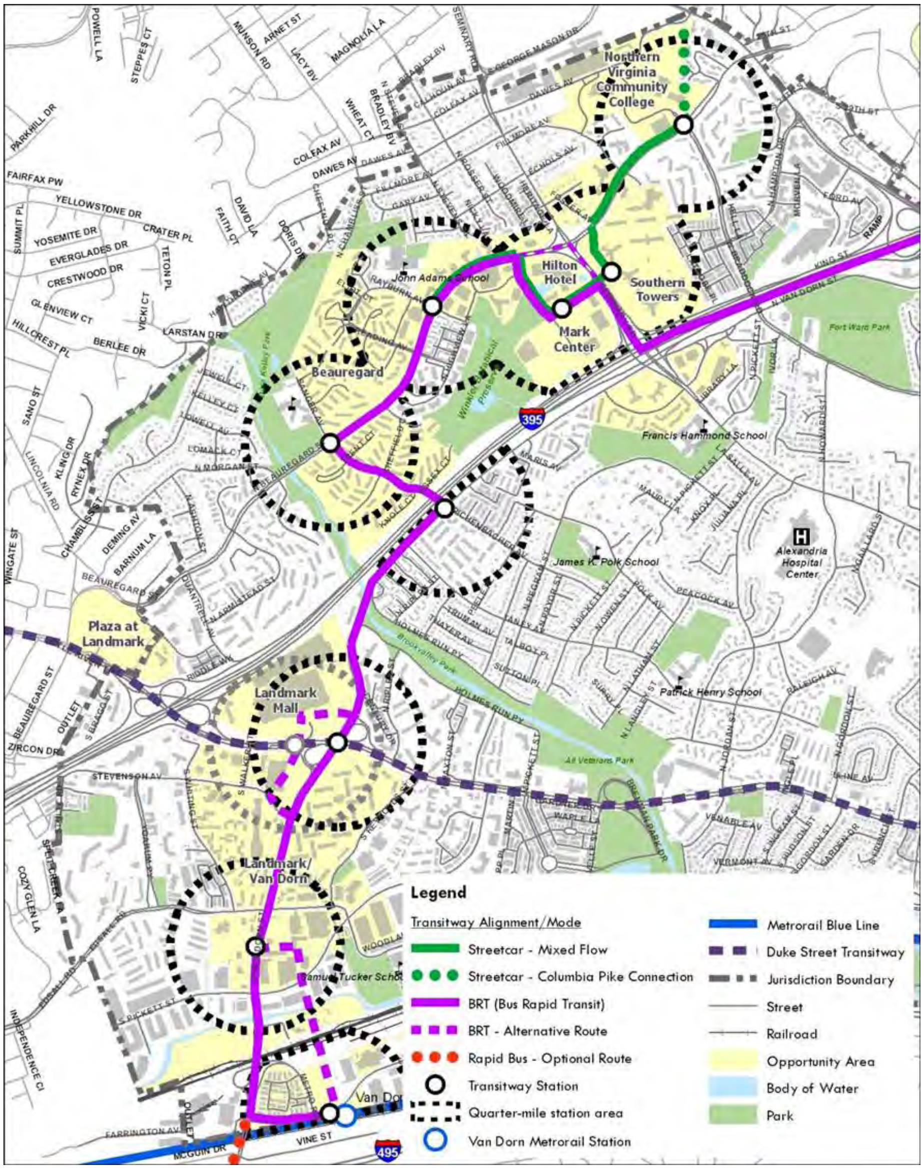


Figure 5.17: Alternative E

Alternative E

This concept represents a combination of BRT in dedicated lanes (where possible) and streetcar. The BRT portion would run between Van Dorn Metrorail station and Southern Towers with stations every half-mile and provide connections to the Pentagon via I-395. The streetcar would be an extension of the Columbia Pike streetcar to Beauregard Town Center, operating north of Seminary Road in mixed-flow lanes. Stations would be located every quarter-mile and direct connections would be made at Mark Center and Southern Towers. Figure 5.17 shows Alternative E. Principal advantages and disadvantages of this concept include:

Advantages

- Serves many local and regional destinations
- Moderate-high capital cost—less than streetcar only options, more than BRT-only options
- Significant improvement in transit travel speeds between termini
- Flexibility in connection to Columbia Pike
- Could be an earlier phase of a full streetcar alternative
- Some attraction to developers

Disadvantages

- Has right-of-way and other physical impacts
- Some transfers required to connect to Columbia Pike streetcar
- Highest operational cost of alternatives containing streetcar due to the use of two transit modes

Alternative G

This alternative provides streetcar service in dedicated lanes for the entirety of the corridor. Stations would be located every half-mile and connection would be provided to the Columbia Pike streetcar. Figure 5.18 shows Alternative G. Principal advantages and disadvantages of this concept include:

Advantages

- Single-seat connection from Van Dorn Metrorail Station to Pentagon/Pentagon City via streetcar
- Significant improvement in transit travel speeds within the Van Dorn/Beauregard corridor
- Some attractiveness to developers
- Lowest operational cost of alternatives (Columbia Pike costs not included)
- Most attractive to development community

Disadvantages

- Substantially higher capital cost than other alternatives studied
- Columbia Pike travel speeds for streetcar will be low (~8 mph)
- Longest travel time between termini
- Has right-of-way and other physical impacts

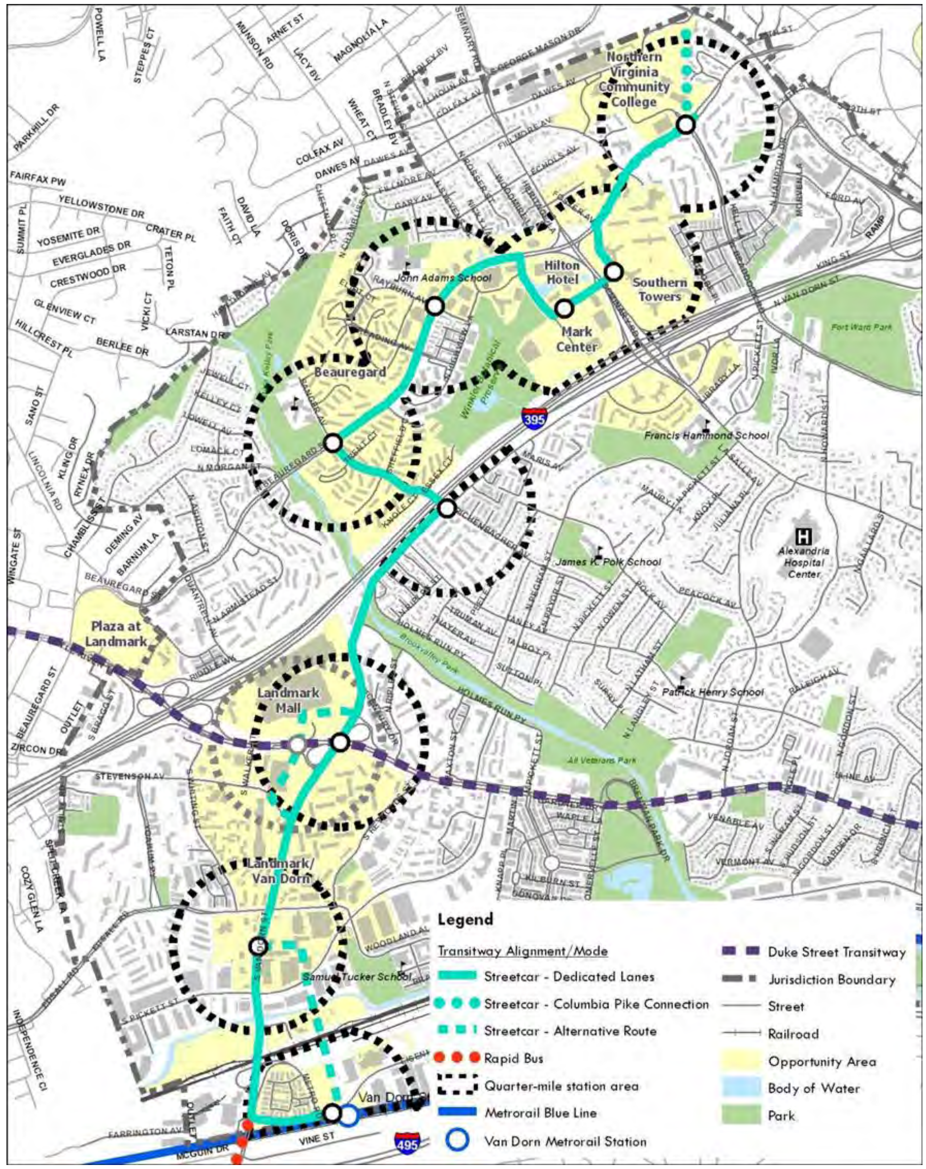


Figure 5.18: Alternative G

Table 5.6: Secondary Screening – Effectiveness

Evaluation Criteria			B (baseline)	D	E	G
		Transit Mode:	Rapid Bus (mixed)	BRT (mixed & dedicated)	Streetcar (mixed) & BRT (mixed & dedicated)	Streetcar (dedicated)
		Northern Connection:	Shirlington & Pentagon	Shirlington & Pentagon	Columbia Pike & Pentagon	Columbia Pike
Coverage	Service to Regional Destinations		◑	◑	●	◑
Coverage	Service to Population, Employment, & Retail in the Corridor		●	◑	◑	◑
Coverage	Transit Connectivity		◑	◑	●	◑
Operations	Running-way Configuration(s)		○	●	●	●
Operations	Corridor Length		◑	◑	●	●
Operations	Capacity		◑	◑	◑	●
Operations	Interoperability		◑	◑	●	●
Operations	Avoidance of Congestion		◑	●	●	●
Operations	Transit Travel Times	In Corridor	◑	●	●	●
Operations	Transit Travel Times	Between Termini	◑	●	●	○
Operations	Ridership		○	◑	●	●
Operations	Intersection Priority		◑	●	●	●
Align-ment	Alignment Quality		◑	◑	◑	◑
Align-ment	Runningway Status		●	◑	◑	◑
Phasing			N/A	●	●	●

Rating:	●	Best	◑	Fair	○	Poor

Table 5.7: Secondary Screening – Impacts

Evaluation Criteria		B (baseline)	D	E	G
	Transit Mode:	Rapid Bus (mixed)	BRT (mixed & dedicated)	Streetcar (mixed) & BRT (mixed & dedicated)	Streetcar (dedicated)
	Northern Connection:	Shirlington & Pentagon	Shirlington & Pentagon	Columbia Pike & Pentagon	Columbia Pike
Econ-omic	Development Incentive	○	◑	◑	●
Natural Enviro-nment	Natural Environment	●	◑	◑	◑
Natural Enviro-nment	Parks and Open Space	●	◑	◑	◑
Neighborhood and Community	Property	●	◑	◑	◑
Neighborhood and Community	Streetscapes	●	◑	◑	◑
Neighborhood and Community	Community Resources	●	●	●	●
Neighborhood and Community	Demographics	●	◑	◑	◑
Neighborhood and Community	Noise and Vibration	○	◑	◑	●
Transportation	Traffic Flow Impact	○	●	●	●
Transportation	Traffic Signals	◑	○	○	○
Transportation	Multimodal Accommodation	○	◑	◑	●
Transportation	Parking	●	◑	◑	◑

Rating:	●	Best	◑	Fair	○	Poor

Secondary Screening

A process similar to the preliminary screening was conducted for the four secondary alternatives. The secondary screening incorporated the preliminary screening criteria and added several more measures of comparison. Each alternative was given a comparative score of 1 (Poor), 2 (Fair), or 3 (Best) for each of the criteria. The criteria were organized into the four groups below:

- Effectiveness
- Impacts
- Cost Effectiveness
- Financial Feasibility

Effectiveness

The effectiveness group of criteria serves to evaluate how well each alternative addresses the transportation issues currently in the corridor. Effectiveness was broken down into four sub-groups: Coverage, Operations, Alignment, and Phasing. In order to rate the alternatives, analysis was performed to forecast transit travel times, total corridor capacity, and total ridership. Table 5.6 summarizes the ratings for the effectiveness group.

Impacts

The impacts group of criteria serves to evaluate the effects of each alternative on four sub-groups. Economic, environmental, community, and transportation impacts were all evaluated. Estimates were made for impacts to property and rights of ways as well as for environmental areas such as parks, streams, and wetlands. Table 5.7 summarizes the ratings for the impacts group.

Cost Effectiveness

The cost effectiveness group of criteria weights the estimated capital, operating, and per-rider costs against their potential benefits. A capital cost estimate based on modal cost per-mile within the City of Alexandria and maintenance facility cost estimation was prepared exclusive of vehicles. The operating cost was based on assumed hours of operations (complementary of Metrorail) and headways. Finally, the cost per rider was calculated based on the forecasted ridership. The cost estimates for each alternative are shown in Table 5.8.

Financial Feasibility

For the financial feasibility group, a scenario of all BRT service (Alternative D) and a scenario of all streetcar service (Alternative G) were analyzed within the scope of the Federal Transit Administration's (FTA) funding allocation programs. Based on the cost estimates, the BRT scenario would fall into the Small Starts program while the streetcar option would be considered a New Start. A review of federally funded projects for fiscal year 2012 shows that New Starts received up to 80% federal funding and Small Start projects received up to 60%. Table 5.9 shows the potential breakdown between federal and local costs for the BRT and streetcar options.

Table 5.8: Secondary Screening – Cost Effectiveness

	Alternative			
	B *(baseline)*	D	E	G
Transit Mode:	Rapid Bus (mixed)	BRT (mixed & dedicated)	Streetcar (mixed) & BRT (mixed & dedicated)	Streetcar (dedicated)
Northern Connection:	Shirlington & Pentagon	Shirlington & Pentagon	Columbia Pike & Pentagon	Columbia Pike
Capital Cost Estimate[1] (exclusive of vehicles, based on modal cost per-mile within the City and maintenance facility cost estimation)	$15 M	$48 M	$67 M	$185 M
25-year Fleet Cost Estimate[2]	$24 M	$20 M	$34 M	$29 M
Right-of-Way Cost Estimate[1, 3]	$0 M	$33 M	$43 M	$50 M
25-year Operating Cost	$67 M	$60 M	$73 M	$59 M
Planning-Level Cost Estimate[4]	**$106 M**	**$161 M**	**$ 217 M**	**$323 M**

Notes

1. Costs assume that Arlington's Columbia Pike streetcar terminates at NVCC at a maintenance facility. Costs for Alternatives E and G would be higher if the Columbia Pike maintenance facility is located in Long Bridge Park due to the location of the terminus of Columbia Pike.
2. Streetcar fleet costs are for the Alexandria portion of the streetcar only and are assumed to supplement Arlington's Columbia Pike fleet.
3. Right-of-way costs do not include property along Eisenhower Avenue, within NVCC, or in locations where development contribution is expected.
4. Planning level cost estimates are shown in year 2010 dollars and do not include additional contingency or escalation to a future year mid-point of construction. Totals listed do not include costs for major utility relocations/new service, or the capital costs for roadway/streetscape improvements that may be implemented concurrently, but are not required for the transit project. Alignments designated as "optional" or "phased" are not included in the cost.

Table 5.9: Conceptual Project Funding

Project	Transit Mode	Total Capital Cost (millions)	Federal Share (millions)	Local Share (millions)	Federal Percent	Section 5309 Project Type
Alternative D	BRT	$88. 0	$70.4	$17.6	80%	Small Starts
Alternative G	Streetcar	$250.00	$150.0	$100.0	60%	New Starts

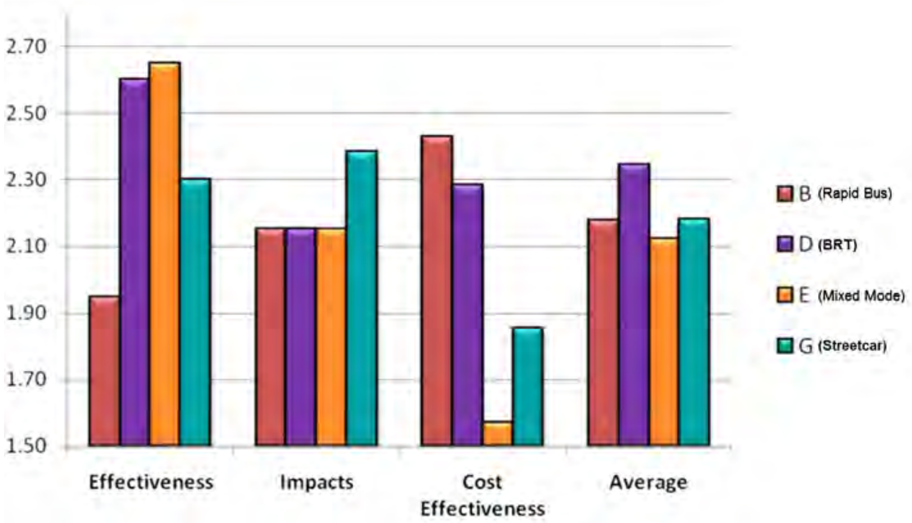


Figure 5.19: Alternative Final Comparative Scores

Scoring

To develop a final score that combined the four groups of criteria, a scoring summary was developed. For each alternative a group score was tabulated, weighting several of the criteria based on importance. The doubly-weighted criteria were:

- Transit travel times in corridor
- Transit travel times between termini
- Ridership
- Phasing
- Traffic flow impact
- Capital cost
- Right-of-way cost
- Operating cost

The scores for the effectiveness, impacts, and cost effectiveness groups were averaged to obtain a final score. The final scores are summarized in Figure 5.19. Alternative D (BRT Service in dedicated lanes) ranked second in each of the three categories and scored the highest of the four of the alternatives.

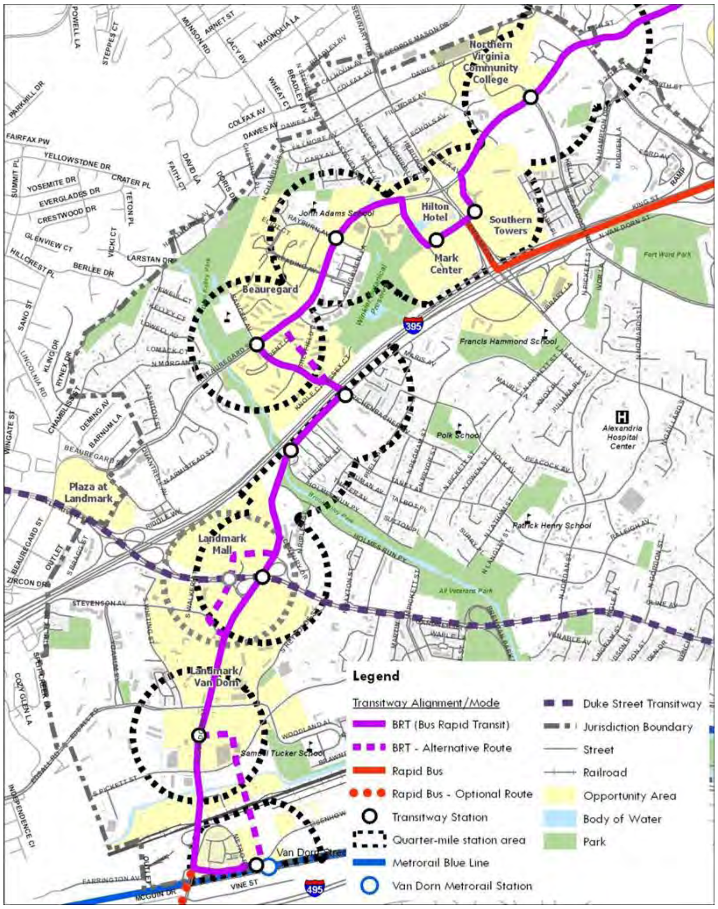


Figure 5.20: Preferred Alternative

Preferred Alternative

As a result of the detailed analysis presented in the previous chapters, it was recommended that Alternative D (BRT service in dedicated lanes) be the concept that is adopted by the Corridor Work Group and ultimately the city. The following sections describe Alternative D's alignment, service, and estimated cost. Figure 5.20 shows Alternative D.

Mode & Connections

Alternative D involves two transit mode technologies. BRT is recommended to operate in mostly dedicated runningway from the Van Dorn Metrorail station to Mark Center Drive. This section of the corridor would provide direct BRT access to major destinations such as Landmark Mall, current and future development along Van Dorn Street, existing and future development along Sanger Avenue and Beauregard Street, and the Mark Center.

At the Mark Center, the transitway service would branch into two lines. Passengers ultimately destined for the line terminus would not need to transfer since both branches would terminate at Pentagon/Pentagon City.

One branch of the service would run express after stopping at the Mark Center and turn onto Seminary Road and use I-395 to make a direct connection to Pentagon/Pentagon City. During peak hours in the peak direction, this branch would use the I-395 HOV lanes.

The second branch of transitway service would travel across Seminary Road and into Southern Towers. This service would then return to N. Beauregard Street as a Rapid Bus service connecting to Pentagon/Pentagon City through Shirlington.

A future connection to Kingstowne via Van Dorn Street on the south end of the corridor is also possible and would need to be coordinated with Fairfax County.

Table 5.10: Preferred Alternative – Anticipated Headways and Hours of Services

Day of Week		Headway	Duration	Total Duration of Operation
Weekdays	Peak	7.5 min	8 hours	18 hours
	Off-Peak	15 min	10 hours	
Saturdays		15 min	18 hours	18 hours
Sundays/ Holidays		20 min	12 hours	12 hours

Table 5.11: Preferred Alternative – Summary of Potential Impacts

Area of Impact	Amount
Parks (Brookvalley Park)	< 1/4 Acre
Waters (Rivers & Lakes)	< 1/8 Acre
Waters (Ditches & Streams)	< 1000 Linear Ft
Wetlands (National Wetland Inventory)	< 3/4 Acre
Right-of-way/Property	~ 14 Acres (62 Parcels)

Table 5.12: Preferred Alternative – Planning-Level Cost Estimate

Capital Cost Estimate	$39 million
25-year Fleet Cost Estimate[2]	$20 million
Right-of-Way Cost Estimate[1,3]	$33 million
25-year Operating Cost Estimate	$60 million
Planning-Level Cost Estimate4	**$152 million**

Notes

1. Costs assume that Arlington's Columbia Pike streetcar terminates at NVCC at a maintenance facility. Costs for Alternatives E and G would be higher if the Columbia Pike maintenance facility is located in Long Bridge Park due to the location of the terminus of Columbia Pike.
2. Streetcar fleet costs are for the Alexandria portion of the streetcar only and are assumed to supplement Arlington's Columbia Pike fleet.
3. Right-of-way costs do not include property along Eisenhower Avenue, within NVCC, or in locations where development contribution is expected.
4. Planning level cost estimates are shown in year 2010 dollars and do not include additional contingency or escalation to a future year mid-point of construction. Totals listed do not include costs for major utility relocations/new service, or the capital costs for roadway/streetscape improvements that may be implemented concurrently, but are not required for the transit project. Alignments designated as "optional" or "phased" are not included in the cost.

Physical Characteristics

Some of the physical characteristics of the BRT service will make the transit service run more efficiently while attracting riders. The BRT vehicles will feature low floors that are accessible to all riders. Off-board fare collection will streamline the boarding process and running in dedicated lanes will make the service faster and more dependable. Service specific branding and substantial transit stations will help attract riders.

Operational Characteristics

Alternative D will feature transit signal priority at some intersections and real-time service information. Transit signal priority allows for extended green time or shortened red time to assist transit vehicles in maintaining their schedule. Real-time service allows riders at stations to know when vehicles will be arriving in addition to allowing for development of mobile phone applications. Table 5.10 provides the headways and hours of service anticipated for Alternative D. Alternative D is forecast to serve 12,500 to 17,500 riders per day.

Cost Estimate

The total planning-level cost estimate* is $152 million which includes costs for capital investments, 25 years of BRT vehicles, right-of-way acquisition, and 25 years of operations. Tables 5.11 and 5.12 summarize the potential impacts and cost estimates for Alternative D respectively. Alternative D has the potential to qualify for federal funding that could account for up to 80% of the project cost under the Small Starts grant program.

These features of Alternative D make it the recommended concept for this study. It should be noted that implementation of Alternative D does not preclude a future streetcar service at a later phase. These recommendations were presented to the Corridor Work Group and the public for discussion.

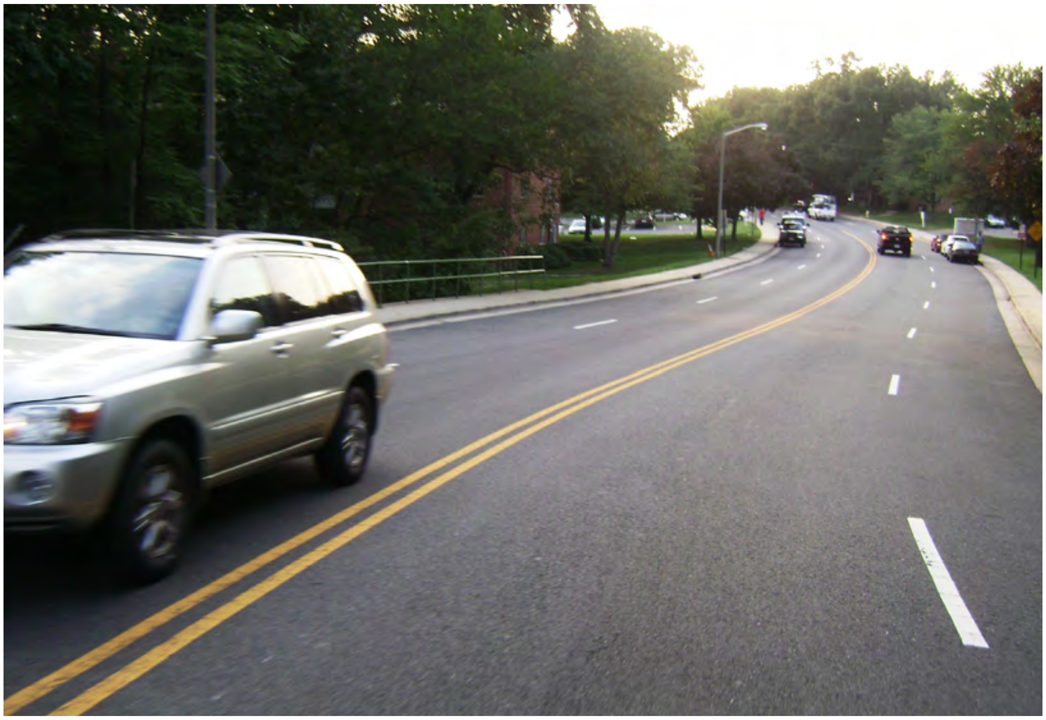
Corridor Work Group Recommendation

The series of Corridor Work Group meetings ultimately concluded with a final recommendation for Corridor C that confirmed Alternative D as the selected concept with the notion that analysis would continue to study the future implementation of Alternative G (streetcar service). On May 11, 2011, the Corridor Work Group concluded:

> *"Alternative D is the preferred alternative for phased implementation of transit in dedicated lanes in Corridor C until such time as Alternative G becomes feasible and can be implemented. This course of action is consistent with the Council's recent decision to provide dedicated lane transit along the segment of Corridor A that is north of Braddock Road. Evaluation and analysis will continue of Alternative D in preparation for future implementation of Alternative G. Construction of transit in Corridor C shall be the first priority of Alexandria's transportation projects. Each subsequent corridor shall be evaluated separately regarding the need to acquire additional right-of-way for dedicated lanes as discussed in the Transportation Master Plan."*

The Corridor Work Group recommendation was approved by the city council on September 17, 2011, following input from the Transportation Commission and Planning Commission, which stressed the need to better serve Northern Virginia Community College.

FUNDING & SCHEDULE
chapter 6


Beauregard Street

Funding Options and Strategies

This section presents funding strategies for the City of Alexandria to meet the capital and operating funding needs for the new transitways under consideration. The potential funding sources and financing options included in this chapter have been considered or employed by other transit agencies for projects similar to those being decided upon by the city. The strategies described here will serve as the basis for identifying and evaluating potential funding approaches that could be developed and utilized by the city.

Some of the capital funding options described here are highly dependent on applying for and receiving federal grant funds from the Federal Transit Administration (FTA). State and local funding are used to provide a local match for federal grant funding and to provide additional funding as needed. The identification of a preferred funding strategy is contingent upon achieving several objectives specific to each project, which may include achieving an equitable balance between the source of funding and the beneficiaries of new transit service; predictability and stability of revenues; elected official and policy maker support; well-defined legal framework for implementing and receiving the funding source; and, if required, pledging to bondholders to support financing.

The information on the FTA process is subject to changes proposed as part of the adoption of the new rule making and regulations on the New Starts, Small Starts, and Alternatives Analysis.

Transit Funding Strategies

Transit agencies nationally fund capital and operating costs from a combination of FTA and other federal grants, state and local funds, farebox revenue, and other directly generated revenue sources. **Capital costs** are the one-time upfront costs associated with the planning, design, and construction of a new or expanded transit service. Capital cost items may include, but are not limited to, design and engineering, right-of-way acquisition, dedicated runningway, stations and terminals, maintenance facilities and equipment, vehicles, and technologies. **Operating costs** are the ongoing costs associated with vehicle operations, maintenance, security, and administration expenses for a transit service.

Federal Funding Sources

Federal funding for the transitways being evaluated by the City of Alexandria is available from several FTA programs. These include: New Starts, Small Starts, and Very Small Starts programs; the Urbanized Area Formula Grants; the Bus Capital Program; and the Fixed Guideway Modernization program. In addition, funding for part of the transitways may be obtained from flexible multimodal capital assistance programs delivered as part of the federal highway program from the Federal Highway Administration (FHWA).

The following text describes the major FTA and FHWA programs that the transitways may be eligible to receive funding from.

- Section 5309 New Starts, Small Starts, Discretionary Bus and Fixed Guideway Modernization Programs: The Section 5309 program consists of several components. For transit agencies pursuing the development and construction of a new service, FTA grants can fund a portion of project costs under the New Starts and Small Starts programs.

  Under the Small Starts program, the total project cost must be less than $250 million. Transit agencies can seek FTA funding for up to 80% of project costs, up to a maximum of $75 million. A project with total costs of greater than $250 million fall under the New Starts program, for which transit agencies can also seek FTA funding for up to 80% of project costs. Funding provided under both of these programs is awarded based on considerations that include an assessment of the project's transportation benefits and local financial commitment. The Section 5309 New Starts and Small Starts programs are highly competitive—grant funds are extremely limited and the demand for these funds is significantly greater than the funds available. Given competition for funding and ongoing resource constraints, transit agencies often apply for funding levels that are less than 80%.

  Section 5309 also includes the Fixed Guideway Modernization program, which provides capital and capitalized maintenance assistance for fixed guideway rail and bus rapid transit services. Bus systems can receive grant funding for the purchase of new vehicles under a discretionary grant program.

  It should be noted that existing FTA project development requirements for New Starts and Small Starts (including alternatives analysis, environmental clearance, and preliminary engineering) could take 3 to 5 years before the construction could begin. FTA is proposing, as part of its 2012 budget, to reduce the steps in the project development process which may reduce the time it currently takes to complete the process. If the city prefers to start construction and operate the selected transitways on a fast track schedule, alternative non-FTA funding sources should be explored.

- Section 5307 Urbanized Area Formula Grant Program: This is the core grant funding program for transit agencies, particularly for bus systems. Section 5307 grants are provided to fund transit capital needs and capitalized maintenance. FTA grants fund up to 80% of eligible project costs and are allocated to urbanized areas by a formula based on demographic, level of service, and ridership variables.

- Other FTA and FWWA Grant Programs: Several smaller grant programs may also be available to support transit capital and operating needs.
  - *FTA Section 5308 Clean Fuels:* Grants are provided for projects such as purchasing or leasing clean fuel buses, including buses that employ a lightweight composite primary structure, vans for use in revenue service, and constructing or leasing clean fuel bus facilities or electrical recharging facilities and related equipment.
  - *FHWA Congestion, Mitigation, and Air Quality (CMAQ) Program:* CMAQ program funds are available to areas designated by the Environmental Protection Agency as "non-attainment" or "maintenance areas" based on national ambient air quality standards for carbon monoxide and ozone.

Eligible activities under the CMAQ program include transit system capital expansion and improvements that are projected to increase ridership, alternative fuel projects, public/private partnerships, travel demand strategies, and construction of high-occupancy vehicle lanes.

State Funding Sources

States provide capital and operating assistance to transit agencies which are derived from allocations of a state transportation trust fund, general fund appropriations, or tax revenues dedicated to transit. Many states provide more than one source of funding for transit. Some of the more common sources of state funding are discretionary transfers from general funds and highway funds, and dedicated sources such as lotteries, special taxes, or sales taxes. Transit systems in states that primarily rely on discretionary funding sources receive funds at the discretion of the state legislatures, resulting in state contributions that can vary significantly from year to year. Transit systems in states with dedicated funding sources such as sales taxes or fees receive relatively more consistent and reliable state contributions, but remain susceptible to macroeconomic volatility.

Regional and Local Funding Sources

According to the Transit Cooperative Research Program's 2009 report entitled *Local and Regional Funding Mechanisms for Public Transportation*, transit agencies serving regions with a population ranging from 200,000 to 1.0 million depend primarily upon tax revenues and general fund contributions for local funding support. The following highlights the features of local and regional funding sources typically used by transit agencies to help fund their capital and operating needs.

Sales Tax: Sales tax is the most commonly accepted dedicated funding source for transit and has historically provided the greatest revenue yield compared to other sources. Sales taxes are sensitive to economic cycles; numerous transit agencies that utilize this revenue source have had to contend with recent declines as a result of the national recession starting in 2008. Sales taxes are typically imposed at rates ranging from 0.25%, such as St. Louis' Bi State Development Agency for its Proposition M tax, to 1% for the Greater Cleveland Regional Transit Authority. The Los Angeles County Metropolitan Transportation Authority has three voter-approved sales taxes dedicated to the construction, improvement, and operation of the county's transit network.

Property Tax: Ad valorem property taxes are the most common revenue source to support general government services. While historically less sensitive to economic cycles than sales taxes, property tax revenue yield and growth is dependent upon economic and demographic conditions and assessed property values. Property taxes have been imposed for special districts and have been dedicated to transit. In addition to funding systemwide transit needs, property taxes can also be used to fund specific projects. Within Fairfax County, a transportation improvement district was established, subject to the approval of the majority of property owners. A tax surcharge on commercial and industrial properties in Tyson's Corner is being used to fund in part the extension of Metrorail service to Dulles International Airport.

Tax Increment Financing: Under a tax increment financing (TIF) district scheme, taxing districts are created to pledge future tax revenues toward funding infrastructure improvements within the district. The TIF district is set up to encourage real estate development of a specific area. The City of Alexandria could set up the TIF district around the new transit corridors. At the beginning of the district's existence, the TIF establishes a base-year tax level for a district. As development in the district occurs, the cumulative value of properties within the district increases, thereby increasing tax revenues. Any taxes generated above that base-year amount through increases in property values are allocated to the district, which could then be used to fund the transit corridor project. TIF revenues are highly sensitive to real estate market conditions and are also dependent upon achieving development expectations within the district. There are a number of other related approaches for transit agencies to generate revenue from the value enhancements of adjacent properties, collectively referred to as value capture strategies.

Developer Agreements: Improved accessibility provided by transit services increase the attractiveness of commercial, retail, and residential properties that are served. Recognizing the benefits of improved transportation access and higher resulting property values, developers are sometimes willing to fund a portion of park and ride lots, overpasses, walkways, and other facilities that connect transit services to these properties. There may be opportunities for dedication of right-of-way by developers, such as with the Corridor C Beauregard area. Developers could also be required to fund such facilities if required through an impact fee scheme. In addition, the transit agency may have the opportunity to enter into a long term lease of any adjacent property not directly needed for the transit services that could be used for commercial or retail development. Such developments also benefit the transit agency through increased ridership. Transit agencies such as MDT in Miami; SEPTA in Philadelphia; WMATA in Washington, D.C.; and MARTA in Atlanta have implemented joint development projects around station areas through ground and air rights leases to provide supplemental revenues. Given that joint development potential is project specific, the revenues derived are sensitive to local real estate conditions and business terms executed with the private developer. While this funding source typically represents a small share of transit revenues, it does provide a supplemental resource that can also yield important ridership benefits.

Fare Revenue: Revenue from passenger fares is a significant source of directly generated transit agency funding. Passenger fares can be paid for an individual transit trip, or can be paid up front by purchasing a monthly pass or other type of pre-paid product. Fare revenue is typically applied to operating costs; the ratio of fare revenue to operating costs is referred to as the farebox recovery ratio.

Other Directly Generated Revenue: Other options that transit agencies have to directly generate funding include advertising (on vehicles or in stations, for example), concessions (fees paid by retailers who sell products at transit stations or terminals), parking (tolls paid by travelers who use park-and-ride lots owned by the transit agency), and investment income (income derived from the investment of transit agency funds).

Transit Financing Strategies

Nationally, transit agencies generally fund their capital expenses utilizing pay-as-you-go funds from federal, state, and regional/local sources. However, a number of agencies utilize debt financing for the acquisition of major capital assets such as buses, facilities, and/or new major infrastructure investments such as to support a bus rapid transit or light rail project. Debt financing is applied when annual revenues are not sufficient for the cost effective acquisition or implementation of a project on a pay-as-you-go basis, but can support debt service payments for bonds issued to finance capital project needs—these payments typically continue after the capital project has been completed. Financing strategies typically used by transit agencies are listed below.

Dedicated Revenue Bonds: This is the most common debt structure used by transit agencies or local governments. Under this structure, an issuer with a dedicated revenue stream, such as a sales tax, pledges the revenues it receives to the repayment of the bonds. Given investors typically want to be protected from a transit agency's operating cost obligations, these types of bonds are secured by all dedicated tax revenues, commonly referred to as a gross revenue pledge. After paying the debt service and other obligations under the bond documents governing the security structure, surplus revenues can then be provided to the transit agency to support operating and pay-as-you-go capital needs. Pledged revenues that are derived from a stable and growing funding source and exceed the amount of annual debt service requirements by two times or greater generally are rated highly by the rating agencies.

General Obligation Bonds: Another security option is the issuance of a general obligation bond where an issuer pledges its full faith, credit, revenues, resources, and property to the full and timely payment of the bonds. General obligation bonds are typical for states and local units of government that have tax-raising authority.

Debt Secured by FTA Formula Funds: Transit agencies have also issued debt secured by and payable from FTA formula funds, typically known as grant anticipation revenue vehicles (GARVEEs). GARVEEs have been employed by a number of agencies including NJ TRANSIT, Chicago Transit Authority, Los Angeles County Metropolitan Transportation Authority, Bay Area Rapid Transit, and the Alaska Railroad. There is a long track record of FTA funding support, and GARVEEs are an accepted security structure.

Another form of bond is the grant anticipation notes (GANs), which are largely equivalent to GARVEEs. This form of bond allows transit agencies and grant recipients to borrow against future FTA funds. Several transit agencies have leveraged their New Starts funds through debt secured by amounts received from the FTA under a Full Funding Grant Agreement (FFGA). Similarly, Small Starts funds can be leveraged through debt secured by amounts received under a Project Construction Grant Agreement (PCGA). Debt terms for these structures typically are relatively short at ten years or less, based on conservative assumptions for the payout of New Start or Small Start funds under the grant agreements.

TIFIA: The Transportation Infrastructure Finance and Innovation Act (TIFIA), which was created in 1998 by Federal TEA-21 legislation, allows funds to be borrowed from the Federal government rather than from the capital market. The strategic goal of the TIFIA program is to leverage Federal resources and stimulate private capital investment by providing credit assistance (up to one-third of the project cost) for major transportation investments of national or regional significance. *As it is an oversubscribed program, TIFIA may not be a realistic funding option for Alexandria and is only included here for informational purposes. MAP-21 increases program funding significantly; however, it is still expected to be substantially oversubscribed.*

The TIFIA program has a minimum project cost threshold for eligibility, which is the lower of $50 million or 33 percent of a state's annual Federal-aid apportionment for highway projects. Interest rates are at the Federal funds' rate rather than the tax-exempt municipal market rate, and are lower than the taxable rate. Funds are underwritten by Federal funding sources from dedicated user revenue streams. The saving between taxable and treasury rates is often between 125 and 200 basis points. Both principal and interest payments can be deferred for at least five years and possibly up to 10 years.

Program Implementation Schedule

This section provides an overview of a program implementation schedule for the City of Alexandria to meet the process and review requirements to gain recommendation and approval for funding from the FTA. The implementation schedule depicts the overall process including major phases and major activities that are typical and required by the FTA under the Small Starts program. A complete implementation schedule, including more detailed activities, start and finish dates, and activity durations may be developed after all the activities have been fully identified and refined.

For the purpose of this document, it is assumed that the selected Corridor C meets the definition and requirements in the Small Starts program. The New Starts and Very Small Starts programs are included for information and comparison purposes only. The process and planning requirements are based on the latest published guidance from the FTA. The information on the FTA process is subject to changes proposed as part of the adoption of the new rule making and regulations on the New Starts, Small Starts, and Alternatives Analysis.

Background

The FTA Capital Investment Grant Program, under Section 5309 of Title 49 of the United States Code, provides federal capital funds to help states, cities, and localities plan and build new heavy rail, light rail, commuter rail, streetcar, and bus rapid transit systems. FTA evaluates and recommends New Starts projects to Congress for grant awards and then provides those grants to project sponsors, typically transit agencies and other local governments. Over the last decade, FTA has provided more than $10 billion in New Starts funding to help design and construct transit projects that annually provide billions of passenger trips nationwide.

In 2005, the Safe, Accountable, Flexible, Efficient Transportation Equity Act-A Legacy for Users (SAFETEA-LU) created a new category of lower cost projects called the Small Starts program. Its purpose is primarily to streamline the project development process and the evaluation and rating criteria that apply to larger-dollar New Starts projects. At the time Small Starts was established, FTA created an even more streamlined evaluation process within the Small Starts program for very low-cost projects called Very Small Starts. An additional category titled Exempt was also added to provide funding for projects identified primarily by Congress. These projects are exempt altogether from the evaluation and rating process. As outlined in Section 5309 of Title 49 of the United States Code, projects are categorized by total cost and federal contribution as well as meeting other requirements to qualify for funding.

New Starts: Projects that have total capital costs of more than $250 million or are requesting $75 million or more in federal funding.

Small Starts: Total estimated project cost is under $250 million and requested federal contribution is under $75 million.

Very Small Starts: Created within the Small Starts program, projects with total estimated project cost under $50 million with requested federal contribution of less than $25 million. These projects are simple, low-risk projects that qualify for a highly simplified project evaluation and rating process by FTA.

Exempt: Projects with federal contribution of under $25 million, regardless of the total project cost, and exempt from the evaluation and rating process.

Small Starts Program

Eligibility

In addition to the cost and funding limits in Section 2, a Small Starts project must (a) meet the definition of a fixed guideway for at least 50 percent of the project length in the peak period, (b) be a new fixed guideway project, or (c) be a new corridor-based bus project with all of the following minimum elements:

- Substantial transit stations
- Traffic signal priority/preemption, to the extent, if any, that there are traffic signals on the corridor
- Low-floor vehicles or level boarding
- Branding of the proposed service
- 10-minute peak/15-minute off-peak headways or better while operating at least 14 hours per weekday

Only projects which feature all of these elements are eligible for Small Starts funding. Projects proposed in corridors with any pre-existing elements are not eligible for Small Starts funding, but would be eligible under FTA's formula capital and discretionary bus programs.

Funding Recommendation Requirements

Small Starts projects that meet the following conditions may be recommended for funding in the President's Budget, subject to funding availability:

- The project must have been approved to enter into project development
- The project must be "ready" to be implemented within the fiscal year the project is proposed for funding
- The project must be rated at least "medium" on the basis of established project justification criteria and local financial commitment. This is described in more detail later in this chapter

As with all Section 5309 Capital Investment Grants, the rating process is separate from the budget decisions. Projects that achieve a "medium" or better rating will be eligible to receive Section 5309 Capital Investment Grant funds, but are not guaranteed to receive any funding in the President's Budget.

Project Development

This section provides an overview of the project development process requirements under FTA's New Starts, Small Starts, and Very Small Starts programs. While the Small Starts program is considered most appropriate for Alexandria's investment opportunities, background on the New Starts and Very Small starts programs are also provided here for context.

MAP-21 Implications Overview

It should be noted that the FTA's Small Starts process under the recently passed Moving Ahead for Progress in the 21st Century (MAP-21) transportation authorization bill is likely to change. These changes will have implications for the program implementation schedule for the City of Alexandria to meet the process and review requirements to gain recommendation and approval for funding from FTA.

It is important to understand that FTA has not fully determined how all MAP-21 requirements —including those for Small Starts projects—will be implemented. Rather, it is expected that FTA will continue to roll out its requirements over the next few years.

Following the discussion in this document of the current FTA Small Starts program are notes on changes are based on the MAP-21 legislation itself and FTA's comments on that legislation as of September 2012. It is suggested that further reviews be conducted at later dates as FTA provides more details on specific program requirements. A date of particular importance for the City's proposed projects is March 2013 when FTA will issue policy guidance for Small Starts review and evaluation criteria. A revised evaluation and rating process rule is due in October 2013.

Current FTA Project Development Overviews

New Starts: Under the New Starts program, projects are required by law to go through a planning and project development process, which is divided into the following phases:

- Alternatives analysis (AA)
- Preliminary engineering (PE)
- Final design (FD)
- Construction (including testing and start-up)

In the alternatives analysis phase, project sponsors identify the transportation needs in a specific corridor and evaluate a range of modal and alignment alternatives to address the locally identified issues in that corridor. Project sponsors complete the AA phase by selecting a locally preferred alternative.

During the PE phase, project sponsors refine the design of the locally preferred alternative and its estimated costs, benefits, and impacts. When the PE phase is completed and federal environmental requirements are satisfied, FTA may approve the project's advancement into final design, after which FTA may recommend the New Starts project for a full funding grant agreement (FFGA). An FFGA establishes the terms and conditions for federal participation in a transit project.

Small Starts and Very Small Starts: The Small Starts and Very Small Starts programs have similar project development processes, with fewer requirements for the Very Small Starts. These processes are condensed relative to the process for larger New Starts projects. For Small Starts, the preliminary engineering

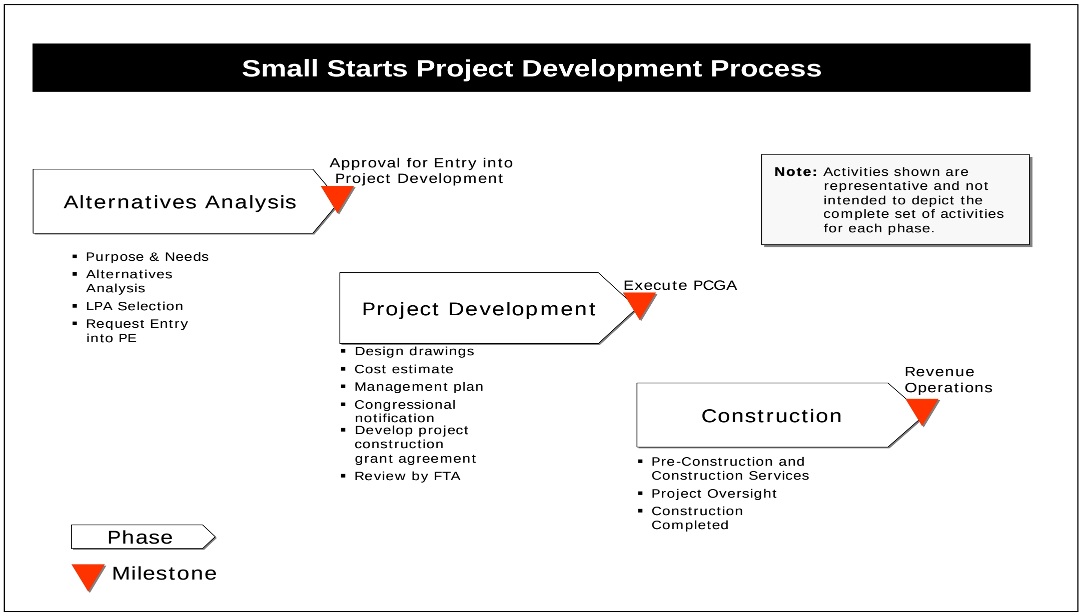


Figure 6.1: Small Starts Project Development Process

and final design phases are combined and referred to as the project development phase. When projects apply to enter project development, FTA evaluates and rates Small Starts projects on both project justification and local financial commitment criteria, but compared to New Starts projects there are fewer statutorily prescribed project justification criteria for these projects. Very Small Starts projects also progress through a single project development phase and are evaluated and rated on simplified project justification criteria.

FTA may recommend Small Starts and Very Small Starts projects to Congress for funding once the projects have been approved to enter into project development and meet FTA's "readiness" requirements. Congress makes the final appropriations decisions on projects. FTA provides funding for Small Starts and Very Small Starts projects in one of two ways:

- Through project construction grant agreements (PCGAs)
- Through single-year construction grants when the New Starts funding request is less than $25 million and can be met with either a single-year appropriation or existing FTA appropriations that remain available for this purpose

Planning and Project Development for Small Starts

During the planning and project development process, FTA evaluates the project's justification and local financial commitment, and the sponsor addresses any remaining planning, environmental, engineering, and design issues and requirements. FTA is required by law to approve the initiation of project development and to make funding recommendations after the project development process is complete. As shown in Figure 6.1, there are three phases in the Small Starts project development process: AA; Project Development; and Construction.

Alternatives Analysis Phase

By law, FTA must consider the results of planning and AA when evaluating proposed projects. Small Starts may utilize a simplified AA process relative to New Starts projects with fewer alternatives evaluated, commensurate with the local decision at hand. Nevertheless, the number of alternatives considered must continue to meet the environmental requirements, good planning practices, and proper identification of project costs and benefits for funding recommendations.

Purpose and Need: The purpose and need of a project is essential in establishing a basis for the development of the range of reasonable alternatives and assists with the identification and eventual selection of a preferred alternative. Items that are typically included in the purpose and need statement include project status, capacity, system linkage;, transportation demand, legislation, social demands or economic development, modal interrelationships, and safety.

AA and Locally Preferred Alternative: During AA, the corridor is evaluated focusing on the effects of alternative solutions to the corridor's transportation problems. The set of alternatives must address the purpose and need for considering a major transportation investment. Information on the costs, benefits, and impacts of each alternative is developed to provide a sound technical basis for project decision-making. At the conclusion of AA, local officials select a preferred mode and general alignment, adopt a plan for financing the project's capital and operating costs, and request FTA's approval to enter project development.

FTA identifies which Small Starts projects are admitted into project development on the basis of project justification criteria, and local financial commitment.

Project Justification Criteria: The project justification criteria used for the project rating process are as follows:

- Cost Effectiveness (one-third) – Incremental project cost divided by incremental user benefits between the Small Starts Baseline and Build alternatives. To achieve a rating of "Medium" or better, the resulting cost effectiveness value must be less than $25.00.
- Transit Supportive Land Use (one-third) – The transit-supportive land use rating for Small Starts projects will be based on existing population and employment within a half-mile of station areas.
- Economic Development Effects (one-third) – The economic development effects rating will be based on the transit-supportive plans and policies in place and the performance and impact of those policies.

FTA assesses other factors not captured by these criteria on a project-by-project basis.

Local Financial Commitment: A simplified evaluation method for local financial commitment applies if the project sponsor can demonstrate the following:

- A reasonable plan to secure funding for the local share of capital costs or sufficient available funds for the local (non-Federal) share
- The additional operating and maintenance cost to the agency of the proposed project is less than 5 percent of the sponsor's system-wide operating budget
- The project sponsor is in reasonably good financial condition as demonstrated by the past three years' audited financial statements

Where these criteria apply, FTA does not require the project sponsor to submit a detailed financial plan. The local financial commitment rating is determined according to the Small Starts funding share requested by the sponsor. If the share is over 50 percent, the rating will be "Medium"; if the share is 50 percent or less, the rating will be "High."

In all other cases, FTA requires the Small Starts project sponsor to submit a detailed financial plan that includes the period up through the opening year of the project. FTA reviews the plan, and assigns a summary local financial commitment rating of “High,” “Medium-High,” “Medium,” “Medium-Low,” or “Low” based on the following factors: Small Starts funding share (20 percent); capital plan strength and reliability (50 percent); and operating plan strength and reliability (30 percent).

Overall Rating: FTA averages the project justification and local financial commitment ratings to determine an overall project rating of “High,” “Medium-High,” “Medium,” “Medium-Low,” or “Low” for each proposed Small Starts project. A “Medium” overall project rating requires a rating of at least “Medium” for both project justification and local financial commitment. Per direction in SAFETEA-LU, a project must receive an overall rating of at least “Medium” to be admitted into project development or receive construction funding.

Project Development Phase

For Small Starts projects, preliminary engineering and final design work is combined into one phase referred to as Project Development. Below are the criteria that must be met for approval for a project to proceed into Project Development:

- Complete Alternatives Analysis
- Adopt Locally Preferred Alternative (LPA)
- LPA is included within the metropolitan planning organization’s (MPO) long range plan
- Complete National Environmental Protection Act (NEPA) scoping
- Receive a “Medium” rating or better from FTA on the basis of project justification criteria and local financial commitment as described previously
- Acceptable project management with a fair and reasonable project budget and schedule

Financial assistance under Section 5309 for construction of a Small Starts project is provided through a Project Construction Grant Agreement (PCGA). FTA will negotiate a Project Construction Grant Agreement with the grantee during project development. Execution of the Project Construction Grant Agreement will be subject to a 60-day congressional review.

Construction Phase

Once the PGCA has been executed, project pre-construction and construction activities can begin.

Estimated Overall Duration

The project development process could take between three to five years from the start of the AA to the start of the construction. The duration is predicated upon the complexity of each project undertaken by the sponsor. A more complete implementation schedule for the Corridor C project can be developed once the City of Alexandria and the Kimley-Horn team refine the activities and their durations for each phase of the project.

MAP-21 Provisions

Moving Ahead for Progress in the 21st Century (MAP-21), the federal transportation authorization bill for FY13 and FY14, was signed into law on July 6, 2012 and takes effect on October 1, 2012. MAP-21 replaces the existing surface transportation authorization (SAFETEA-LU), which expires on September 30, 2012. Changes to the law are permanent,

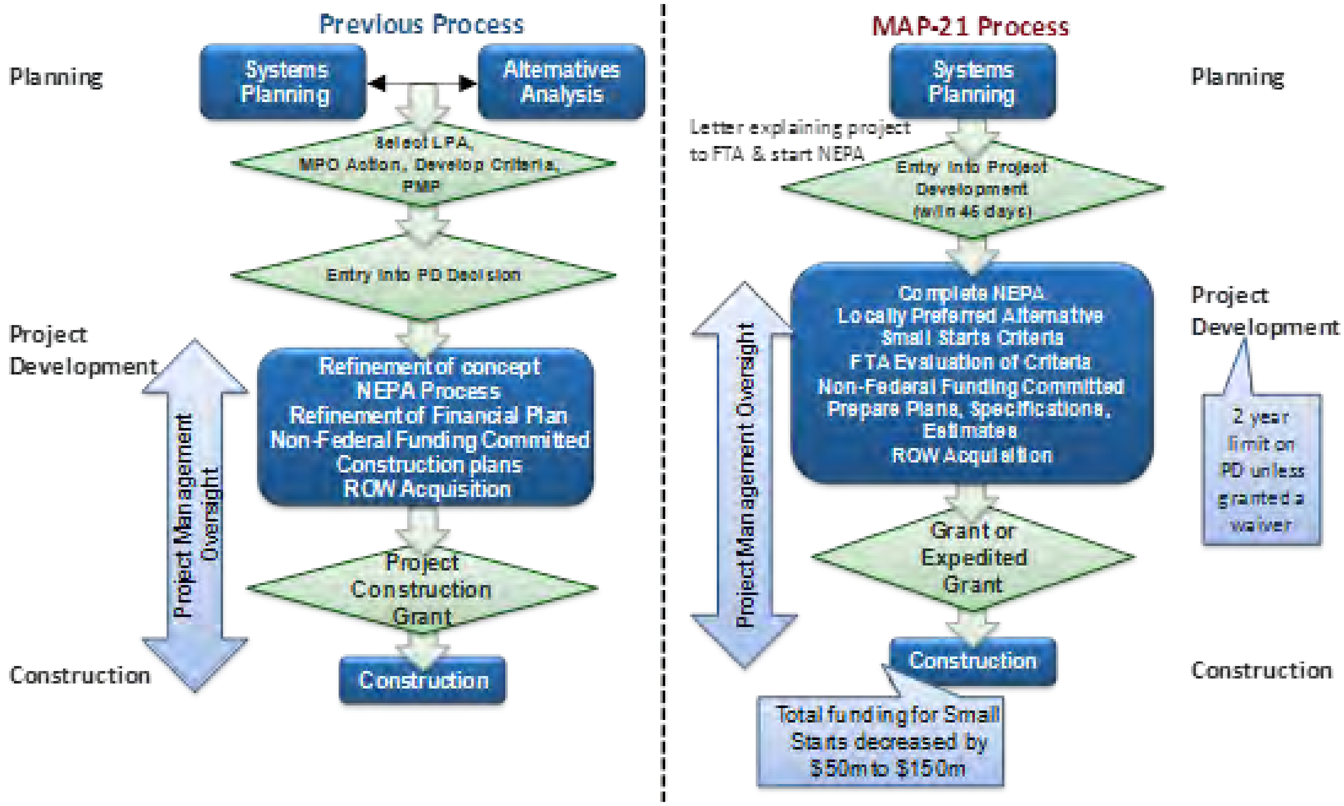


Figure 6.2: Changes to Small Starts Process from SAFETEA-LU to MAP-21

even though it only authorizes two years of funding.

MAP-21 provides funding authorization and deadlines for the Federal Transit Administration (FTA), with a focus on accelerating processes to enable FTA to review and approve projects more quickly. While overall FTA funding authorization increases under MAP-21 (from $10.46 billion in FY12 to $10.58 billion in FY13 and $10.76 billion in FY14), increases in funding and some redistribution between funding programs are intended to place increased emphasis on State of Good Repair (SGR) related investments.

Changes to FTA Small Starts Program

Funding: MAP-21 authorized $150 million in Small Starts Program funds for both FY13 and FY14, down from $200 million in FY12. Existing New Starts/Small Starts funding commitments will be honored before FTA provides any new approvals. Eligibility for Small Starts funding remains limited to projects under $250 million in total cost and seeking less than $75 million in Federal funding.

Streamlined Process: MAP-21 streamlined the Small Starts process as shown in Figure 6.2. The objectives of streamlining are both to simplify the process and to shorten the period of project development and construction:

- The Alternatives Analysis component is removed (to "eliminate duplication with NEPA"), although a Locally Preferred Alternative (LPA) must still be identified from a review of potential alternatives derived from the metropolitan planning and environmental review processes.
- No Build is now considered the Baseline Alternative; Transportation System Management (TSM) is no longer included in the process.

To request entry into PD/NEPA, grantees must submit a letter explaining the project to FTA. FTA is to respond to the request within 45 days.

The PD phase still consists of multiple components including the NEPA process, Small Starts Criteria Evaluation, non-federal funding commitment assessment and right-of-way acquisition. There is a two-year limit to complete the PD phase unless a waiver is granted by FTA. Project management oversight activities are initiated at PD.

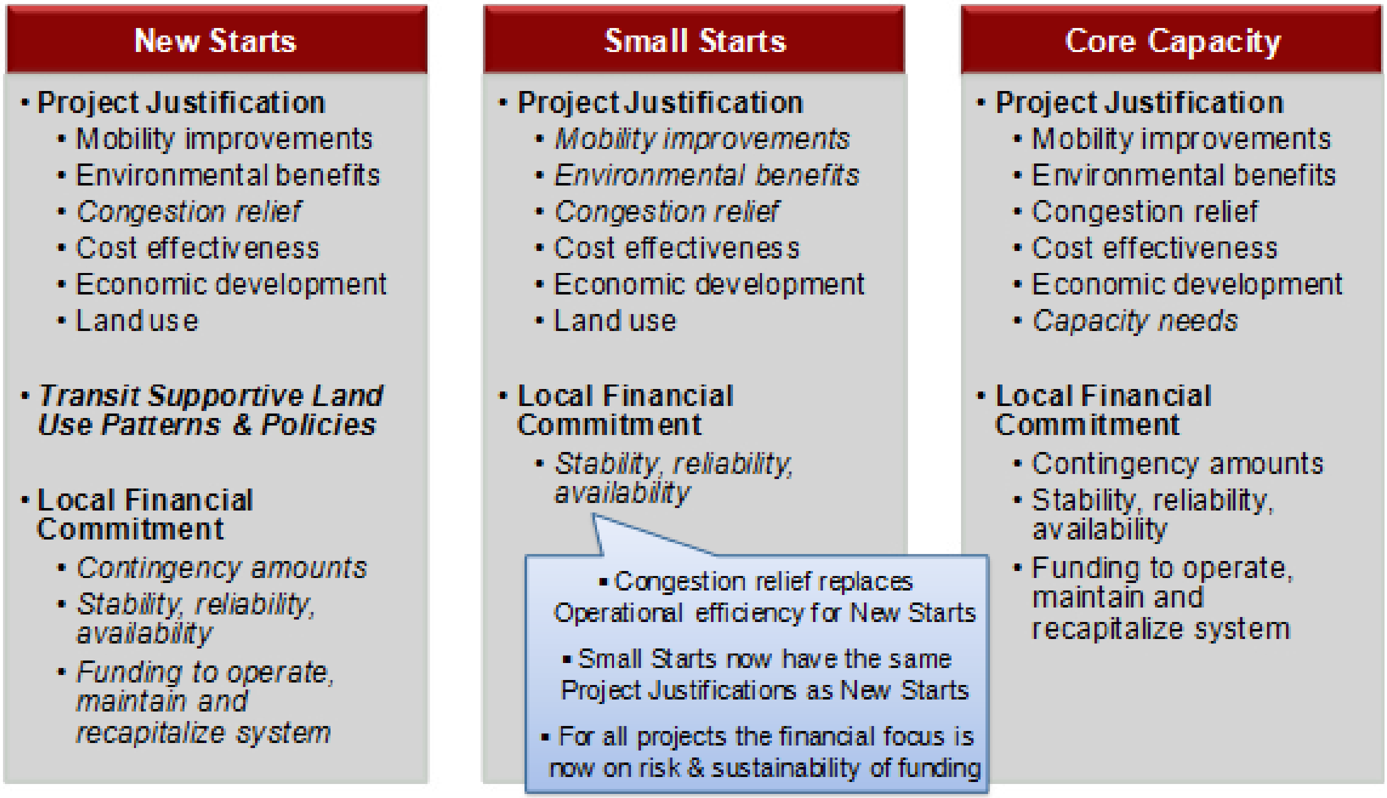


Figure 6.3: Project Justification Criteria under MAP-21

- Congressional notification of grant award is 10 days for Small Starts projects.
- Small Starts are funded projects through a single year grant or an expedited grant agreement.

Ratings Criteria: The project justification criteria for Small Starts have expanded under MAP-21 and are now the same as for New Starts as shown in Figure 6.3. Specifically, the rating criteria for Small Starts projects now include:

- Mobility improvements (new for Small Starts)
- Environmental benefits (new for Small Starts)
- Congestion relief (new for Small Starts. replaces operational efficiencies for New Starts, calculation TBD)
- Cost Effectiveness (new calculation TBD)
- Economic development
- Land use

Under certain conditions (not yet specified), MAP-21 allows for the use of "warrants" that "pre-qualify" a project for automatic ratings on some justification criteria based on that project characteristics. These automated ratings are also intended to help streamline project development. In addition, MAP-21 requires FTA to evaluate the benefits of Small Start projects against the Federal share of the project, rather than the total project cost when developing the project justification rating (potentially making Small Starts projects with small Federal shares more competitive).

Cost Effectiveness: Cost Effectiveness Index (CEI), measured as the cost per hour of travel time saved, has been replaced by Cost per Rider using opening day conditions. It is unclear what model of ridership (regional or national) FTA will use as a basis for this calculation.

Other: Other MAP-21 changes with potential impacts for both New Starts and Small Starts projects include:

- The definition of Bus Rapid Transit (BRT) has been revised to include two types:
  - Fixed guideway BRT project with more than half of the route alignment in dedicated right-of-way
  - Corridor-based bus projects with less than half of the alignment in dedicated right-of-way are eligible for Small Starts funding only

- Transit on HOV lanes has been eliminated from the Fixed Guideway funding formula, unless the lanes are used exclusively by transit
- The Cost Effectiveness Index (CEI), measured as the cost per hour of travel time saved, has been replaced by Cost per Rider in determining cost effectiveness
- Operational Efficiency has been eliminated as an evaluation criterion; it is replaced by Congestion Relief

Implications of Small Starts Program Changes

FTA has recently announced that grantees will follow the FY11 Project Evaluation Guidance until such time as new policies and procedures can be developed. Policy guidance for New Starts and Small Starts review and evaluation criteria are expected in March 2013, and a revised evaluation and rating process rule due in October 2013.

At present, it is unclear how FTA will specifically implement some of the process changes to the Small Starts program. It is not clear whether projects already engaged in the Small Starts process will be grandfathered in the current system under SAFETEA-LU or allowed to choose which process to follow (SAFETEA-LU or MAP-21). The role of analyses previously included in the Alternatives Analysis with respect to entry into PD is not clear—in particular, what FTA will require specifically for justification for entry into PD. Similarly, it is unclear whether projects currently in AA should (or can) role current AA into NEPA (this is best determined based on discussions with regional FTA staff).

The Annual Report for FY 2013 Evaluation and Rating Process has only one change from the previous year. Annual inflation adjustment to cost effectiveness breakpoints is based on GDP Index instead of CPI. By keeping the reporting requirements the same as last year until such time as new policies and procedures can be developed, FTA believes the burden on project sponsors is minimized.

Small Starts policy decisions have not yet been published in the Federal Register or on the FTA website. Project sponsors with existing projects seeking a funding recommendation in the FY14 Annual Report may submit information under the existing Reporting Instructions. Project sponsors with projects seeking entry into the major capital investment program for the first time are to wait until FTA publishes interim policy guidance implementing the provisions of MAP-21.

MAP-21 Summary

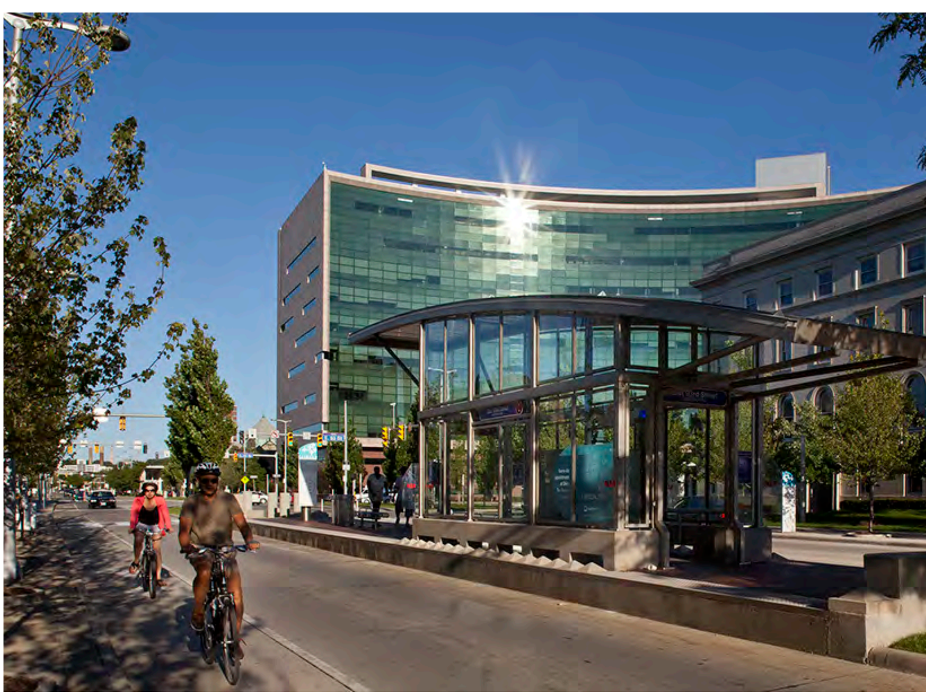
Overall, the changes to the Small Starts Program under MAP-21 are positive; however, there are some new challenges within the new program.

Overall funding for the program has decreased by $50 million annually (from $200 million to $150 million). This decrease in funding results in increased competition for the same pot of funds.

The Small Starts process has been streamlined and simplified to reduce complexity and project delivery time. However, the precise impact of these changes to project implementation remains to be determined (e.g., what documentation/analysis FTA will require for entry into PD with Alternatives Analysis discontinued).

The number of justification criteria for Small Starts projects has expanded to include mobility improvements, environmental benefits and congestion relief. Small Starts project sponsors will now need to develop analyses and reporting for each of these new criteria.

While Small Starts project sponsors can benefit here from the prior experience of New Starts projects with the first two measures (mobility improvements and environmental benefits), the congestion relief measure is new to both Small and New Starts and it remains to be determined how this criterion will be evaluated. It also remains to be determined how the cost effectiveness measure will be calculated.



Kimley-Horn and Associates, Inc.