K Street Transitway

Final Report

Prepared By:

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For:

Washington Metropolitan Area Transit Authority

and

District Department of Transportation

District of Columbia

May 2005

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In cooperation with:

Parsons Transportation Group
Parsons Brinckerhoff
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For:

Washington Metropolitan Area Transit Authority
and
District Department of Transportation
District of Columbia

May 2005

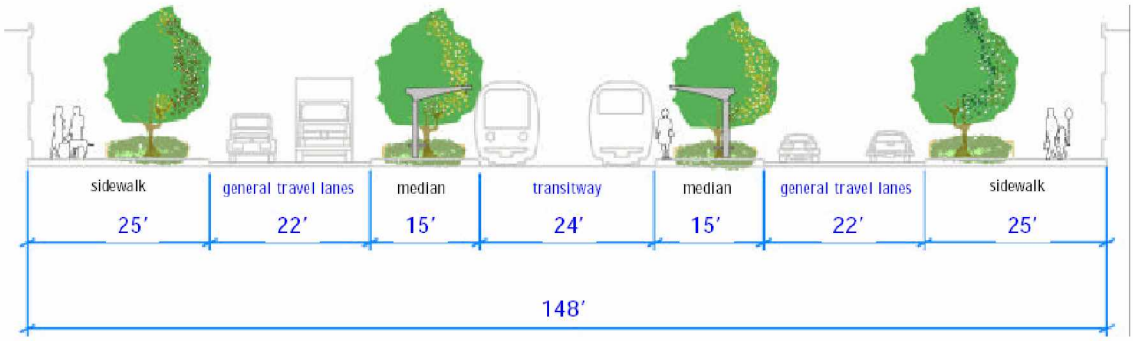
PREFACE

After the analyses for the K Street Transitway Study were completed and a report presenting findings and recommendations was submitted, the District Department of Transportation (DDOT) requested the National Capital Planning Commission (NCPC) to organize a working group to review the recommendations of the K Street Transitway Study and to recommend a preferred alternative. The working group included members from DDOT, the District of Columbia Office of Planning, the Washington Metropolitan Area Transit Authority (WMATA), the Downtown D.C. Business Improvement District (Downtown BID), and the Golden Triangle Business Improvement District. The working group organized a K Street Design Charrette—a forum of nationally renowned urban design and transportation experts—to independently assess the needs of K Street and to develop recommendations that DDOT could use in developing the final K Street design.

The design panel convened in July 2004. At the conclusion of the Design Charrette, the design panel presented findings and recommendations. The findings and recommendations are summarized in the document "A New Way on K Street – Proceedings from the K Street Urban Design Charrette – July 21-23, 2004." This document is included as Appendix T of this report. Some of the recommendations are similar to those made by the K Street Transitway Study, described in this report. The primary recommendations of the Design Charrette panel were the following:

- Maintain a consistent street width by maintaining the northern curb line and widening the street where needed.
- Eliminate the service roads.
- Eliminate on-street parking on K Street.
- Eliminate, in the long term, access to the parking garages and alleys along K Street.
- Provide extensive tree canopy and additional landscaping.
- Use one organization to oversee the implementation of improvements.
- Provide wider sidewalks, 25 feet, to accommodate pedestrian traffic and allow for more pedestrian amenities (see figure with recommended cross-section below).
- Provide a 24-foot exclusive transitway located in the center of the roadway with 15-foot medians separating the transitway from the mixed-traffic lanes (see figure with recommended cross-section below).

K Street Design Charrette Panel Recommended Cross-Section



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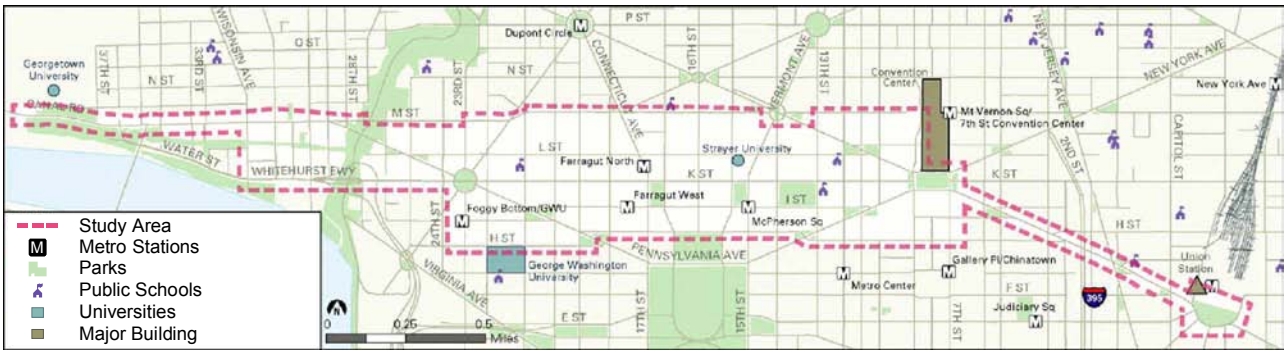
EXECUTIVE SUMMARY

The District of Columbia has one of the largest Central Business Districts in the nation, with a variety of activity nodes that include office concentrations, tourist venues, large institutions, universities, entertainment and mixed commercial areas. Yet there is no single, high-performance transit link to serve the workers, shoppers, convention attendees and other visitors who travel along the CBD's east-west dimension.

This report summarizes the findings and recommendations of a study that led to a concept plan for a high-performance transit link and related pedestrian and traffic operations improvements to the city's central core. The transit link would connect Georgetown to Union Station, as shown in the study area map presented in Figure ES-1.

The transportation study was a joint effort by the District Department of Transportation (DDOT) and the Washington Metropolitan Area Transit Authority (WMATA).

Figure ES-1 – Study Area



ES-1. CURRENT CONDITIONS

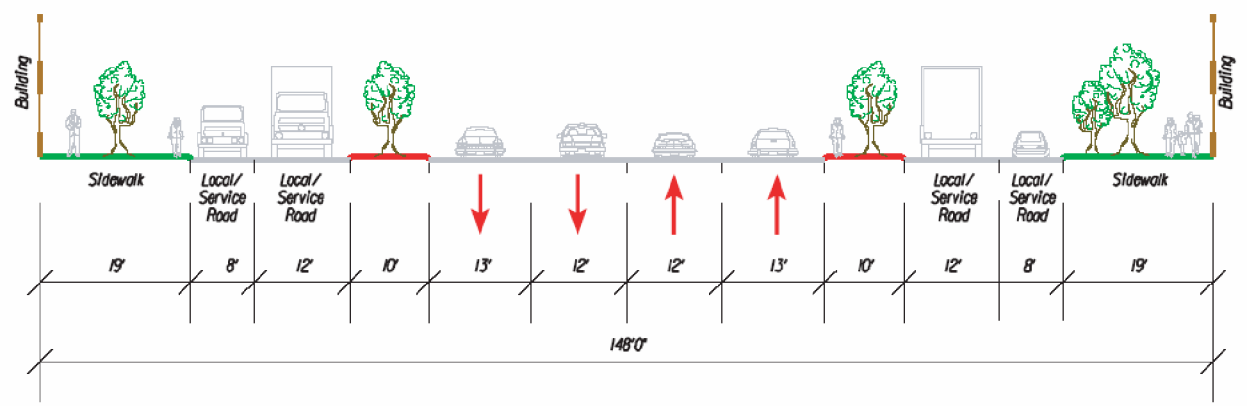
The impetus for this project was the need to reconstruct K Street through Downtown Washington, DC. The current infrastructure of K Street[1] is roughly 30 years old. Pavement and crosswalks have deteriorated and are in poor condition. The corridor's service lanes are an inefficient use of right-of-way that lead to severe traffic congestion and encourage parking violations. The combination of the corridor's geometry, shown in Figure ES-2, and traffic congestion results in significant vehicle-pedestrian conflicts and pedestrian safety issues.

In addition, there is no continuous, east-west, cross-town transit service connecting Georgetown, Downtown, the new Convention Center and Union Station. Anyone wishing to travel between these destinations must take multiple buses or a combination of bus and Metrorail. Buses in mixed traffic travel at slow speeds and have difficulty maintaining schedules due to traffic

[1] All streets in the study area are located in the northwest quadrant of the District, with the exception of those around Union Station east of North Capitol Street. Therefore, throughout this report where the NW designation is omitted, it should be understood that the street is located in the northwest quadrant of the District.

congestion and parking violations. Routes and schedules are difficult to understand, especially for tourists and infrequent riders, and bus stops are poorly located, lack amenities and do not provide adequate pedestrian access.

Figure ES-2 – Existing Peak Period K Street Typical Cross-Section



ES-2. PROJECT GOAL

The goal of the transportation study was to identify a system of transit, roadway and infrastructural enhancements that would improve the movement of people and goods through the District of Columbia's central core. The system would be designed to enhance traffic flow and vehicular safety, provide higher quality transit service, establish needed cross-town transit connections, improve pedestrian safety and access, and facilitate the management of parking and loading zones.

ES-3. TRANSIT IMPROVEMENTS

To enhance mobility in the study corridor, the Study Team recommends the following transit improvements:

- ***Busway on K Street*** — Construction of a dedicated busway on K Street between Washington Circle and Mount Vernon Square. The Study Team found that there are two feasible alternatives for the implementation of this busway. One of the feasible alternatives consists of a median busway with exclusive bus lanes in the two center lanes of K Street, separated by medians from non-bus travel lanes. The other feasible alternative provides exclusive curbside bus lanes on K Street from Washington Circle to Mount Vernon Square.
- ***Curbside bus lanes*** — Provision of exclusive curbside bus lanes on Massachusetts Avenue between H Street and Union Station.
- ***New Cross-town bus route*** — New Downtown Circulator bus service connecting Georgetown and Union Station. Low-floor, high-quality buses with multiple-door boarding capabilities are recommended for this route. As shown in Figure ES-3, the

Downtown Circulator would use the exclusive busway on K Street between Washington Circle and Mount Vernon Square.

Figure ES-3 – Busway Configuration

- ***Bus route re-routing*** — Re-routing of existing bus routes of regional significance to make use of the busway.
- ***Customer amenities*** — Improved customer amenities on buses and at bus stops and bus stations. As shown in Figure ES-4, bus stations would have enhanced passenger information features, including area and regional maps, and real time bus arrival information.
- ***Fare collection*** — Improved fare collection system (SmarTrip®).
- ***Pedestrian access*** — Better pedestrian access to stops and stations.
- ***Bus signal priority*** — Signal system improvements that enable buses to operate with traffic signal priority systems.
- ***Bus enhancements*** — Less frequent stops and color coded buses

Figure ES-4 – Artist's Rendering of Bus Station

ES-3.1. BUS ROUTE REROUTING AND BUS STOPS

To make best use of the exclusive busway facility on K Street, the Study Team recommends the implementation of a revised transit service plan. This will entail shifting routes traversing short sections of K Street to parallel streets to minimize turns from the K Street busway. Routes from parallel streets traversing long east-west distances will be moved to the busway.

Only the Downtown Circulator and other routes of regional significance (30, 32, 34, 35, 36, 38B, D1, D3, D6 ,6Y and 80) will use the K Street busway. The busway will serve between 50 and 65 peak direction buses during peak hours. Bus stops will be located approximately every two blocks throughout the central core.

ES-3.2. DOWNTOWN CIRCULATOR

The Downtown Circulator will be the principal mode of transit on the K Street Transitway. It will provide cross-town, high-quality, high-performance service connecting Georgetown, downtown, the Convention Center and Union Station. The Circulator will offer high-frequency, all-day operation with special features to maximize efficiency and passenger convenience. Its primary markets are expected to be DC residents, workers, visitors and conventioneers, representing an anticipated 13,000 trips per day by 2015.

The recommended routing of the Downtown Circulator is as follows[1]:

Westbound Route — The Circulator will start at Union Station and travel on Massachusetts Avenue to Mount Vernon Square. The portion of this alignment between 1st Street NE and H Street will be on exclusive curbside bus lanes. The Circulator will travel across the south side of Mount Vernon Square and turn right on 9th Street. It will travel on a contra-flow bus lane on 9th Street and turn left on K Street, continuing to 10th Street, where the K Street busway begins.

The Circulator will continue westbound on K Street to the end of the busway at Washington Circle, where it will go under Washington Circle and continue onto Lower K Street at 27th Street. It will then turn right onto Wisconsin Avenue and travel to M Street in Georgetown, turning right on M, the starting point of the eastbound return trip.

Eastbound Route — From the intersection of Wisconsin Avenue and M Street, the Circulator will travel on M Street and Pennsylvania Avenue to 24th Street. The Circulator will pass through Washington Circle to the K Street Service Road, joining the K Street busway at 21st Street. It will travel the length of the busway to 9th Street, where it will turn right. The Circulator will then

[1] After the analyses for the K Street Transitway study were completed, the operators of the Circulator developed a route for the Circulator in the vicinity of the Convention Center slightly different from the one recommended by the K Street Transitway Study Team. Under the modified routing, the eastbound Circulator will travel east on Massachusetts Avenue, east on Mount Vernon Place, south on 7th Street and east on Massachusetts Avenue. The westbound Circulator will travel west on Massachusetts Avenue, north on 7th Street, west on Mount Vernon Place, south on 9th Street and west on New York Avenue.

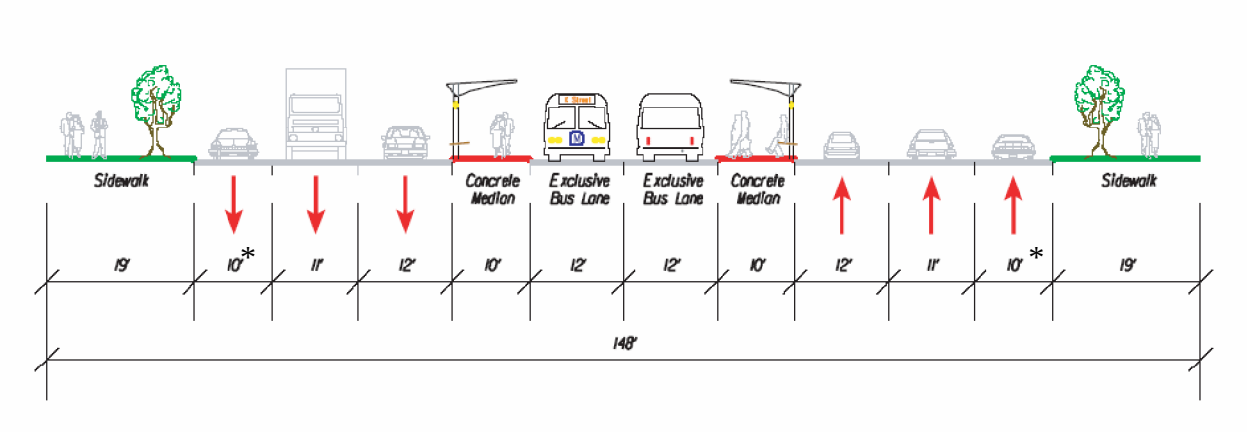
turn left to travel across the south side of Mount Vernon Square to Massachusetts Avenue, which it will use to return to Union Station. The portion of the alignment on Massachusetts Avenue between H Street and 1st Street NE will be on exclusive curbside bus lanes.

ES-4. STREET IMPROVEMENTS

The Study Team recommends the elimination of the existing K Street service lanes and the provision of an exclusive busway on K Street between Washington Circle and Mount Vernon Square. This change would improve transit flow, vehicular and pedestrian safety, and traffic management throughout the corridor. It would also allow more efficient use of the available right-of-way on K Street.

The Study Team found that there are two feasible alternatives for the implementation of this busway. One of the feasible alternatives consists of a median busway with exclusive bus lanes in the two center lanes of K Street, separated by medians from non-bus travel lanes. Figure ES-5 shows a cross-section of the proposed median busway; Figure ES-6 shows a computer-generated visualization.

Figure ES-5 – Typical Cross-Section of Center-Running Busway



* Parking would be allowed during off-peak hours

The other feasible alternative for the busway on K Street between Washington Circle and Mount Vernon Square provides exclusive curbside bus lanes on K Street from Washington Circle to Mount Vernon Square. Figures ES-7 and ES-8 show cross-sections of the proposed curbside busway.

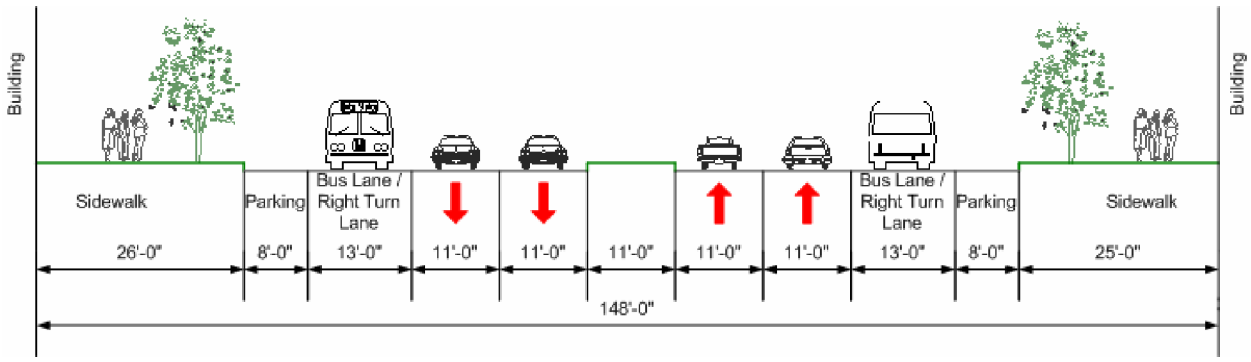
Also recommended are:

- Replacement of pedestrian crosswalks to improve visibility and pedestrian safety.
- Streetscape improvements, including new medians, landscaping and distinctive colored pavement treatments for the exclusive bus lanes.

- Curbside management improvements, including changes to parking and delivery zones and enforcement of regulations.

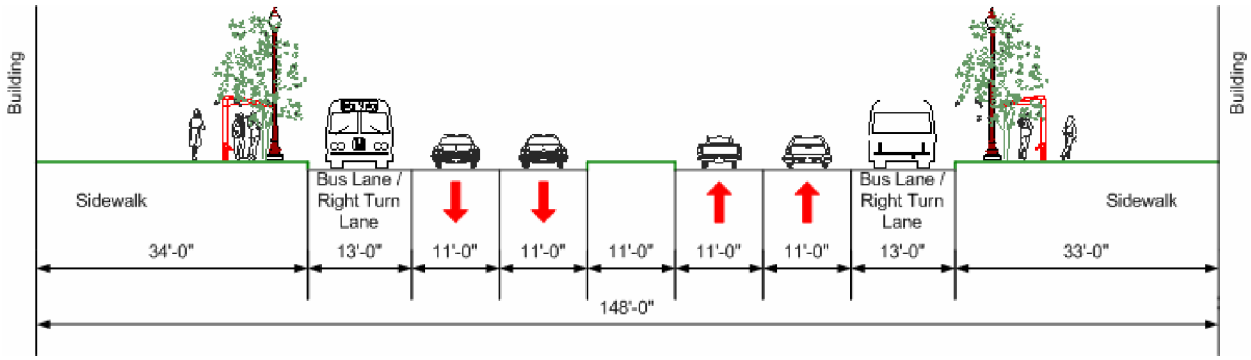
Figure ES-6 –K Street Transitway Computer-Generated Visualization of Center-Running Busway

Figure ES-7 – Typical Cross-Section of Curbside Busway at Mid-Block



Mid-Block

Figure ES-8 – Typical Cross-Section of Curbside Busway at Intersection



Intersection

ES-5. ALTERNATIVES CONSIDERED

The Study Team evaluated alternative geometric configurations and various transit service operational schemes for the K Street Transitway. The Study Team analyzed the alternatives described in Table ES-1 and reached the conclusion that Alternatives G and H are the most feasible for implementation.

ES-6. FEASIBLE ALTERNATIVES

Table ES-2 shows that the most feasible alternatives, G and H, compare favorably to a no-build scenario. When compared to a future no-build scenario, the implementation of Alternatives G and H would have the following effects:

- Increased transit ridership as a result of improved transit service
- Significantly more reliable bus service under Alternative G and more reliable bus service under Alternative H
- Enhance pedestrian safety
- Significantly reduced bus travel times with Alternative G
- Slightly reduced bus travel times with Alternative H
- Increased person throughput at key locations
- No worse congestion for general traffic during the PM peak hour, and increased congestion on streets parallel to K Street and north-south streets during the AM peak hour
- Improvement in the level of service at some critical intersections during the PM peak hour and degradation in levels of service at some critical intersections during the AM and PM peak hour
- $1.5 and $2.0 million savings in bus subsidies per year with the implementation of Alternative H and G, respectively

Table ES-1 – Characteristics of Alternatives Considered

Characteristic	Alternative							
	A	B	C	D	E	F	G	H
Center median busway between Washington Circle and Mount Vernon Square	ü	ü	ü	ü	ü	ü	ü	
Curbside busway between Washington Circle and Mount Vernon Square								ü
No exclusive curbside bus lanes east of Mount Vernon Square or west of Washington Circle	ü	ü						
Exclusive curbside bus lanes east of Mount Vernon Square and west of Washington Circle			ü	ü	ü	ü		
Exclusive curbside bus lanes east of Mount Vernon Square. No exclusive curbside bus lanes west of Washington Circle.							ü	ü
Bus service plan with 60 to 75 peak direction buses per hour in exclusive busway section	ü	ü	ü		ü			
Bus service plan with 50 to 65 peak direction buses per hour in exclusive busway section				ü		ü	ü	ü
Circulator service to Georgetown University	ü	ü	ü	ü	ü	ü		
All-day parking on K Street curb lanes between Washington Circle and Mount Vernon Square	ü							ü
Midday / evening / night parking on K Street curb lanes between Washington Circle and Mount Vernon Square. No parking during peak periods (7:00 – 9:30 AM and 4:00 – 6:30 PM)		ü	ü	ü	ü	ü	ü	
No parking on south side of M Street between Wisconsin Avenue and Pennsylvania Avenue. No parking on south side of Pennsylvania Avenue between M Street and Washington Circle.			ü	ü	ü	ü		
No parking on Massachusetts Avenue between H Street and Union Station			ü	ü	ü	ü	ü	ü
Bus stops every two blocks on K Street in exclusive busway section				ü	ü	ü	ü	ü
No right turns allowed from westbound K Street to northbound Connecticut Avenue between 7:00 AM and 7:00 PM				ü		ü	ü	ü
Eight-foot widening on the south side of K Street between Connecticut Avenue and 17th Street (Farragut Square) to accommodate three through general traffic lanes in the westbound direction	ü	ü	ü	ü				
Center median busway between Washington Circle and Mount Vernon Square, but no exclusive eastbound bus lane between 18th Street and 16th Street.					ü			
No widening on the south side of K Street between Connecticut Avenue and 17th Street (Farragut Square) with only two through general traffic lanes in the westbound direction.						ü	ü	ü

Table ES-2 – Evaluation of Feasible Alternatives

	2015 No-Build Scenario	Feasible Alternative 1 Alternative G	Feasible Alternative 2 Alternative H
Transit Ridership Impacts			
Transit Reliability			
Transit System Clarity			
Pedestrian Safety			
Vehicular Safety			
Transit Access to Adjacent Land Uses			
Bus Travel Times			
Increased Person Throughput at Key Locations			
Congestion for General Traffic			
Levels of Service at Critical Intersections			
Savings in Bus Subsidies per Year			
Capital Cost Savings			
Effects on Parking and Loading			
Light Rail Operations	N/A		
Poor Very Good			

- One-time estimated $2.2 million capital cost savings due to reduced fleet requirements with the implementation of Alternative H and $4.0 million with the implementation of Alternative G
- Loss of 53 parking spaces on Massachusetts Avenue
- Gain of 41 peak-hour parking spaces on K Street between Washington Circle and Mount Vernon Square if Alternative H (with curbside busway) were to be implemented
- Gain of three peak-hour parking spaces on K Street between Washington Circle and Mount Vernon Square if Alternative G (with median busway) were to be implemented

Alternatives G and H are feasible for implementation because they reduce travel times for east-west buses, increase person throughput at critical locations in the corridor, do not result in significant worsening of congestion for general traffic, and help reduce transit operating cost. Alternatives G and H are also the most feasible because they provide improvements with respect to transit system clarity, transit ridership, transit reliability and pedestrian safety. Neither Alternative G nor Alternative H precludes the future switch to a light rail system on the busway right-of-way. The change to light rail, however, would require significant modifications to the transitway infrastructure. The exclusive transit right-of-way of Alternative G allows for more efficient light rail operations than the shared curbside lanes of Alternative H.

ES-7. K STREET TRANSITWAY AT FARRAGUT SQUARE

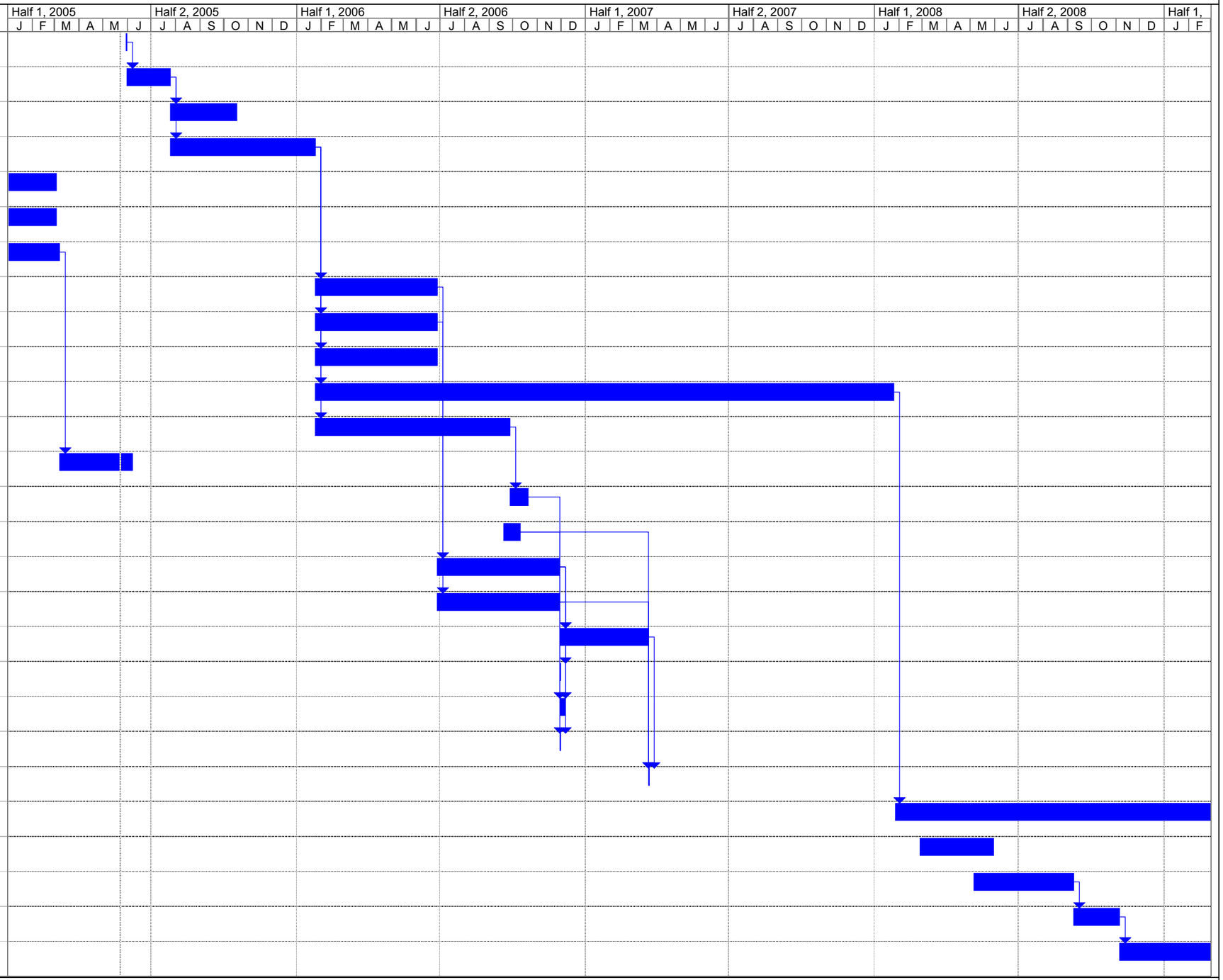
Alternatives G and H assume no widening on K Street at Farragut Square. The acquisition of eight feet of right-of-way from Farragut Square, which is owned by the National Park Service (NPS), would allow for the provision of one extra lane of traffic which would help improve traffic and transit operations. Without the eight-foot strip from Farragut Square (Alternatives G and H), the geometric configurations and parking restrictions on K Street generally would be the same except between 16th and 18th Streets. Traveling eastbound on K Street, the roadway cross-section would be shifted to the north between 18th Street and Connecticut Avenue. A six-lane cross-section would be provided between Connecticut Avenue and 17th Street, with one exclusive bus lane in each direction and two non-bus travel lanes in each direction. Continuing eastbound on K Street, the cross-section would shift back to the south in the block between 17th and 16th Streets.

ES-8. IMPLEMENTATION PLAN

The full implementation of the recommended improvements is expected to take approximately four years. The tasks necessary for the implementation of the K Street Transitway recommended improvements, the sequencing and the estimated duration are presented in Figure ES-9. In order to mitigate the effects on bus and vehicular flow associated with construction of the busway on K Street, the Study Team recommends the provision of exclusive curbside bus lanes on I and L Streets until the K Street busway is fully operational. The tasks associated with the provision of curbside bus lanes on I and L Streets are presented in the Implementation Plan.

Figure ES-9
Implementation Plan Schedule

ID	Task Name
1	K Street Busway Planning Study Completed
2	Conduct Additional Public/Stakeholder Meetings
3	Identify Potential Funding Sources
4	Environmental Assessment
5	Acquire Circulator Buses
6	Develop Branding Concept for Circulator, Bus Lanes and Busway
7	Develop Detailed Plan for Fare Collection System
8	Bus Lane Design on I and L Streets
9	Bus Lane Design on Massachusetts Avenue
10	Design Signal Priority for Massachusetts Avenue
11	Design K Street Transitway
12	Finalize Interim Service Plan with Routes on I and L Streets
13	Make Modifications to Vehicles to Implement Modified Fare Collection
14	Conduct Public Meetings to Discuss Route Changes to I and L Streets
15	Prepare Regulation/Notices for Elimination of Parking Spaces
16	Construct Bus Lanes on I and L Streets
17	Construct Bus Lanes on Massachusetts Avenue
18	Construct and Implement Signal Priority for Massachusetts Avenue
19	Begin Circulator Service Using I and L Streets
20	Implement Route Changes to I and L Streets
21	Begin Operation of Curbside Bus Lanes on I and L Street
22	Begin Operation of Curbside Bus Lanes on Massachusetts Avenue
23	Construct K Street Transitway
24	Design Removal of Curbside Bus Lanes on I and L Streets
25	Finalize K Street Transitway Service Plan
26	Conduct Public Meetings to Discuss Route Changes to K Street Busway
27	Open K Street Transitway and Implement Transitway Service Plan



1. INTRODUCTION

This report summarizes the findings and recommendations of a study that evaluated options for providing a high-performance transit link and related pedestrian and traffic operations improvements in the K Street[1] Corridor from Georgetown to Mount Vernon Square and the Massachusetts Avenue corridor from Mount Vernon Square to Union Station. The study area, shown in Figure 1-1, is located in Northwest Washington, DC. The transportation study was a combined effort of the District Department of Transportation (DDOT) and the Washington Metropolitan Area Transit Authority (WMATA).

The recently completed "Transit Expansion Study," sponsored by the District Department of Transportation and carried out by the Washington Metropolitan Area Transit Authority, designated a number of corridors for implementation of new rapid transit segments to expand and/or complement the Metrorail system. In the plan that emerged from the study, these segments were identified as being either Metrorail or Light Rail Transit (LRT) in their ultimate configuration. However, the study emphasized that one or more of the segments could be developed incrementally, starting with Bus Rapid Transit (BRT) and then moving to LRT and even Metrorail as markets matured and sufficient resources became available. In the development of the rapid transit expansion plan, there was a significant emphasis on improved intra-District of Columbia, cross-town connections. The Washington Regional Bus Study completed in 2002 also identified the Union Station to Georgetown corridor as a location needing a high-quality bus link.

1-1. NEED FOR CROSS-TOWN RAPID TRANSIT

The District of Columbia has one of the largest Central Business Districts (CBD) in the nation, with over 350,000 jobs north of the Mall and about 100,000 jobs south of the Mall. Because of the physical constraints of the Mall (monuments and museums) and other parks, the CBD is much longer east-west than it is wide north-south. There are several activity nodes along the long east-west dimension of the CBD that differ markedly in terms of their character. These range from a mostly office concentration around Capitol Hill, to a mixed commercial area in the vicinity of the Washington Convention Center, to the tourist venues (e.g., White House), institutions (e.g., World Bank) , universities, entertainment and mixed commercial activity center in the west end of the CBD in Foggy Bottom and Georgetown.

There is currently no single continuous, high-quality, high-performance rapid transit link from the eastern end of the CBD, in the vicinity of Capitol Hill (Union Station), to the part of the CBD west of Farragut Square. This makes it difficult for workers, shoppers, convention attendees and other visitors to travel among the disparate activity nodes in the CBD.

[1] All streets in the study area are located in the northwest quadrant of the District, with the exception of those around Union Station east of North Capitol Street. Therefore, throughout this report where the N.W. designation is omitted, it should be understood that the street is located in the northwest quadrant of the District.

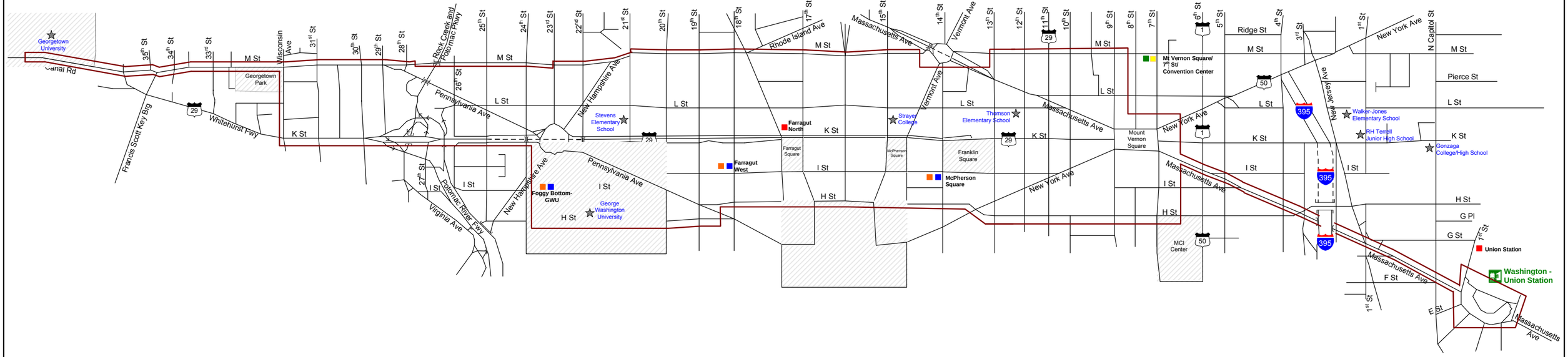


FIGURE 1-1

Study Area Map

Scale: 1" = 944'

LEGEND

- Study Area Boundary
- School/College/University
- Metro Station
- Amtrak/MARC Rail Station

K Street Transitway

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This negatively affects not only the efficient distribution/collection of travelers using public transportation for primary work trips, but also impacts non-home-based trips made during the middle of the day. At the same time, there has been a significant increase in the number of passengers using the Maryland and Virginia commuter rail networks, to a total of about 30,000 trips per day, most of which have a CBD origin or destination accessed through Union Station. Most of the commuter rail travelers using Union Station destined for the Farragut Square Area, the office employment heart of the CBD, use Metrorail's Red Line for access/egress. This has led to significant crowding on the Red Line inbound in the AM peak period as well as outbound, between Gallery Place and Union Station, and overcrowding at Metro Center due to the large number of transfers between the Red and Blue/Orange lines at this station.

The structure and performance of the conventional local bus system in the heart of the CBD does not lend itself to serving the important CBD travel needs noted above. At least two major east-west streets, Pennsylvania Avenue and E Street are closed around the White House for security reasons; and as noted in the Washington Regional Bus study, there were too many bus services utilizing a street network that was inadequate even before the closings. In addition to significant congestion-related speed and reliability problems, the lack of clarity of the current bus network makes it extremely difficult for frequent transit users, let alone visitors, to understand routes and schedules well enough to use buses for either intra-CBD trips or for primary work trips originating or destined to areas outside the CBD.

1-2. PURPOSE OF PROPOSED BUS RAPID TRANSIT (BRT) LINK

A Bus Rapid Transit (BRT) line would provide a continuous, high-quality, high-performance transit link from the eastern end of the CBD (Union Station) to Georgetown. BRT, with its high performance and unique identity could provide workers, shoppers, students, convention attendees and other visitors with a high-quality transit link that could be used to satisfy their peak as well as off-peak travel needs. It would:

- Mitigate the adverse impacts on east-west movement from the closing of Pennsylvania Avenue and E Street near the White House;
- Serve as an east-west AM distributor and PM collector for Metrorail, commuter rail and commuter bus passengers;
- Facilitate the intra-CBD, non-home-based travel among the CBD's disparate activity nodes during the middle of the day and in the evening; and
- Provide an important mobility resource for the growing numbers of residents in the CBD.

1-3. STUDY GOALS AND OBJECTIVES

The situation described above has led the District of Columbia to place a high priority on providing a new rapid transit link from Union Station to Georgetown. Accordingly, this study was undertaken to develop a concept plan for a BRT link in the K Street/Massachusetts Avenue corridor from Georgetown to Union Station.

Recommendations developed in the study are expected to serve as the framework for near-term capital investment decisions as they pertain to the reconstruction and possible reconfiguration of K Street between Washington Circle and Mount Vernon Square.

1-4. STUDY APPROACH

Recognizing that rapid transit is an integrated system comprised of many parts, the study looked at the following elements of Bus Rapid Transit for application to the corridors, both individually and as part of an integrated system:

1. Stops, Stations and Terminals
2. Running Ways
3. Service Plan
4. Type of Vehicle (multiple doors, low-floor)
5. Intelligent Transportation Systems (signal priority, communications)

Consideration was also given to how concurrent plans for WMATA vehicle acquisition and fare system changes (i.e., smart cards) would impact the functionality of a BRT line operating over an exclusive busway facility on K Street. Finally, the study establishes criteria for determining the appropriate mix of BRT, local and regional services on the busway, by examining the impact on overall bus system performance of a variety of levels and types of services on the facility.

With respect to exclusive busway facilities, the study examines how implementation of a dedicated busway could improve mobility, transit and traffic operations and pedestrian and parking access. To accomplish this objective, existing traffic conditions in the corridors connecting Georgetown to Union Station via K Street and Massachusetts Avenue were evaluated. In addition, alternative geometric modifications to the K Street roadway configuration were analyzed so that recommendations could be made with respect to the most effective configuration to improve mobility through the study corridors.

A variety of traffic operations improvements were analyzed with the intention of providing the BRT system with reliable high speed while ensuring that the overall CBD transportation system is efficient and effective. In view of the high level of congestion in the CBD and its physical size, special attention was afforded to the nexus of transit operations and general traffic.

Because of the large number of visitors, convention goers and tourists, conveying passenger information and establishing a unique identity and image for the BRT line is also examined. Finally, because of the intent of the District to move to LRT at a future date as future travel in the corridor grows, special attention is given to incremental development and transition issues.

1-5. MAJOR ACTIVITIES

The Study was built on the broad principles that underlie the Transportation Element of the District's "Comprehensive Plan and the Transportation Vision, Strategy and Action Plan"

(1997). It also utilizes the finding and recommendations of the Washington Regional Bus Study (2002) and "Transit Expansion Study (2002) to undertake the following activities[1]:

- Evaluation of related plans and programs, including Core Capacity Study, Circulator Study, Washington Regional Bus Study, and Transit Expansion Study
- Collection of relevant traffic and transit operating data
  - Link volumes, turning movements
  - Pedestrians flows
  - Transit ridership data
- Analysis of transit travel times
- Investigation of the engineering feasibility of a reconfiguration of the study corridors to accommodate an exclusive transit right-of-way
- Assessment of the impacts of recommended modifications to the roadway network
- Assessment of station location options for the BRT line
- Assessment of the impacts of the alternative alignments on transit and traffic operations
- Evaluation of ridership potential
- Ongoing public involvement and communications

The following chapters of this report summarize the assessment of existing conditions in the study area, present alternative improvement options to address future conditions, describe the evaluation of alternatives, and present findings and recommendations. The Report also includes a sketch plan for the implementation of the preferred alternative.

[1] The documents describing the scope of services for this project are included in Appendix A.

2. EXISTING CONDITIONS

2-1. EXISTING TRANSPORTATION FEATURES

The current infrastructure of K Street is roughly 30 years old. Pavement and crosswalks have deteriorated and are in poor condition. The corridor's service lanes are an inefficient use of right-of-way that leads to severe traffic congestion and encourage parking violations. The combination of the corridor's geometry and traffic congestion result in significant vehicle-pedestrian conflicts and pedestrian safety issues.

In addition, there is no continuous east-west cross-town transit service connecting Georgetown, Downtown, the new Convention Center and Union Station. Anyone wishing to travel between these destinations must take multiple buses or a combination of bus and Metrorail. Bus service is slow and unreliable, with routes and schedules that are difficult to understand, especially for tourists and infrequent riders. Bus stops are inadequate in location, condition, amenities and pedestrian access.

The Study Team conducted an extensive data collection effort to gain an understanding of existing conditions in the study area. In addition to collecting data for the quantitative assessment of existing conditions, the Study Team conducted field evaluations throughout the study area during peak and off-peak hours to further assist in the assessment of existing conditions. This section of the report summarizes the data collected for the study and addresses issues and deficiencies in the transportation infrastructure.

2-1.1. MAJOR ROADWAYS IN THE STUDY AREA

The study area is primarily located in Northwest Washington, DC. The primary streets that the Bus Rapid Transit system is expected to use are the following:

- K Street
- Massachusetts Avenue
- Wisconsin Avenue
- M Street / Canal Road
- Pennsylvania Avenue

The associated characteristics of these roadways are described within the limits shown in Figure 1-1. The existing lane configurations differ during the AM, midday and PM peak hours. Each peak hour lane configuration is shown in Appendix B, Figures B-1 through B-9.

2-1.1.1. K Street

K Street is primarily a two way principal arterial[1] running east-west through the study area. In the Western Section of the study area from Wisconsin Avenue to 27th Street, Lower K Street is a minor arterial with two lanes. Parking is allowed in sections from 30th Street to Wisconsin Avenue. From 27th Street to 21st Street, K Street is a four-lane divided roadway with access and exit ramps to Washington Circle and parking is not allowed at any time.

In the Central Section, there are a total of four lanes on K Street from 21st Street to 12th Street with limited access one-way service roads. Parking is allowed during the off-peak hours along the right side of the K Street service roads except on the block from Connecticut Avenue to 17th Street. Service roads are provided in the following blocks:

- North and south sides of K Street between 21st Street and Connecticut Avenue; between 17th Street and 15th Street; between Vermont Avenue and 14th Street and between 13th Street and 12th Street
- North side of K Street between Connecticut Avenue and 17th Street; between 15th Street and Vermont Avenue and between 14th Street and 13th Street

Parking is not allowed on the main K Street roadway from 27th Street to 12th Street, and most left turns are not allowed during the AM and PM peak periods. Most right-turn-on-red maneuvers are limited at all times from K Street and K Street service roads in the Central Section. Many parking garage entrances and exits are accessible from the service roads in this section.

From 12th Street to 10th Street, K Street is reduced to two-lane operation with parking allowed on both sides of the roadway during off-peak hours. The block of K Street from 9th Street to 10th Street is one-way westbound operation with two lanes and angled parking allowed on the north side of the roadway during off-peak hours.

In the Eastern Section, K Street from 9th to 7th Street runs in front of Mount Vernon Square. K Street is a two-way roadway with three westbound lanes and two eastbound lanes. Parking is allowed in this block of K Street on both sides of the roadway during the off-peak hours. The speed limit on all sections of K Street in the study area is 25 mph.

2-1.1.2. Massachusetts Avenue

Massachusetts Avenue is a two-way principal arterial running southeast-northwest through the Eastern Section of the study area from K Street at 7th Street to Columbus Circle at Union Station. From 7th Street to H Street, Massachusetts Avenue has two lanes in each direction with limited parking allowed during the off-peak hours. From H Street to Columbus Circle, Massachusetts

[1] All roadway classifications were taken from the District of Columbia Functional Classification Map, January 1, 2002.

Avenue has three lanes in each direction with limited parking allowed during the off-peak hours. The speed limit is 25 mph.

2-1.1.3. Wisconsin Avenue

Wisconsin Avenue is a two-way minor arterial running north-south through the Western Section of the study area from K Street to M Street. Wisconsin Avenue has two lanes in each direction with parking allowed on the east side of the roadway and limited parking on the west side. Parking along Wisconsin Avenue is allowed only during off-peak hours. The speed limit is 25 mph.

2-1.1.4. M Street

M Street is a two-way principal arterial running east-west between 28th Street / Pennsylvania Avenue and Canal Road / Whitehurst Freeway in the Western Section of the study area. M Street has three lanes in each direction with parking allowed on both sides of the roadway during off-peak hours. The speed limit is 25 mph.

2-1.1.5. Canal Road

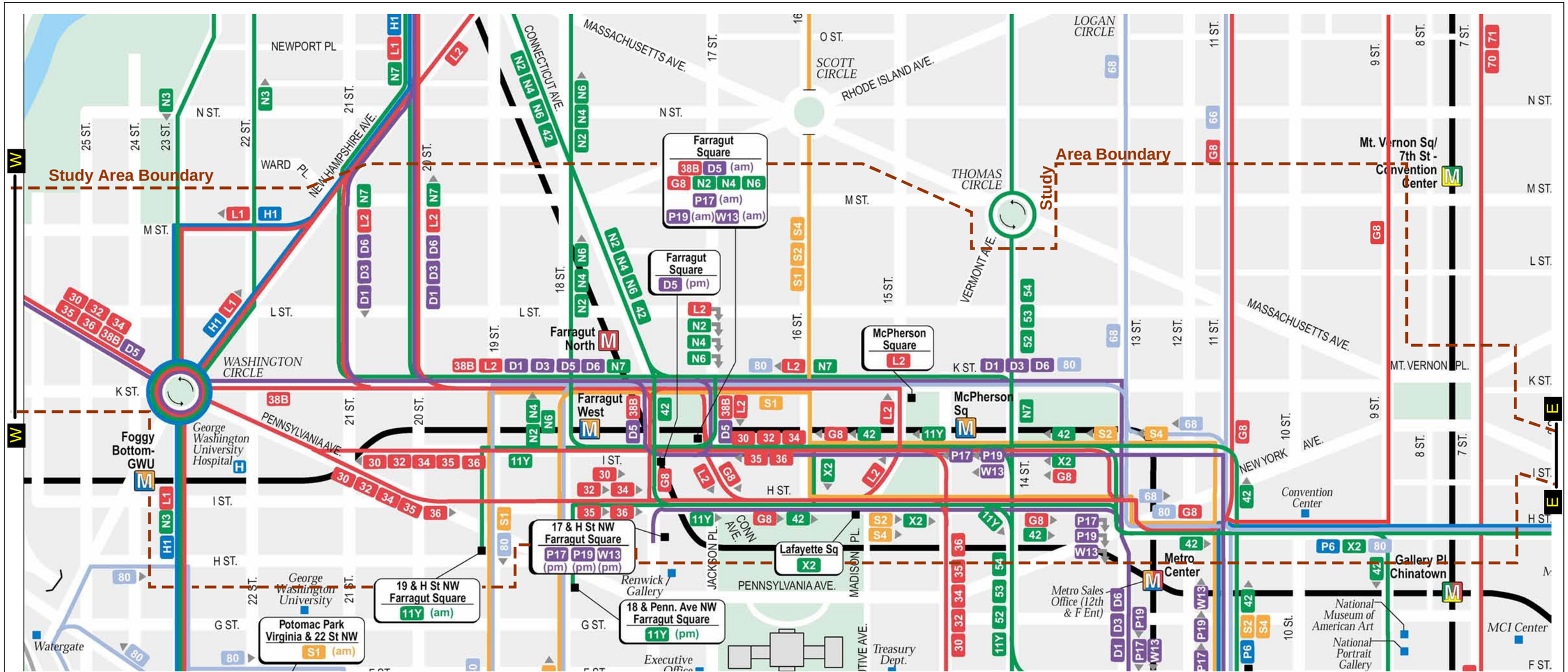
At Whitehurst Freeway, M Street becomes Canal Road, which is a two-way principal arterial running east-west. Canal Road has two lanes in each direction and parking is not allowed along this roadway at any time. The speed limit along is 30 mph.

2-1.2. PUBLIC TRANSPORTATION

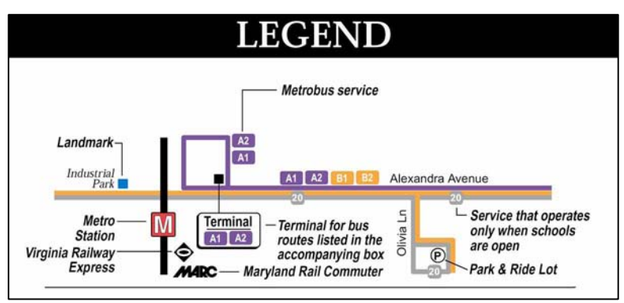
WMATA provides extensive bus and rail service in the study area. As shown in Figures 2-1A and 2-1B, east-west service along M Street is provided by eight routes (30, 32, 34, 35, 36, 38B, B11[1] and D5) in the Western Section of the study area. Also shown in Figures 2-1A and 2-1B, routes that provide east-west service along K Street include 16Y, 38B, 80, L2, D1,D3, D5, D6, N7[2] and S1 in the Central Section of the study area. As shown in Figure 2-2, in the Eastern Section of the study area, service along Massachusetts Avenue to Union Station is provided by five routes (80, 96, D1, D4, D6 and D8).

In addition to WMATA buses, there are a significant number of commuter buses that use K Street during the AM and PM peak hours. There are approximately 31 commuter buses that travel westbound along K Street during the AM Peak hour from 13th Street to Washington Circle. During the PM Peak hour, there are approximately 31 commuter buses that travel eastbound along K Street from Washington Circle to 11th Street.

[1] Route B11 was eliminated on December 28, 2003
[2] Route N7 was eliminated on December 28, 2003



LEGEND



Source: Washington Metropolitan Area Transit Authority, 2002.
Note: Routes N7 and B11 were discontinued effective 12/28/03.

FIGURE 2-1A

Existing Public Transit in the Western and Central Sections of the Study Area (1)

Not to Scale

K Street Transitway

May 2005

Route	Terminals	AM Rush	PM Rush	Midday	Evening	Saturday	Sunday	B/A Restrictions	;	Remarks
11Y	MOUNT VERNON / FARRAGUT SQUARE	In	Out	–	–	–	–			Special Fare
30	FRIENDSHIP HTS M / POTOMAC AVE M	•	–	–	–	–	–		•	Late night / Sunday
32	FRIENDSHIP HTS M / SOUTHERN AVE M	•	•	•	•	•	•		•	
34	FRIENDSHIP HTS M / NAYLOR ROAD M	•	•	•	•	•	–		•	
35	FRIENDSHIP HTS M / NAYLOR ROAD M	Out	In	•	•	•	•		•	
36	FRIENDSHIP HTS M / NAYLOR ROAD M	In	Out	•	•	•	•		•	Via Hillcrest
38B	BALLSTON M / FARRAGUT N & W M	•	•	•	•	•	•		•	
42	MT. PLEASANT / METRO CENTER M	•	•	•	•	•	•		•	
52	TAKOMA M / L'ENFANT PLAZA M	•	•	•	•	•	•		•	
53	TAKOMA M / BUREAU OF ENGRAVING	In	Out	–	–	–	–		•	Via The Portals Building
54	TAKOMA M / L'ENFANT PLAZA M	•	•	•	•	•	•		•	Via F St.
68	GEORGIA AV–PETWORTH M / FEDERAL TRIANGLE	•	•	•	•	–	–		•	Via Sherman Ave. & 13th St.
70	SILVER SPRING M / HALF & O STS SW	•	•	•	•	•	•		•	
71	SILVER SPRING M / BUZZARD POINT	•	•	–	–	–	–		•	
80	FORT TOTTEN M / KENNEDY CENTER	•	•	•	•	•	•		•	
B11	ROSSLYN M / MEDICAL CTR M	Out	In	–	–	–	–		•	
D1	GLOVER PARK / UNION STATION M	In	Out	–	–	–	–		•	
D3	IVY CITY / SIBLEY HOSPITAL	In	Out	–	–	–	–		•	
D5	SANGAMORE RD / FARRAGUT N & W M	In	Out	–	–	–	–			
D6	SIBLEY HOSP / STADIUM–ARMORY M	•	•	•	•	•	•		•	
D51	CONGRESS HEIGHTS M / DUKE ELLINGTON HS	In	–	–	–	–	–			Public school open only
G8	AVONDALE / FARRAGUT N & W M	•	•	•	•	•	•		•	
H1	BROOKLAND–CUA M / POTOMAC PARK	In	Out	–	–	–	–			
L1	CHEVY CHASE CIR / POTOMAC PARK	In	Out	–	–	–	–			
L2	CHEVY CHASE CIR / MCPHERSON SQ M	•	•	•	•	•	•		•	
N2	FRIENDSHIP HTS M / FARRAGUT N&W M	•	•	•	–	–	–		•	Via Cathedral Ave., Tnlytwn–AU M
N3	FRIENDSHIP HTS M / FEDERAL TRIANGLE	In	Out	–	–	–	–			
N4	FRIENDSHIP HTS M / FARRAGUT N&W M	•	•	•	–	–	–		•	Via Berkshire Apts.
N6	FRIENDSHIP HTS M / FARRAGUT N&W M	–	–	–	•	•	•		•	
N7	MONTGOMERY MALL / FEDERAL TRIANGLE M	In	Out	–	–	–	–	•	•	Special Express Fare
P6	ANACOSTIA M / RHODE ISLAND AVE M	•	•	•	•	•	•		•	Via Capitol Hill
P17	FORT WASHINGTON Ⓟ / FARRAGUT SQUARE	•	•	–	–	–	–	•		
P19	FORT WASHINGTON Ⓟ / FARRAGUT SQUARE	•	•	–	–	–	–	•	•	
S1	16TH ST / POTOMAC PARK	In	Out	–	–	–	–			
S2	SILVER SPRING M / FEDERAL TRIANGLE	•	•	•	•	•	•		•	Via Alaska Ave
S4	SILVER SPRING M / FEDERAL TRIANGLE	•	•	•	•	•	•		•	Via 16th St. direct
W13	FRIENDLY / FARRAGUT SQUARE	In	Out	–	–	–	–	•		
X2	MINNESOTA AVE M / LAFAYETTE SQUARE	•	•	•	•	•	•		•	

Source: Washington Metropolitan Area Transit Authority, 2002.
Note: Routes N7 and B11 were discontinued effective 12/28/03.

SERVICE GUIDE KEY

IN = Inbound
OUT = Outbound

• = Both Directions
– = Not Available
Ⓟ = Park & Ride lot

B/A = Boarding/Alighting Restrictions
; = Wheelchair Lift-Equipped Service

FIGURE 2-1B

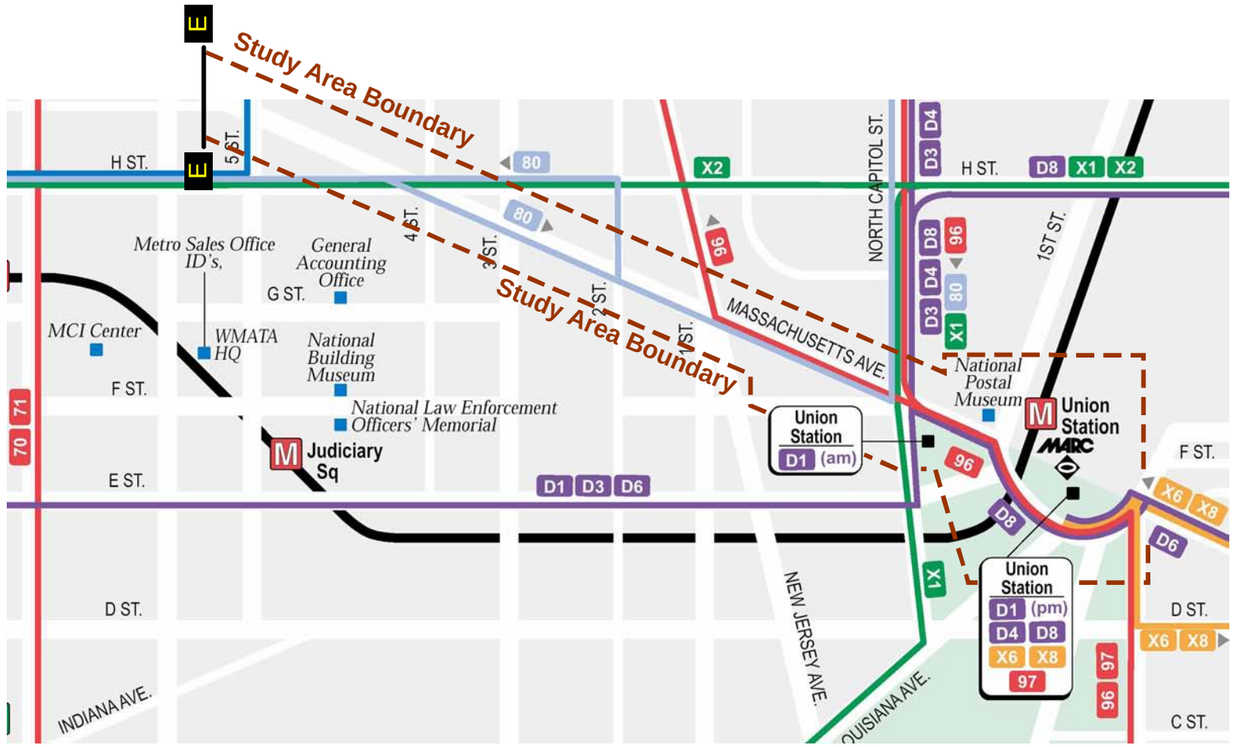
Existing Public Transit in the Western and Central Sections of the Study Area (2)

Not to Scale

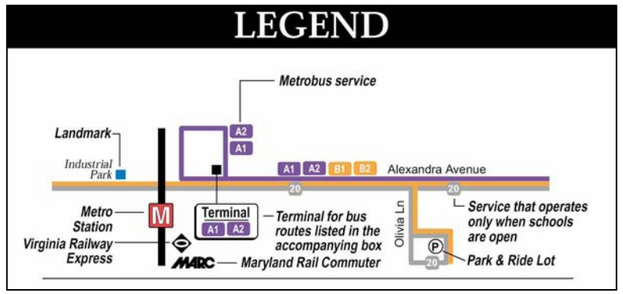
N

K Street Transitway

May 2005



MASSACHUSETTS AVE
(MT. VERNON SQ - UNION STATION)



Source: Washington Metropolitan Area Transit Authority, 2002.

Route	Terminals	AM Rush	PM Rush	Midday	Evening	Saturday	Sunday	B/A Restrictions		Remarks
70	SILVER SPRING M / HALF & O STS SW	•	•	•	•	•	•		•	
71	SILVER SPRING M / BUZZARD POINT	•	•	–	–	–	–		•	
80	FORT TOTTEN M / KENNEDY CENTER	•	•	•	•	•	•		•	
D1	GLOVER PARK / UNION STATION M	In	Out	–	–	–	–		•	
D3	IVY CITY / SIBLEY HOSPITAL	In	Out	–	–	–	–		•	
D4	IVY CITY / UNION STATION M	•	•	•	•	•	•		•	
D6	SIBLEY HOSP / STADIUM–ARMORY M	•	•	•	•	•	•		•	
D8	WASHINGTON HOSP CTR / UNION STATION M	•	•	•	•	•	•		•	Via H St. NE
X1	MINNESOTA AVE M / POTOMAC PARK	In	Out	–	–	–	–			
X2	MINNESOTA AVE M / LAFAYETTE SQUARE	•	•	•	•	•	•		•	
X6	UNION STATION M / NATIONAL ARBORETUM	–	–	–	–	•	•		•	
X8	CARVER TERRACE / UNION STATION M	•	•	•	•	•	•		•	
96	CAPITOL HTS M / DUKE ELLINGTON BRIDGE	•	•	•	•	•	•		•	Via DC General Hospital
97	CAPITOL HTS M / UNION STATION M	•	•	–	–	–	–			Via E. Capitol St. direct

FIGURE 2-2

Existing Public Transit in the Eastern Section of the Study Area

Not to Scale

K Street Transitway

May 2005

WMATA's Blue and Orange Metro lines provide east-west service through the study area with stops at Foggy Bottom, Farragut West and McPherson Square. WMATA's Red Metro line also provides service through the study area from the stop at Farragut North to Union Station. There are no Metro stations in the Western Section of the study area. Connection to the Western Section of the study area is provided by the existing Georgetown shuttle from Foggy Bottom Metro to Georgetown. Metro stations located in the Central Section are Foggy Bottom, Farragut North, Farragut West and McPherson Square. The only Metro station in the Eastern Section of the study area is Union Station.

2-1.2.1. Existing Bus Routes

Further information on the bus routes that currently operate in the study area along the proposed BRT route is described in the following paragraphs:

2-1.2.1.1. WMATA Routes 30, 32, 34, 35 and 36 – Pennsylvania Avenue Line

Routes 30, 32, 34, 35 and 36 operate along M Street and Pennsylvania Avenue through the Western Section of study area. During weekdays, these routes provide service throughout the day with eastbound service operating from 4:33 AM until 2:13 AM. Westbound service operates from 4:57 AM until 2:50 AM.

2-1.2.1.2. WMATA Route 16Y – Columbia Pike-Farragut Square Line

Route 16Y operates along K Street from McPherson Square to 19th Street in the Central Section of the study area. During weekdays, this route provides eastbound service operating from 6:52 AM until 9:33 AM. Westbound service operates from 4:30 PM until 7:03 PM.

2-1.2.1.3. WMATA Route 38B – Ballston-Farragut Square Line

Route 38B operates on M Street and Pennsylvania Avenue in the Western Section of the study area and along K Street to Farragut West Metro in the Central Section of the study area. During weekdays, this route provides service throughout the day with eastbound service operating from 5:44 AM until 1:55 AM. Westbound service operates from 5:20 AM until 2:19 AM.

2-1.2.1.4. WMATA Route 80 – North Capitol Street Line

Route 80 operates on K Street from 19th Street to 13th Street in the Central Section of the study area and along Massachusetts Avenue from H Street to North Capitol Street in the Eastern Section of the study area. During weekdays, this route provides service throughout the day with eastbound service operating from 5:28 AM until 2:19 AM. Westbound service operates from 5:01 AM until 2:17 AM.

2-1.2.1.5. WMATA Route 96 – East Capitol Street-Cardozo Line

Route 96 operates along Massachusetts Avenue from Union Station to New Jersey Avenue in the Eastern Section of the study area. During weekdays, this route provides service throughout the day with eastbound service operating from 5:01 AM until 2:12 AM. Westbound service operates from 5:20 AM until 2:06 AM.

2-1.2.1.6. WMATA Route B11[1] – Bethesda Reverse Commute Line

Route B11 operated until December 28, 2003 along M Street in the Western Section of the study area. During weekdays, this route provided eastbound service from 6:02 AM until 8:42 AM. Westbound service operated from 4:53 PM until 7:53 PM.

2-1.2.1.7. WMATA Route D1, D3 and D6 – Sibley Hospital-Stadium-Armory Line

Routes D1, D3 and D6 operate along K Street from 21st Street to 13th Street in the Central Section of study area. Routes D1 and D6 also operate along Massachusetts Avenue from North Capitol Street to Union Station. During weekdays, these routes provide service throughout the day with eastbound service operating from 5:42 AM until 3:09 AM. Westbound service operates from 4:40AM until 2:20 AM.

2-1.2.1.8. WMATA Route D4 – Ivy City-Union Station Line

Route D4 operates along Massachusetts Avenue from North Capitol Street to Union Station in the Eastern Section of the study area. During weekdays, this route provides service throughout the day with eastbound service operating from 4:22 AM until 2:33 AM. Westbound service operates from 4:20 AM until 2:59 AM.

2-1.2.1.9. WMATA Route D5 – MacArthur Boulevard-Georgetown Line

Route D5 operates along Canal Road, M Street and Pennsylvania Avenue through the Western Section of study area. Route D5 continues through the Central Section of the study area running along K Street from Washington Circle to Farragut North Metro Station. During weekdays, these routes provide eastbound service operating from 7:16 AM until 9:20 AM. Westbound service operates from 4:29 PM until 6:46 PM.

2-1.2.1.10. WMATA Route D8 – Ivy City-Union Station Line

Route D8 operates along Massachusetts Avenue from North Capitol Street to Union Station in the Eastern Section of the study area. During weekdays, this route provides service throughout

[1] Route B11 was eliminated on December 28, 2003. The analyses for this study were completed prior to the elimination of this route.

the day with eastbound service operating from 6:05 AM until 2:48 AM. Westbound service operates from 5:40 AM until 2:00 AM.

2-1.2.1.11. WMATA Route L2 – Connecticut Avenue Line

Route L2 operates along K Street from McPherson Square Metro station to 21st Street in the Central Section of the study area. During weekdays, this route provides service throughout the day with eastbound service operating from 5:30 AM until 1:59 AM. Westbound service operates from 5:40 AM until 3:10 AM.

2-1.2.1.12. WMATA Route N7[1] – Montgomery Mall-Federal Triangle Express Line

Route N7 operated until December 28, 2003 along K Street 14th Street to 21st Street in the Central Section of the study area. During weekdays, this route provided eastbound service from 7:16 AM until 8:45 AM. Westbound service operated from 5:02 PM until 6:25 PM.

2-1.2.1.13. WMATA Route S1 – 16th Street Potomac Park Line

Route S1 operates along K Street from 19th Street to 16th Street in the Central Section of the study area. During weekdays, these routes provide eastbound service operating from 4:18 PM until 6:14 PM. Westbound service operates from 6:10 AM until 9:17 AM.

2-1.2.2. Existing Bus Ridership

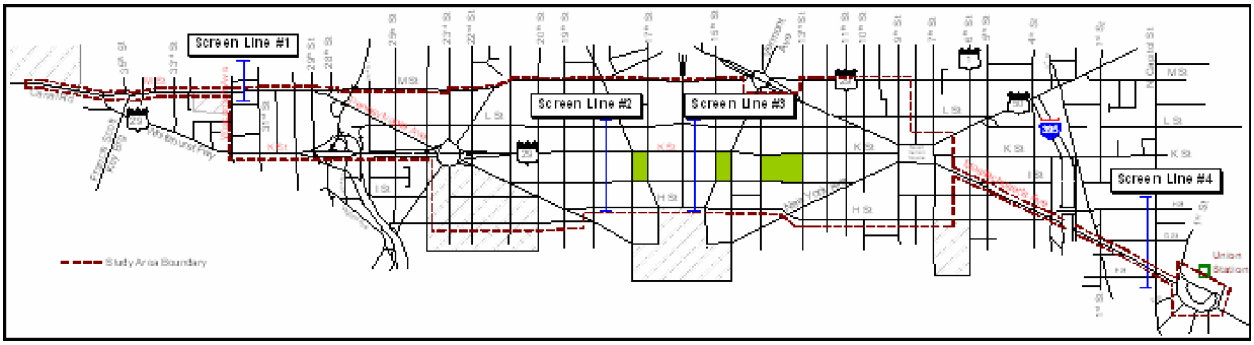
To support the K Street Transitway study, the Study Team performed an analysis of existing bus ridership. This section of the report summarizes existing bus ridership throughout the study area.

For purposes of this analysis, four screenlines in the study area were defined. These screenlines, identified below and depicted in Figure 2-3, cross several streets and allow for total transit ridership to be summarized at key locations in the study area:

- Screenline 1: M Street – just east of Wisconsin Avenue
- Screenline 2: H, I, K, and L Streets – just west of Connecticut Avenue/17th Street
- Screenline 3: H, I, K, and L Streets – just west of 15th Street/Vermont Avenue
- Screenline 4: Massachusetts Avenue, E Street, and H Street – just west of North Capitol Street

[1] Route N7 was eliminated on December 28, 2003. The analyses for this study were completed prior to the elimination of this route.

Figure 2-3
Screenline Locations



Seventeen major WMATA bus routes traverse at least one of the four screenlines. In addition, the Georgetown University Shuttle travels on M Street across Screenline 1. Table 2-1 shows the existing bus routes, bus trips, and total passenger trips. Existing ridership information was obtained from the Washington Metropolitan Area Transit Authority (WMATA).

As Table 2-1 shows, Screenlines 2 and 3 are the most traversed, due to their location in the CBD. A difference of almost 5,000 passengers between the two screenlines indicates the magnitude of this transit destination.

The 30-series (30, 32, 34, 35, 36) and the D-series (D1, D3, D6) are the most heavily traveled bus routes across these two screenlines.

2-2. TRAFFIC VOLUMES

The Study Team collected turning movement counts at the intersections shown in Appendix B, Figures B-10 through B-18. (Accompanying pedestrian counts are presented in Appendix B, Figures B-19 through B-21 for weekdays). Counts were conducted during the AM peak period (7:00 AM to 9:00 AM, midday peak period (11:30 AM to 1:30 PM) and PM peak period (4:00 PM to 6:00 PM). These volumes form the primary input to the simulation model used to evaluate existing traffic conditions throughout the study area.

In order to improve the modeling of existing traffic conditions, the Study Team applied standard traffic engineering techniques to adjust the turning movement counts at intersections where minor unjustified imbalances were found. The many garages and parking lots throughout the study area were taken into consideration while balancing the volumes between intersections. Appendix B, Figures B-10 through B-18 show the existing balanced turning movement count data. Counts were taken during the months of December 2002, January, February and March 2003. No traffic was counted during holiday weeks or while District public schools and universities were not in session. There was no traffic counted on snow days or while schools and businesses were closed.

Table 2-1
Existing (Year 2003) Weekday Bus Trips and Ridership

Route(s)	Street	Weekday Trips		Weekday Passengers		AM Peak Trips		AM Peak Passengers		PM Peak Trips		PM Peak Passengers		Weekday Two-Way Passengers			
		EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	AM	PM	Off-Peak	Total
Screenline 1: M Street just east of Wisconsin Avenue																	
30,32,34,35,36	M Street	147	161	2,894	2,365	16	19	570	331	14	11	292	390	901	682	3,676	5,259
38B	M Street	44	44	496	441	4	4	65	42	4	4	59	46	107	105	725	937
D5	M Street	6	6	129	76	3	0	90	0	0	3	0	55	90	55	60	205
Georgetown Univ Shuttle	M St	----	----	----	----	----	----	----	----	----	----	----	----	450	750	300	1,500
Total Screenline 1		197	211	3,519	2,882	23	23	725	373	18	18	351	491	1,548	1,592	4,761	7,901
Screenline 2: H, I, K, and L Streets just west of Connecticut Avenue/17th Street																	
38B	K Street	44	44	410	320	4	4	52	49	4	4	57	67	101	124	505	730
L2	K Street	45	46	230	240	4	4	86	18	3	4	35	45	104	80	286	470
D1,D3,D6	K Street	82	85	1,300	1,320	13	12	261	294	9	7	240	200	555	440	1,625	2,620
D5	K Street	6	6	120	60	3	0	87	0	0	3	0	43	87	43	50	180
N7[1]	K Street	4	3	70	40	2	0	37	0	0	2	0	30	37	30	43	110
80	K Street	70	73	790	780	4	7	48	216	6	5	163	121	264	284	1,022	1,570
S1	K Street	11	24	210	660	0	11	0	476	6	0	187	0	476	187	207	870
16Y	K Street	6	6	71	88	2	0	24	0	0	2	0	36	24	36	99	159
30,32,34,35,36	H & I St	147	161	2,830	2,790	16	19	567	387	14	11	395	365	954	760	3,906	5,620
11Y	H & I St	4	5	18	29	0	3	0	15	2	0	10	0	15	10	22	47
Total Screenline 2		419	453	6,049	6,327	48	60	1,162	1,455	44	38	1,087	907	2,617	1,994	7,765	12,376
Screenline 3: H, I, K, and L Streets just west of 15th Street/Vermont Avenue																	
L2	K Street	45	46	230	240	4	4	86	18	3	4	35	45	104	80	286	470
D1,D3,D6	K Street	82	85	1,300	1,320	13	12	261	294	9	7	240	200	555	440	1,625	2,620
N7[1]	K Street	4	3	70	40	2	0	37	0	0	2	0	30	37	30	43	110
80	K Street	70	73	790	780	4	7	48	216	6	5	163	121	264	284	1,022	1,570
16Y	K Street	6	6	48	43	2	0	7	0	0	2	0	17	7	17	67	91
S2,S4	H & I St	161	153	1,490	1,760	19	6	871	98	12	15	367	590	969	957	1,324	3,250
30,32,34,35,36	H & I St	147	161	2,830	2,790	16	19	567	387	14	11	395	365	954	760	3,906	5,620
G8	H & I St	63	62	276	304	4	7	9	159	6	4	158	38	168	196	216	580
42	H & I St	108	105	650	730	8	6	48	30	6	6	23	93	78	116	1,186	1,380
P17,P19	H & I St	15	18	170	125	0	8	0	60	6	0	55	0	60	55	180	295
11Y	H & I St	4	5	46	57	0	3	0	30	2	0	25	0	30	25	48	103
W13	H & I St	9	12	67	49	0	5	0	35	4	0	30	0	35	30	51	116
X2	H & I St	131	127	525	419	8	8	45	147	9	10	106	88	192	194	558	944
Total Screenline 3		845	856	8,492	8,657	80	85	1,979	1,474	77	66	1,597	1,587	3,453	3,184	10,512	17,149
Screenline 4: Massachusetts Avenue and H Street just west of North Capitol Street																	
X2	H Street	131	127	3,277	3,685	8	8	169	432	9	10	405	299	601	704	5,657	6,962
96	Mass Ave	0	60	0	906	0	4	0	106	0	4	0	72	106	72	728	906
80	Mass Ave	70	73	1,013	1,006	4	7	84	238	6	5	189	118	322	307	1,390	2,019
D1,D3,D6	E Street	82	85	1,192	1,423	13	12	66	283	9	7	234	99	349	333	1,933	2,615
Total Screenline 4		283	345	5,482	7,020	25	31	319	1,059	24	26	828	588	1,378	1,416	9,708	12,502

Note: EB=eastbound, WB=westbound

Source: Washington Metropolitan Area Transit Authority

[1] Route N7 was eliminated on December 28, 2003. The analyses for this study were completed prior to the elimination of this route.

As the turning movement counts indicate, K Street from Washington Circle to 12th Street has very high volumes during all peak periods; however, the PM peak hour has the highest volumes. All east-west streets within the study area also experience high volumes. The pedestrian volume figures show that, as expected, high-pedestrian volumes are found along K Street due to the concentration of businesses and transit availability. The highest number of pedestrians on weekdays can be found at Connecticut Avenue, the intersection closest to the Farragut North Metro station.

The Study Team collected automated Average Daily Traffic (ADT) counts over a 72 hour period throughout March 2003 at the following locations:

- H Street between 18th Street and Connecticut Avenue
- I Street between 18th Street and Connecticut Avenue
- K Street between 15th and 14th Street
- K Street between 17th and 16th Street
- K Street between 18th Street and Connecticut Avenue
- L Street between 18th Street and Connecticut Avenue
- Massachusetts Avenue between New Jersey Avenue and North Capitol Street
- K Street under Washington Circle
- K Street between Thomas Jefferson Street and Wisconsin Avenue
- Pennsylvania Avenue between 24th Street and 25th Street

The two-way daily traffic volumes are shown in Appendix B, Figure B-10. In the Western Section of the study area, K Street below Whitehurst Freeway carries approximately 11,300 vehicles during a typical weekday[1]. The daily traffic on K Street below Washington Circle is approximately 20,800, and the daily traffic on Pennsylvania Avenue on a typical weekday is approximately 19,400 vehicles.

In the Central Section of the study area, K Street carries approximately 28,200 vehicles during a typical weekday. The daily traffic on L Street on a weekday is approximately 20,000 vehicles. The average daily traffic on H Street and I Street is approximately 16,000 and 13,600 vehicles, respectively.

In the Eastern Section of the study area, Massachusetts Avenue carries approximately 15,900 vehicles between New Jersey Avenue and North Capitol Street.

Figures 2-4 and 2-5 show the average daily traffic volumes for weekdays at two of the locations where average daily traffic volumes were recorded. Figures for the remaining eight locations are presented in Appendix B, Figures B-22 through B-29. As shown in Figure 2-4, in the Central Section, the weekday traffic volumes for K Street are consistently higher from approximately 8:00 AM to 7:00 PM. Also, the westbound K Street traffic volume is generally higher than the K Street eastbound traffic volumes for most of the day, with the exception of the PM Peak period.

[1] Average of total 24-hour traffic volume in both directions.

Figure 2-4
Weekday Hourly Distribution of Vehicular Trips -
K Street Between 14th and 15th Streets

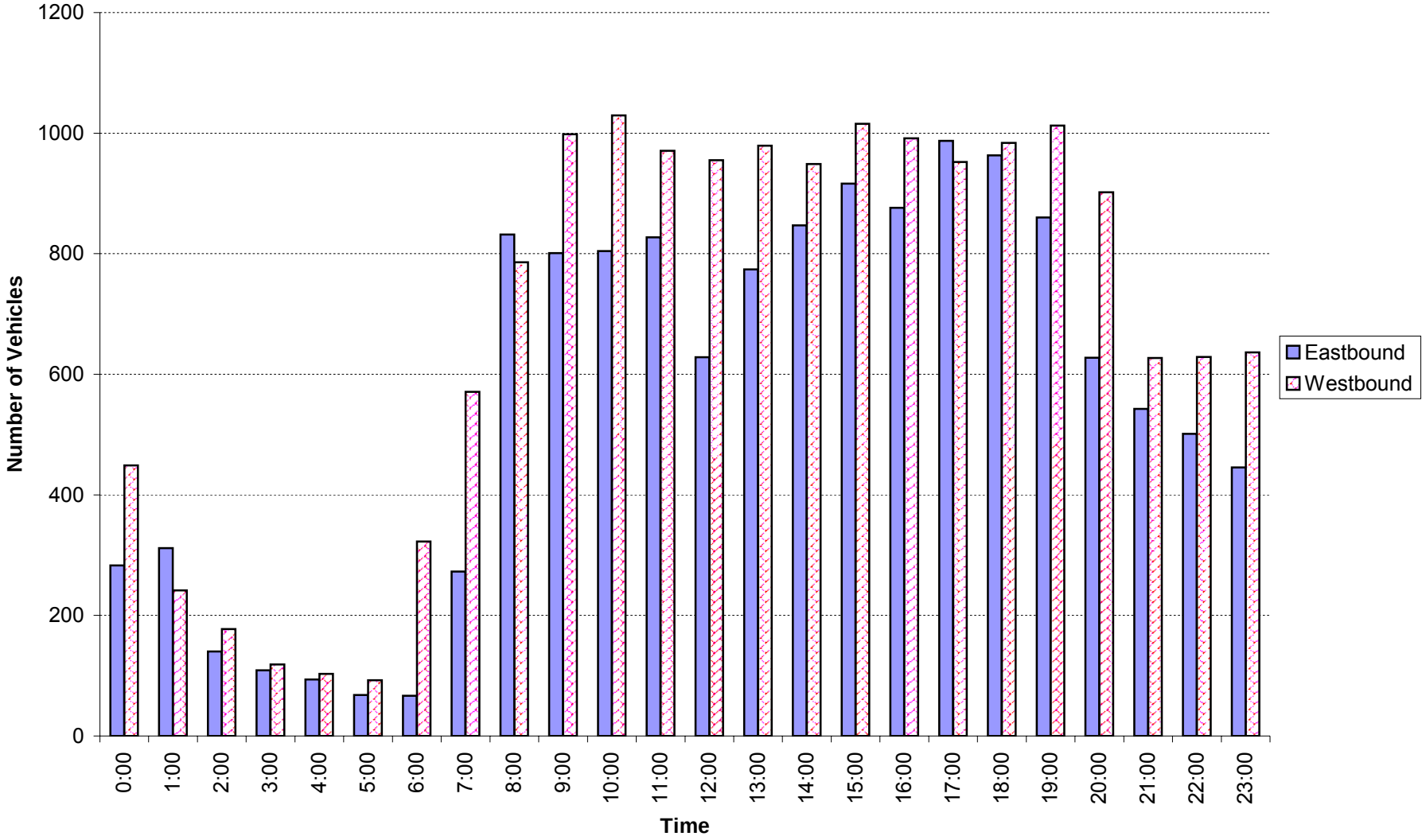
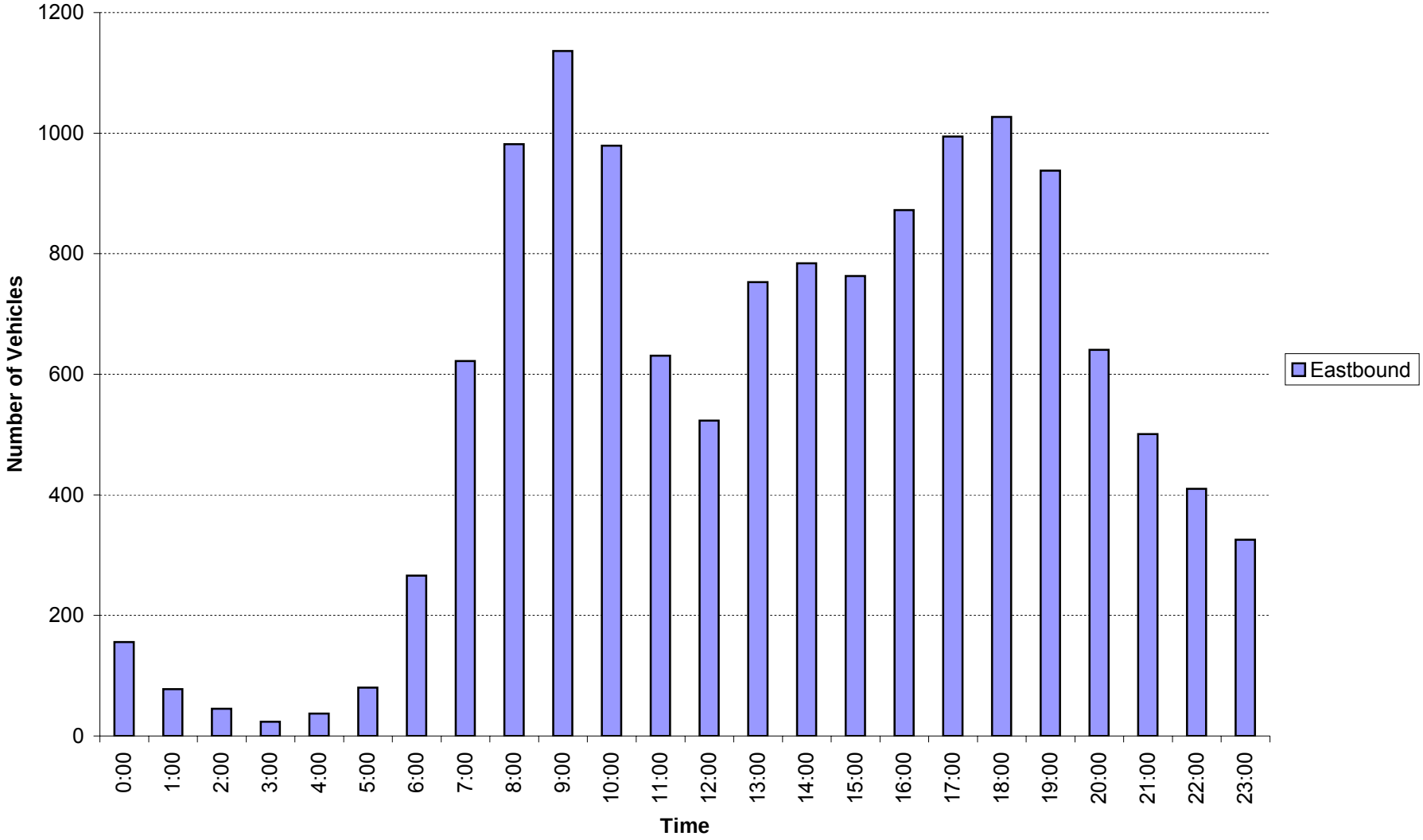


Figure 2-5
Weekday Hourly Distribution of Vehicular Trips -
H Street Between 17th and 18th Streets



However, as shown in Figure 2-5, traffic volumes on H Street during the AM peak hour are higher than the traffic during the PM peak hour, with a noticeable drop in volume during the midday peak hours. This decline in traffic volumes during the midday peak hours is also found on other east-west streets studied in the Central Section of the study area.

Automated vehicle classification counts taken over a two-week period in the study area indicate that approximately two percent or less of average weekday traffic in the Central Section along K Street is comprised of heavy vehicles between the hours of 7:00 AM and 7:00 PM[1].

2-3. SPEED AND TRAVEL TIMES

In order to gain an understanding of driving patterns and gather information needed in the development of the traffic model for the study area, the Study Team collected information on speed and travel times on key streets in the study area. The Study Team collected data on travel times and delay from January 16, 2003, to February 12, 2003.

Study Team data collectors drove sections of K Street, L Street, M Street, H Street, I Street, Massachusetts Avenue and Pennsylvania Avenue several times in each direction during the AM, midday and PM peak hours and recorded the elapsed travel times at predetermined travel points and the distance between the selected travel points. For the travel time runs, the data collectors were instructed to drive at the same speed as most of the vehicles traversing the study area.

The Study Team calculated average speed for each roadway segment as well as an overall average speed for the corridor using the travel times and distances between time points. Table 2-2 presents overall travel speeds for the key corridors for AM, midday and PM peak hours, respectively. Midday peak period speeds are lower overall throughout the study area due to high volumes, the removal of turning restrictions and parking that is allowed during the midday peak period. However, there are some portions of H Street and I Street that also experience slow speeds during the AM peak period.

Speeds in the Western Section of the study area along M Street are consistent throughout the day; however, Pennsylvania Avenue experiences slower speeds during the PM peak period.

In the Eastern Section of the study area, along Massachusetts Avenue from Mount Vernon Square to 6th Street, low speeds are constant for both the AM and PM peak periods. The speeds along Massachusetts Avenue are similar in both the eastbound and westbound directions.

These travel speeds include signal delay; therefore, overall average speeds are considerably slower than the speed limits of the roadways. There are only two sections of all of the corridors where average speeds met or exceeded the speed limit, as can be seen in Table 2-2. In particular, traffic traveling on M Street westbound between 23rd and 25th Streets and eastbound K Street between 25th and 20th Street slightly exceeded the speed limit.

[1] Classification count data is presented in Appendix C.

Table 2-2
AVERAGE VEHICULAR TRAVEL SPEEDS
(Miles Per Hour)

	Road	Section	AM Peak	Midday Peak	PM Peak
K STREET	K Street Eastbound	25th Street - 20th Street	8.1	26.2	17.5
	K Street Eastbound	20th Street - Connecticut Avenue	8.3	7.1	5.1
	K Street Eastbound	Connecticut Avenue - 14th Street	8.1	8.1	8.1
	K Street Eastbound	14th Street - 11th Street	12.5	9.9	15.6
	K Street Eastbound	11th Street - 9th Street	6.3	3.8	8.4
	K Street Eastbound	9th Street - 7th Street	10.7	4.5	8.4
	K Street Eastbound	25th Street - 7th Street	8.7	7.8	9.1
	K Street Westbound	7th Street - 9th Street	4.0	8.0	3.7
	K Street Westbound	9th Street - 11th Street	11.7	13.9	9.3
	K Street Westbound	11th Street - 14th Street	13.7	9.0	6.5
	K Street Westbound	14th Street - Connecticut Avenue	11.3	7.0	8.1
	K Street Westbound	Connecticut Avenue - 20th Street	7.1	11.9	8.6
	K Street Westbound	20th Street - 25th Street	13.7	18.9	20.2
	K Street Westbound	7th Street - 25th Street	9.8	10.5	8.2
L STREET	L Street Eastbound	25th Street - 23rd Street	13.4	11.2	5.0
	L Street Eastbound	23rd Street - 20th Street	17.3	5.6	8.2
	L Street Eastbound	20th Street - Connecticut Avenue	5.9	6.8	6.7
	L Street Eastbound	Connecticut Avenue - 14th Street	14.7	5.0	12.7
	L Street Eastbound	14th Street - 11th Street	6.7	9.0	6.7
	L Street Eastbound	25th Street - 11th Street	9.9	6.4	7.7
M STREET	M Street Westbound	11th Street - 14th Street (Enter)	8.8	9.9	8.2
	M Street Westbound	14th Street (Enter) - 14th Street (Exit)	10.0	7.5	5.2
	M Street Westbound	14th Street (Exit) - 17th Street	12.4	7.7	14.1
	M Street Westbound	17th Street - Connecticut Avenue	6.9	4.9	10.5
	M Street Westbound	Connecticut Avenue - 20th Street	13.3	12.0	13.8
	M Street Westbound	20th Street - 23rd Street	12.3	13.3	22.8
	M Street Westbound	23rd Street - 25th Street	15.3	23.5	26.1
	M Street Westbound	11th Street - 25th Street	11.0	9.6	12.7

Table 2-2 (Continued)
AVERAGE VEHICULAR TRAVEL SPEEDS
(Miles Per Hour)

	Road	Section	AM Peak	Midday Peak	PM Peak
H STREET	H Street Eastbound	23rd Street - 20th Street	10.2	9.3	12.8
	H Street Eastbound	20th Street - 17th Street	3.1	8.1	9.3
	H Street Eastbound	17th Street - Connecticut Avenue	3.1	16.2	9.0
	H Street Eastbound	Connecticut Avenue - 14th Street	9.8	6.8	7.3
	H Street Eastbound	14th Street - 11th Street	10.4	7.1	9.7
	H Street Eastbound	11th Street - 9th Street	11.9	12.1	21.3
	H Street Eastbound	23rd Street - 9th Street	6.0	8.6	9.9
I STREET	I Street Westbound	12th Street - 14th Street	10.1	7.4	8.4
	I Street Westbound	14th Street - Connecticut Avenue	5.0	4.4	9.5
	I Street Westbound	Connecticut Avenue - 20th Street	10.8	4.7	10.3
	I Street Westbound	20th Street - 21st Street	2.4	5.2	5.2
	I Street Westbound	21st Street - 23rd Street	7.4	6.3	7.0
	I Street Westbound	12th Street - 23rd Street	6.3	5.2	8.5
UNION STATION	Massachusetts Avenue Eastbound	9th Street at K Street - 7th Street	10.7	4.5	8.4
	Massachusetts Avenue Eastbound	7th Street - 6th Street	6.1	8.8	10.6
	Massachusetts Avenue Eastbound	6th Street - 3rd Street/ H Street	11.8	8.0	3.6
	Massachusetts Avenue Eastbound	3rd Street/H Street - N. Capitol Street	9.8	15.5	14.7
	Massachusetts Avenue Eastbound	9th Street at K Street - N. Capitol Street	8.9	9.6	7.3
	Massachusetts Avenue Westbound	N. Capitol Street - 3rd Street/ H Street	22.4	15.6	13.9
	Massachusetts Avenue Westbound	3rd Street/H Street - 6th Street	12.3	5.1	17.2
	Massachusetts Avenue Westbound	6th Street - 7th Street	5.3	8.3	4.9
	Massachusetts Avenue Westbound	7th Street - 9th Street	4.0	8.0	3.7
	Massachusetts Avenue Westbound	9th Street - 9th Street at K Street	3.3	3.1	N/A
	Massachusetts Avenue Westbound	N. Capitol Street - 9th Street at K Street	9.2	9.8	8.7

Table 2-2 (Continued)
AVERAGE VEHICULAR TRAVEL SPEEDS
(Miles Per Hour)

	Road	Section	AM Peak	Midday Peak	PM Peak
GEORGETOWN	Canal Road Eastbound	Entrance to Georgetown Univ. - Key Bridg	11.2	7.4	7.3
	Canal Road Eastbound	Key Bridge - Wisconsin Avenue	8.1	8.7	11.7
	M Street Eastbound	Wisconsin Avenue - Pennsylvania Avenue	13.8	8.2	9.4
	Pennsylvania Avenue Eastbound	29th Street - 24th Street	10.7	18.5	10.7
	Pennsylvania Avenue Eastbound	24th Street - Upper K Street	16.1	5.5	3.2
	Upper K Street Eastbound	Pennsylvania Avenue - 20th Street	5.9	12.9	12.9
	Canal Road/M Street Eastbound	Entrance to Georgetown Univ. - 20th St.	9.4	11.3	9.9
	Lower K Street Westbound	21st Street - 25th Street	18.3	24.0	15.9
	Lower K Street Westbound	25th Street - 27th Street	16.3	26.6	16.3
	Lower K Street Westbound	27th Street - Thomas Jefferson Street	13.9	14.8	15.7
	Lower K Street Westbound	Thomas Jefferson St. - Wisconsin Ave.	14.4	12.3	11.3
	Wisconsin Avenue Northbound	Lower K Street - M Street	12.7	5.7	11.0
	Canal Road Westbound	Wisconsin Avenue - Key Bridge	8.1	7.5	9.6
	Canal Road Westbound	Key Bridge - Entrance to Georgetown Uni	20.0	11.3	16.3
	Lower K Street Westbound	21st St. - Entrance to Georgetown Univ.	13.7	11.3	13.7
	Canal Road Eastbound	Entrance to Georgetown Univ. - Key Bridg	11.2	15.2	7.3
	Canal Road Eastbound	Key Bridge - Wisconsin Avenue	8.1	8.7	11.7
	Wisconsin Avenue Southbound	M Street - Lower K Street	10.3	12.3	9.2
	Lower K Street Eastbound	Wisconsin Ave. - Thomas Jefferson St.	13.3	9.9	13.0
	Lower K Street Eastbound	Thomas Jefferson Street - 27th Street	8.1	8.1	5.7
	Lower K Street Eastbound	27th Street - 25th Street	14.2	26.6	26.6
	Lower K Street Eastbound	25th Street - 21st Street	24.0	25.7	27.9
	Lower K Street Eastbound	Entrance to Georgetown Univ. - 21st St.	11.4	12.7	10.6

Also, in order to gain an understanding of bus driving patterns and to gather information needed in the development of the traffic model for the study area, the Study Team collected information on speed and travel times for specific bus routes in the study area. The Study Team collected the data on bus travel times and delay from March 10 through 21, 2003. As predicted, the bus travel times are lower than the vehicular travel times. The travel times collected are shown in Table 2-3.

Table 2-3
Existing Average Bus Travel Speeds
(Miles Per Hour)

	Georgetown Shuttle		WMATA Route 80		WMATA Route D6	
	EB	WB	EB	WB	EB	WB
	From R St./ Wisconsin Ave. to Foggy Bottom	From Foggy Bottom To M St./ Wisconsin Ave.	From 18th St./ K St. to Mass Ave./ N Capitol	From Mass Ave./ N Capitol to K St./ 19th St.	From K St./ 21st St to Union Station	From Union Station to K St./ 20th St.
AM Peak Period	11.2	11.5	5.7	6.3	5.3	5.0
Midday Peak Period	13.4	11.0	4.1	5.4	4.8	5.2
PM Peak Period	6.7	6.0	4.7	6.6	4.3	4.1

Notes: AM Peak Period: 7:00 AM - 9:00 AM
Midday Peak Period: 11:30 AM - 1:30 PM
PM Peak Period: 4:00 PM - 6:00 PM
Travel times recorded from March 10 through 21, 2003

The Study Team also collected information on bus dwell times to gain an understanding of bus stop and service patterns and to gather information needed in the development of the traffic model for the study area. The bus dwell time is the combination of passenger flow time and door open/close time. The Study Team collected the data on bus dwell times on March 5, 2003. The dwell times were recorded for all routes servicing the bus stop at K Street and Connecticut Avenue from 4:00 PM to 6:00 PM in both the eastbound and westbound directions. The maximum bus dwell time was approximately 30 seconds for the eastbound stop and 40 seconds for the westbound stop. The dwell data is shown in Appendix D.

2-4. QUEUES AT CRITICAL INTERSECTIONS

The Study Team collected information on existing queues, the number of vehicles lined up at an intersection during the red phase of a traffic signal, at critical intersections in the study area. This information was needed to adequately develop a computerized simulation model of existing traffic conditions. The Study Team observed AM, midday and PM peak hour queues for each of the approaches of all the critical intersections inside the study area. The Study Team calculated the maximum queues for all of the approaches. Appendix B, Figures B-30 and B-31 summarize the observed maximum queues for all the critical intersections.

2-5. PARKING INVENTORY

The Study Team performed a detailed parking inventory for the entire study area. As shown in Appendix B, Figures B-32 and B-33, parking restrictions vary along the corridors. For example, parking is not allowed at metered parking locations on the K Street service roads between 7:00 AM to 9:30 AM and between 4:00 PM until 6:30 PM. Parking is not allowed on Pennsylvania Avenue or Massachusetts Avenue during the same time period. Non-metered parking locations are signed as two-hour parking all day only on K Street from Wisconsin Avenue to Thomas Jefferson Avenue.

From 22nd Street to 9th Street, there are 151 parking meters along the westbound K Street service roads and 125 parking meters along the eastbound K Street service roads. There are no parking meters directly on mainline K Street in the Central Section of the study area, except between 12th and 6th Streets. In addition to K Street, metered parking is found on the north side of L Street between 18th and 19th Streets and between 20th and 22nd Streets and on the south side of L Street between 22nd and 18th Streets and between 17th and 12th Streets. Along I Street, metered parking is found on the north side between 11th and 15th Streets and between 20th and 21st Streets and on the south side between 12th and 21st Streets. Parking is primarily limited to two hours at most of these meters.

The Study Team recorded parking utilization along K Street and K Street service roads from 22nd Street to 6th Street for different time periods on a typical weekday during January 2003. The three time periods studied were the AM off-peak period from 9:30 AM to 11:30 AM, midday peak period from 11:30 AM to 1:30 PM and PM off-peak period from 1:30 PM to 4:00 PM. As metered parking is not allowed during AM and PM peak periods on the roads in the Central Section of the study area, no parking utilization inventory was performed in the study area during these peak periods. Detailed information of parking utilization on different sections of the study area is available in Appendix E.

Parking utilization was very high during the AM off-peak and midday peak hours. The only exception was the section of K Street between 10th and 9th Streets with approximately 50 percent utilization during the AM off-peak and midday peak hours and only 25 percent in the PM off-peak. In general, parking utilization is lower in the PM off-peak hours.

2-6. MODELING OF EXISTING CONDITIONS

Simulation modeling is used in transportation engineering as an analysis tool to assess existing conditions and evaluate existing and future alternatives over a specific period of time. The computerized transportation model attempts to simulate the traffic conditions along the described roadway links coded into the model. The model parameters can be used to evaluate each intersection, link and the entire study area. For this feasibility study, the Study Team developed simulation models for the existing AM, midday and PM peak hours in CORSIM. CORSIM is a stochastic microscopic simulation program capable of modeling individual vehicle interactions on complex roadway networks. CORSIM uses inputs such as lane assignments and geometries,

intersection turning movement volumes, vehicle speeds, percentages of vehicles by type, and pre-timed and/or actuated signal timing to produce output that contains measures of effectiveness commonly used in the traffic engineering profession, including total delay, stopped delay, and queue lengths. The CORSIM models used in this study cover all roadway segments in the study area.

The base existing AM, midday and PM peak hour models were completed in CORSIM and calibrated to field data. The Study Team used the information on corridor travel speeds, queues, bus dwell times and bus speeds to develop the existing conditions models. The principal measurement to calibrate the model was the vehicular speeds along K Street and parallel corridors.

The existing peak hour CORSIM models were simulated five consecutive times with randomly selected seed values. Calibration tables were completed comparing the results from the existing CORSIM simulation models to the existing travel times. As shown in Table 2-4, the existing conditions peak models replicate adequately the travel speeds observed in the field.

Table 2-4

Calibration Results

Road	Section	AM Peak Hour			PM Peak Hour		
		Average Field Speed (mph)	Average CORSIM Speed (mph)	Percentage difference of field compared to CORSIM	Average Field Speed (mph)	Average CORSIM Speed (mph)	Percentage difference of field compared to CORSIM
K Street Eastbound	20th Street - Connecticut Avenue	8.3	5.8	-30%	5.1	4.4	-14%
K Street Eastbound	Connecticut Avenue - 14th Street	8.1	8.3	2%	8.1	5.5	-33%
K Street Eastbound	14th Street - 11th Street	12.5	10.2	-18%	15.6	11.8	-24%
K Street Eastbound	**20th Street - 11th Street**	**9.1**	**7.3**	**-19%**	**7.7**	**5.6**	**-28%**
K Street Westbound	11th Street - 14th Street	13.7	11.2	-18%	6.5	6.7	3%
K Street Westbound	14th Street - Connecticut Avenue	11.3	9.7	-14%	8.1	8.7	7%
K Street Westbound	Connecticut Avenue - 20th Street	7.1	8.8	24%	8.6	8.6	0%
K Street Westbound	**11th Street - 20th Street**	**9.9**	**9.5**	**-5%**	**7.7**	**8.3**	**7%**
L Street Eastbound	20th Street - Connecticut Avenue	5.9	6.4	9%	6.7	8.3	24%
L Street Eastbound	Connecticut Avenue - 14th Street	14.7	16.1	9%	12.7	11.2	-12%
L Street Eastbound	**20th Street - 11th Street**	**9.3**	**10.7**	**14%**	**9.4**	**10.0**	**6%**
M Street Westbound	14th Street (Exit) - Connecticut Ave	10.0	10.8	8%	12.8	14.0	10%
M Street Westbound	Connecticut Avenue - 20th Street	13.3	14.2	6%	13.8	16.4	18%
M Street Westbound	**14th Street - 20th Street**	**10.8**	**12.0**	**10%**	**13.1**	**14.8**	**13%**
H Street Eastbound	Connecticut Avenue to 14th Street	9.8	10.2	5%	7.3	7.8	8%
H Street Eastbound	14th Street to 11th Street	10.4	8.9	-14%	9.7	9.6	-1%
H Street Eastbound	**Connecticut Ave to 11th St**	**10.0**	**9.9**	**-2%**	**8.2**	**8.3**	**1%**
I Street Westbound	14th Street - Connecticut Avenue	5.0	6.2	24%	9.5	11.4	20%
I Street Westbound	Connecticut Avenue - 20th Street	10.8	8.6	-21%	10.3	12.5	22%
I Street Westbound	**14th Street - 20th Street**	**6.8**	**7.0**	**4%**	**9.8**	**11.8**	**20%**

Table 2-4 (Continued)

Calibration Results

Road	Section	AM Peak Hour			PM Peak Hour		
		Average Field Speed (mph)	Average CORSIM Speed (mph)	Percentage difference of field compared to CORSIM	Average Field Speed (mph)	Average CORSIM Speed (mph)	Percentage difference of field compared to CORSIM
Canal Road Eastbound	Entrance to Georgetown Univ. - Key Bridge	11.2	12.6	13%	7.3	8.2	11%
M Street Eastbound	Key Bridge - Wisconsin Avenue	8.1	10.0	23%	11.7	12.2	4%
M Street Eastbound	Wisconsin Avenue - Pennsylvania Avenue	13.8	17.5	26%	9.4	9.7	3%
Pennsylvania Avenue Eastbound	29th Street - 24th Street	10.7	12.9	21%	10.7	9.5	-11%
Canal Road/M Street Eastbound	**Entrance to Georgetown Univ. - 20th St.**	**10.5**	**12.5**	**19%**	**9.5**	**9.5**	**0%**
Lower K Street Westbound	25th Street - 27th Street	16.3	15.4	-6%	16.3	13.9	-14%
Lower K Street Westbound	27th Street - Thomas Jefferson Street	13.9	12.8	-8%	15.7	14.0	-11%
Lower K Street Westbound	Thomas Jefferson St. - Wisconsin Ave.	14.4	15.5	8%	11.3	11.6	3%
Wisconsin Avenue Northbound	Lower K Street - M Street	12.7	12.0	-5%	11.0	9.3	-16%
M Street Westbound	Wisconsin Avenue - Key Bridge	8.1	7.1	-12%	9.6	8.8	-8%
Canal Road Westbound	Key Bridge - Entrance to Georgetown Univ.	20.0	20.2	1%	16.3	19.0	17%
Lower K Street Westbound	**21st St. - Entrance to Georgetown Univ.**	**12.8**	**14.1**	**9%**	**12.7**	**12.6**	**-1%**
Wisconsin Avenue Southbound	M Street - Lower K Street	10.3	12.1	17%	9.2	10.0	9%
Lower K Street Eastbound	Wisconsin Ave. - Thomas Jefferson St.	13.3	14.2	7%	13.0	13.6	5%
Lower K Street Eastbound	Thomas Jefferson Street - 27th Street	8.1	5.8	-28%	5.7	6.1	7%
Lower K Street Eastbound	27th Street - 25th Street	14.2	18.2	28%	26.6	24.9	-7%
Lower K Street Eastbound	**Entrance to Georgetown Univ. - 21st St.**	**10.5**	**11.9**	**13%**	**9.3**	**9.3**	**0%**
Massachusetts Avenue Eastbound	7th Street - 6th Street	6.1	6.9	13%	10.6	11.6	-10%
Massachusetts Avenue Eastbound	6th Street - 3rd Street/ H Street	11.8	8.5	-28%	3.6	4.1	-16%
Massachusetts Avenue Eastbound	3rd Street/H Street - N. Capitol Street	9.8	9.9	1%	14.7	10.8	26%
Massachusetts Avenue Eastbound	**9th Street at K Street - N. Capitol Street**	**9.5**	**8.3**	**-13%**	**6.7**	**7.1**	**-6%**
Massachusetts Avenue Westbound	N. Capitol Street - 3rd Street/ H Street	22.4	18.0	-20%	13.9	14.9	-7%
Massachusetts Avenue Westbound	3rd Street/H Street - 6th Street	12.3	12.5	2%	17.2	13.8	20%
Massachusetts Avenue Westbound	6th Street - 7th Street	5.3	6.4	21%	4.9	3.7	24%
Massachusetts Avenue Westbound	**N. Capitol Street - 9th Street at K Street**	**12.5**	**13.4**	**7%**	**11.5**	**8.2**	**29%**

3. FUTURE CONDITIONS

3-1. 2015 NO-BUILD SCENARIO

The Study Team developed a no-build, base-case scenario for the year 2015, the chosen analysis year. The 2015 no-build scenario assumes growth in regional background traffic, no exclusive busway and no exclusive bus lanes. It does include the Downtown Circulator bus route. The 2015 no-build scenario was developed to provide a frame of reference for the evaluation of "build" alternatives.

The 2015 volumes were developed based on the following considerations:

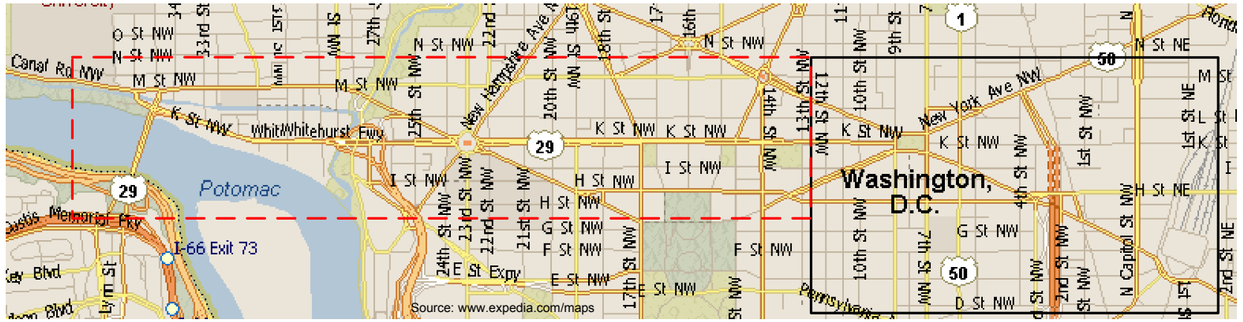
- New Convention Center: additional traffic and new traffic patterns.
- Growth in regional background traffic: the analysis of future year data developed by the Metropolitan Washington Council of Governments indicates that traffic in the study area is expected to grow at a rate of 0.4 percent per year.

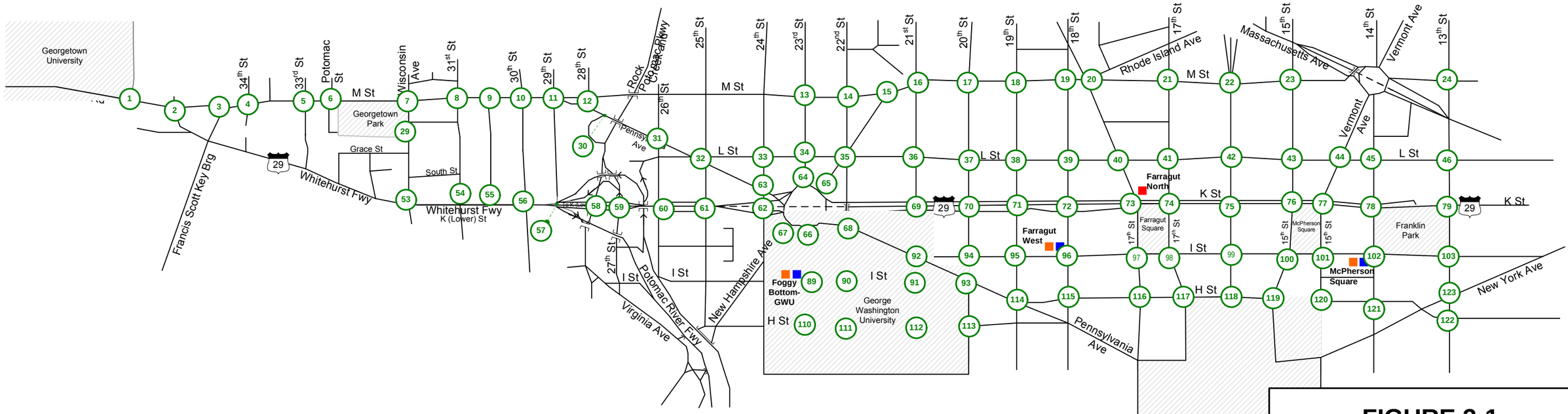
2015 intersections studied and peak hour no-build traffic volumes are presented in Figures 3-1 through 3-6.

The 2015 no-build scenario was modeled in CORSIM for the AM and PM peak hours, using existing signal cycle length and phasing and lane configurations. Each model was simulated five times. The results of the simulation are documented in measures of effectiveness (MOE) including:

- Vehicular travel speeds,
- Vehicular travel times,
- Bus travel times,
- Bus travel speeds,
- Intersection delay and levels of service,
- Person throughput and
- Person trip delay

The travel speed and travel time results describe the traffic flow both of the vehicles using the travel lane and the buses using the roadway network. The intersection delay provides information about the operation performance of the intersections along the study corridors. Person throughput results account for the vehicle throughput as well as the passenger occupancy. Furthermore, the person-trip delay results assess an overall benefit both for general vehicle and bus passengers. MOEs for the 2015 no-build scenario are summarized in the "Evaluation of Alternatives" section of this chapter.





LEGEND

- Metro Station
- Amtrak/MARC Rail Station
- 9 — Intersection Number

Intersection No.s INDEX

1 - 24	M St
29 - 46	L St
53 - 79	K St
89 - 103	I St
110 - 123	H St
62 - 67	Washington Cr

FIGURE 3-1

Intersections Studied for 2015 No-Build AM Peak Hour Traffic Volume in the Western and Central Sections of the Study Area

Not to Scale

K Street Transitway

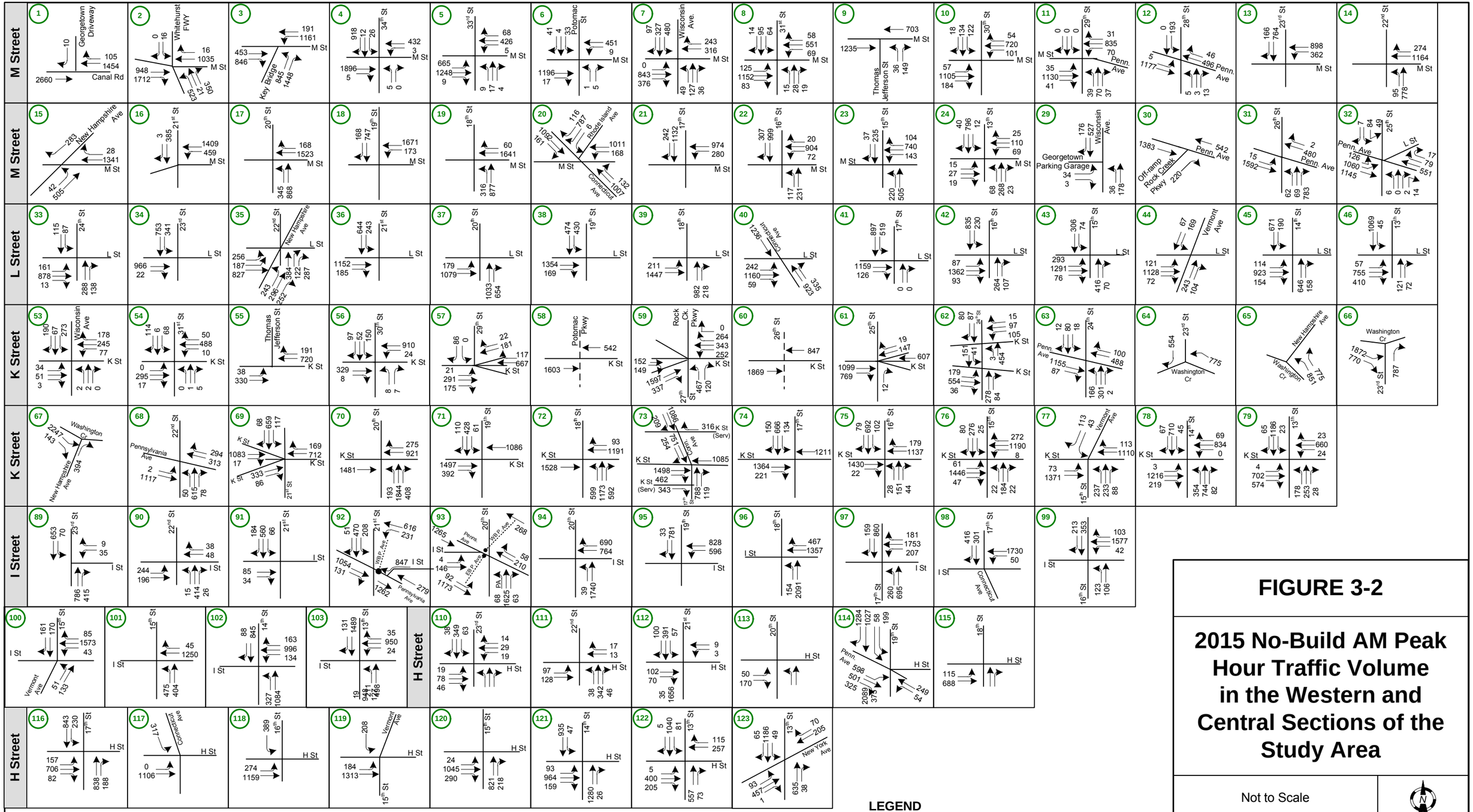


FIGURE 3-2

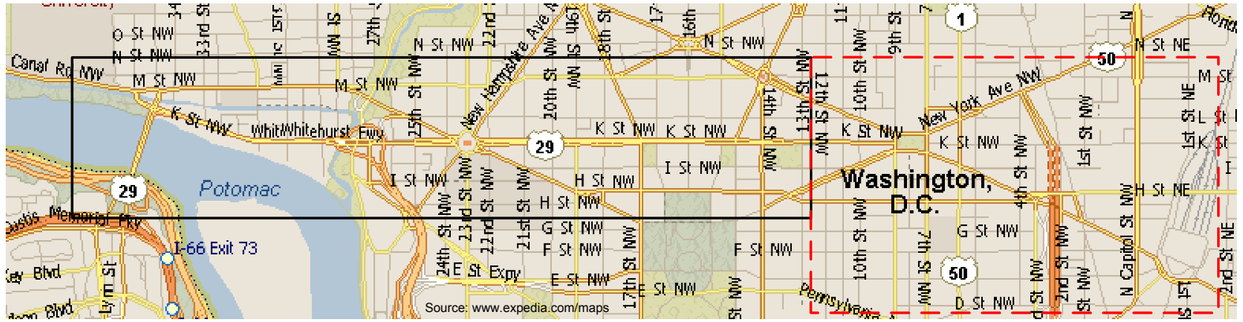
2015 No-Build AM Peak Hour Traffic Volume in the Western and Central Sections of the Study Area

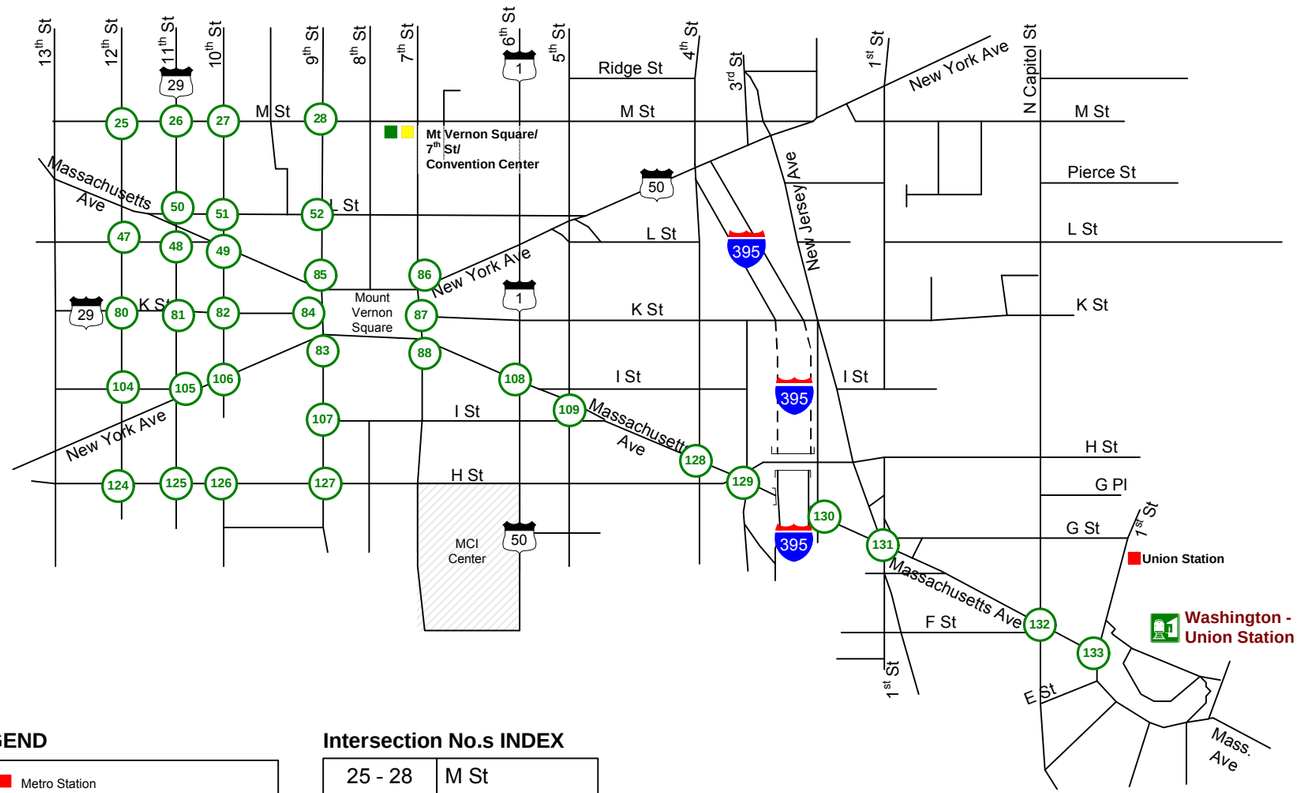
Not to Scale

N

K Street Transitway

May 2005





LEGEND

- Metro Station
- Amtrak/MARC Rail Station
- 9 — Intersection Number

Intersection No.s INDEX

25 - 28	M St
47 - 52	L St
80 - 88	K St
104 - 109	I St
124 - 127	H St
128-133	Mass. Ave
83 - 88	Mt Vernon Sq

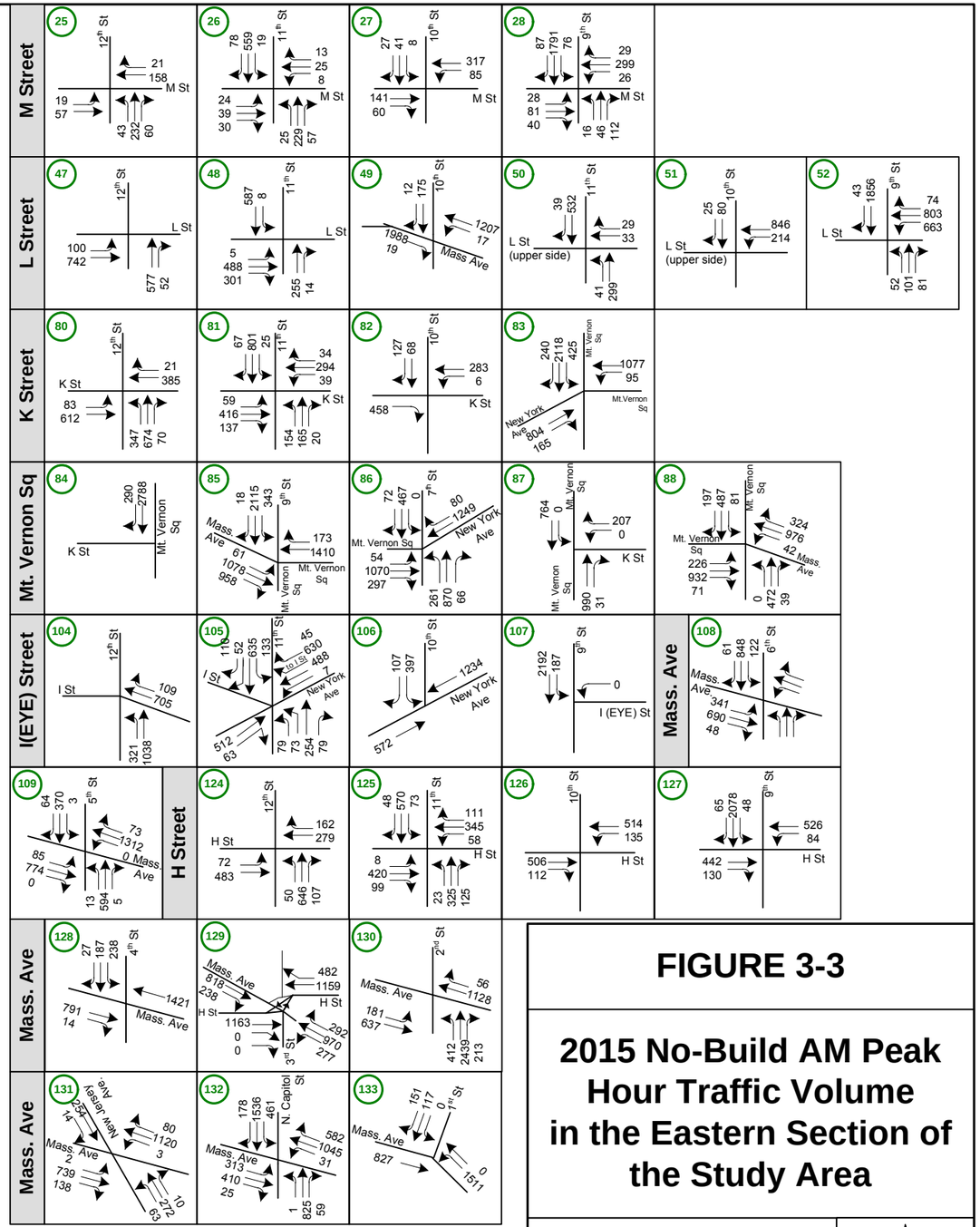


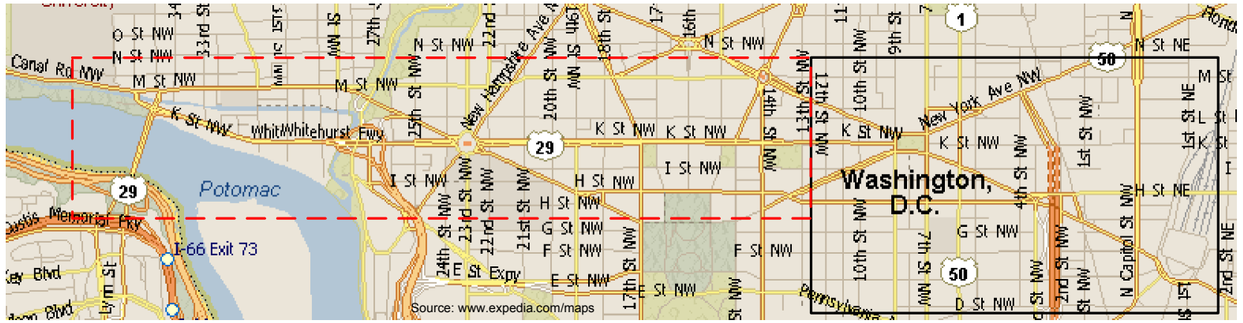
FIGURE 3-3

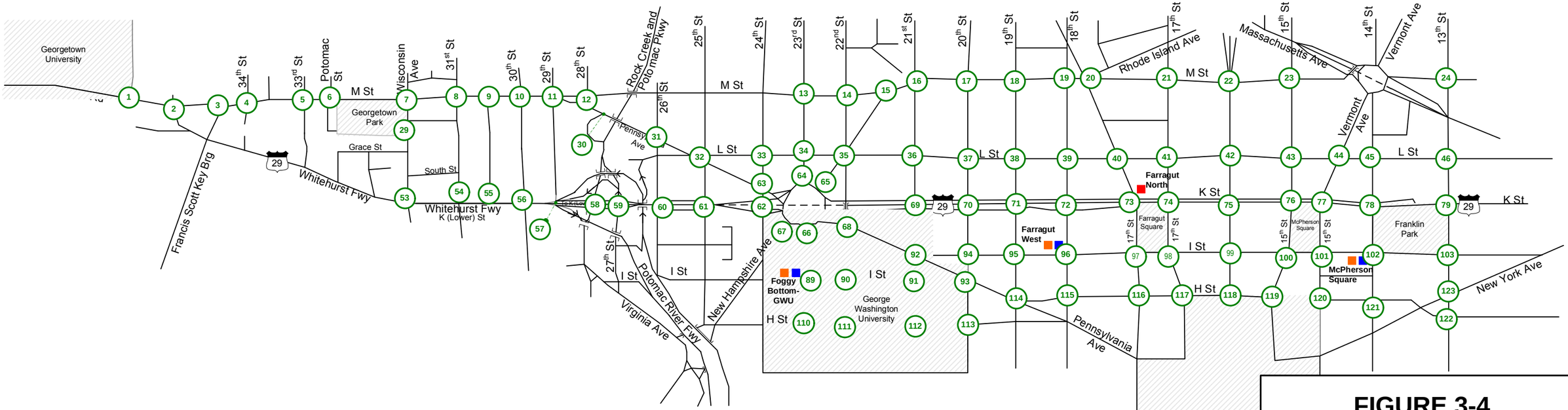
2015 No-Build AM Peak Hour Traffic Volume in the Eastern Section of the Study Area

Not to Scale

K Street Transitway

May 2005





LEGEND

- Metro Station
- Amtrak/MARC Rail Station
- 9 — Intersection Number

Intersection No.s INDEX

1 - 24	M St
29 - 46	L St
53 - 79	K St
89 - 103	I St
110 - 123	H St
62 - 67	Washington Cr

FIGURE 3-4

Intersections Studied for 2015 No-Build PM Peak Hour Traffic Volume in the Western and Central Sections of the Study Area

Not to Scale

K Street Transitway

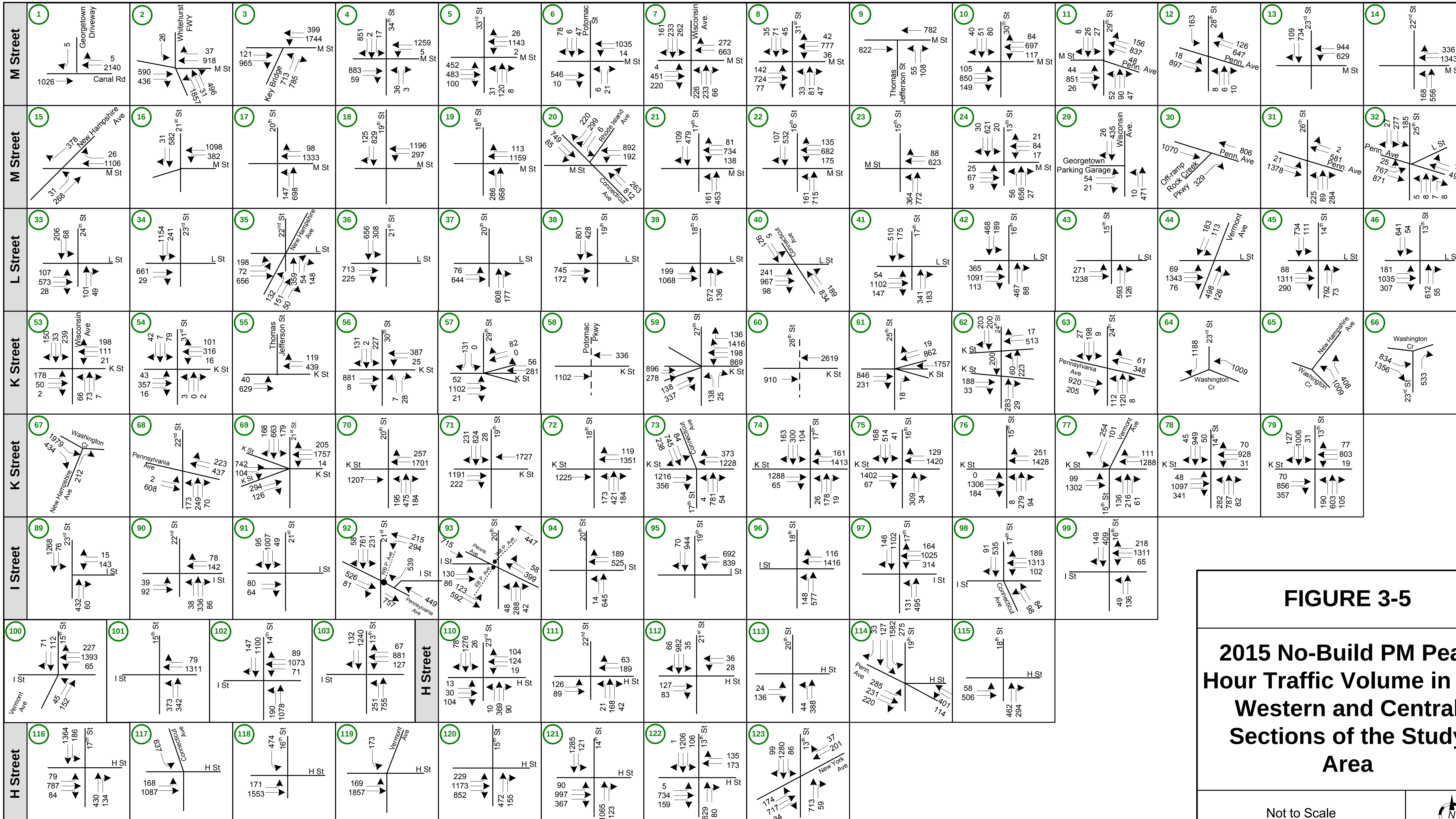


FIGURE 3-5

2015 No-Build PM Peak Hour Traffic Volume in the Western and Central Sections of the Study Area

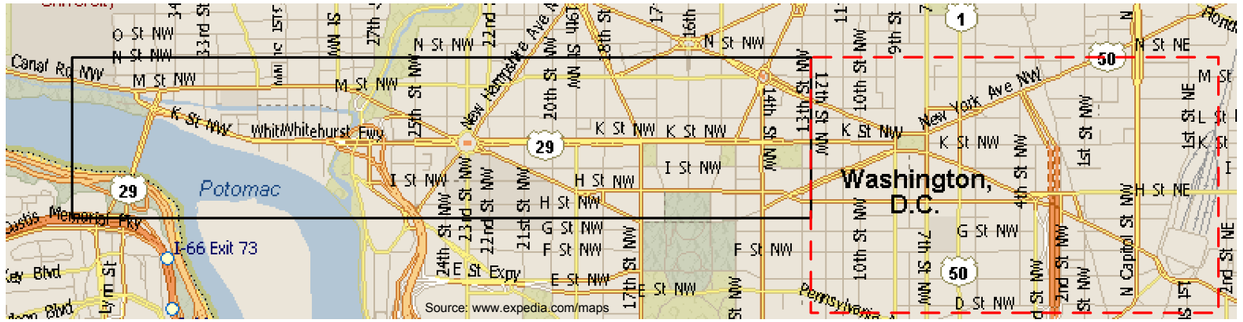
Not to Scale

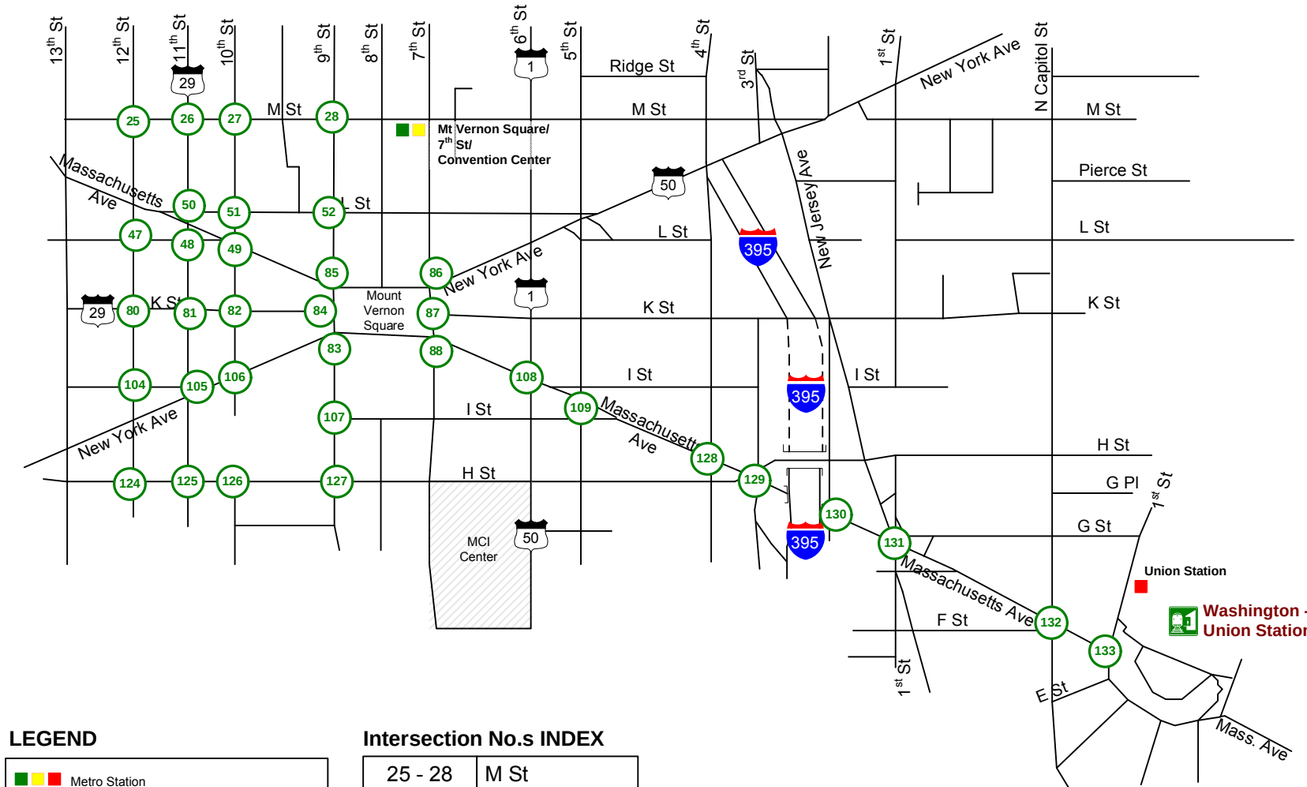
K Street Transitway

LEGEND

9 Intersection Number

May 2005





LEGEND

- Metro Station
- Amtrak/MARC Rail Station
- 9 — Intersection Number

Intersection No.s INDEX

25 - 28	M St
47 - 52	L St
80 - 88	K St
104 - 109	I St
124 - 127	H St
128-133	Mass. Ave
83 - 88	Mt Vernon Sq

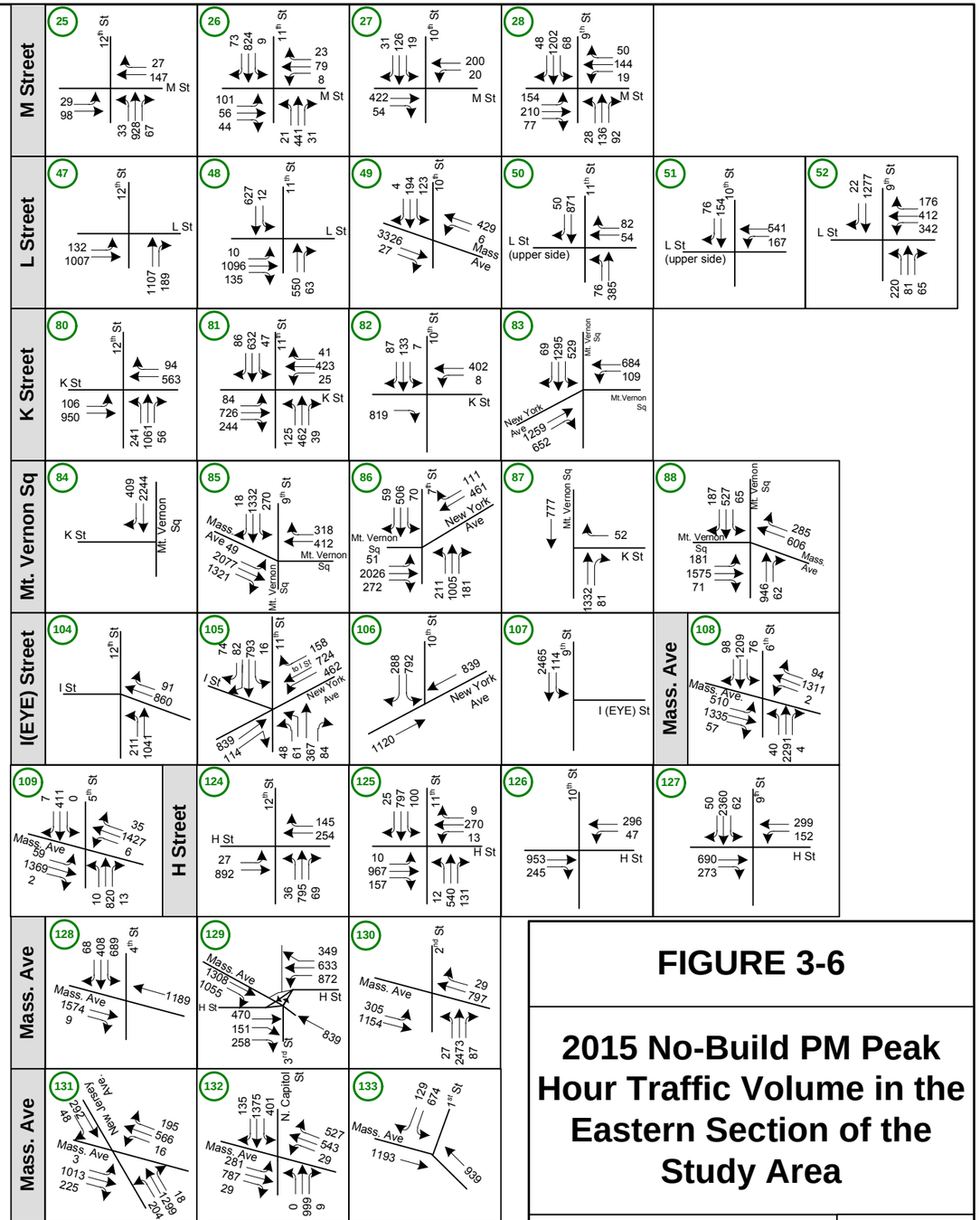


FIGURE 3-6

2015 No-Build PM Peak Hour Traffic Volume in the Eastern Section of the Study Area

Not to Scale

K Street Transitway

May 2005

3-2. 2015 BUILD SCENARIO ALIGNMENT OPTIONS

The next step in the process of developing future condition scenarios and alternatives was to identify alignment and routing options for the new bus rapid transit (BRT) service in all three sections of the corridor – from Georgetown University/Georgetown to Washington Circle, from aWashington Circle to Mount Vernon Square, and from Mount Vernon Square to Union Station.

3-2.1. CENTER SECTION – WASHINGTON CIRCLE TO MOUNT VERNON SQUARE

The Study Team evaluated several potential alignments in the Center Section of the study area, between Washington Circle and Mount Vernon Square. The options included using an exclusive busway facility as the east-west spine of the improved transit facility, as well as options that utilized dedicated bus lanes on streets parallel to K Street (H, I, L and M Streets) to accommodate the most significant east-west routes including the proposed new east-west route, called the Downtown Circulator. K Street was selected for the busway for the following reasons:

- K Street is the only continuous two-way east-west through street in the northern section of the Central Business District.
- K Street is deteriorated and is in need of major reconstruction. The reconstruction provides an opportunity to reconfigure the street in a way that would improve transit service, and pedestrian and vehicular safety.
- K Street has adequate width to provide a two-way busway. The operation of a two way busway is much clearer for transit users unfamiliar with the transit system than the operation of exclusive bus lanes on one-way pairs. While streets parallel to K Street, such as H, I, L and M Streets, are less suited to accommodate the exclusive bus lane facility, they could potentially accommodate rerouted WMATA buses.
- There is a significant amount of bus service that currently uses the K Street corridor between Washington Circle and Mount Vernon Square.
- There are several Metrorail stations in the vicinity of K Street that could be served by buses operating on the busway.

3-2.2. WESTERN EXTENSION – GEORGETOWN TO WASHINGTON CIRCLE

The scope of work for this study identifies Georgetown as the western terminus of the BRT route. DDOT and WMATA staff indicated that alternatives should consider a connection to Georgetown University through the recently constructed new access point on Canal Road. Georgetown University has expressed interest in improved transit service. Bus turnaround options at the University are discussed in the Service Plan section of this chapter. The Study Team evaluated options to provide service to the university. However, at the conclusion of the study, the university indicated that at this time, they would prefer to continue providing their own transit services rather than those of outside providers.

3-2.2.1. BRT Routing Considerations and Discussion

The use of Lower K Street through Georgetown for the outbound (westbound) BRT route was identified as an option, as this street is underutilized today. There is no existing Metrobus service on this roadway. The Georgetown Shuttle (operated by the Georgetown Partnership) is the only route that operates on Lower K Street. The Georgetown Shuttle runs every 10 minutes. The Shuttle operates from 7:00 AM until midnight Monday through Thursday, 7:00 AM until 2:00 AM on Fridays, 8:00 AM until 2:00 AM on Saturdays, and 8:00 AM until midnight on Sundays. Lower K Street is an emerging employment destination. It has been subject to redevelopment recently and is growing into a role as an entertainment destination. Using Lower K Street as the outbound route would further support redevelopment on the Potomac River waterfront. Under this scenario buses would travel north on Wisconsin Avenue to M Street and return via Pennsylvania Avenue (eastbound) to Washington Circle.

The inbound (eastbound) route from Georgetown that uses M Street and Pennsylvania Avenue has certain advantages. Both M Street and Pennsylvania Avenue provide good accessibility to riders and will tie in with existing Metrobus routes that use M Street and Pennsylvania Avenue. A disadvantage is that both Pennsylvania Avenue and M Street are congested due to other traffic on the roadway. This route is more accessible and will have higher ridership. An option to loop back to Lower K Street using Wisconsin Avenue, M Street, and one of the streets east of Wisconsin Avenue south of M Street was assessed but was dismissed because of physical constraints and less service coverage than the option that uses Pennsylvania Avenue for the eastbound route.

Two other outbound routing options initially identified but dismissed for the new BRT service were:

1. Using Pennsylvania Avenue and M Street in the outbound direction, and using Lower K Street as the inbound route and
2. Using the Whitehurst Freeway in the outbound direction, and using M Street as the inbound route.

The problem with using Pennsylvania Avenue and M Street outbound was the delay getting through the westbound approach to Washington Circle on the north side of the K Street frontage road, and a required left turn from M Street to southbound Wisconsin Avenue (to access Lower K Street). The problem with the Whitehurst Freeway outbound option is that it would not be possible to provide a station on the freeway viaduct to serve either Lower K Street or the M Street corridor, and bus riders would have to wait until the bus circled back on M Street to access the central Georgetown area. Neither option was considered preferable to the Lower K Street – M Street – Pennsylvania Avenue routing.

The Study Team decided to evaluate the Lower K Street – M Street – Pennsylvania Avenue routing option in further detail in the study, including the option of extending the BRT service west of Wisconsin Avenue to Georgetown University. Figure 3-7 shows the Western Section of

LEGEND

① - LOWER K TO PENNSYLVANIA ROUTE

Ⓔ - POTENTIAL EXTENSION TO GEORGETOWN UNIVERSITY

- SUBWAY LINE

- DECISION POINT

Page 3-10	Not to Scale May 2005	N	K Street Transitway	Western Alignment Selected for Evaluation	FIGURE 3-7

the corridor from Washington Circle to Georgetown University with the alignment alternative selected for evaluation.

3-2.3. EASTERN EXTENSION – MOUNT VERNON SQUARE TO UNION STATION

The scope of work for this study identifies Union Station as the eastern terminus, but does not designate whether service should access the north or south side of the station. Two alternatives were identified east of Mount Vernon Square that would allow buses to reach Union Station. One alternative would follow Massachusetts Avenue south to Columbus Circle (on the south side of Union Station), where buses currently turn around. The second alternative would use Massachusetts Avenue and H Street to access the north side of the Station. A modification to this alternative, that was considered but dismissed, was to divert the BRT service to the south via 7th and 9th Streets to serve the MCI Center and the Gallery Place/Chinatown Metro station, then access H Street and cross Massachusetts Avenue to access Union Station.

3-2.3.1. BRT Routing Considerations and Discussion

The Study Team considered BRT routing options through the Convention Center/Mount Vernon Square area. One alternative discussed would extend the bus preferential treatment further east on K Street just northwest of Mount Vernon Square. This would involve the conversion of K Street between 9th and 10th Streets, which is currently one-way westbound, to two-way operation, or the creation of an eastbound contra flow bus lane on K Street in this block. Allowing for two-directional bus operation on K Street between 9th and 10th Streets would provide more flexibility in serving the new Convention Center from the south or through the middle of the Convention Center site. With two-directional traffic for buses on K Street between 9th and 10th Streets, eastbound and westbound buses could stop near the Convention Center on K Street just west of 9th Street.

The other alternative would be for buses to travel directly through the middle of the Convention Center site using L Street, accessing L Street on the east side of the Center via 7th Street, and with westbound buses returning to K Street west of the Center via 9th Street. Eastbound buses would have to divert to L Street via 11th Street to access the Center. There has been some concern on the part of the neighborhood along L Street west of 9th Street as to bus traffic on this street, which could make such an eastbound bus routing difficult.

If two-directional bus traffic on K Street between 9th and 10th Streets is not possible, then eastbound buses would have to divert south to New York Avenue via 10th Street (with a stop on the south side of Mount Vernon Square), with westbound buses still able to use New York Avenue or L Street to access westbound K Street. If 10th Street were to become a two-way operation between K Street and Massachusetts Avenue, eastbound buses could also divert north on 10th Street to Massachusetts Avenue and east on Massachusetts Avenue to a stop on Mount Vernon Place directly across the street from the new Convention Center.

The Study Team decided to further evaluate the scenario of routing two-directional bus traffic on K Street between 9th and 10th Streets. Eastbound service would run on K Street to 9th Street, then

divert to Massachusetts Avenue around the south side of Mount Vernon Square. Westbound service would be routed on Massachusetts Avenue across the south side of Mount Vernon Square and then to K Street by means of a northbound contra-flow exclusive bus lane on 9th Street. Service between Union Station and Mount Vernon Square would take place via Massachusetts Avenue. This routing is illustrated in Figure 3-8. Bus turnaround operations at Union Station are discussed in detail in the Service Plan section of this chapter.

3-2.4. PREFERRED OVERALL ALIGNMENT

At the end of the above process, a preferred alignment was established. As shown in Figure 3-9 BRT service would operate on the following roads:

- Eastbound: M Street, Pennsylvania Avenue, Washington Circle, K Street, 9th Street, K Street, Massachusetts Avenue
- Westbound: Massachusetts Avenue, K Street, 9th Street, K Street, Wisconsin Avenue

The preferred alignment led to the development of eight alternatives described later in this chapter.

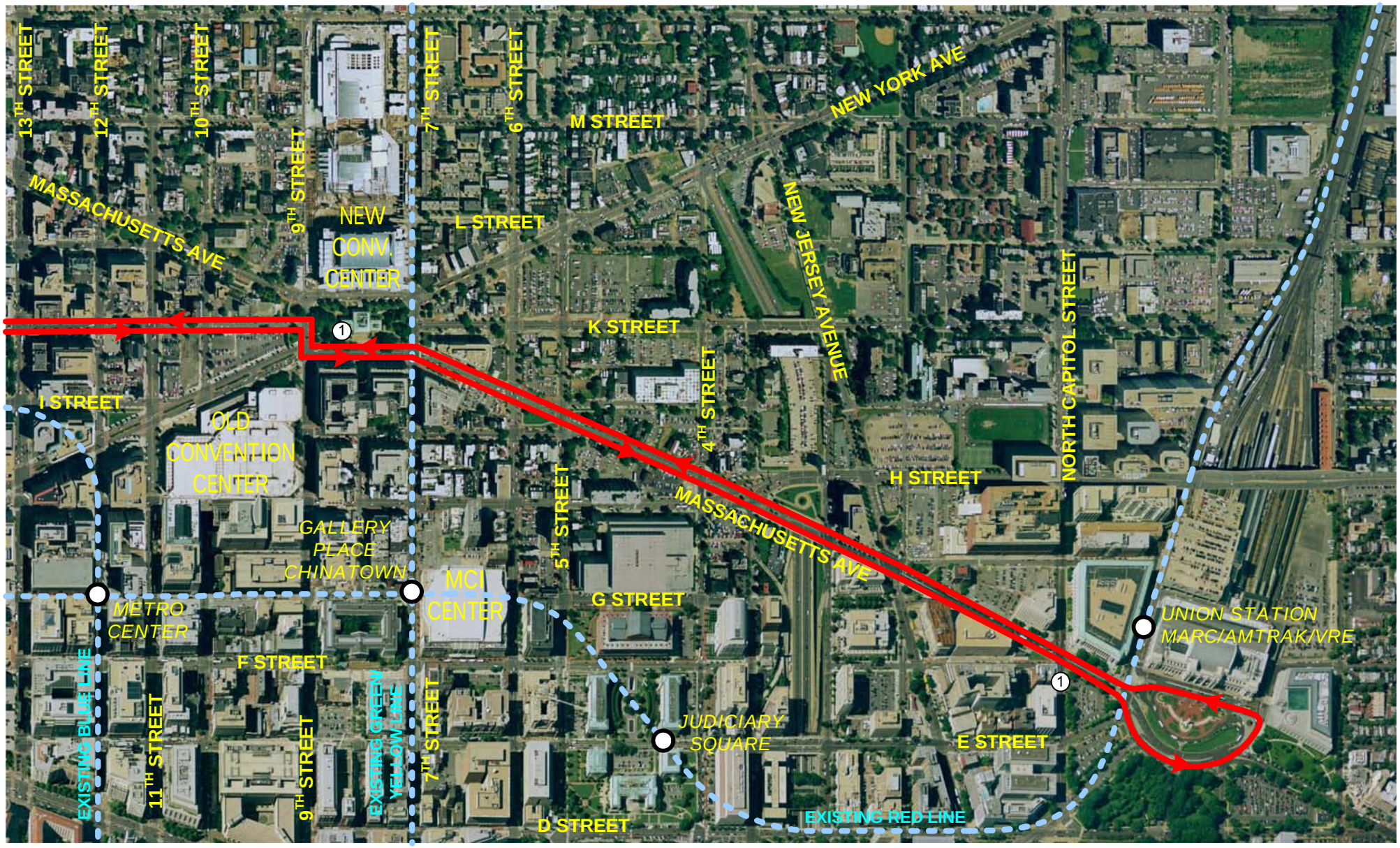
3-3. K STREET TRANSITWAY CONFIGURATIONS

After choosing K Street for the alignment in the Center Section of the study area, the next task undertaken by the Study Team was to choose busway configurations for the Center Section. The Study Team undertook an analysis of the following concepts:

Option 1A:	Curbside running bus lanes adjacent to existing sidewalks with new center landscaped median
Option 1B:	As stated in Option 1A but maintains or exceeds existing sidewalk widths
Option 2:	Center median with bus lanes running parallel to the median
Option 3A:	Center split median with bus lanes running between medians
Option 3B:	As stated in Option 3A but maintains existing sidewalk widths

3-3.1. EXISTING ROADWAY CROSS-SECTION

K Street has a typical existing curb-to-curb width of 110 feet, with 19-foot sidewalks on each side. The National Park Service (NPS) owns three parkland reservations along K Street – Farragut Square, McPherson Square and Franklin Square. The curb-to-curb width of K Street at these locations is less than the typical width. The typical K Street cross-section, showing lane usage and widths, is presented in Figure 3-10.

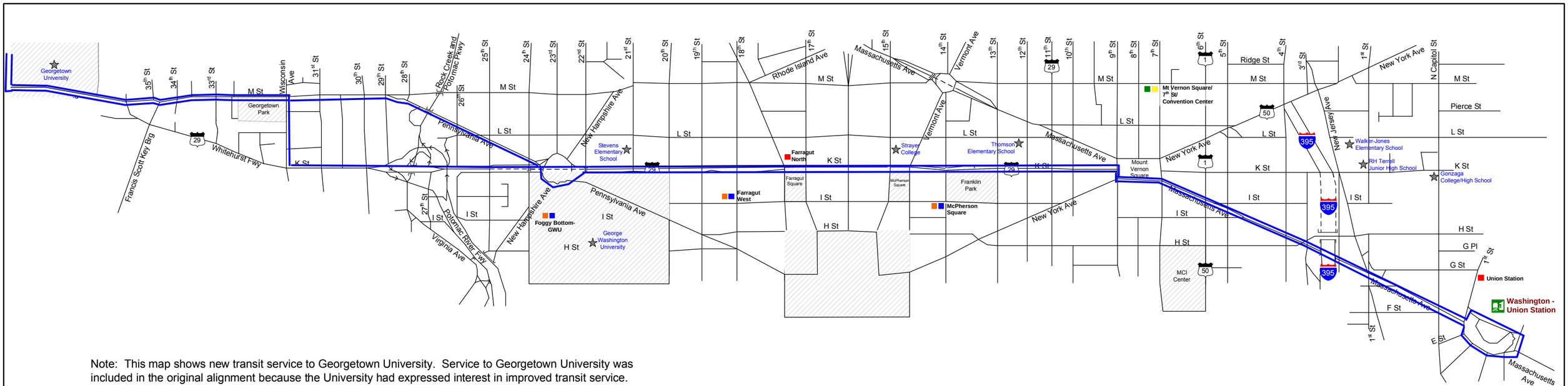


LEGEND

① - MASSACHUSETTS AVE TO COLUMBUS CIRCLE

- SUBWAY LINE

Page 3-13	Scale: 1" = 720'	N	K Street Transitway	Eastern Alignment Selected for Evaluation	FIGURE 3-8
	May 2005				



Note: This map shows new transit service to Georgetown University. Service to Georgetown University was included in the original alignment because the University had expressed interest in improved transit service. However, at the conclusion of the study, the university indicated that at this time they would prefer to continue providing their own transit services rather than those of outside providers.

FIGURE 3-9

Preferred BRT Alignment

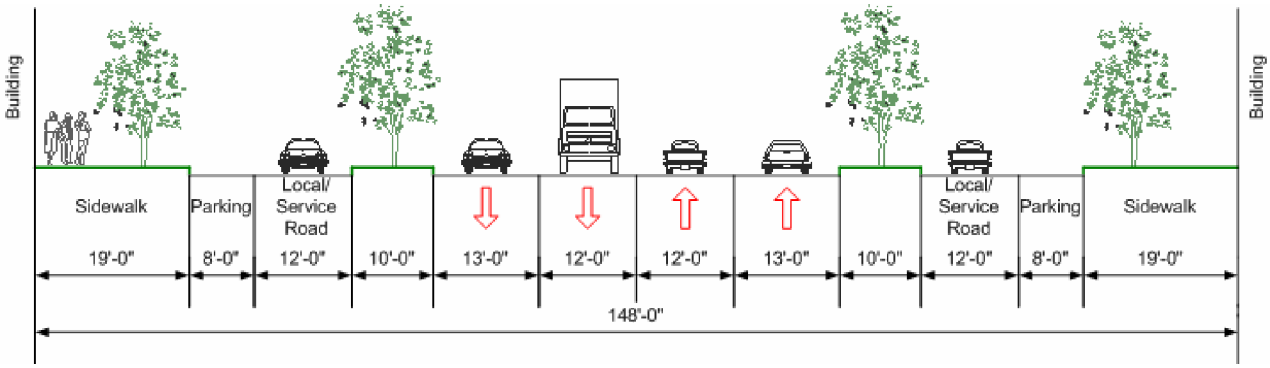
Scale: 1" = 950'

LEGEND

- BRT Alignment
- School/College/University
- Metro Station
- Amtrak/MARC Rail Station

K Street Transitway

Figure 3-10
Existing K Street Cross-Section



3-3.2. OPTION 1: CURBSIDE RUNNING

Busway configuration Option 1 features exclusive curbside running bus lanes adjacent to existing sidewalks on K Street. A new landscaped median would be constructed in the center of K Street, as shown in Figure 3-11. Option 1A requires the removal of four feet of sidewalk from each side of K Street, as shown in the typical cross-section presented in Figure 3-12. Figures 3-13 and 3-14 show the typical cross-section of K Street under Option 1B, which would increase sidewalk width throughout much of the corridor.

3-3.2.1. Option 1 Advantages:

- Curbside running transit lanes would be more conducive to initial dedicated bus lane operation.
- Construction of curbside station platforms on sidewalks would be easier to the construction for center median options.
- There would be more flexibility in bus stop location.
- Construction of dedicated left turn lanes would be easier.
- Additional sidewalk width would be gained throughout much of the corridor, providing additional space for landscaping under Option 1B.
- Pedestrians would have shorter distance to cross K Street under Option 1B.

3-3.2.2. Option 1 Disadvantages:

- Buses would have to share the bus lane with right turning vehicles.
- Curbside running bus would have excessive interface with all curb cuts (e.g. building parking, service alleys, other service access).
- Station platform locations would be limited; platforms cannot be located at existing garage entry curb cuts.
- Building parking access may require additional traffic control signaling under Option 1A.

- Service access to buildings would have to be provided through cuts in the median separating the parking lanes and the curbside service roads under Option 1A.
- Local access roads are limited in usefulness and cannot be used for service access under Option 1A.
- Option 1A requires the removal of four-feet of sidewalk on each exterior curb, even with the assumption of minimal 10-foot traffic lanes.
- Under Option 1A, drivers parking on K Street have to walk to the corners on a very narrow sidewalk. Disabled drivers that park on K Street cannot reach the corners in the four-foot sidewalk.

Figure 3-11
Photo Rendering of Option 1A

Figure 3-12
Typical K Street Cross-Section under Option 1A: Curbside Running with Reduced Sidewalk Width

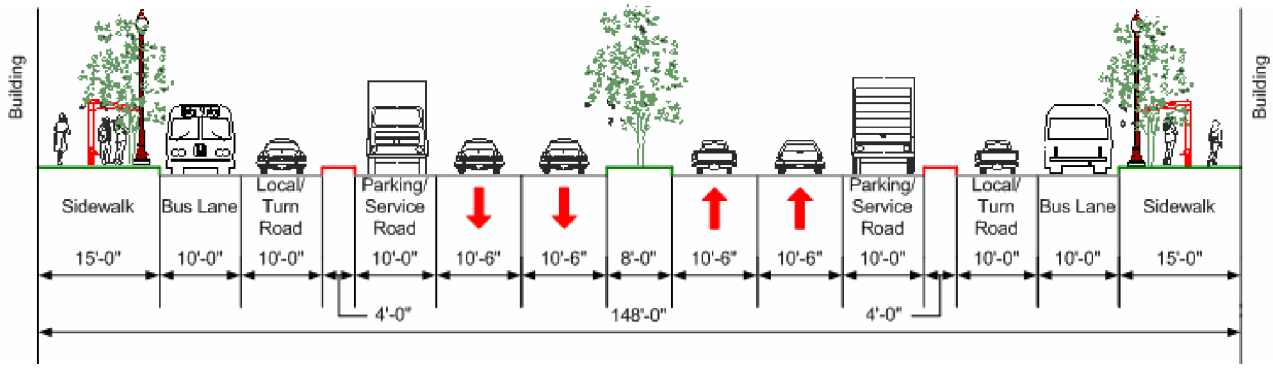


Figure 3-13
Typical K Street Mid-Block Cross-Section under Option 1B: Curbside Running with Additional Sidewalk Width

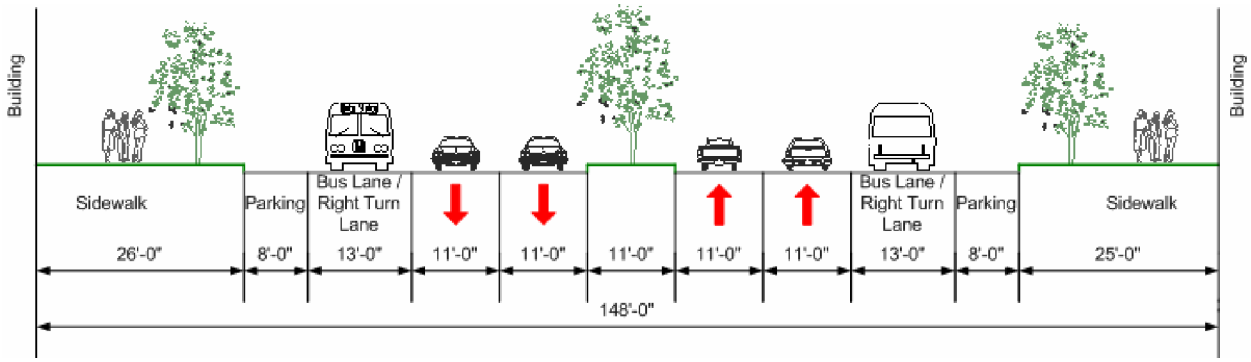
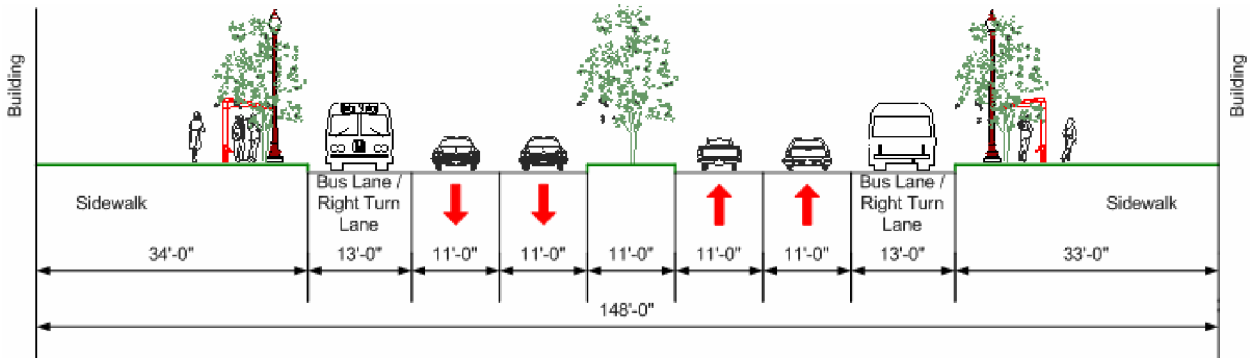


Figure 3-14
Typical K Street Corner Cross-Section under Option 1B: Curbside Running with Additional Sidewalk Width



3-3.3. OPTION 2: CENTER MEDIAN WITH BUS LANES RUNNING PARALLEL TO THE MEDIAN

K Street Transitway configuration Option 2 features a new landscaped center median with buses running in exclusive lanes parallel to the median, as shown in Figures 3-15 and 3-16. New bus stations would be constructed in the median. Reverse running buses would be required to permit the use of conventional right-hand door boarding and alighting.

3-3.3.1. Option 2 Advantages:

- Continuous center median would most likely be the easiest option to construct, although maintenance of vehicular traffic during construction would be more complex.
- Existing traffic patterns could be maintained at service and local lanes.

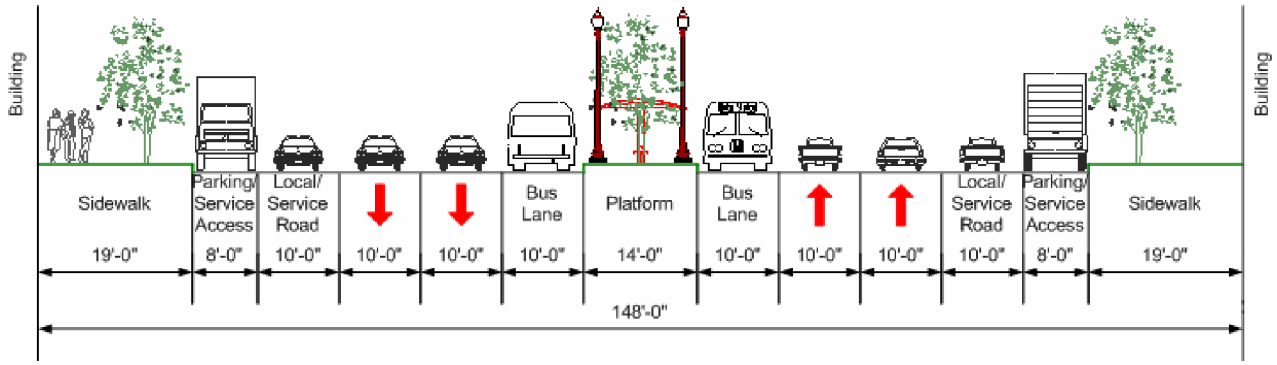
- Right turns from building parking and service alleys would be maintained.
- Station locations would be more flexible and relatively unrestricted by existing conditions (curb cuts, left turn lanes, etc.)

3-3.3.2. Option 2 Disadvantages:

- Reverse running buses would be required to permit use of conventional right hand door configuration.
- Dedicated left turns would require special signals.

Figure 3-15
Photo Rendering of Option 2

Figure 3-16
Typical K Street Cross-Section under Option 2: Center Median with Reverse Running Buses



- Special U-turn pockets with special signals may need to be provided just prior to intersections for access to parking garages.
- Left turns would be very difficult, requiring the crossing of two widely separated bus lanes.
- When a bus is disabled on the bus lane, upstream buses would have to bypass the disabled vehicle by traveling against on-coming traffic on a very congested roadway.
- Parkland at Farragut Square would be lost.

3-3.4. OPTION 3: SPLIT CENTER MEDIAN

Option 3 features the construction of a new landscaped, split center median, as shown in Figure 3-17. One exclusive lane would be provided in each direction between the medians for bus operations. As shown in the typical cross-section presented in Figure 3-18, Option 3A would require the removal of five feet of sidewalk from each side of K Street in order to provide the cross-section shown. Option 3B, presented in Figure 3-19, would result in no sidewalk loss, but it would provide one less travel lane in each direction than Option 3A.

Figure 3-17
Photo Rendering of Option 3

Figure 3-18
Typical K Street Cross-Section under Option 3A: Split Center Median with Modified Sidewalk

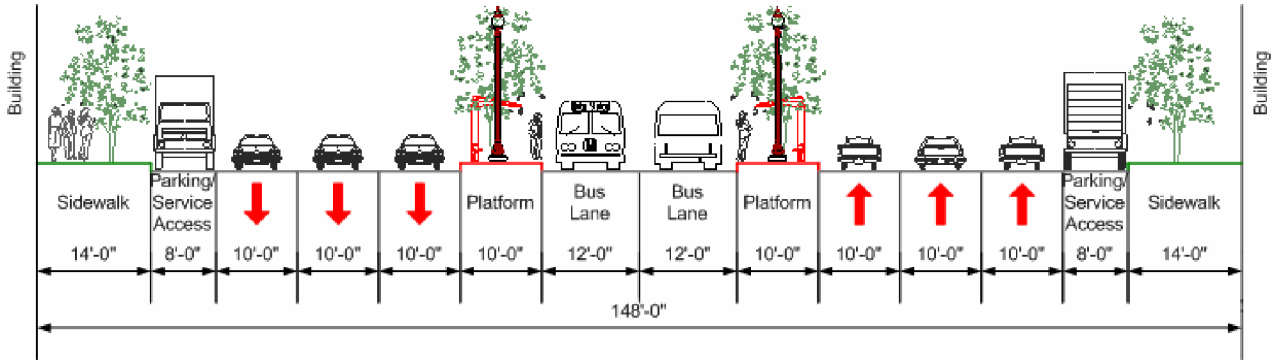
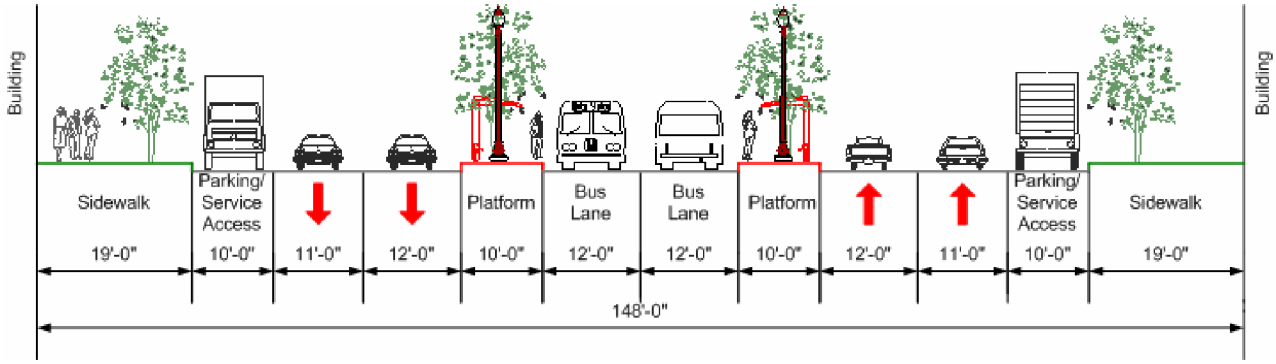


Figure 3-19
Typical K Street Cross-Section under Option 3B: Split Center Median with Existing Sidewalk



3-3.4.1. Option 3 Advantages:

- More landscaped median area would be than under other options.
- Final traffic signaling would be more straightforward.
- Interaction between buses and cars would be reduced.
- Dedicated vehicular left turn lanes would be possible.
- There would be greater median separation of bus operation and vehicular traffic.
- Right turns from building parking and service alleys would be easily accommodated.
- Station platform locations would be restricted only by vehicular left turn lanes and bus right turn lanes.
- Mid-block illegal left turns into parking garages would be precluded.

3-3.4.2. Option 3 Disadvantages:

- Construction would be more difficult.
- There would be no dedicated service roadway. Building parking and service access would have to be coordinated with parking along curb lanes.
- Left turns from building parking and service alleys would be more difficult to design.
- Bus turns would require special signal phasing.
- Passengers waiting for buses would have vehicular traffic moving behind them.

3-3.5. EVALUATION OF K STREET TRANSITWAY CONFIGURATIONS AND RECOMMENDED OPTION

Based on the assessment of advantages and disadvantages of the different busway configuration options and the qualitative analysis summarized in Table 3-1, the Study Team selected options 1B and 3B as feasible K Street Transitway configurations. Option 1B would be the easiest alternative to construct. It would increase sidewalk width throughout the corridor, increasing pedestrian space and safety, and providing more space for landscaping. Option 1B would also provide good station access and flexibility. Reductions in the width of K Street at intersections would increase pedestrian safety.

Option 3B would provide for the most straightforward traffic operation of the alternatives. It would more easily accommodate right turns to K Street from parking garages and left turns from K Street. Increasing the distance between bus and vehicular traffic and physically separating bus and vehicular traffic would reduce friction and increases safety. Finally, Option 3B would provide the most landscaped area of the three options. Option 3B would maintain existing sidewalk widths on K Street, necessary for the heavy pedestrian traffic experienced throughout the corridor.

3-4. 2015 BUILD SCENARIO TRANSIT SERVICE PLAN

This section presents the Study Team's recommendations for changes in bus service in the Washington CBD to take advantage of a K Street Busway and complementing bus-only lanes. The changes include modifications to existing bus routes, additions of new routes, and modifications to bus stop locations. These changes flow from an iterative process that was based on the basic concepts developed for the Washington Regional Bus Study completed in 2002. That study recommended a transition to a comprehensive regional bus system comprised of a family of services. Each member of the system would perform a distinct function for different but complimentary markets. At the lowest geographic end of the spectrum, the study recommended implementation of circulators, serving relatively short trips made in neighborhoods and major activity centers like Washington's extensive CBD and Tysons Corner in Virginia.

Table 3-1
K Street Transitway Configuration Qualitative Analysis

	Existing	Option 1A	Option 1B	Option 2	Option 3A	Option 3B
Landscaping / Trees						
Sidewalks						
Effects on Parkland						
Pedestrian Safety						
Bus Operations						
Traffic Operations						
Bus / Vehicle Interaction						
Turns						
Parking / Loading						
Station Access / Flexibility						

Poor → Good

At the other end of the spectrum, the study recommended the development of a system of regional, "high quality" bus corridors. These would serve those trips crossing jurisdictional boundaries, connecting travel origin and destinations of regional significance. The purposes of these corridors were to compliment Metrorail lines, extend their reach and serve as precursors to new Metrorail and LRT lines. Adding weight to the recommendations of the Bus Study, the Metrorail "Core Capacity" study identified the need for a high-quality cross-town bus corridor between Union Station and Farragut Square to relieve the crowding problems during peak periods on Metrorail's Red Line.

The recommended service plan progressed from an initial service plan that underwent a moderately detailed level of analysis through several iterations based on significantly more detailed proof-of-concept simulation analyses. Along the way, certain initial assumptions, such as the need for separate bus rapid transit (BRT) and Downtown Circulator routes, and the role of the K Street Transitway in the regional transit system, were revisited.

3-4.1. CRITERIA USED IN THE DEVELOPMENT OF THE TRANSIT SERVICE PLAN

Development of the service plan was based on the recommendations of the Washington Regional Bus Study. It also was developed taking into consideration that a busway can be most effective if it is part of a comprehensive, permanently integrated system. Given these precepts the following criteria were used in the development of the proposed Washington CBD service plan.

3-4.1.1 Circulator(s) on Busway, Bus Lanes

The proposed Circulator route benefits most from the type of service that the busway will provide. With high volumes of ridership connecting the various major activity centers within the CBD, the route will be of regional significance. A key objective of the circulator is to attract visitors to DC and the Region as well as to serve trips by residents and commuters. There are significant marketing and informational advantages to be gained by having them on an easily recognized facility, at easily recognized stops. Also, dwell times should not be a problem for these routes since circulator vehicles will be configured for the short trip, intense off and on market they will serve.

3-4.1.2 Only Routes of Citywide and Regional Significance Use the Facilities

The Washington bus study and its predecessor, the Regional Mobility Study, identified routes of regional significance. By definition, virtually all routes within the District of Columbia are regionally significant because of the importance of the District to the welfare of the entire region. More significant are the routes that serve major regional activity centers, such as Friendship Heights, Georgetown and the entire extended CBD, routes with an above average trip length and volume.

Restricting the busway to these routes prevents overcrowding of the facilities caused by low ridership on buses serving short-distance routes. This restriction reduces overall person hours of travel and produces the greatest benefits.

Commuter express buses may not be allowed on the busway because of dwell time issues. Every day, thousands of commuters to Washington's CBD utilize hundreds of peak hour commuter buses operated by a number of Virginia jurisdictions and the Maryland MTA. The reason for not allowing the commuter buses the use of the busway is that the vehicles used for these services traditionally feature a maximum number of wide seats, a narrow aisle and only a single, narrow door. They thus have inordinately high boarding and alighting times. Boarding and alighting times per passenger on commuter express buses can be up to four times longer than equivalent unit times on low floor BRT vehicles.

The busway alignment does not allow room for on-line passing at stations. Allowing commuter buses on the busway would result in a significant degradation of over-all busway capacity, speed and reliability, offsetting the very reason that a busway would be proposed in the first place.

3-4.1.3 Minimum Turns On/Off, Maximum Distance on Busway

Depending on the alignment selected, vehicles turning on and off the busway will require a special signal phase at intersections, and possibly a turning pocket to reduce delay for following vehicles. To reduce the traffic engineering challenges this creates and to take maximum advantage of the K Street facility, the routing for services using the facility will minimize turns from/to it and maximize operation over its length.

3-4.2. CRITERIA FOR ROUTES USING THE K STREET TRANSITWAY

The K Street Transitway will be a new transit facility in downtown Washington that offers the potential for significant reductions in travel times and travel time variability for the bus routes that use it. However, the busway has a finite capacity and, therefore, the bus routes assigned to it must be carefully selected. The following criteria were considered in this selection, listed in order of importance:

1. Downtown Circulator service, providing a limited-stop bus rapid transit service between Union Station, and Georgetown;
2. Routes of regional significance, in terms of ridership, trip length, origin-destination patterns, and rail relief potential;
3. Other local WMATA routes that could travel along a significant length of the busway;
4. MTA commuter buses; and
5. Charter and other buses.

The service plan described in this chapter limits busway usage to the Downtown Circulator, regionally significant routes, and selected local routes, up to the busway's design capacity. Other

local routes currently using K Street, including lines D5, L2 and N7[1] are reassigned to parallel streets (i.e., H, I and L Streets). The large number of MTA commuter buses using K Street are recommended to remain in the general traffic lanes, as their single-door loading and unloading creates significantly longer dwell times than WMATA buses, which would result in delays to other buses using the busway and a lower overall busway capacity. However, under the option that includes curbside bus lanes, commuter buses would be allowed to use selected busway stop locations for their boarding and alighting operations.

3-4.3. CRITERIA FOR THE NUMBER AND LOCATION OF STOPS

Selecting the number and locations of bus stops along the K Street busway is critical to its efficient operation and success. The Study Team used the following criteria when choosing the number and locations of bus stops throughout the system.

1. Fewer rather than more (spacing, minimum 2 blocks)
2. Direct service to major generators/attractors (e.g., World Bank)
3. Facilitate transfers (bus to bus, bus to rail, rail to bus)
4. Far side where possible

The single most important criterion governing stop locations on a busway is to limit them to major activity centers and transfer points and thus minimize the number of stops. Experience all over the world (e.g., with MetroRapidBus in Los Angeles, the new limited bus network in Chicago, etc.) has shown that people will walk further for high quality, fast and reliable service. Many more riders are gained by the speed advantages of limited stops than are lost by slightly increased walking distance, particularly in a CBD as attractive, interesting and active as Washington's. The purpose of the far side rather than near side stops is to minimize interference with turning movements of any kind and reduce dwell times.

3-4.4. CENTRAL BUSINESS DISTRICT BUS SERVICE CHANGES

This section addresses service planning issues in the CBD, including the K Street busway corridor. Specifically, this section reviews busway bus stop capacity, dwell times at Connecticut Avenue, and bus routing assumptions, among other issues related to bus operations in the CBD.

3-4.4.1. Busway Bus Stop Capacity

In an exclusive bus facility where one bus cannot pass another bus that is picking up or dropping off passengers, such as the one under consideration for K Street, the capacity of the bus stop is a major determinant of the overall capacity of the busway. The capacity of a bus stop depends on a number of factors:

[1] Route N7 was eliminated on December 28, 2003. The analyses for this study were completed prior to the elimination of this route.

- *Passenger flow time*—the time required for passengers to get on and off the bus;
- *Door open and close time*—delay before the doors open, and delay in closing the doors after passenger flow ends, as the operator makes sure that all passengers have alighted;
- *Clearance time*—time spent waiting for a gap in traffic to depart the bus stop (if the bus stops out of traffic), plus the time required for a bus to travel its own length and clear the stop, and for the next bus to enter the stop and come to a halt;
- *Traffic signal timing*—the amount of green time provided to the street where the bus stop is located, which limits when buses can enter and leave the stop; and
- *The number of loading areas (berths) provided*—a stop that can accommodate more than one bus at a time has more capacity than a stop only long enough for one bus.

For the purposes of this report, "dwell time" refers to the combination of passenger service (boarding and alighting) time and door open/close time.

An additional consideration is whether "maximum capacity" or "design capacity" is desired. Maximum capacity refers to the maximum number of buses that a stop or facility can serve in an hour, without regard to service reliability or bus speeds. Design capacity is less than maximum capacity, and considers reliability and speed issues. Both types of capacity are discussed in the following section.

3-4.4.2. Dwell Times at Connecticut Avenue

Based on daily passenger boarding and alighting data provided by WMATA, the westbound and eastbound Connecticut Avenue[1] stops on K Street have the highest passenger volumes and thus would be expected to have the highest dwell times. The stop with the highest dwell time, in turn, will generally control the bus capacity of the entire street.

The Study Team conducted a dwell time survey at the westbound and eastbound Connecticut Avenue stops on K Street between March 5 and 7, 2003 (Wednesday through Friday), during weekday AM peak, midday, and PM peak periods (each combination of time period and direction was surveyed once). The following data were recorded for each bus arrival:

- Route number;
- Bus ID number;
- Bus arrival time;
- Door opening time;
- Time the main passenger flow ended (i.e., stragglers were not included in this time);
- Door closing time;
- Bus departure time; and
- Number of passengers boarding and alighting, by door.

[1] Throughout this report, intersections and stops are referred to by the name of the cross street on the north side of K Street, as there are two 15th Streets and two 17th Streets on the south side.

Passenger flow times averaged between 10 and 11 seconds during the weekday AM peak period (with an average of 3.3 passengers boarding per westbound bus), between 7 and 13 seconds during the weekday midday period and between 9 and 15 seconds during the weekday PM peak period. The longer midday and PM peak times reflect, among other factors, fare payments by boarding passengers. The longest times observed were generally no more than twice the average time, except in the morning at the westbound stop, where two S1 buses had flow times of 40 seconds and one Route 80 bus had a flow time of 56 seconds. Boarding volumes associated with these longer flow times were 10 to18 passengers. According to WMATA service planning staff, these higher boarding volumes mainly consist of passengers bound for the State Department area that are transferring from the Metro Red Line at the adjacent Farragut North station.

Average dwell times, measured as bus arrival time to door closing time, ranged from 13 to 21.5 seconds during the weekday AM peak, from 13 to17 seconds during the weekday midday period, and from13 to 20 seconds during the weekday PM peak. Buses were generally able to re-enter the street soon after the doors closed, except during the weekday AM peak period in the westbound direction, when the average bus waited at the stop for 11.5 seconds after the doors closed before it re-entered traffic. This re-entry delay would be eliminated with local bus use of the busway.

3-4.4.3. Initial Bus Routing Assumptions

As an initial working assumption, a preliminary service plan developed by WMATA was used to estimate future bus usage of the Connecticut Avenue stop. WMATA's plan had three main objectives:

- Maximize bus use of exclusive lanes,
- Maintain routes on their current alignments as much as possible, and
- Minimize the number of signalized intersections where bus turning movements would have to be accommodated.

Under the WMATA plan, lines 16Y, 38B, 80, D1, D3, D5, D6, L2 and N7[1] that currently use the Connecticut Avenue stop would continue to do so. Line 38B, which currently terminates at Farragut Square, would be extended to the Convention Center. Lines 30, 32, 34, 35, and 36 would be shifted from H and I Streets to K Street, while the northbound/eastbound S1 would be shifted to L Street. Lines that presently only use K Street for a block or two, such as the N2, N4 and N6, would be rerouted to avoid turns on and off K Street.

Two blocks of 15th Street (East) between K and H Street would be converted to two-way operation, using a southbound contraflow bus lane, to serve routes 30, 32, 34, 35 and 36 and to get routes D5 and L2 to a terminal stand on the northwest side of McPherson Square. The

[1] Route N7 was eliminated on December 28, 2003. The analyses for this study were completed prior to the elimination of this route.

inbound 16Y would be moved to 15th Street (East) to eliminate turns out of the busway at 14th Street.

The initial service plan assumed two new lines: (1) an all-day BRT line between Union Station and Georgetown, with intermediate stops only at the Convention Center, Connecticut Avenue, and the Washington Circle vicinity, and (2) a downtown visitor- and employee-oriented Downtown Circulator line following the BRT route, but with stops approximately every other block, and with service starting in the mid-morning. The Study Team initially assumed that six BRT buses per hour per direction would serve the Connecticut Avenue stop during weekday AM, midday, and PM peak periods and that six Downtown Circulator buses per hour per direction would serve the Connecticut Avenue stop during weekday midday and PM peak periods (i.e., no AM circulator service was assumed).

Based on ridership data and information on the number of scheduled bus trips supplied by WMATA, the dwell times of the 30, 32, 34, 35 and 36 buses will be somewhat longer than the current average dwell time of buses using the Connecticut Avenue stop. The Downtown Circulator buses were assumed to have dwell times equal to the current average, while the BRT buses were assumed to have 45-second dwell times. Initial service planners assumed on-board collection of cash fares mixed with some transfer pass use. When all of these factors are accounted for, future dwell times at Connecticut Avenue under the initial service plan were estimated to average between 25 and 30 seconds.

3-4.4.4. Calculated Capacity for the K Street Transitway

The procedures given in the *Transit Capacity and Quality of Service Manual* were used to estimate the bus capacity of the Connecticut Avenue stop, using an average 30-second dwell time and a 60 percent coefficient of variation of dwell times (somewhat longer than currently observed, because of the longer dwell times that would be introduced by the 30, 32, 34, 35 and 36 and BRT services). Two loading areas were assumed, based on a desire to balance maximizing stop capacity with minimizing potential passenger confusion about where to wait for a bus. The current fare collection approach (single file past driver, mostly cash fares) was also assumed.

Based on these assumptions, the maximum busway capacity at Connecticut Avenue is 82 buses per hour per direction. However, if 82 buses per hour were to be scheduled, there would be considerable interference between the buses and a relatively high likelihood of more than two buses showing up at a stop at a time. The result would be delays and unreliable bus operations. If the full busway capacity were to be scheduled, average bus speeds through the 15th and 18th Street section would be approximately half of the best speed that could be achieved.[1]

[1] Average bus speeds begin to be affected by interference from other buses when approximately half of the facility's capacity is used.

As an alternative, the busway's capacity was estimated based on a desire that, on an average, three or more buses would arrive at the Connecticut Avenue stop at the same time no more than 5 percent of the time during an hour (i.e., during no more than two traffic signal cycles during the hour). This scenario results in much more reliable operations than scheduling the full busway capacity, while maintaining a relatively high usage of the busway. Under this scenario, the busway's design capacity is 55 buses per hour per direction. If all 55 buses were scheduled, average bus speeds in the 15th and 18th Street section would only be 9 percent lower than if less than half the busway's capacity (i.e., less than about 40 buses) were scheduled.

Mentioned in a previous section of this chapter, the following priorities were developed for busway use, in the event that insufficient capacity was available to accommodate all buses:

- Downtown Circulator,
- WMATA routes of regional significance (prioritized by ridership),
- WMATA local buses,
- MTA commuter buses, and
- Charter and other buses.

3-4.4.5. Capacity Impacts on Bus Service Planning

Under the initial service plan, the Connecticut Avenue busway stop would be served in the westbound direction by 63 and 50 buses during the weekday AM and PM peak hours, respectively, and by 54 and 48 buses eastbound during the weekday AM and PM peak hours, respectively. All of these volumes are within the busway's design capacity, except for the AM peak hour westbound. In addition, 31 MTA commuter buses (westbound in the AM peak hour and eastbound in the PM peak hour) would use the general traffic lanes at Connecticut Avenue.

The Study Team initially considered re-routing some lines to reduce the weekday AM westbound bus volume to less than design capacity. The most likely candidate to re-route was the southbound/westbound S1 line, with 11 weekday AM peak hour buses. However, because the S1 serves transfers from the Metro Red Line to the State Department area, WMATA service planning staff expressed a desire to keep this service on K Street. The staff also recommended keeping the other existing routes on K Street. As a result, the initial service plan included weekday AM westbound volumes somewhat higher than desired, but still well within the busway's maximum capacity. Average bus speeds in the 15th and 18th Street segment during the weekday AM peak period under the initial service plan were estimated to be 17 percent lower than if less than half the busway's capacity were to be scheduled. Overall service speeds and capacity would be increased by a fare collection approach that would allow multiple door boarding.

Even if spare capacity were to be available, commuter and charter bus use of the busway is not recommended, due to dwell times that are significantly longer than those of WMATA buses because of the single door, narrow aisle configuration of the buses used for commuter service. In addition, under the initial service plan, MTA would likely not want to route its commuter

buses on the busway, as the commuter buses would be unable to pass on the busway and thus would be delayed by WMATA buses.

3-4.4.6. Busway Stop Locations

The initial recommendations for busway stop locations were based on the following considerations (listed in order of priority):

- Work within the busway design concept (e.g., not propose bus stops in the blocks adjacent to McPherson and Farragut Squares, where a constrained right-of-way exists);
- Maintain the current bus stop spacing as much as possible;
- Take advantage of the existing K Street signal timing as much as possible to maximize bus speeds and minimize the need for active bus signal priority treatments;
- Consider transfer opportunities to north-south routes and to/from Metrorail;
- Minimize travel time variability between buses on a route to the extent possible, so that buses with longer-than-average dwell times would not have substantially longer travel times than buses with average dwell times; and
- Consider impacts of buses turning out of the busway.

3-4.4.6.1. Local Buses

A spreadsheet model incorporating the existing traffic signal timing plan was used to evaluate local (i.e., non-BRT) bus movements along the busway. Two types of buses were modeled: a bus having an average dwell time at each stop and a bus with a dwell time 60 percent longer than average at each stop. Eastbound and westbound directions were modeled separately, for the weekday AM, midday, and PM peak hours. The following information and assumptions were used:

- Traffic signal timing data provided by DDOT.
- Average dwell times were assumed to be 30 seconds at Connecticut Avenue, based on the analysis described earlier, and 15 seconds at most other stops, based on an analysis of daily passenger boardings and alightings at each stop provided by WMATA. Average dwell times of 10 seconds were used at 10th, 21st and 22nd Streets that have – or are anticipated to have – relatively low-passenger volumes, with not all buses needing to stop. An average 25-second dwell time was used for the eastbound 9th Street stop, which initially was assumed would also be the eastbound convention center stop for the BRT and Downtown Circulator services.
- Distances between intersections were measured using GIS software.
- Average bus speeds while in motion between intersections were assumed to be 15 mph, accounting for cruising speed and acceleration/deceleration delays. A comparison with current bus travel speeds indicated that this was a reasonable assumption.

The result of this work was the identification of initial busway stop locations that would maximize bus speeds along the busway within the constraints listed previously (in particular, the desire to maintain the existing one-block stop spacing). The recommended locations took advantage of the existing traffic signal progression and minimized variations in bus travel times due to differing dwell times at stops. Opportunities for providing active signal priority to further improve bus speeds were investigated as part of the simulation analysis and are described later in this report. In addition, the simulation verified that bus speeds could be substantially improved if fewer stops were used, and subsequent iterations of the service plan increased the stop spacing from the initial level.

3-4.4.6.2. Bus Rapid Transit

The initial service plan identified a limited-stop Bus Rapid Transit route through the K Street corridor. Typically, when express and local services share a busway, passing opportunities are provided at bus stops to allow the express or limited stop BRT service to bypass the local buses without being delayed. This design allows a high volume of buses to use the busway without generating interference between the local and express buses. However, right-of-way constraints prevent the development of passing lanes at bus stops along the K Street busway. As a result, an express bus (such as BRT) that uses the full length of the busway would be held up by the first local bus it encountered and would, as a result, travel along most of the busway like a local bus. Under the option that includes curbside bus lanes, express buses would be able to bypass local buses via one of the regular travel lanes of K Street.

The BRT route initially was assigned the highest priority of K Street bus users, and was intended to provide high-speed, reliable service between Union Station and Georgetown. A service plan requiring BRT to travel at the same speed as local buses would not have been desirable. At the same time, reserving the busway solely for a BRT service operating every 10 minutes would have been an inefficient use of the facility. As a compromise between these two extremes, the initial service plan called for the left-hand general traffic lane on K Street to serve the passing lane function for BRT, as the left lane would be free from turning movements, parking activity, and other traffic interferences normally associated with mixed-traffic operation. However, the initial simulation run showed that operating the BRT route on sections of the general traffic lanes adjacent to the exclusive busway in each direction on K Street produced congestion in the remaining general-purpose lanes. Since the initial service plan's BRT routing required under-capacity conditions in the general-purpose lanes in order to be viable, this routing was subsequently dropped from consideration. Integrating mid-block passing lanes into the busway design was also considered, but rejected due to safety, operational difficulty, and aesthetic concerns.

3-4.4.7. Bus Signal Priority

Signal priority serves to reduce signal delays to buses (thus improving bus speeds) and helps improve schedule reliability. If provided at the capacity-controlling stop (typically the stop with the longest average dwell times), signal priority can also provide a modest capacity benefit.

Active signal priority measures (where the traffic signal controller reacts to the presence of a bus) that extend a green or return to green earlier to serve buses will not have general application in the busway section of the K Street corridor. The volume of buses in the corridor would result in a priority call virtually every cycle and, consequently, it would be more efficient to permanently retime the signals to replicate the benefit of active priority. Special bus phases to accommodate bus turns from the busway (under an option with a median busway) would have a smaller impact on general traffic operations if the special bus phase was activated only when a turning bus was present, as opposed to being activated on every cycle or when any bus was present.

Passive strategies (that adjust signal timing whether or not a bus is present) have wider potential application in the corridor. These strategies include changing signal offsets to provide better progression for buses and providing additional green time for K Street (to accommodate longer bus dwells, for instance). However, since K Street is part of a broader downtown signal system, signal timing modifications along K Street will have impacts on signal progression on the cross streets that must also be considered.

Specific bus signal priority measures were not proposed as part of the initial service plan, other than the special bus phases needed for buses to turn out of the busway, in order to first focus on the broad service planning concepts that would produce the majority of the bus speed improvements. An analysis of signal priority was incorporated into the second simulation analysis, to identify locations where additional improvements might be possible.

The simulation analysis determined that it is not desirable to provide mainline active signal priority along the K Street busway, due to certain constraints. Currently, side-street green splits are dictated by the time necessary for pedestrians to cross K Street. As proposed at most intersections, K Street would be over 100 feet wide curb-to-curb. At a minimum, 30 seconds for the walk and clearance interval is necessary to provide for safe pedestrian crossing. In light of the amount of pedestrians who use K Street daily, an interval of 33 seconds or more is preferred. Until September 2003, the intersections in the K Street corridor were operated with an 80-second cycle length. This short cycle length does not allow much flexibility to shorten side-street green times to provide extra green time for buses. With the 80-second cycle length, K Street green splits were already maximized, reducing the side street splits to the minimum amount of time necessary to serve pedestrians. This resulted in little or no additional time available to provide to the bus without impacting K Street traffic or pedestrians. In September 2003, the cycle length of the intersections in the corridor was changed to 100 seconds. The additional time generated by the increase in cycle length was allocated to the east-west K Street movements. Buses in the busway would benefit with the additional time allocated to the east-west movements. Therefore, the introduction of mainline active signal priority in the Central Section of the study area is not recommended. However, traffic signal priority on the sections where exclusive bus lanes are provided in the study area (Massachusetts Avenue) would help to improve bus operations.

3-4.4.8. Service Plan Refinements

The initial service plan sought to maximize the number of buses that could use the busway (within reasonable limits), while minimizing walking distances to access the facility (by providing frequent stops). Initial simulation of this concept using the CORSIM and VISSIM models revealed that this concept could operate acceptably, given issues to be resolved related to general traffic operations along a reconfigured K Street. However, the modeling also revealed that modifications to the initial service plan could be implemented that would further reduce bus delays.

Other service plan changes were necessitated by the inability to obtain a bus stop adjacent to the Convention Center, as originally proposed. As the project progressed, the need for both BRT and Downtown Circulator services was questioned, and the BRT line was eventually dropped from consideration. Discussions between the Study Team, and WMATA and DDOT staff for consolidating some closely spaced stops resulted in a plan with an average stop spacing of two blocks that was used for the second simulation run. Finally, a comparison of the initial service plan with criteria developed for similar situations in other cities suggested that a small reduction in the number of buses using the exclusive busway and even longer stop spacing would improve overall reliability and speed, as well as improve identity for the services using the facility.

3-4.4.8.1. Bus Routing Changes

The second simulation runs indicate that most buses will be able to access the busway from side streets without undue delay caused by traffic congestion. The exception is at Vermont Avenue/15th Street (East), where queues in the westbound general traffic lanes of K Street in the short block between 15th Street (West) and 15th Street (East) create congestion on northbound 15th Street (East) in the block between I and K Streets. This congestion, in turn, produces delays to Lines 30, 32, 34, 35 and 36. Westbound buses on these lines are recommended to travel north on 14th Street and turn left from 14th Street onto the K Street Transitway to avoid the congestion. Three non-regionally significant lines with the lowest average peak-hour load factors would be rerouted to H, I and/or L Streets to reduce the number of special bus phases required for turns off of the busway, and to reduce potential passenger confusion, especially among visitors and occasional transit users caused by a larger number of different lines using the busway. These lines, which currently use K Street, are:

- **Line D5.** This line carries an average of 29 passengers per bus eastbound and 14 passengers per bus westbound during peak hours. The route west of Washington Circle would remain as it currently exists. Eastbound buses would travel to a terminal at McPherson Square via Pennsylvania Avenue, H Street, Vermont Avenue, and 15th Street (West). Westbound buses would travel via 15th Street (West), K Street (in the general traffic lanes), 15th Street (East), I Street, and Pennsylvania Avenue.

- **Line L2.** This line carries 12 to 21 passengers per bus eastbound and 5 to 11 passengers per bus westbound during peak hours. Southbound, the line would approach its terminal

at McPherson Square via 21st Street, L Street, 17th Street, Connecticut Avenue, H Street, Vermont Avenue, and 15th Street (West). Northbound, the line would return via 15th Street (West), K Street (in the general traffic lanes), 15th Street (East), I Street, and 20th Street.

- **Line N7[1].** This line carried an average of 19 passengers per bus eastbound and 15 passengers per bus westbound during peak hours. The line initially proposed by the Study Team would travel much like the N7 did until December 28, 2003[1], except that it would use L Street (south/eastbound) and I Street (north/westbound) rather than K Street. However, because the N7 route was eliminated on December 28, 2003, this route is not shown on the map that summarizes the recommended service plan for the K Street Transitway study.

Under these realignments[2], the following peak-hour reassignments to parallel streets of local buses would occur on the busway, compared to the initial service plan:

- AM, eastbound: 19 percent fewer local buses, representing 21 percent of local passengers
- PM, eastbound: 6 percent fewer local buses, representing 4 percent of local passengers
- AM, westbound: 6 percent fewer local buses, representing 1 percent of local passengers
- PM, westbound: 18 percent fewer local buses, representing 14 percent of local passengers

These changes would reduce the number of local buses using the Connecticut Avenue stops by nine buses in the AM peak hour eastbound, four buses in the AM peak hour westbound, three buses in the PM peak hour eastbound, and nine buses in the PM peak hour westbound. With the extension of Downtown Circulator service into the AM peak hour (resulting in a total of 12 buses per hour per direction, compared to the 6 BRT buses used in the initial service plan), the net change in buses using the Connecticut Avenue stops during the AM peak hour would be –3 eastbound and +2 westbound, compared to the initial service plan.

The total number of bus trips during the peak hour using the busiest stop, Connecticut Avenue, would be 65 and 41 westbound during the AM and PM peak hours, respectively, and 51 and 45 eastbound during the AM and PM peak hours, respectively. Reducing the number of buses on the busway during most hours will improve travel times for the remaining buses, as less interference will occur between buses that could cause a bus to miss its green traffic signal phase. In addition, fewer turning movements will be required from the busway at 13th Street, 15th Street (East), and 20th Street, resulting in improved traffic flow in the general traffic lanes on K Street at those locations.

The inability to obtain a bus stop on L Street in front of the Convention Center produced two additional routing changes from the initial service plan. First, the Downtown Circulator will not

[1] Route N7 was eliminated on December 28, 2003. The analyses for this study were completed prior to the elimination of this route.
[2] Includes Route N7. The analyses for this study were completed prior to the elimination of this route.

directly serve the Convention Center, but will instead travel between K Street and Massachusetts Avenue in both directions via the south and west sides of Mount Vernon Square[1]. This routing will require a short northbound contraflow lane on 9th Street between New York Avenue and K Street. Second, Line 38B will circulate through the Convention Center on L Street, but will terminate on 9th Street across the street from the Convention Center[2].

3-4.4.8.2. Bus Stop Consolidation

The second simulation consolidated closely spaced stops at 12th and 13th Streets into a single stop at 12th Street, and also consolidated stops at 19th and 20th Streets into a single stop at 19th Street. The 15th Street (West) stop was proposed to be used by local buses only. The following additional consolidations are recommended:

- **10th Street.** When the initial service plan was first developed, it was thought that buses would be able to stop on L Street in front of the Convention Center. After this was determined not to be feasible, major stops were proposed at 9th Street. Given the proximity of the 9th Street stops, stops at 10th Street are no longer essential.

- **15th Street (West).** The July 2003 service plan proposed this stop for local buses only, as it had been previously determined that 16th Street was a more appropriate stop location for the Circulator. Given the proximity of the 14th and 16th Street stops to this location, a stop at 15th Street (West) is not essential. Connections to the McPherson Square Metro station can be made from the 14th Street stop. Eliminating this stop would also eliminate potential delays to Circulator buses caused by local buses using this stop.

The resulting stop spacing is approximately one stop every two to three blocks, to further improve bus travel times along the busway, while still providing easy access to venues of interest to visitors to the District and direct access to major businesses and office complexes.

3-4.4.8.3. Designation of "B" or BRT Routes and Associated Improvements

During the recently completed Washington Regional Bus Study, it was recommended that a number of high-quality bus corridors be established throughout the region, as initial incremental improvements in corridors where Metrorail extensions or future light rail lines are envisioned (e.g., Dulles Corridor), to provide capacity relief to crowded Metrorail lines or in other corridors that are also high-demand/high-average trip length, and/or of regional significance. The presence of a dedicated busway on K Street and associated bus-only lane connections east and west presents a unique opportunity to move this "high-performance/high-quality bus corridors" concept forward.

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[1] After the completion of the analyses for this study, a decision was made to directly serve the Convention Center with stops in the eastbound and westbound directions on Mount Vernon Place thus eliminating the contra-flow lane on 9th Street.

[2] After the completion of the analyses for this study, a decision was made not to extend Route 38B to the Convention Center.

One Virginia line, the 38B originating in Arlington's core, potentially fits the criteria (i.e., Metrorail crowding relief, crosses jurisdictional boundaries) noted above as do the 30S, S2 and L, for example. Though beyond the scope of the K Street Transitway Study, it is recommended that consideration be given to designating a number of these lines (i.e., one per major corridor) as "BRT" routes, and making changes in their stop spacing and/or alignments to provide improvements in identity, revenue speed and overall quality commensurate with their use of the K Street Transitway and rapid transit function. These changes could be augmented with adoption of a standard stop or shelter design for these routes along with use of rolling stock specially configured for high turn-over, high-demand routes (e.g. multiple door boarding capabilities, SmarTrip® card readers in vehicle). Dissemination of SmarTrip® cards and associated hardware throughout the WMATA system could be used to facilitate multiple door boarding at high-demand stop locations on the BRT routes, such as at Ballston, along K Street, Friendship Heights, at Chevy Chase Circle and Union Station.

3-4.4.9. Recommended K Street Transitway Service Plan

Figure 3-20 depicts the recommended service plan for the K Street Transitway in terms of stop locations and usage, and bus routings. Appendix F provides a detailed listing of recommended Downtown Circulator stop locations. Appendices O and P provide more detailed information on the location of bus stops for each of the feasible alternatives.

3-4.5. GEORGETOWN BUS SERVICE CHANGES

This section addresses service planning issues in Georgetown, at the west end of the K Street Transitway corridor. Specifically, this section reviews existing transportation services to Georgetown that potentially would be duplicated by the Downtown Circulator, and alternative terminus locations for the Circulator. It incorporates discussions with WMATA and DDOT staff throughout the study process.

3-4.5.1. WMATA Services Planned to Use K Street Transitway and Serve Georgetown

The following lines are planned to use the K Street Transitway and continue west via Pennsylvania Avenue and M Street to Georgetown:

- Lines 30, 32, 34, 35 and 36: From Georgetown, these lines travel north on Wisconsin Avenue to the Friendship Heights Metro station. On K Street, these routes will leave the busway at 15th Street (East) and proceed to their destinations in the southeast portion of the District (Potomac Avenue Metro, Naylor Road Metro, or Southern Avenue Metro).

- Line 38B: From Georgetown, this line crosses the Potomac River on the Key Bridge and continues to the Ballston Metro station via Rosslyn. It is the only all-day WMATA service using the Key Bridge. The line is proposed to use all of the K Street Transitway and to terminate adjacent to the Convention Center. After the completion of the analyses for this study, a decision was made to not extend Route 38B to the Convention Center.

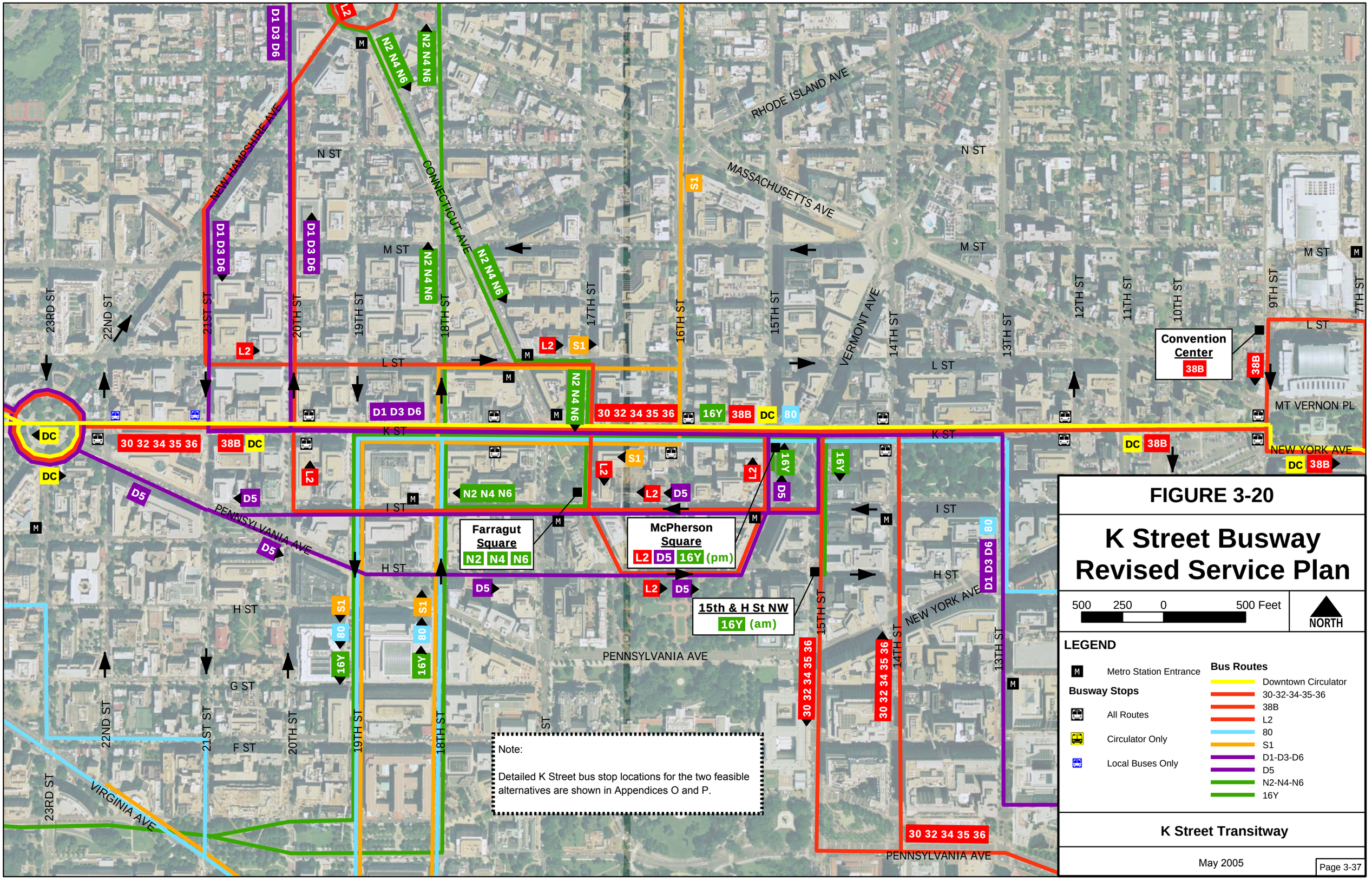


FIGURE 3-20

K Street Busway Revised Service Plan

500 250 0 500 Feet

NORTH

LEGEND

- Metro Station Entrance

Busway Stops

- All Routes
- Circulator Only
- Local Buses Only

Bus Routes

- Downtown Circulator
- 30-32-34-35-36
- 38B
- L2
- 80
- S1
- D1-D3-D6
- D5
- N2-N4-N6
- 16Y

K Street Transitway

May 2005

Of these routes, only the 38B substantially duplicates the Downtown Circulator routes. However, the Downtown Circulator may not have the same operating hours or fare system. In addition, the 38B provides a one-seat ride from Arlington into the District, helping to relieve crowding on the parallel Blue and Orange Metro lines. This line would be less attractive to riders if a transfer to another bus was required. Consequently, the 38B supplements the other services, rather than duplicating them. Routes D1, D3, and D6 also use a portion of the K Street Transitway, but pass through Georgetown on Q Street and do not duplicate Downtown Circulator service.

3-4.5.2. Georgetown Metro Connection

The Georgetown Metro Connection consists of two bus routes linking Georgetown to three nearby Metro stations. Service is funded by the Georgetown Partnership (the Georgetown Business Improvement District, a special taxing area within the District of Columbia), Arlington County, and Rosslyn Renaissance (a public-private partnership of Rosslyn businesses, developers and residents, and Arlington County). Fares had been 50 cents one-way, or 25 cents with a Metrorail transfer, but increased to $1 and 35 cents, respectively, on July 1, 2003. Service began in the summer of 2001 and is provided from 7:00 AM (8:00 AM on Sundays) to midnight (2:00 AM on Fridays and Saturdays).

- Route 1 travels south along Wisconsin Avenue from 35th Street to K Street, stops at Washington Harbour on K Street and then travels express to the Foggy Bottom-GWU Metro station.
- Route 2 begins at the Rosslyn Metro station, crosses the Key Bridge, makes five stops in Georgetown along M Street and then travels express to the Dupont Circle Metro station.

The Downtown Circulator duplicates the portion of Route 1 between central Georgetown and the Foggy Bottom-GWU Metro station. However, it will stop two to three blocks farther away from the station entrance than does the Georgetown Metro Connection.

3-4.5.3. Georgetown University Transportation Shuttle (GUTS)

Georgetown University operates shuttles connecting Leavey Center to the following:

- Dupont Circle Metro;
- Rosslyn Metro;
- Georgetown University Law Center, on Massachusetts Avenue between 1st and 2nd Streets;
- Locations in North Arlington along Lee Highway, Kirkwood Road and 10th Street;
- Off-campus offices at 2115 and 2233 Wisconsin Avenue; and
- Satellite parking located at the Marriott Key Bridge in Rosslyn.

Persons with a Georgetown University ID ride for free; others pay a one-way fare of $1.00. Headways are generally 10 to 15 minutes, except the North Arlington loop (hourly, with no early afternoon service) and the Law Center shuttle (70-minute headways are typical).

If service were to be provided to Georgetown University, the Downtown Circulator could serve the Law Center needs with a stop adjacent to the Law Center and more frequent service than the campus shuttle.

3-4.5.4. Potential Connections to Georgetown

The summary of other Georgetown transportation services listed above identified the following potential connections that are currently being served by other providers that could be served by the Downtown Circulator:

- Foggy Bottom-GWU Metro,
- Rosslyn Metro and
- Georgetown University.

Each potential connection is addressed in the following sections.

3-4.5.4.1. Foggy Bottom-GWU Metro

The Foggy Bottom-GWU Metro station is a terminus of Georgetown Metro Connection Route 1. Although service between Georgetown and locations within a few blocks of the station is also provided by WMATA Lines 30, 32, 34, 35, 36, 38B, and D5, the Georgetown Metro Connection offers several advantages:

- Service to the station entrance;
- Only two intermediate stops between Wisconsin Avenue and M Street and the station; and
- A lower fare to the station: $1.00 versus $1.25. The fare from the station is the same for the Metro Connection and WMATA buses: 35 cents with a Metrorail transfer. Once SmarTrip® cards are accepted for fare payment on all WMATA regional buses, rail-to-bus transfers will only be possible via SmarTrip® cards, and a 40-cent discount will be provided in both directions, compared to the present 85-cent discount in one direction.

The Downtown Circulator could potentially replace the K Street portion of Georgetown Metro Connection Route 1, as it has similar stops and (potentially) fare structure. However, Route 1 would still be attractive to passengers bound to and from Foggy Bottom-GWU Metro because it would eliminate a two-to-three block walk to make the bus-to-rail transfer. Further, deviating the Circulator to stop at the station entrance, as the Metro Connection does, is not recommended because of the time delay involved with getting buses back onto K Street.

3-4.5.4.2. Rosslyn Metro

The Rosslyn Metro station is a terminus of Georgetown Metro Connection Route 2 and is also served by WMATA Line 38B. It could also serve as a terminus for the Downtown Circulator.

Beginning a Circulator route in Rosslyn would provide relief to the Metro system by serving major downtown destinations. The Rosslyn-Convention Center connection could be particularly useful, as the trip by Metro involves either two transfers (at Metro Center and Gallery Place-Chinatown) or an out-of-direction trip for the direct transfer to the Green and Yellow lines at L'Enfant Plaza.

Traffic congestion on the Key Bridge – and its effects on bus reliability – would be a concern for this routing. Line 38B is currently scheduled for as much as eight minutes of travel time between Wisconsin Avenue and M Street and Rosslyn Metro during peak periods. Also, all of the southbound bus bays on Moore Street adjacent to the Rosslyn station's escalator entrance are presently in use. One of these bays is assigned to the Georgetown Metro Connection, which potentially could be replaced by BRT or Circulator service, thereby freeing up the bay for the new service. A second bus bay is dedicated solely to Line 38B.

Without a fare incentive for passengers to change modes, BRT would be unlikely to attract transfer ridership from the Blue and Orange lines, as the total trip cost to passengers would be greater when BRT was part of their trip. Treating BRT as part of the MetroRail (rapid transit) system, rather than part of the MetroBus network, and allowing free Metro-to-BRT transfers using SmarTrip® cards could overcome this obstacle. This kind of fare system would be similar to Boston, which treats its Silver Line BRT line as a rapid transit line and allows free transfers between BRT and the Blue, Orange, and Red rapid transit lines and the Green streetcar line. (Free bus-to-bus transfers are also provided between the Silver Line and local bus routes.) Out-of-system transfers using magnetically-encoded farecards are also used for transfers between subway and/or elevated rail lines at specific locations in downtown Chicago, Illinois, and Manhattan and Queens, New York.

From a regional planning perspective, the Regional Bus Plan calls for bus routes designed to provide relief to the Blue and Orange lines to start from outer stations in order to free up capacity in Arlington. However, there is a significant need to serve travel between the District and Arlington and vice-versa.

Either enhanced Line 38B service or the Circulator potentially could replace the Georgetown Metro Connection service to Rosslyn and still provide express service to Georgetown. However, a new terminus for Metro Connection Route 2 would be needed in Georgetown, as service to Dupont Circle Metro via Route 2 would still be required.

3-4.5.4.3. Georgetown University

The Study Team evaluated options to provide service to Georgetown University. However, at the conclusion of the study, the university indicated that at this time, they would prefer to continue providing their own transit services rather than those of outside providers. A western terminus for the Downtown Circulator along the southern edge of the Georgetown University campus, at the southern entrance to the University off Canal Road, was identified as a possibility. The initial planning for the Downtown Circulator also calls for a turnaround in this area. A stop in this

location would be remote to much of the campus (note that the university shuttles all go to the north side of campus and that the Georgetown University Hospital is also located on the north side of campus), and no other major traffic generator is located nearby.

A second option evaluated by the Study Team was to continue the Circulator north on Wisconsin Avenue and west on Reservoir Road (or a combination of Q Street, 35th Street and Reservoir Road) to a turnaround at either the Leavey Center entrance or the hospital/medical office building entrance one block farther west. This location on the north side of campus would provide a much greater trip generation potential than the first option, and the medical offices would continue to generate trips even when the University was not in session. This routing could relieve the University's need (and associated costs) to provide a shuttle connecting the Law Center with the main campus. Obtaining permission to drive onto campus and layover would need to be obtained from the University. The Georgetown neighborhoods west of Wisconsin Avenue are sensitive about bus traffic and the second option would result in an increase of four bus trips per hour per direction through the neighborhood for much of the day. This second option would also duplicate the north portion of Georgetown Metro Connection Route 1. The northernmost stop on Wisconsin Avenue for Route 1 is at R Street, although the bus continues farther north in order to turn around.

The third and best option is to serve the University via the Canal Road driveway and to get the Circulator buses to follow the routes within campus shown in Figures 3-21 and 3-22. The bus stop would be provided in the vicinity of the Intercultural Center. Prior to construction of the McDonough School of Business, the bus stop would be placed at the parking lot which is the future site of the McDonough School of Business. After completion of the McDonough School of Business, the turnaround and bus stop facilities would be provided along the border between the McDonough School of Business and the football field south of this site[1].

Due to current prohibition of left turns from the Georgetown University driveway to Canal Road between the hours of 6:00 AM and 10:15 AM, an alternative routing would have to be provided during these times. During these times, the westbound Circulator would enter campus via the Canal Road driveway. The eastbound Circulator would exit campus via Prospect Street. It would travel east on Prospect Street, turn right to southbound 34th Street and left onto eastbound M Street. Travel time runs conducted by the Study Team show that routing the eastbound Circulator via Prospect Street rather than Canal Road will add 45 to 60 seconds between Georgetown University and the intersection of Wisconsin Avenue and M Street.

At the conclusion of this study, Georgetown University indicated that at this time they would prefer to continue providing their own transit service and not use the Downtown Circulator service. However, if in the future, University officials request that Circulator service be extended to Georgetown University, routing decisions will be made with input from them. If the above

[1] Appendix G presents additional details on the evaluation of alternatives to provide service to Georgetown University.

Figure 3-21
Interim Georgetown University Turnaround

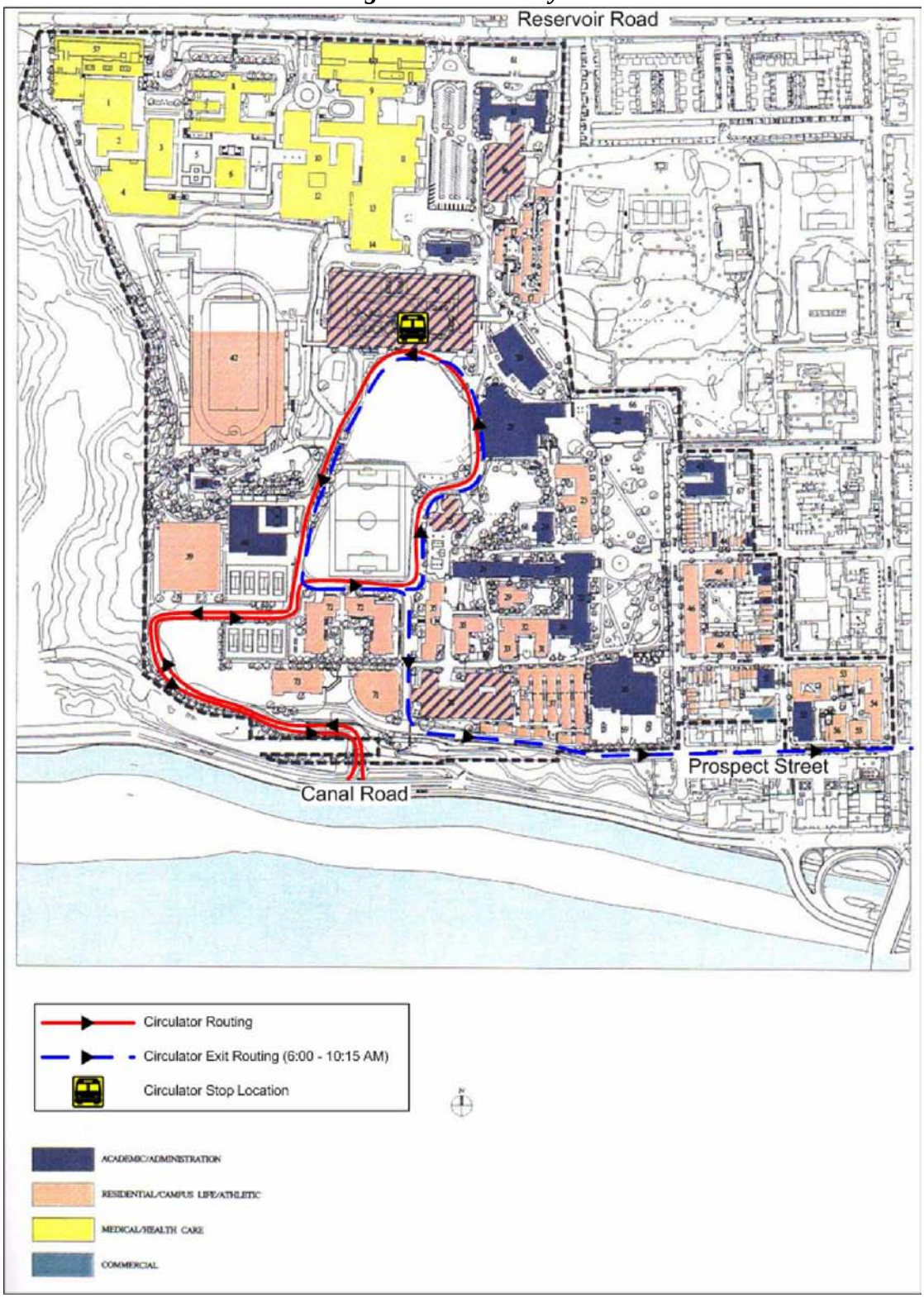
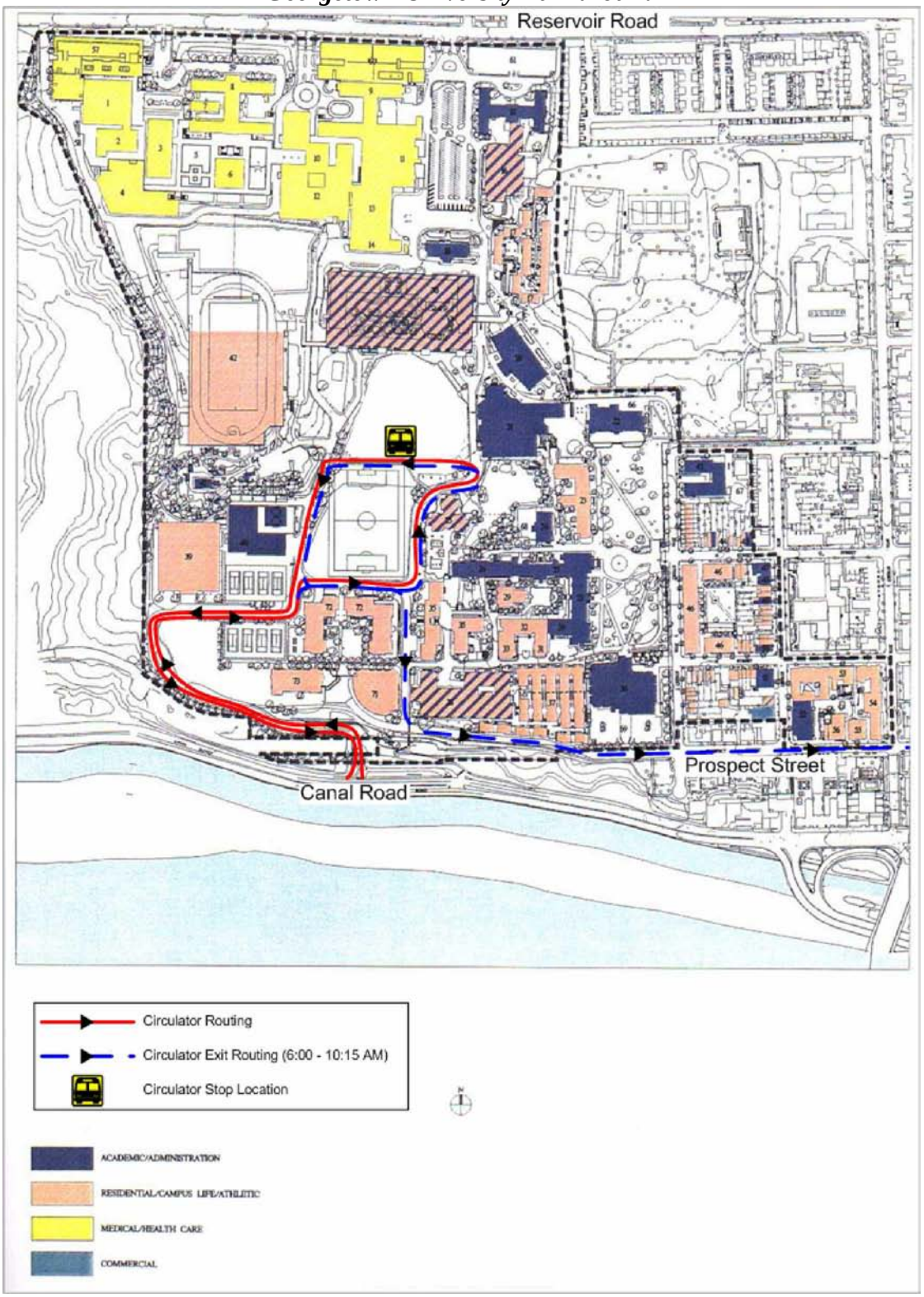


Figure 3-22
Georgetown University Turnaround



AM route is found to be undesirable by the University, the Circulator could leave the campus between 6:00 AM and 10:15 AM by turning right at the Reservoir Road driveway and travel east on Reservoir Road, turn right to southbound 35th Street, left to eastbound Q Street, right to southbound Wisconsin Avenue and left onto eastbound M Street. Travel times runs conducted by the Study Team show that routing the eastbound Circulator via Reservoir Road rather than Canal Road will add 60 to 90 seconds between Georgetown University and the intersection of Wisconsin Avenue and M Street. This routing would require the elimination of two eastbound Circulator stops on M Street between the Key Bridge and Wisconsin Avenue during the hours of 6:00 AM and10:15 AM. These stops would be operational at all other times of the day.

3-4.5.4.4. Turnaround in Georgetown

The Study Team identified turning around the Downtown Circulator in central Georgetown as an alternative to turning the routes around at the Georgetown University campus. The proposed routing was west from Washington Circle via Lower K Street, north on Wisconsin Avenue and east back to Washington Circle via M Street and Pennsylvania Avenue. Because of narrow streets and bridges over the C&O Canal east of Wisconsin Avenue that are in need of rehabilitation, the only other viable turnaround option in central Georgetown would be west on the Whitehurst Freeway, east on M Street, south on Wisconsin Avenue and east on Lower K Street. The latter routing would encounter traffic congestion around the Key Bridge approach.

Central Georgetown provides convenient access to restaurants, shopping and visitor attractions, and therefore is a good location to anchor the Downtown Circulator route, which is intended to serve these kinds of trips. Two hotels are located along M Street. Passengers wishing to travel to restaurants and businesses located along Wisconsin Avenue to the north would need to transfer to the Georgetown Metro Connection in central Georgetown or use one of the MetroBus routes on the K Street Transitway.

One disadvantage of a loop routing is that the planned Circulator bus stops at Lower K Street and Thomas Jefferson Street (Washington Harbour) and at Lower K Street and Wisconsin Avenue, as well as stops along M Street and Pennsylvania Avenue, would be served in one direction only. Passengers using these stops would have to wait on the bus during its layover, transfer to the next bus departing the layover point, or walk several blocks on either their inbound or outbound trip. Because of the number of businesses located along M Street and Wisconsin Avenue that would be affected by loss of on-street parking, blocked views of storefronts, noise and exhaust issues, finding a suitable layover point in central Georgetown may be difficult. Because the Downtown Circulator route is relatively short, it might be feasible to have all layovers occur at Union Station. This would result in more irregular headways on the eastbound trips.

3-4.5.5. Service Recommendations

The Study Team developed recommendations with respect to Downtown Circulator operations in the Georgetown area. Figure 3-23 shows the recommended service plan for the Georgetown area.

3-4.5.5.1. Service Frequency Decisions

In this study, the Study Team developed service recommendations for the Downtown Circulator assuming that the Circulator would serve Georgetown University. However, at the conclusion of this study, Georgetown University officials indicated that at this time they are not interested in providing Downtown Circulator service at the University. The description that follows assumes Downtown Circulator service to the University.

With service to Georgetown University, some Downtown Circulator buses would travel into the University campus. Based on round-trip travel times between Wisconsin Avenue and M Street and the University developed from the CORSIM model, having every third bus continue to the university works best from a scheduling standpoint, resulting in 15-minute headways to the University. Appendix H provides an example schedule based on the Downtown Circulator service plan providing service to the University. Because the University is not anticipated to generate as many trips as central Georgetown, not every Circulator bus needs to serve the University. Without service to Georgetown University, all Circulator buses would maintain a five-minute headway during peak hours.

3-4.5.5.2. Routing Decisions

No changes will be made to existing WMATA or Georgetown Metro Connection service in Georgetown. All westbound Circulator buses will approach Georgetown via the underpass beneath Washington Circle, Lower K Street and Wisconsin Avenue. Downtown Circulator buses terminating in central Georgetown will return eastbound via M Street, Pennsylvania Avenue and Washington Circle, due to a lack of alternative turnaround options. If Circulator buses were to serve Georgetown University, they would approach the University via M Street and Canal Road to the south university access driveway. Buses terminating at Georgetown University would return eastbound via this route, with the exception of buses serving Georgetown University between the hours of 6:00 AM and 10:15 AM. These buses would depart the University via Prospect Street, continuing east to 34th Street, turning right on 34th Street, and turning left on M Street before rejoining the main Circulator route at the intersection of Wisconsin Avenue and M Street. Without service to the University, all Downtown Circulator buses would turn right from northbound Wisconsin Avenue to eastbound M Street.

3-4.5.5.3. Decisions on Stop Locations

The District of Columbia preliminarily identified stop locations for the K Street Downtown Circulator route in the Downtown Circulator study. The locations identified in that study for the Georgetown area are recommended to be used, except for the section of the route on M Street, which is a different route than originally studied. Appendix F in this report provides a detailed list of the recommended Circulator stop locations.

A location on Wisconsin Avenue immediately south of the C&O Canal bridge is recommended as the terminus for buses not continuing to the University. This location, like nearly all

candidate locations, is currently used for on-street parking. The adjacent land use is an off-street parking lot. The location is located within sight of the intersection of Wisconsin Avenue and M Street, an important consideration for visitors unfamiliar with the area, and avoids a long uphill walk that would be required with a terminus on Lower K Street.

3-4.6. UNION STATION

This section addresses recommended bus access, circulation, and layover configurations and provisions at Union Station[1]. The Study Team conducted vehicular traffic counts at Union Station, visited the site to observe existing bus operations, conducted a field survey to identify the number and length of time buses stop and layover in front of Union Station, and assessed the ability of the Union Station Redevelopment Corporation's (USRC's) proposed layout to accommodate bus movements and bus operations at Union Station.

This analysis was initially reviewed with WMATA and DDOT staff, with follow-up meetings with Union Station representatives to review potential changes in bus layover and bus access and circulation provisions associated with the Columbus Plaza reconstruction.

3-4.6.1. Existing Bus Operations at Union Station

As shown in Table 3-2, six WMATA bus routes serve Union Station: Lines D1, D4, D8, N22, X8, and 97. These buses currently stop in the plaza area southwest of the station building, and enter and exit the site via the east side driveway off Massachusetts Avenue. As Table 3-2 indicates, additional WMATA routes and the Downtown Circulator are planned to serve Union Station in the future. Currently, the WMATA buses layover directly south of the plaza along the south side of the access road. The layover time for WMATA buses ranges from four to ten minutes.

3-4.6.1.1. Tour Buses

The Tourmobile is a local sightseeing vehicle (60 feet in length) that stops directly in front of the station next to the doorway entrance (outside of the WMATA bus plaza). This service operates primarily between 9:30 AM and 4:30 PM, offering five daylight tours and one evening tour of the Washington, DC area.

The DC Ducks is another sightseeing vehicle that stops directly in front of the station. This vehicle operates on 60-minute headway seven days a week, from March through October.

[1] This report presents recommendations with respect bus layover and bus stop locations at Union Station. However, after the Study Team completed the analyses and development of recommendations, DDOT, WMATA and Union Station developed a final plan for operations at Union Station which includes modifications to the recommendations of the K Street Transitway Study presented in this section of the report.

The Old Town Trolley is another sightseeing vehicle that stops in front of Union Station. The service operates on 30-minute headways seven days a week, starting at 9:00 AM Mondays to Saturdays, and at 10:00 AM on Sundays.

Table 3-2
Existing and Proposed Metrobus Service at Union Station

Route	AM Peak Hour Departures	PM Peak Hour Departures	Scheduled Layover (minutes)	Bus Bays**
Existing Routes				
D1*	0	3	10	0
D4	4	4	4	1
D8	4	7	7	1
N22	7	6	4	1
X8	3	3	4	1
97	4	4	7	1
Total Existing (Excluding D1)	22	24		5**
Proposed Routes				
K Street BRT Circulator	12	12		2
White House/Capitol Clockwise	15	15		2
White House/Capitol Counterclockwise	15	15		2
Rail Relief	33	33		4
H Street NE	6	6		1
Total Proposed Routes	81	81		11**
Total Existing and Proposed	103	105		16**

*D1 was rerouted out of Union Station in June 2004
** The number of bus bays shown in the table represents the maximum needed. However, with the implementation of improvements in bus operations, three bus bays would provide adequate service for existing routes and seven additional bus bays would be needed for the proposed routes. Therefore, a total of ten bus bays would be sufficient to accommodate the existing and future WMATA bus service.

3-4.6.1.2. Gallaudet University

Gallaudet University operates a shuttle between Union Station and the university seven days a week. During weekdays, service is provided from Union Station every 15 minutes, and every 30 minutes during midday. The university bus stops in front of the station next to the Tourmobile stop location.

3-4.6.1.3. Charter Buses

Currently there is a designated charter bus parking area on the bus/rental car deck of the parking structure behind Union Station. This deck is accessed via a traffic signal off H Street. There are currently bus bays provided for charter bus parking on the east side of this deck. Field

observations also identified several charter buses dropping off and picking up passengers in front of the station, in particular Coach USA, Elite Coach, Yellow Coach, Sauk Trails, Lakefront, and BBC Express.

3-4.6.1.4. Bus Layover Survey

To obtain better information on the number of buses stopping and laying over in front of Union Station today, a field survey was conducted from 4:30 PM to 5:30 PM on Thursday, May 29, 2003, and from 8:00 AM to 9:00 AM on Friday, May 30, 2003. The survey identified that as many as nine buses are stopped at one time in front of Union Station during the weekday PM hour, and as many as seven buses during the AM peak hour. Of these, as many as four WMATA buses at a time layover during both the AM and PM peak hours.

3-4.6.2. Union Station Redevelopment Corporation (USRC) Proposed Future Bus Operations at Station

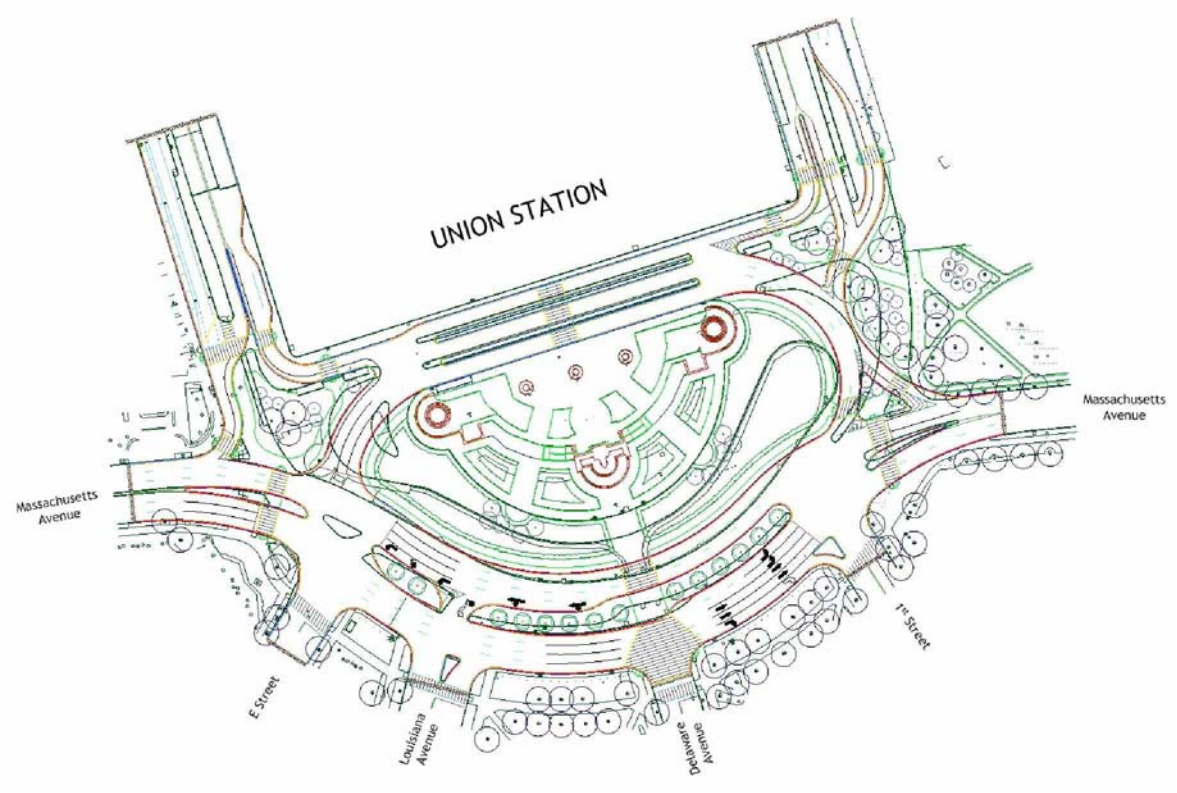
Figure 3-24 displays USRC's proposed layout for Columbus Plaza. The plans reflect the following features:

- West side of Columbus Plaza.
- Elimination of the circulation roadway on the south side of Columbus Plaza north of Massachusetts Avenue.
- Channelization of the ramp on the east side of the station to only access the roadway in front of the station, with no access to the outer two pedestrian boarding islands.
- Buses to operate from the third service lane, the one furthest from the entrance to the station.
- Taxis and private cars picking up and dropping off passengers would use the first and second service lanes (closest to the entrance to Union Station).
- Layover space for buses is provided on the deck in the back of Union Station.

With this concept, the bus plaza on the southwest side of the station would be eliminated, and in its place, the southernmost island across from the station would be devoted to bus stop/layover area. At this time, WMATA buses have been identified to occupy the curb space on this island west of the pedestrian crosswalk, which would be sufficient to accommodate three buses at one time. East of the crosswalk on this island, the Tourmobile, DC Ducks and any other sightseeing buses would be accommodated. Total curb space for five to six buses along this island would be available.

Because the current plan does not appear to serve adequately the layover needs of WMATA buses, including the proposed Downtown Circulator, WMATA and DDOT representatives requested that the Study Team evaluate the geometric and traffic operations adequacy of the proposed reconfiguration plan in front of Union Station. The most important concerns are:

Figure 3-24
USRC's Proposed Columbus Plaza Layout



- Inability of buses traveling south on the eastern ramp, after laying over at the deck, to reach the third lane to pick up passengers,
- Inability of buses traveling from the third lane to the western ramp to reach the layover deck, and
- Traffic operations issues with buses having to cross two busy lanes of traffic to reach the western ramp.

WMATA and DDOT representatives also requested that the Study Team evaluate the adequacy of the deck behind Union Station to accommodate the bus layover requirements and potential bus stop requirements.

3-4.6.3. Use of Street System to Access Bus Layover Area behind Station

With the proposed future site access and circulation changes at Union Station, space for only three WMATA buses would be provided on the outermost island in front of the station, which would not be sufficient to provide adequate layover area in the future, particularly with the new Downtown Circulator services to be accommodated. The next logical scenario would be to have buses stop in front of the station to pick up and drop off passengers, but layover on the bus/rental

car deck behind the station. However, the USRC's proposed site access and circulation design would preclude buses from accessing the ramp up the west side of the building to layover behind the station, and from re-entering the island after the layover. In addition, a layover behind the station would conflict with taxicab access behind the station, where the access road is too narrow to allow both stopped vehicles and two-directional traffic. Given these geometric and operational restrictions, two turnaround alternatives for the layover of buses at Union Station using the existing street system around the station were considered.

Both alternative routes originate at the existing signalized exit from the Union Station layover deck along H Street. Both alternatives were investigated with regards to existing geometry and travel times were measured during the AM peak hour.

Under Alternative A, buses would travel west out of the exit along H Street to North Capitol Street, south along North Capitol Street to Massachusetts Avenue, and east onto Massachusetts Avenue to enter Columbus Circle for service to Union Station. This route is approximately 3,000 feet long and takes an average of 3 minutes 44 seconds to travel. Additional time would be required for buses to travel from Columbus Circle back to the layover deck. Assuming a similar travel time for the return trip, a roundtrip travel time would be almost 8 minutes. This extra travel time would require that additional buses be added to the number serving the high frequency routes stopping at the station at a cost of millions of dollars per year. Both H Street and North Capitol Street are wide, with three lanes in each direction, and Massachusetts Avenue west of Union Station is also three lanes wide in each direction. The traffic signal at the intersection of North Capitol Street and Massachusetts Avenue currently has an extended protected phase for southbound traffic on North Capitol Street. The traffic signal at the intersection of North Capitol Street and H Street does not have a protected left-turn phase for westbound traffic on H Street.

Under Alternative B, buses would travel east out of the exit along H Street to 3rd Street NE, south on 3rd Street NE to Massachusetts Avenue, and west along Massachusetts Avenue to enter Columbus Circle from the east for service to Union Station. This route is approximately 4,200 feet long and takes an average of 4 minutes 47 seconds to travel. Additional time would be required for buses to travel from Columbus Circle to the layover deck. Assuming a similar travel time for the return trip, a roundtrip travel time would be almost 10 minutes. Although H Street is a wide three-lane roadway westbound along this route, 3rd Street NE is a narrow two-way, two-lane roadway with parking allowed on both sides of the roadway. Massachusetts Avenue west of Union Station has two lanes and a parking lane on each side of the roadway.

3-4.6.4. Union Station Alternatives

3-4.6.4.1. USRC Alternative

The Study Team evaluated the configuration proposed by Union Station and found that it cannot be implemented as currently proposed. Under the USRC's proposed geometric configuration, shown in Figure 3-24, buses cannot negotiate the movement from the eastern ramp to the

southernmost service lane in front of Union Station. Furthermore, buses cannot negotiate the movement from the southernmost service lane to the western ramp. Geometric modifications would have to be made to accommodate these two movements. The Study Team made geometric modifications to accommodate these movements, as shown in Figure 3-25, and tested the adequacy of traffic operations of the proposed plan.

The Study Team used the CORSIM traffic simulation model to assess the adequacy of traffic operations of the USRC Alternative. The analysis indicates that under the proposed plan (with the geometric modifications), the buses would experience severe delays due to the difficulty to cross two lanes of traffic to travel from the southernmost service lane to the western ramp. The Study Team found that this alternative would be inadequate to accommodate bus operations with WMATA buses serving the front of the building and laying over on the deck in the back of Union Station. Figures 3-26 and 3-27 present screenshots showing the congested conditions that are expected to occur under the proposed Union Station plan.

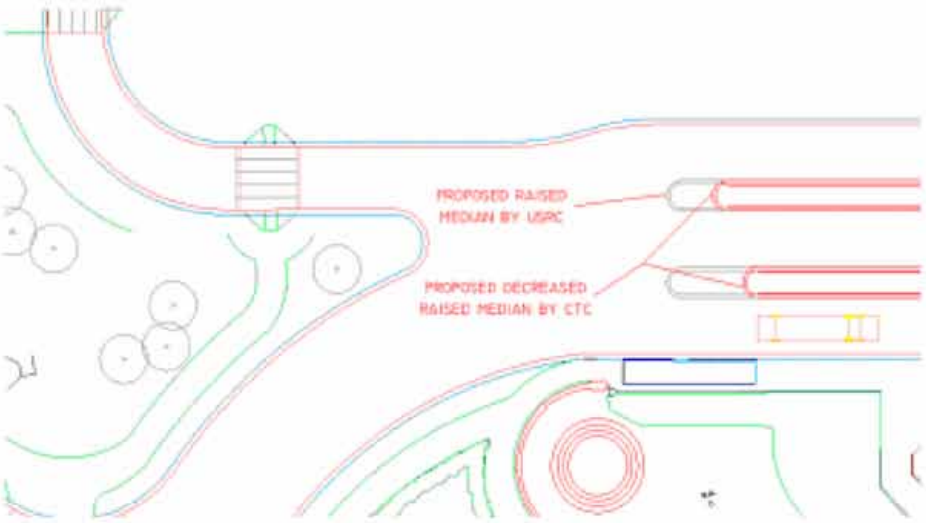
3-4.6.4.2. Alternatives with WMATA Service in the Southernmost Lane In Front of Union Station

Because the USRC alternative does not adequately work, the Study Team analyzed alternative arrangements for bus operations in front of Union Station. Two alternative layover routes were analyzed for the WMATA buses servicing Union Station. Under Union Station Alternative A, buses would travel west out of the bus lane and access the bus deck via the western ramp at Union Station to layover on the bus deck behind Union Station. Under this Union Station alternative all of the service lanes would have to be signalized to allow the buses to maneuver safely across two lanes of traffic from the southernmost service lane to the western ramp (to travel to the deck to layover). Buses would reenter Columbus Plaza via a new connector from the eastern ramp.

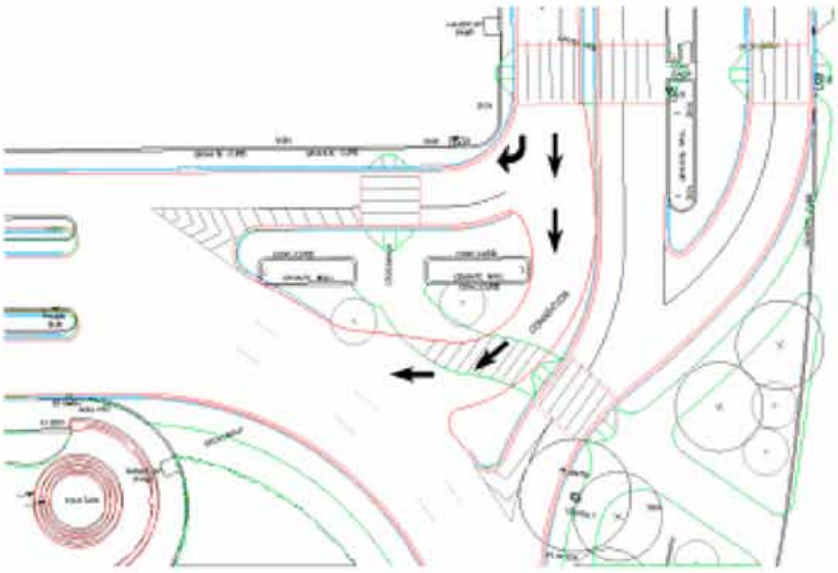
For Union Station Alternative A, bus turning radii templates were tested on the proposed redevelopment geometry. For buses to access the proposed western ramp to the bus deck and to accommodate the required turning radii of the bus wheel paths, it will be necessary to reduce the outside raised median by approximately 25 feet and approximately 15 feet of the inside raised median will need to be removed. This would reduce the bus storage capacity to five bus bays instead of six bays. The proposed revised geometry is shown in the top portion of Figure 3-25.

Under Union Station Alternative B, buses would travel west out of Columbus Plaza and turn right onto Massachusetts Avenue and then turn right onto North Capitol Street. Buses would continue on North Capitol Street and turn right onto H Street and finally enter the bus deck from an entrance on H Street behind Union Station. The buses would then reenter Columbus Plaza as in Union Station Alternative A via the connector. The proposed new connector is shown in the bottom portion of Figure 3-25.

Figure 3-25
Study Team Proposed Revised Geometry for Ramp Access



Proposed, Revised Geometry for Bus Access to Western Ramp



Proposed Connector from the Eastern Ramp

Figure 3-26
Screen Capture 1 of USRC Alternative

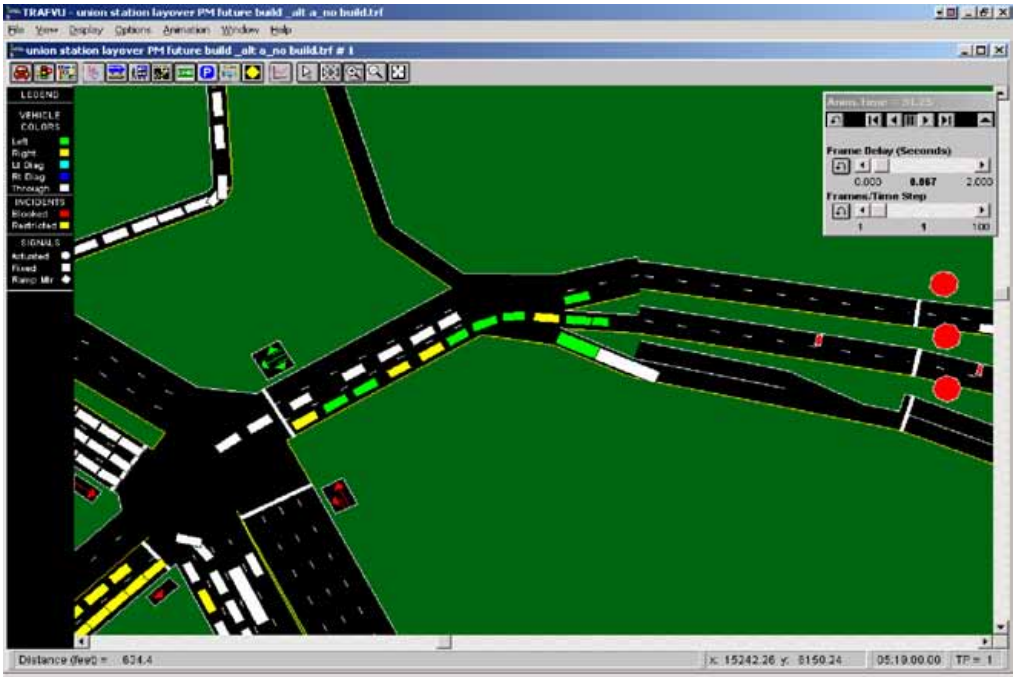
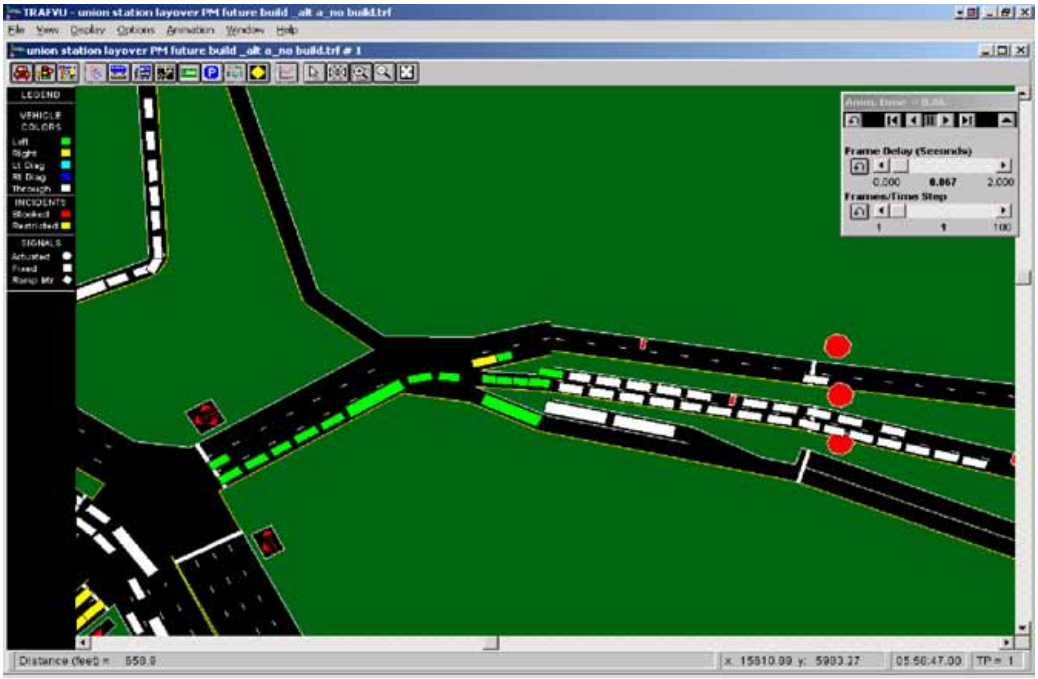


Figure 3-27
Screen Capture 2 of USRC Alternative



3-4.6.5. Analysis Data and Tools

3-4.6.5.1. Existing Turning Movement Counts

Existing PM peak hour counts were taken at Columbus Plaza in front of the Union Station entrance in each existing divided lane. The existing volumes for the exclusive bus lane were derived by field data and the data on WMATA bus operations summarized earlier in Table 3-2.

3-4.6.5.2. Future Volumes

Figure 3-28 summarizes the existing counts at the Union Station service lanes and the volumes used in the analysis of future conditions. The only addition to existing WMATA service included in the analysis was the Downtown Circulator. This means that the Study Team assessed a best case scenario rather than a worst case scenario (one with all other proposed WMATA services implemented in the future). The buses shown in Figure 3-28 include all WMATA buses, sightseeing buses and Gallaudet University buses. The Study Team assumed that charter buses would not serve the front of Union Station.

3-4.6.5.3. CORSIM Analysis

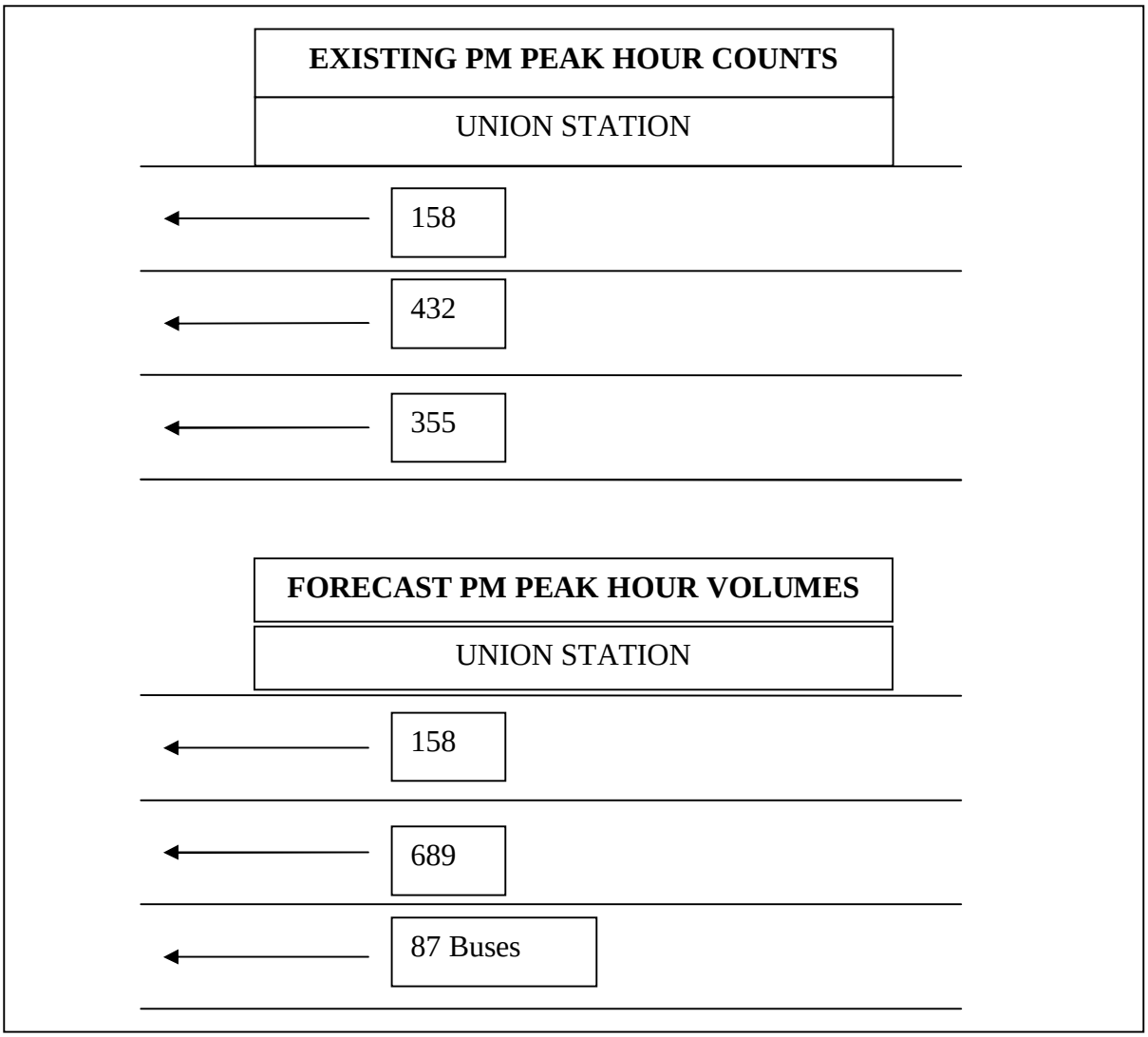
A microscopic PM peak hour traffic model was developed in CORSIM to analyze the proposed Union Station Alternative A and B circulation schemes. The Union Station Redevelopment Plan was used as the base, with the geometry revised in Union Station Alternative A to allow the WMATA buses to access the ramp on the western end of the building. For both Union Station alternatives, the geometry was also revised to allow the WMATA buses to reenter the exclusive bus lane via the connector created through a landscaped area proposed by USRC.

In order for the buses to safely travel to the western ramp from the exclusive bus lane, a signal was provided. The cycle length was chosen to be consistent with other signal cycle lengths currently used in the vicinity of Union Station.

The Study Team estimated that 21 of the 24 existing WMATA PM peak hour buses would continue to serve the front of Union Station (Line D1 was rerouted out of Union Station in June 2004). The Downtown Circulator would add 12 additional buses during the PM peak hour. In addition to the public transit buses, approximately 21 other buses would serve Union Station during the PM peak hour. In both Union Station alternatives, it was assumed that all public transit buses would layover on the bus deck and enter Columbus Plaza to service Union Station via the proposed eastern connector. This results in 87 buses circulating through the exclusive bus lane during the PM peak hour.[1] Bus headways used were taken from existing data collection of bus activity at Union Station.

[1] The public transit buses travel the service lane twice during the peak hour: the first time on the way to the layover deck and the second time traveling from the layover deck to pick up passengers in the service lane.

Figure 3-28
Existing and Forecast PM Peak Hour Volumes at Union Station



3-4.6.6. Evaluation of Bus Service from the Southernmost Lane in Front of Union Station

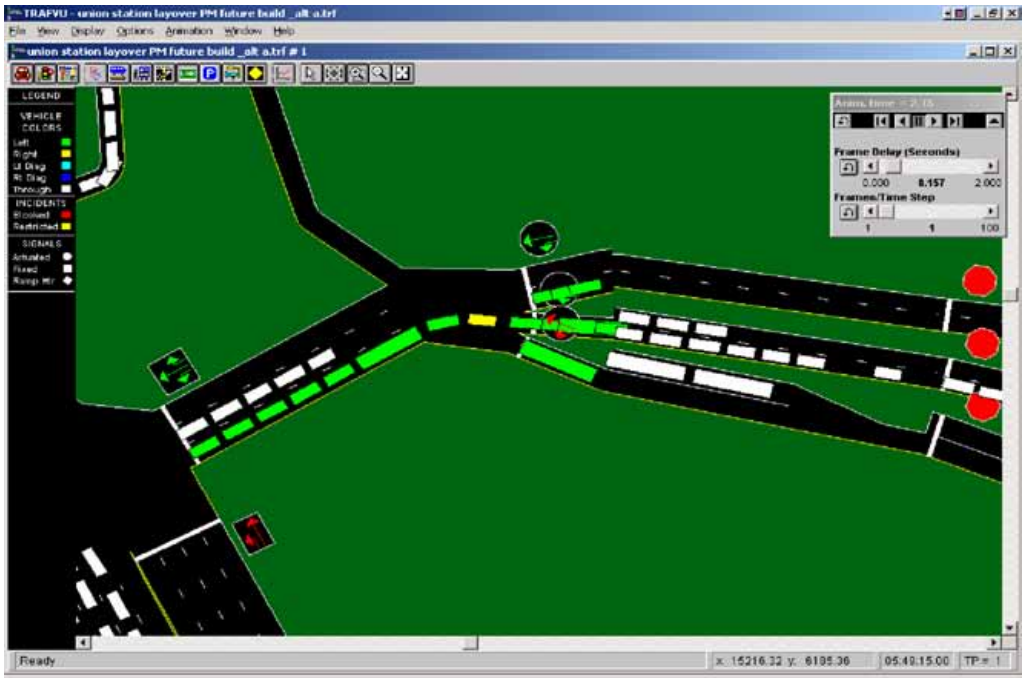
In order for either Union Station alternative to be an effective layover option, buses should have an unimpeded exit from the exclusive bus lane to the bus deck by either the western ramp (Union Station Alternative A) or local streets (Union Station Alternative B). In the proposed USRC plan, the maximum storage space for the southbound approach for the new signal at E Street and Columbus Circle is approximately 140 feet (this storage space refers to the distance between the stop bar at the signal and the western ramp, as shown in Figure 3-25). Southbound vehicles attempting to exit Columbus Plaza have a difficult time clearing the intersection due to the downstream congestion on westbound Columbus Circle. The Study Team found that Union

Station Alternatives A and B generate excessive delays for public transit buses and therefore are not recommended for implementation.

3-4.6.6.1. Union Station Alternative A – Entrance and Exit To and From the Layover Deck Via Western and Eastern Ramps

The results of the analysis for Union Station Alternative A show that queues longer than the available stacking space would often form on the southbound approach of the signal at the western end of Union Station. These southbound queues would back through Columbus Plaza and, as shown in Figure 3-29, would often extend beyond the point where the western ramp begins. The simulation demonstrates that, due to long queues, buses would often be prevented from traveling from the exclusive bus lane to the ramp that provides access to the bus deck during their green phase. This situation would reduce the ability to service the front of Union Station and provide adequate time to layover on the bus deck. If the buses have to wait for an additional signal cycle to enter the ramp to the bus deck, one to two minutes would be lost from the already limited layover time.

Figure 3-29
Screen Capture of Union Station Alternative A

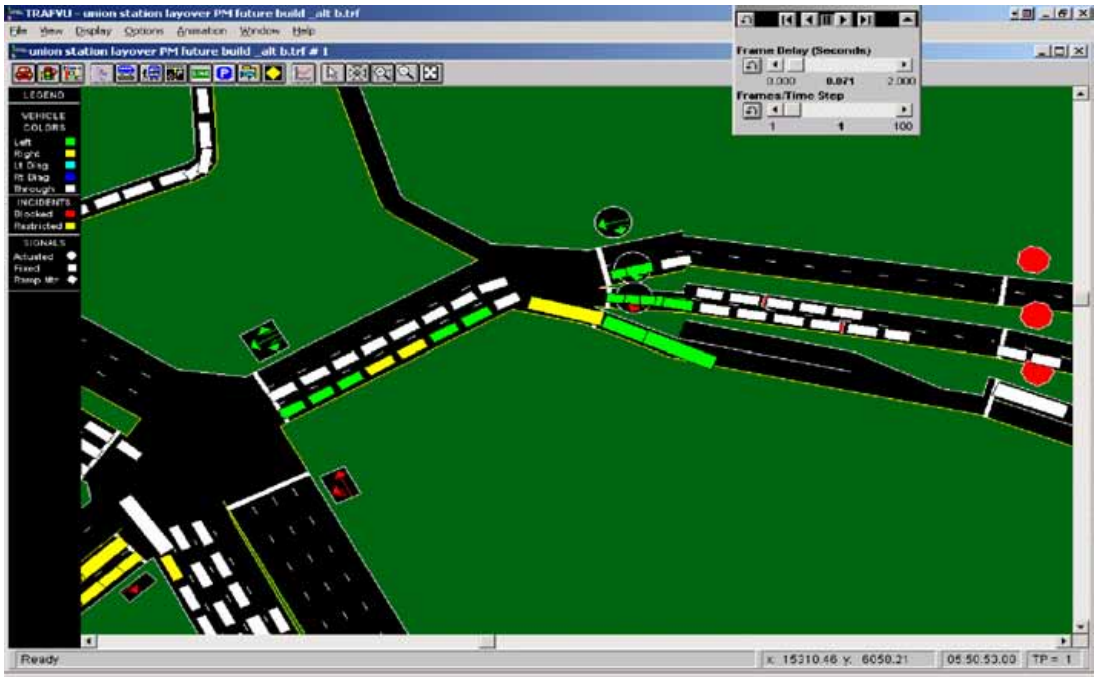


3-4.6.6.2. Union Station Alternative B – Entrance to Layover Deck Via H Street and Exit from Layover Deck Via Eastern Ramp

For Union Station Alternative B, buses would continue through Columbus Plaza and turn right at the new signal at the intersection of E Street onto Massachusetts Avenue. Buses would continue north on North Capitol Street, turn right on H Street, and would enter the layover deck from the H Street entrance. Under this alternative, buses would travel from the layover deck to the front of Union Station via the eastern ramp.

Under this Union Station alternative, most public transit buses would try to reach the westernmost lane at the exit from Columbus Plaza to turn right, to be in a position to turn right again at the intersection of Massachusetts Avenue and North Capitol Street. However, as shown in Figure 3-30, the CORSIM simulation indicates that the queues at the southbound approach to the intersection of E Street and Columbus Circle often block the buses trying to exit the bus service lane. Buses would spend approximately one minute leaving Union Station, five minutes traveling from Union Station to the H Street entrance to the layover deck, and one minute traveling from the layover deck to the front of the building. Therefore, under Union Station Alternative B buses would spend seven minutes traveling to and from the layover deck. These excessive times, as well as the excessive operating cost associated with the extra bus travel, make Union Station Alternative B unfeasible.

Figure 3-30
Screen Capture of Union Station Alternative B



3-4.6.7. Other Union Station Alternatives

The Study Team found that Union Station Alternatives A and B generate excessive delays for WMATA buses and therefore are not recommended for implementation. The Study Team identified three other alternatives that may provide better bus operations at Union Station.

3-4.6.7.1. Union Station Alternative C – WMATA Passenger Service And Layovers on the Deck Behind Union Station

Under Union Station Alternative C, WMATA buses (not including the Downtown Circulator) would pick up and drop off passengers at the deck behind Union Station. The Downtown Circulator would pick up and drop off passengers at the southernmost lane at the front of the building. The service lanes would still need to be signalized under this alternative to facilitate the pullout of buses from the bus lane to either the western ramp (if Circulator buses are laying over at Union Station) or to the southbound approach of Columbus Plaza to Columbus Circle (if the Circulator bus is not laying over). All of the geometric modifications shown in Figure 3-25 would have to be provided. This alternative would result in increased bus operating costs, would reduce the visibility of WMATA buses and would significantly reduce ridership.

3-4.6.7.2. Union Station Alternative D – Bus Service from the Lane Closest to the Station

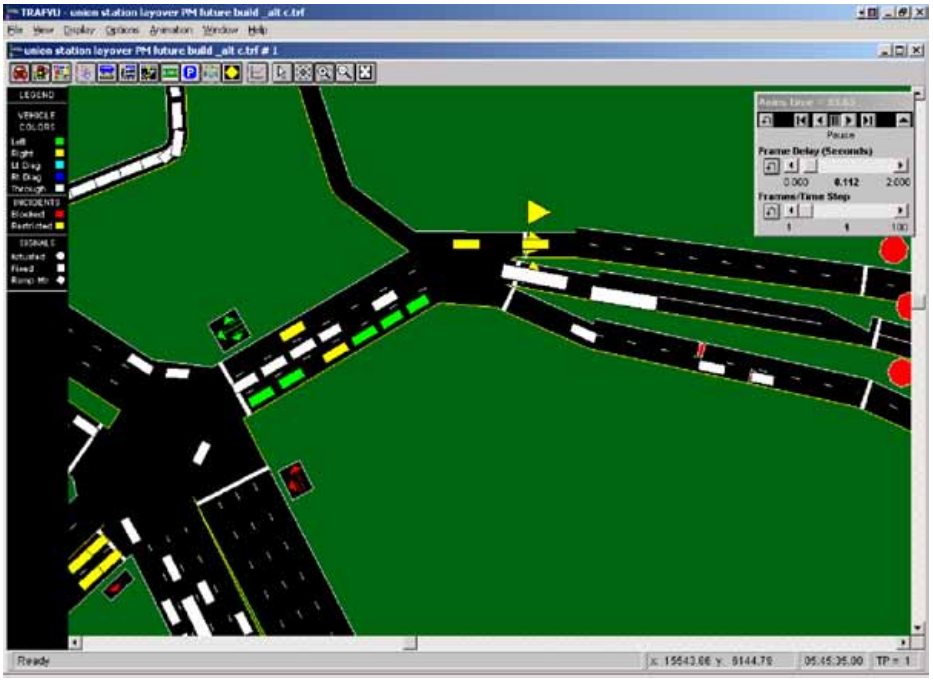
Under Union Station Alternative D, all buses would serve the front of Union Station from the lane closest to the station. This alternative would eliminate the conflicts between buses trying to reach the layover deck and vehicles using the other two service lanes. Taxis destined to the taxi layover spaces via the western ramp would be allowed to travel on the proposed bus service lane (closest to Union Station) or could potentially reach the taxi stand area on the ramp behind Union Station by entering from H Street and traversing the deck behind the station. It is important to note that Union Station representatives have indicated that Union Station Alternative D is not a desirable option because of building security reasons, as well as the inconvenience to station patrons of having to carry their luggage through a bus lane to reach the front of the building.

3-4.6.7.3. Union Station Alternative E – Bus Service from Second Lane

The Study Team also evaluated an alternative that would reserve the second lane for the buses, the first lane (closest to the building) for taxis and the third lane (farthest from the building) for private automobiles. Under Union Station Alternative E, the buses would use the western ramp to reach the layover deck and the eastern ramp to travel back from the deck to the front of the station. With the elimination of the gore area at the bottom of the eastern ramp and the relocation to the north of the median separating the first and second service lanes, the proposed eastern ramp connector, shown at the bottom of Figure 3-25, would not be needed to accommodate the bus turns to reach the second service lane. The traffic simulation analysis indicates that if bus service were provided from the second lane, there would be no need to signalize the pullout movements from the service lanes. Buses would find gaps in the taxi lane to traverse from the

second lane to the western ramp. Moreover, as Figure 3-31 shows, the traffic simulation indicates that this alternative minimizes delays and queues for all vehicles.

Figure 3-31
Screen Capture of Union Station Alternative E



3-4.6.8. Summary of Findings and Recommendations for Bus Service and Bus Layover Operations at Union Station

The Study Team evaluated five different alternatives for proposed bus service at Union Station. The evaluation is summarized in Table 3-3. Union Station Alternatives A and B result in long delays for the buses to reach the layover deck. Union Station Alternative C would result in increased bus operating cost and would reduce the visibility of WMATA buses. Union Station Alternative D has significant negative effects on taxi operations. The Study Team recommends the implementation of Union Station Alternative E[1] because it results in adequate traffic operations and improved bus operations to reach the layover deck, and has no negative effects on taxi operations.

[1] Subsequent to the analysis performed by the K Street Transitway Study Team, WMATA, DDOT and Union Station agreed on an alternative for bus routing and layover operations at Union Station that is different from the alternatives evaluated in this study.

Table 3-3
Summary of Evaluation of Union Station Alternatives

Alternative and Description	Bus Passenger Access to the Station	Passenger Transfers	Safety for Pedestrian Arriving by Auto	Safety for Pedestrian Arriving by Bus	Bus Operations	Bus Operating Cost	Traffic Operations	Impact on Geometrics	Taxi Operations	Layover Time
Union Station Alternative A - *Buses reach layover deck via western ramp – 3rd Service Lane*	◒	◔	◔	◒	○	◔	○	○	●	◔
Union Station Alternative B - *Buses reach layover deck via local streets – 3rd Service Lane*	◒	◔	◔	◒	○	○	○	○	●	○
Union Station Alternative C - *WMATA service (except BRT) from bus deck*	○	◔	◔	◔	◔	◒	●	◔	●	●
Union Station Alternative D - *Bus service from lane closest to station*	●	◔	◒	●	●	●	●	●	◒	●
Union Station Alternative E - *Bus service from the second lane*	◔	◔	◒	◔	◔	●	●	◔	●	●

It is important to note that the implementation of Union Station Alternative E, with buses operating on the second lane, would require that the bus lane be constructed with a width of 24 feet minimum or 25 feet recommended to allow departing buses to pass parked buses. The existing USRC plan does not provide the recommended 25 feet. It provides 20 feet of width for all three lanes. The widening of the second lane would require a reduction in the width of the first and third lanes to accommodate the recommended 25 feet of width on the second lane.

Reducing the width of the first (northernmost) lane would improve the geometry for buses maneuvering from the east ramp to the second lane and from the second lane to the west ramp. Provisions should be implemented to facilitate buses turning right at the southeast corner of Union Station. Detailed engineering plans will need to be developed by Union Station to finalize all of the details of the proposed scheme. Additionally, the circulation roadway behind Union Station must be converted to one-way operation in the eastbound direction to allow buses to travel from the layover area in the bus deck to the bus stop in front of Union Station. Taxis regularly queue in one of the two lanes of this roadway, and it will be essential to bus operations to allow buses to pass queued taxis.

3-4.6.9. Summary of Findings and Recommendations for the Layover Deck

The Study Team developed two layover plans for the deck behind Union Station. Layover Plan A was developed for the condition where public transit buses would travel to the deck from the front of the building, layover at the deck and travel back to the front of the building via the eastern ramp. Layover Plan B would have buses accessing the deck from H Street.

3-4.6.9.1. Layover Deck Plan A

Layover Deck Plan A was developed for the condition where public transit buses would serve passengers in front of the building and would use the eastern and western ramps to travel to and from the layover deck. Under this option, charter buses and Greyhound buses are assumed to enter the deck via H Street. Public transit buses would use the deck for layover purposes and would not pick up or drop off passengers at the deck. The proposed deck layout for Layover Plan A is presented in Figure 3-32. Since the Study Team is recommending the provision of public transit passenger service at the front of the building, Layover Plan A is the one recommended for implementation.[1]

3-4.6.9.2. Layover Deck Plan B

Layover Deck Plan B would have buses accessing the deck from H Street. This plan is illustrated in Figure 3-33. The plan would accommodate WMATA, Downtown Circulator, tour, Greyhound and charter buses. The plan would have a right-in only access for buses where taxis currently access the parking garage off H Street, as well as a signalized full movement access for buses at

[1] It is important to note that the layout shown in this document is a scheme developed at the planning level of analysis. Detailed engineering plans will need to be developed by Union Station to finalize all of the details of the proposed scheme.

Figure 3-32
Potential Union Station Bus Deck Layout – WMATA Bus Access/Egress from/to the South

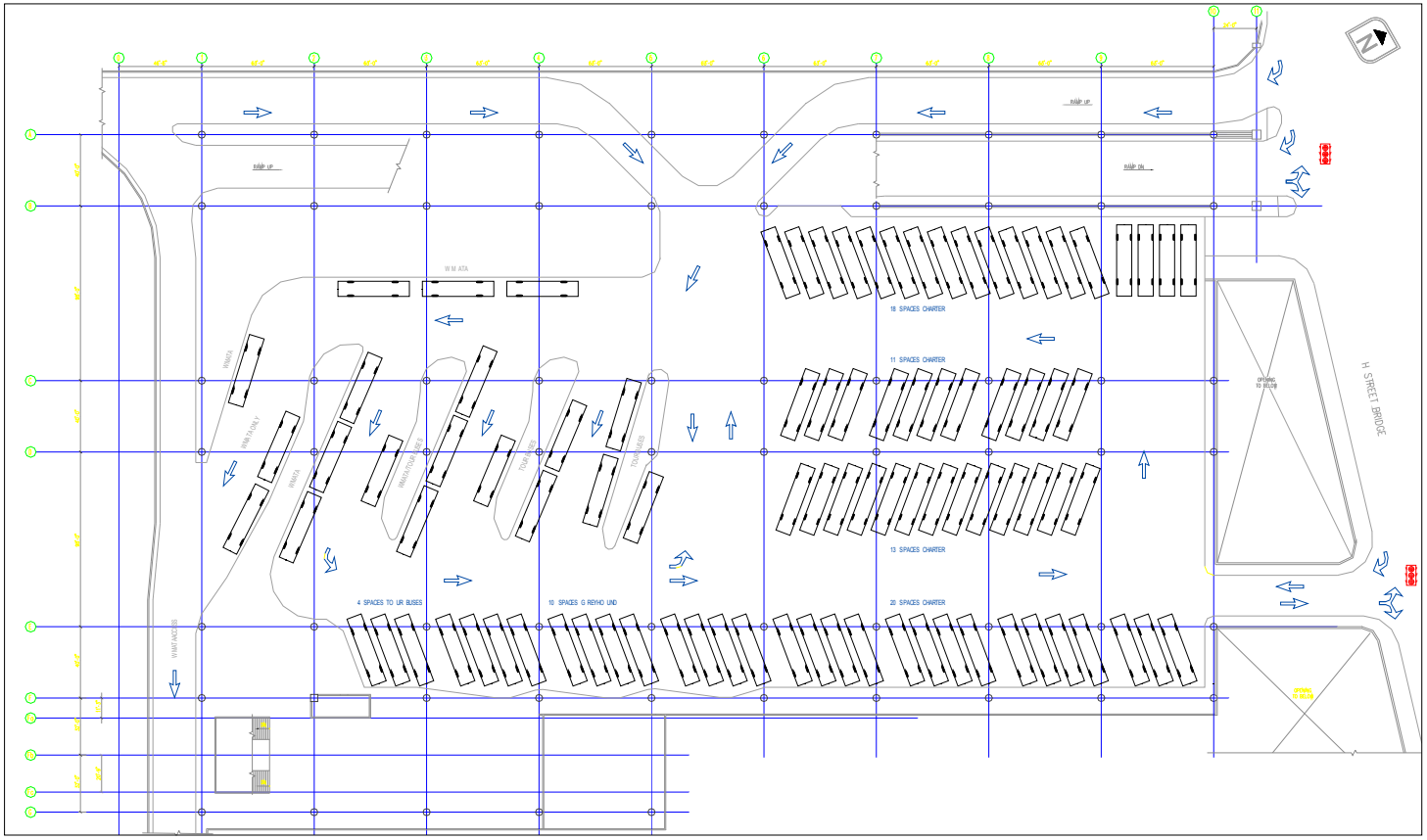
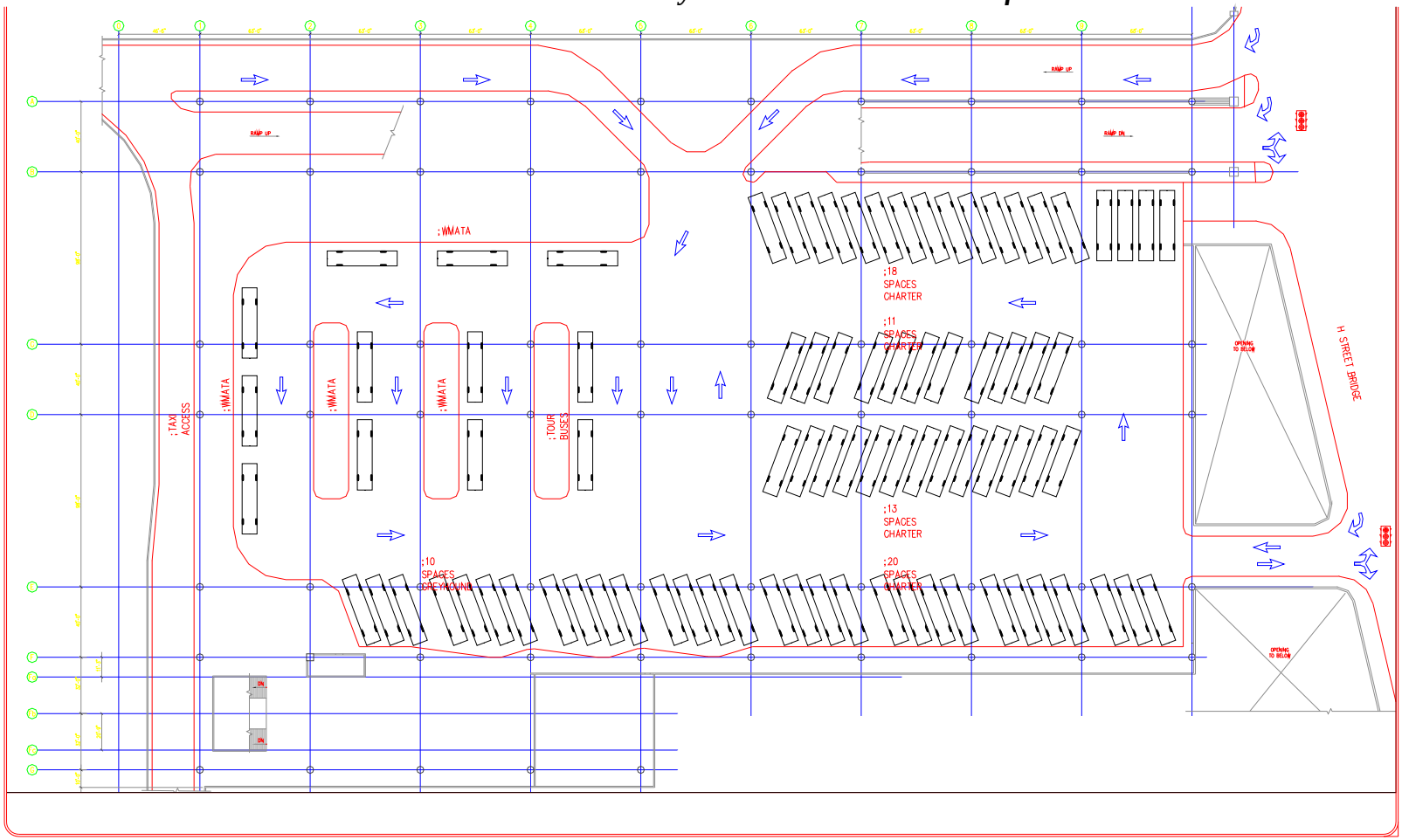


Figure 3-33
Potential Union Station Bus Deck Layout – WMATA Bus Access from H Street



the existing easterly parking garage driveway on H Street which today is reserved for right-in, right-out only bus access. A new traffic signal would be required at this east intersection, with the current west bus deck ramp off H Street (which shares a traffic signal with the parking deck ramp) removed. With the layout shown in Figure 3-33, there would be an opportunity for buses to access the middle of the bus deck from the existing ramp on the west side of the station, but no egress to the ramp on the east side of the station would be possible.

The layout plan for the Union Station alternative where WMATA routes (not including the Downtown Circulator), pick up and drop off passengers on the back of the station, shown in Figure 3-33, would have WMATA buses circulating to the south side of the bus deck, stopping in a linear bus bay "U" shaped area, with one or two supplemental islands available for WMATA buses to the north. WMATA Operations Planning staff has indicated that their buses must pull through the bus deck area, and it was not acceptable to park buses in an angled space and back them out. With the identified concept, the access off the taxi ramp on the south side of the bus deck would be closed, with an extended pedestrian concourse area developed that would facilitate pedestrian transfers from the escalators, elevator, and stairway in the southeast portion of the bus deck to the WMATA bus stop area. With as many as 8 to 10 bus bays available, all WMATA buses would stop and layover in the same location.

Tour buses would have at least the third northernmost center island reserved for their use north of the WMATA stop area. At least the articulated Tourmobile would stop in a center island area, as it would have more difficulty backing out of an angled parking space. Added space for tour buses would be provided in angle berths next to the elevator and close to the escalators, where the existing Grey Line tour buses are located. North of the tour buses along the east side of the bus deck, spaces for Greyhound buses would be provided. As many as 10 spaces for Greyhound have been identified. The rest of the bus deck would be allocated to charter buses, with as many as 50 spaces being available.

3-4.6.10. Service Recommendations

Figure 3-34 shows the proposed Downtown Circulator alignment and stop locations between Mount Vernon Square and Union Station. Appendix F provides detailed stop descriptions for the Circulator. To reduce dwell times at Union Station, one of the most critical stops in the CBD bus system, it is recommended that SmarTrip® card vending machines, with capabilities to dispense new SmarTrip® cards and/or add value to SmarTrip® cards held by passengers, be provided at this site to support multiple-door boardings. This would significantly reduce bus boarding times and would improve bus circulation. The provision of SmarTrip® card vending machines is also recommended at other stops in the corridor used by significant numbers of infrequent riders. These stops include, but are not limited to: Convention Center, 14th and K Streets, Connecticut Avenue and K Street, Wisconsin Avenue and K Street, and Wisconsin Avenue and M Street.

FIGURE 3-34

Union Station Revised Service Plan

500 250 0 500 Feet

NORTH

LEGEND

- Metro Station Entrance
- **Bus Stops**
  - All Routes
  - Circulator Only
  - Local Buses Only
- **Bus Routes**
  - Downtown Circulator
  - 30-32-34-35-36
  - 38B
  - L2
  - 80
  - S1
  - D1-D3-D6
  - D5
  - N2-N4-N6
  - 16Y

K Street Transitway

May 2005

N ST
9TH ST
7TH ST
6TH ST
M ST
NEW YORK AVE
NORTH CAPITOL ST
Convention Center
38B
L ST
MT VERNON PL
DC 38B
K ST
3RD ST
MASSACHUSETTS AVE
DC
80
2ND ST
H ST
G ST
NEW JERSEY AVE
F ST
E ST
D ST
D1 D3 D6
Union Station
D1 (am)
Union Station
DC
LOUISIANA AVE
DC D6
D6
D3

3-4.7. DOWNTOWN CIRCULATOR SERVICE REQUIREMENTS

This section presents service requirements for the Downtown Circulator K Street route, in terms of fleet requirements, travel times, and daily vehicle hours and miles of service. The assumptions used to develop these requirements are also described.

3-4.7.1. Service Assumptions

The Study Team made assumptions on the following aspects of the Downtown Circulator K Street route: service span, frequency, travel times, travel distances, layover and recovery. These assumptions were used to develop requirements for the Downtown Circulator K Street route.

3-4.7.1.1. Service Span

The original Downtown Circulator plan called for a service that was oriented towards visitors and downtown employees making midday trips, and the proposed service span reflected that market: 8:00 AM to 9:00 PM. However, the K Street Circulator will also be serving a commuter market that had originally been proposed to be served by a separate BRT route and, therefore, an earlier start would be appropriate. In addition, a 9:00 PM end of service would not serve many potential customers with late-evening dining or entertainment plans in Georgetown or along K Street. Therefore, a service span departing Union Station of 6:00 AM to 11:40 PM is proposed to accommodate these additional markets[1].

3-4.7.1.2. Frequency

The proposed frequency between Union Station and central Georgetown is 10 minutes from 6:00 AM to 7:00 AM, 5 minutes from 7:00 AM to 7:00 PM, 10 minutes from 7:00 PM to 11:00 PM, and 20 minutes from 11:00 PM to 11:40 PM. All times reflect departures from Union Station. Service to Georgetown University from Union Station is proposed to depart at 6:00 AM, 6:30 AM, every 15 minutes from 7:00 AM to 7:00 PM, and every 30 minutes from 7:00 PM to 11:00 PM.

3-4.7.1.3. Travel Times

Based on output from the CORSIM model, the following travel times were used for scheduling:

[1] In the future, if the Downtown Circulator replaces the Georgetown Metro Connection, service would need to operate until 2:00 AM on Fridays and Saturdays.

Segment	Travel Time (min)
AM (6:00 AM to 2:00 PM)	
Union Station to Georgetown	30
Georgetown to Georgetown University	9
Georgetown University to Georgetown (6:00 AM – 10:15 AM)	7
Georgetown University to Georgetown (10:30 AM – 2:00 PM)	6
Georgetown to Union Station	29
PM (2:00 PM to 7:30 PM)	
Union Station to Georgetown	29
Georgetown to Georgetown University	10
Georgetown University to Georgetown	5
Georgetown to Union Station	30

NOTE: Times to and from Georgetown University include an assumed two minutes of travel time in each direction on campus.

Evening travel times (after 7:30 PM) were assumed to be the same as the PM times, except that the Georgetown to Union Station travel time was reduced to 28 minutes.

In addition, two minutes were allowed to get from the Union Station passenger drop-off to the bus deck, and two minutes were allowed to return from the bus deck to the passenger pick-up area.

3-4.7.1.4. Travel Distances

The round-trip distance between Union Station and central Georgetown, including travel on the bus deck access roads and maneuvering on the bus deck, is 7.33 miles. The round-trip distance between Union Station and Georgetown University is 9.37 miles, assuming a turnaround location 0.40 miles inside the campus. Between 6:00 AM and 10:15 AM, due to the turning restrictions on Canal Road and the need for the return via Prospect Street between Georgetown University and Georgetown, the round-trip distance between Union Station and Georgetown University is also 9.37 miles.[1]

3-4.7.1.5. Layover and Recovery

Three minutes of recovery time were assumed at the Georgetown end of the route, except for trips terminating at Georgetown University between the hours of 6:00 AM and 10:15 AM, when two minutes of recovery time were assumed, as a result of the longer return trip and the desire to maintain five-minute eastbound headways. This time provides some margin for maintaining regular headways on the return trip to Union Station, while minimizing the amount of curb space required to accommodate buses laying over. Nine minutes of layover and recovery time are generally provided at Union Station, with longer layovers (11 to 16 minutes) on selected evening trips during the transition period from 5- to 10-minute headways.

[1] If the return trip between the hours of 6:00 AM and 10:15 AM is made via Reservoir Road instead of Prospect Street, the round-trip distance between Union Station and Georgetown University is 9.77 miles.

There may be opportunities to reduce the Union Station layover if the round trip to the bus deck takes less time than assumed; however, based on the current (conservative) set of assumptions, the alternative layover time would be only four minutes, which the Study Team feels would be short for a driver break. In addition, the longer layover makes it easier to control headways along the route, which is an important consideration for a high-profile route running at 5-minute headways.

3-4.7.1.6. Service Requirements

A total of 16 buses would be required in maximum service on the K Street route. Including an allowance for 3 spares, a fleet of 19 buses would be required.[1] Daily vehicle revenue hours would be 232.34. Daily vehicle revenue miles would be 1,408.74.[2] Appendix H includes an example schedule for the route.

3-5. 2015 BUILD ALTERNATIVES

The development of 2015 build alternatives reflects discussions over the course of the study among the Study Team, WMATA and DDOT, as well as a number of basic principles derived from the recent Washington Regional Bus Study. The basic principles that were followed are:

1. The bus routes on the K Street Transitway include routes of regional significance. These are routes that cross jurisdictional boundaries and/or carry significant patronage as measured in passenger miles (trips x trip length) of travel;
2. The busway is viewed as an integral part of a comprehensive cross-town limited stop service that will have a minimum five-minute headway utilizing vehicles with a unique identity;
3. Busway stops will have shelters of a size and overall design quality, and having the same passenger information and other amenities as LRT stations might have, subject to right-of-way (ROW) availability, pedestrian access and other factors;
4. The total number of buses on the busway will be sufficient to justify it being dedicated to transit (i.e., carry at least as many person trips as one general traffic lane each way), but not so high that there are route identity, speed and reliability problems.
5. To increase speed and reliability, designated limited-stop service on the busway will have fewer stops than on a conventional local bus route.

The eight alternatives analyzed by the Study Team are defined by differences in three elements. These elements are as follows:

1. Busway and Bus Lane Alignments – Which streets will be used for the busway and/or exclusive bus lanes? What constraints, geometric or otherwise, would limit the ability to provide efficient, effective service along these streets?

[1] The number of required buses may be reduced if no service is provided to Georgetown University.
[2] If the return trip between the hours of 6:00 AM and 10:15 AM is made via Reservoir Road instead of Prospect Street, the daily vehicle revenue miles would be 1,413.94.

2. Busway Cross-Section/Configuration – How many lanes will be provided for the busway and for non-bus vehicle traffic? Will parking be provided and at which locations? Where will medians separate the busway from non-bus travel lanes? What are the characteristics of these medians?
3. Service Plan – How many bus stops will be provided? Where will these bus stops be located?

3-5.1. ALTERNATIVE A

As shown in Figure 3-35, this alternative provides an exclusive median busway on K Street between 21st Street and 9th Street and all-day parking (including during AM peak and PM peak periods) on most blocks of K Street between 21st Street and 9th Street. Under this alternative, no exclusive busway or bus lane is provided on the Georgetown or Union Station sections of the study area. The service plan developed for this alternative is shown in Figure 3-36. With the implementation of this service plan, 60 to 75 buses per hour would use the exclusive busway section. The transit service plan developed for Alternative A tries to minimize the number of turns in and out of the exclusive busway by rerouting bus lines that use short sections of K Street to parallel streets. This transit service plan also made changes to bus routes in the corridor to try to maximize the number of routes that travel long distances on the busway.

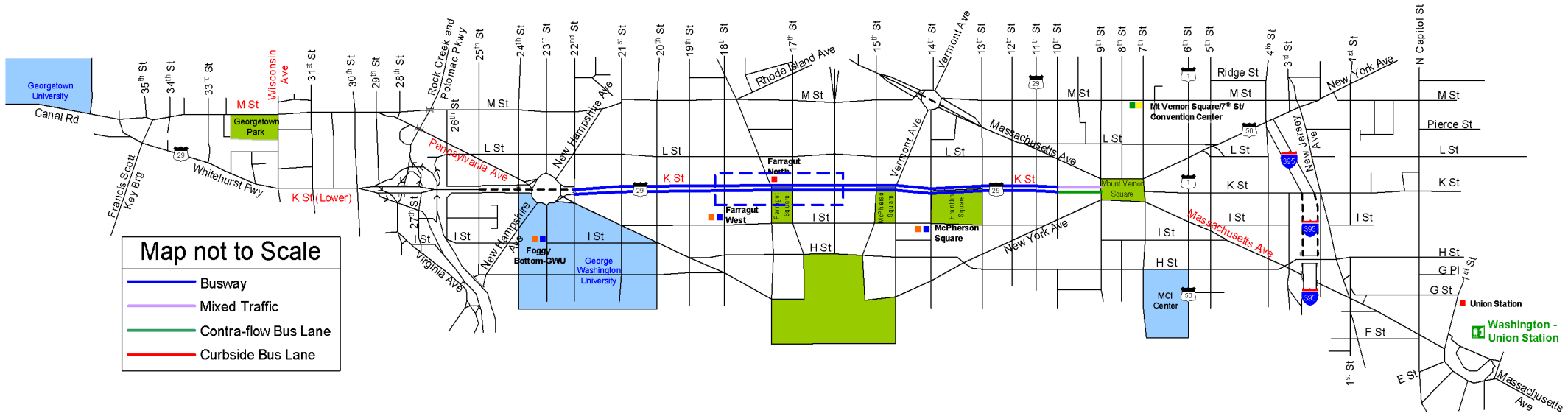
3-5.2. ALTERNATIVE B

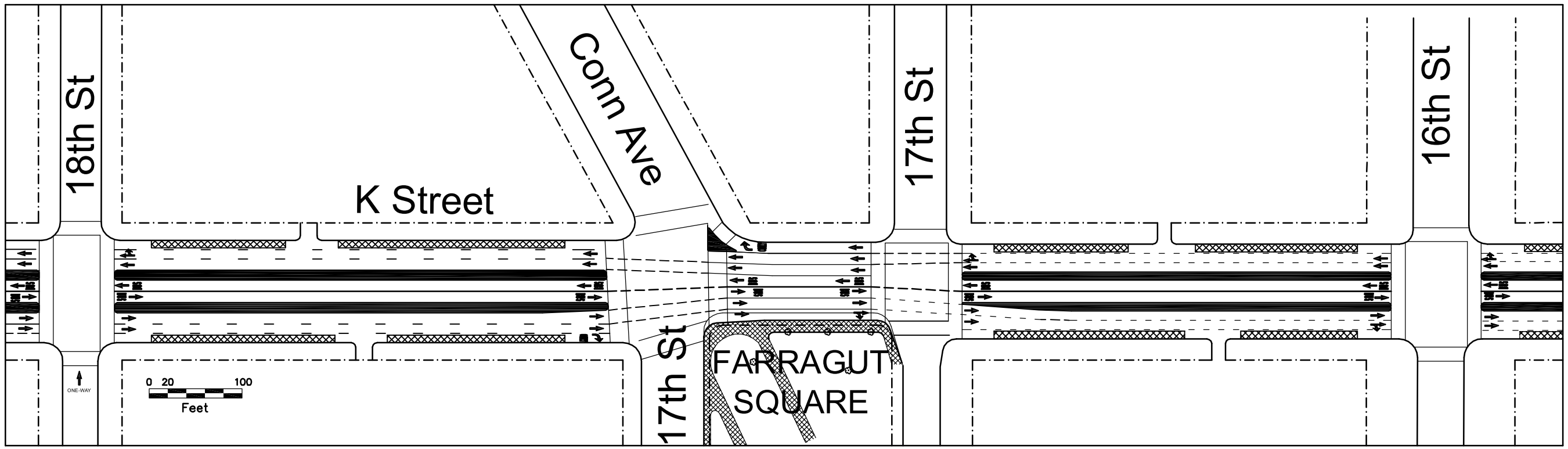
This alternative provides an exclusive median busway in the Central Section, as shown in Figure 3-37. In the central section of the study area, parking during the AM peak and PM peak (7:00 AM to 9:30 AM and 4:00 to 6:30 PM) periods is only provided on K Street between 9th and 10th Street, between 12th and 13th Street and between 14th Street and Vermont Avenue. Off-peak parking would be provided on the north and south sides of K Street between 9th Street and 21st Street. Under this alternative, no exclusive busway or bus lane is provided on the Georgetown or Union Station sections of the study area. The service plan developed for this alternative, displayed in Figure 3-36 is the same as the service plan developed for Alternative A.

3-5.3. ALTERNATIVE C

This alternative provides an exclusive median busway in the central section. The service plan developed for this alternative, displayed in Figure 3-36 is the same as the service plan developed for Alternative A.

In the central section of the study area, parking during the AM peak and PM peak periods is only provided on K Street between 9th and 10th Street, between 12th and 13th Street and between 14th Street and Vermont Avenue. Off-peak parking would be provided on the north and south sides of K Street between 9th Street and 21st Street.





Legend

R.O.W.	
New Edge of Pavement	
Proposed Sidewalk	
All Day Parking	

Note: Existing southern edge of Farragut Square sidewalk (not shown) located under Right-of-Way line.

FIGURE 3-35
Alternative A Alignment

K Street Transitway

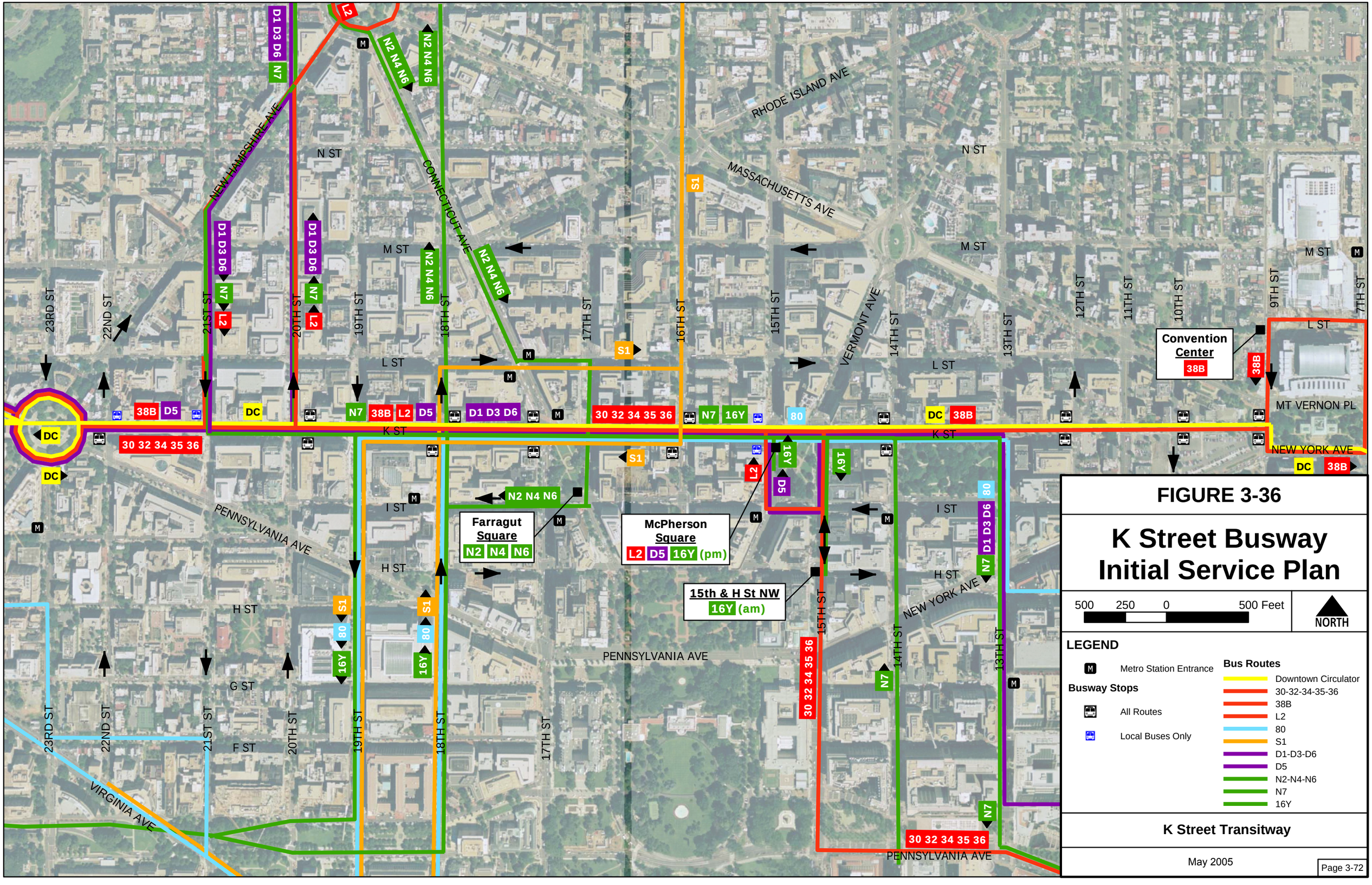


FIGURE 3-36

K Street Busway Initial Service Plan

500 250 0 500 Feet

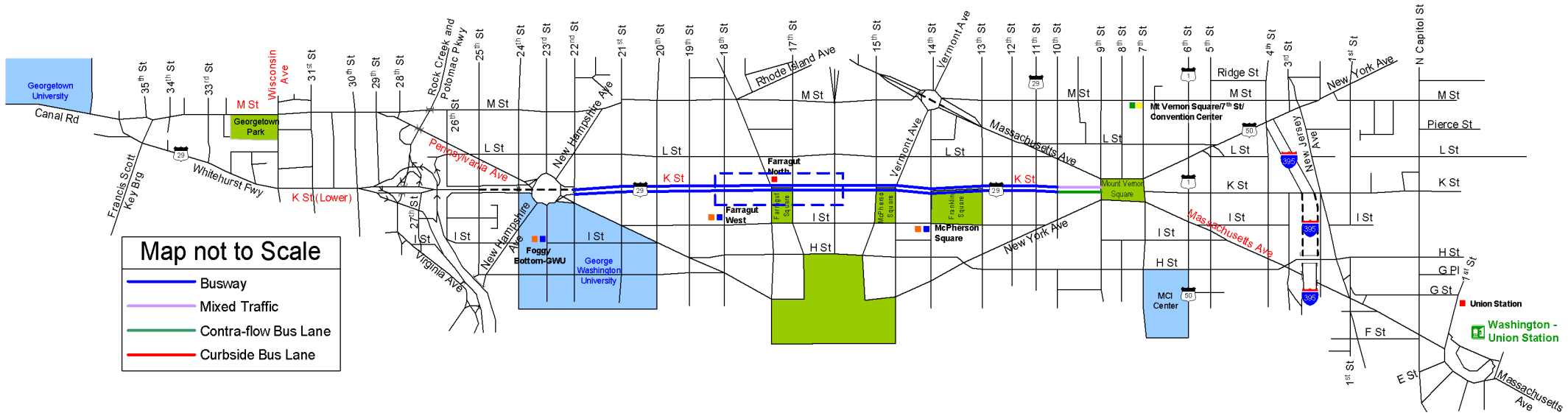
NORTH

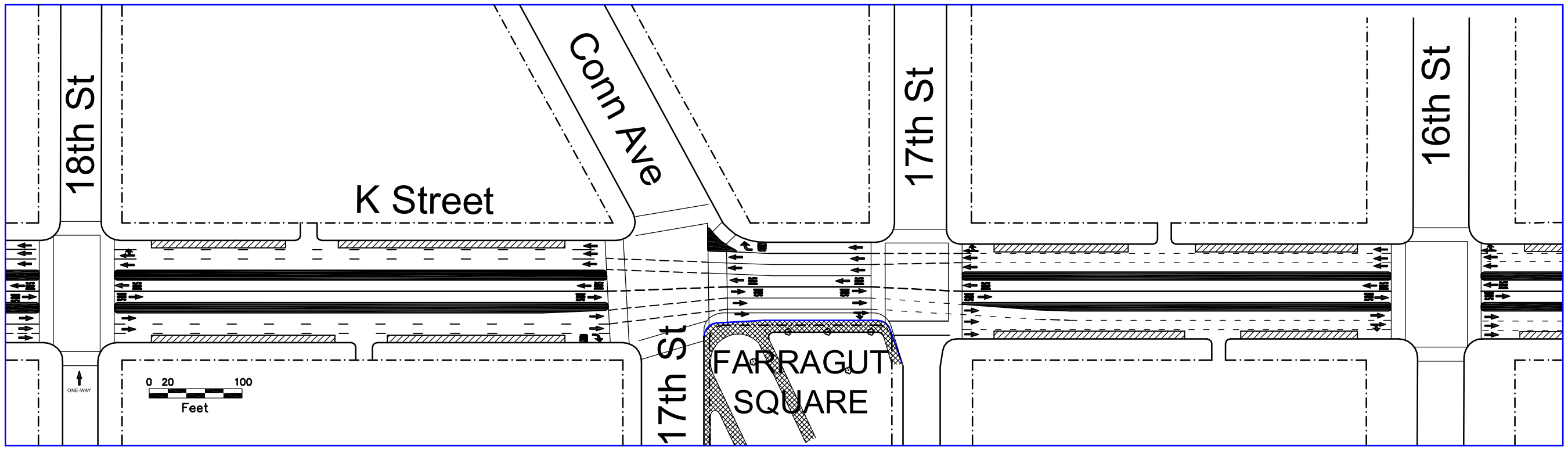
LEGEND

- Metro Station Entrance
- **Busway Stops**
  - All Routes
  - Local Buses Only
- **Bus Routes**
  - Downtown Circulator
  - 30-32-34-35-36
  - 38B
  - L2
  - 80
  - S1
  - D1-D3-D6
  - D5
  - N2-N4-N6
  - N7
  - 16Y

K Street Transitway

May 2005





Legend

R.O.W.	
New Edge of Pavement	
Proposed Sidewalk	
Mid-day Parking	

Note: Existing southern edge of Farragut Square sidewalk (not shown) located under Right-of-Way line.

FIGURE 3-37

Alternative B Alignment

K Street Transitway

Figure 3-38 shows that this alternative includes an exclusive all-day curbside bus lane on portions of the Georgetown section of the study area. The bus lane would be shared with right turning vehicles at intersections. The exclusive bus lane would be provided on eastbound M Street from Wisconsin Avenue to Pennsylvania Avenue and on eastbound Pennsylvania Avenue from M Street to 24th Street. The provision of the all-day bus lane would require the elimination of midday parking spaces and loading zones.

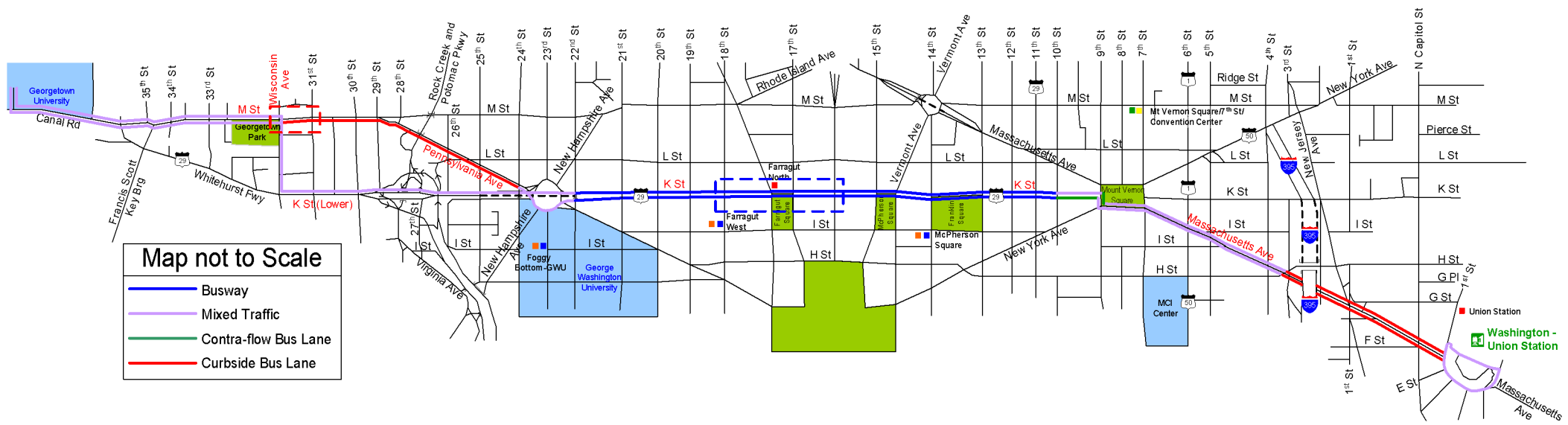
Under this alternative, an exclusive all-day bus lane would also be provided on portions of the Union Station section of the study area. The bus lane would be a curb bus lane which would be shared with right turning vehicles at intersections. The exclusive bus lane would be provided on both directions of Massachusetts Avenue between H Street and 1st Street NE. The provision of the all-day bus lane would require the elimination of a number of midday parking spaces.

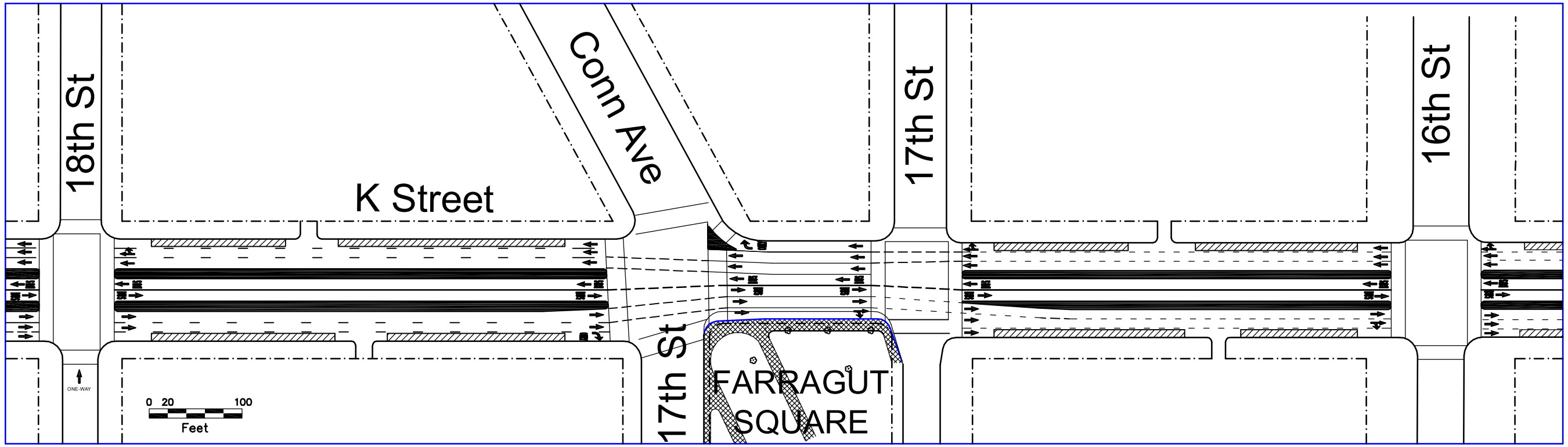
3-5.4. ALTERNATIVE D

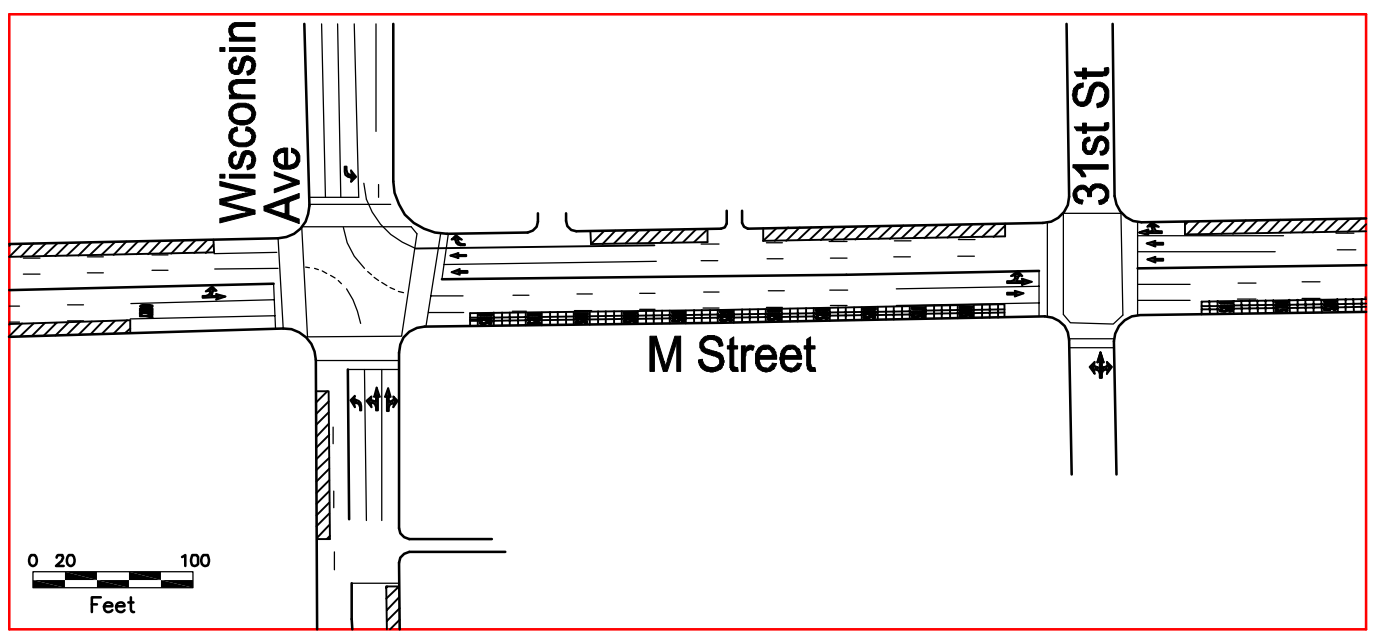
This alternative has the same geometric configuration and parking restrictions as Alternative C, as shown in Figure 3-38. The only difference between these two alternatives is the service plan associated with each of them. The service plan used for Alternative D is shown in Figure 3-20. A comparison of Figures 3-36 and 3-20 indicates that Alternative D uses a reduced number of bus routes on the exclusive busway and a reduced number of bus stops compared to the bus routes and stops used for Alternative C. In addition, the service plan used in Alternative D relocates a few routes from the K Street busway to streets parallel to K Street.

The characteristics of this alternative are as follows:

- Median Busway between Washington Circle and Mount Vernon Square.
- Exclusive curbside bus lanes on M Street between Wisconsin Avenue and Pennsylvania Avenue; on Pennsylvania Avenue between M Street and Washington Circle; and on Massachusetts Avenue between H Street and 1st Street NE.
- Off-peak parking on curb lane of K Street between Washington Circle and Mount Vernon Square. No parking during peak periods (7:00 AM to 9:30 AM and 4:00 PM to 6:30 PM).
- No parking or loading on south side of M Street between Wisconsin Avenue and Pennsylvania Avenue. No parking or loading on south side of Pennsylvania Avenue between M Street and Washington Circle. No parking or loading on Massachusetts Avenue between H Street and 1st Street NE.
- Bus service plan with 50 to 65 buses per hour in exclusive busway section.
- Bus stops every two blocks in busway section (between Washington Circle and Mount Vernon Square).
- Convert 17th Street to two-way traffic during the morning peak period..







Legend

R.O.W.	
New Edge of Pavement	
Proposed Sidewalk	
Mid-day Parking	
Exclusive Bus Lane	

Note: Existing southern edge of Farragut Square sidewalk (not shown) located under Right-of-Way line.

FIGURE 3-38
Alternatives C and D Alignment

K Street Transitway

3-5.5. ALTERNATIVE E

The Study Team found that Right-of-Way (ROW) from Farragut Square would be required to be able to provide a continuous bus lane on K Street between 21st Street and 9th Street with acceptable geometric design. As detailed in Appendix I, a strip of land eight feet wide, extending from Connecticut Avenue to 17th Street, would be needed from Farragut Square to provide the continuous bus lane on K Street. DDOT submitted a letter to the National Park Service (NPS) requesting that NPS provide to the District of Columbia the right-of-way from Farragut Square necessary for the implementation of the busway along K Street. While no response has been received from NPS, DDOT requested that the K Street Transitway Study Team evaluate alternative concepts assuming that the land from the squares is not available for the construction of the busway. The full evaluation of these alternative concepts is presented in Appendix I.

DDOT also requested that one of these alternatives be fully evaluated. The alternative selected for evaluation by the Study Team, Alternative E, has the same general service plan as Alternative C. Geometric configurations and parking restrictions are generally the same as Alternative C, with the exception of K Street between 16th and 18th Street, as shown in Figure 3-39.

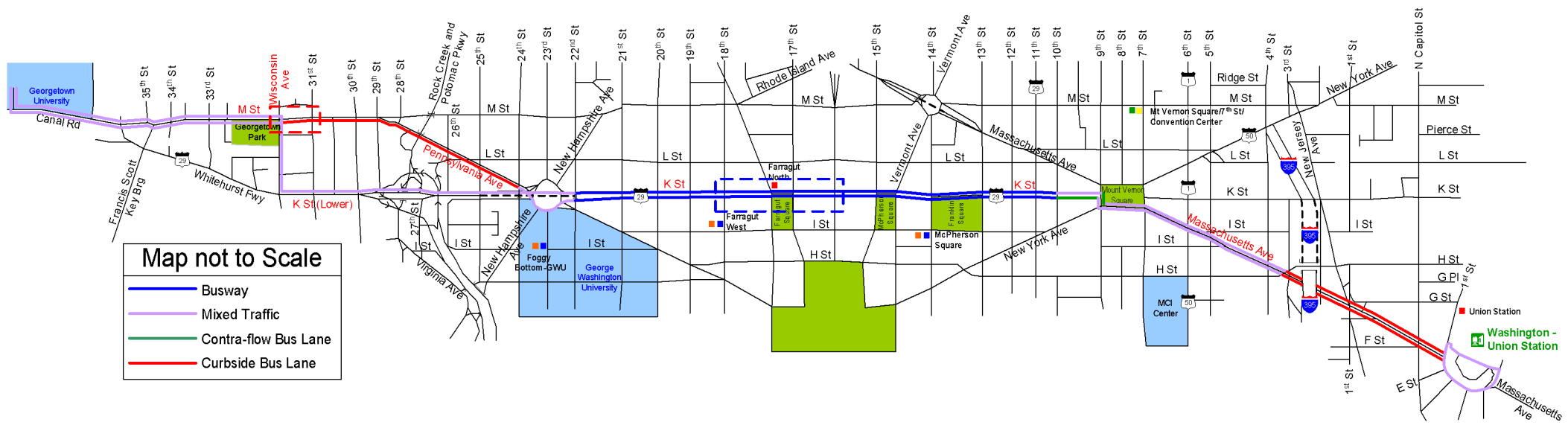
Alternative E eliminates the exclusive busway for eastbound buses from 18th Street to a point one half block between 17th Street and 16th Street. Eastbound buses would merge with non-bus traffic in the block east of 18th Street. There would be no exclusive busway from this point, across Farragut Square, and to a point mid-block approaching 16th Street, where bus and non-bus traffic would separate. The westbound exclusive busway would remain unchanged from the above alternatives.

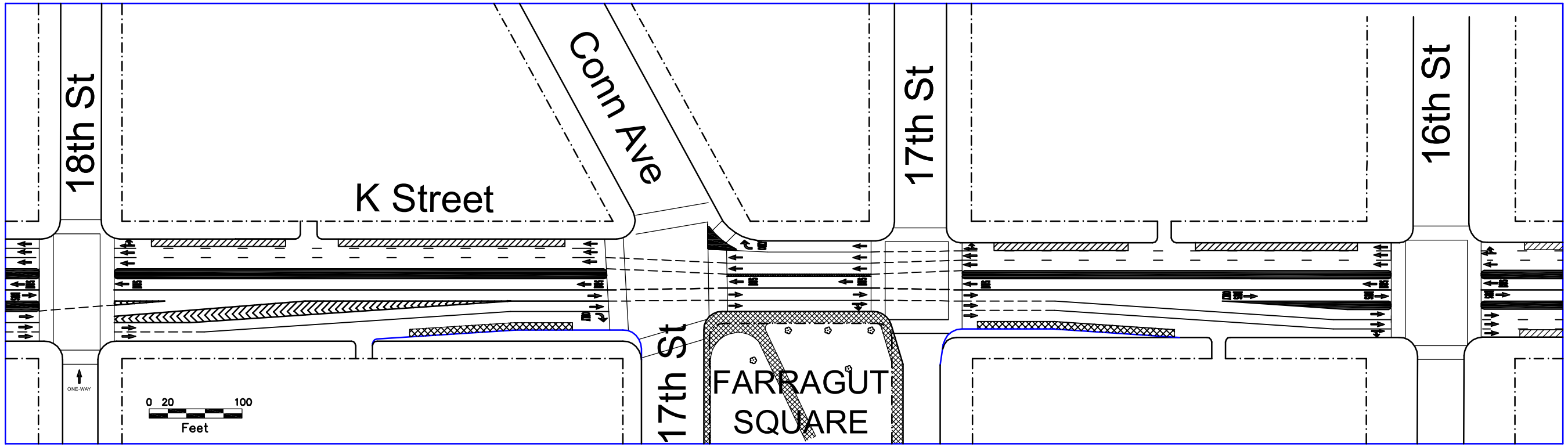
3-5.6. ALTERNATIVE F

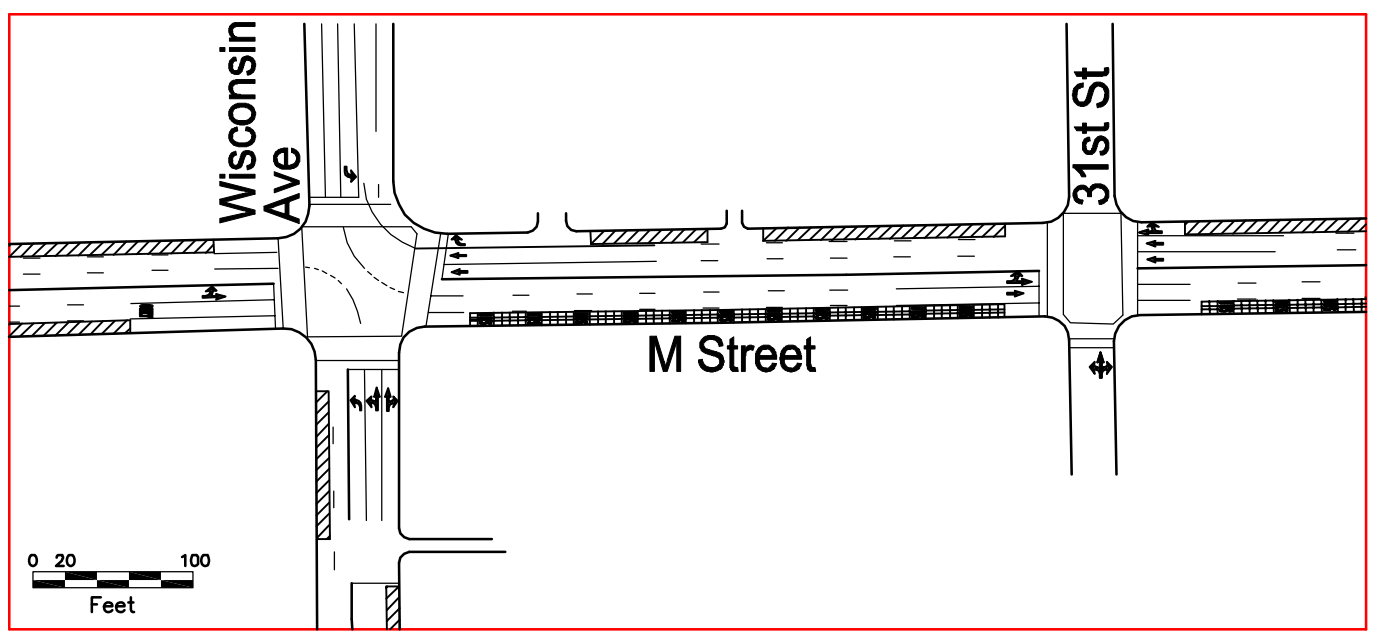
Because Alternative E does not provide an exclusive eastbound busway across Farragut Square, and also due to pedestrian safety issues in the area surrounding the Farragut North Metro station, the Study Team developed an additional alternative that assumes the NPS would not provide right-of-way for the construction of the K Street Transitway.

Alternative F has the same transit service plan as Alternative D. Geometric configurations and parking restrictions are generally the same as Alternative D with the exception of K Street between 16th Street and 18th Street. As shown in Figure 3-40, traveling eastbound on K Street, the roadway cross-section is shifted to the north between 18th Street and Connecticut Avenue. A six-lane cross-section is provided between Connecticut Avenue and 17th Street, with one exclusive bus lane in each direction and two non-bus travel lanes in each direction, separated by medians. Continuing eastbound on K Street, the cross-section would shift back to the south in the block between 17th and 16th Streets.

In order to provide this cross-section on K Street, and to improve pedestrian safety, the existing westbound exclusive right turn lane at Connecticut Avenue would be converted into a shared







Legend

R.O.W.	
New Edge of Pavement	
Proposed Sidewalk	
Mid-day Parking	
All Day Parking	
Exclusive Bus Lane	

Note: Existing southern edge of Farragut Square sidewalk (not shown) located under Right-of-Way line.

FIGURE 3-39
Alternative E Alignment

K Street Transitway

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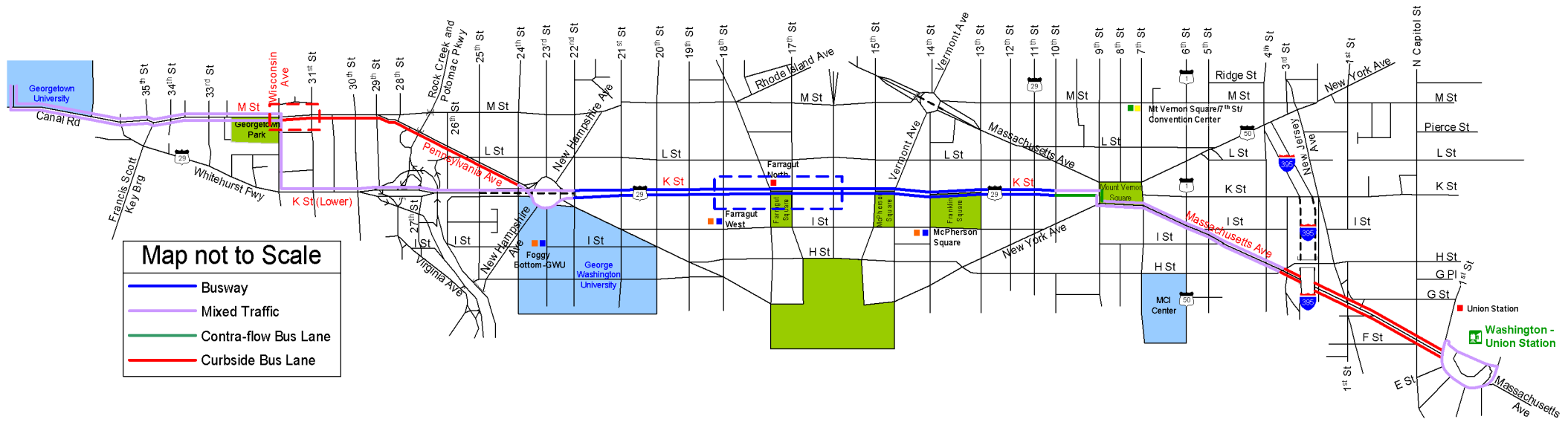
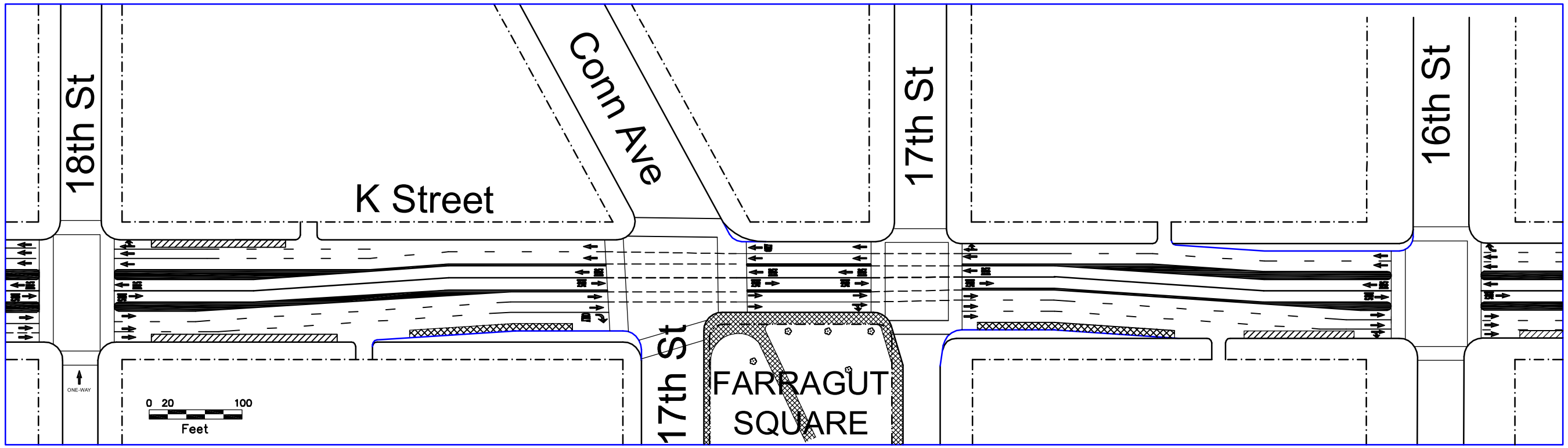
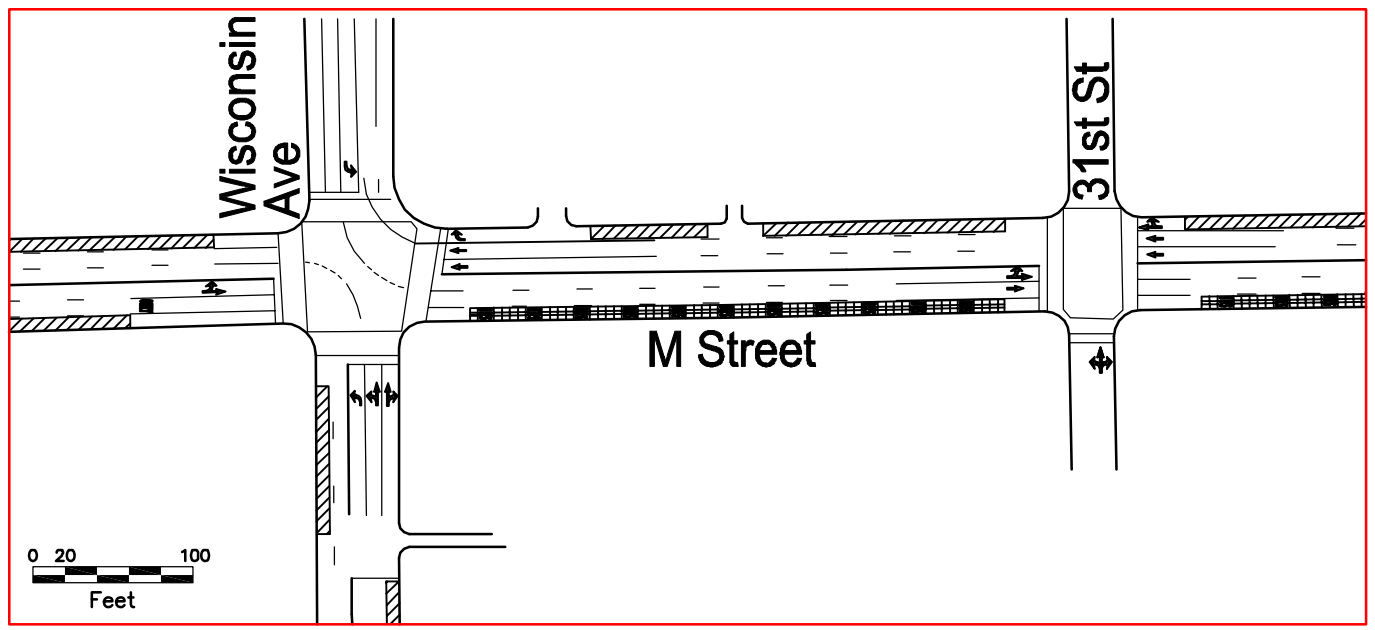






Legend

R.O.W.	
New Edge of Pavement	
Existing Sidewalk	
Mid-day Parking	
All Day Parking	
Exclusive Bus Lane	

Note: Existing southern edge of Farragut Square sidewalk (not shown) located under Right-of-Way line.

FIGURE 3-40
Alternative F Alignment

K Street Transitway

May 2005

through/right lane. Due to the high existing right turn volume at this intersection, right turns from westbound K Street to Connecticut Avenue would be prohibited between the hours of 7:00 AM and 7:00 PM.

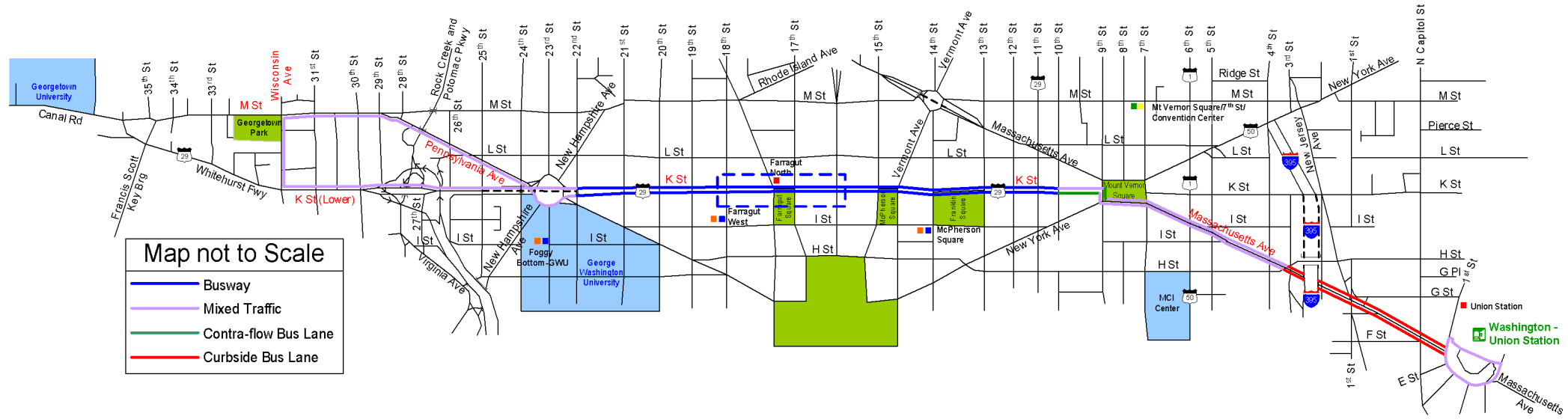
Thus, the characteristics of this alternative are as follows:

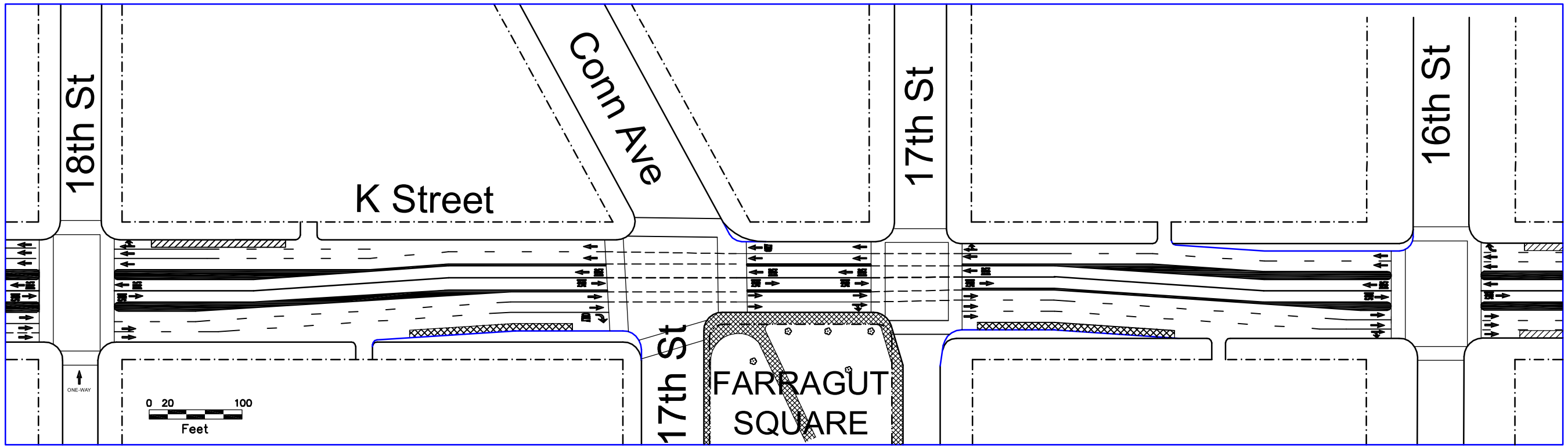
- Median busway between Washington Circle and Mount Vernon Square.
- No right turns allowed from westbound K Street to northbound Connecticut Avenue between the hours of 7:00 AM and 7:00 PM.
- Exclusive curbside bus lanes on M Street between Wisconsin Avenue and Pennsylvania Avenue; on Pennsylvania Avenue between M Street and Washington Circle; and on Massachusetts Avenue between H Street and 1st Street NE.
- Midday/evening/night parking on curb lane of K Street between Washington Circle and Mount Vernon Square. No parking during peak periods (7 AM to 9:30 AM and 4 PM to 6:30 PM).
- No parking on south side of M Street between Wisconsin Avenue and Pennsylvania Avenue. No parking on south side of Pennsylvania Avenue between M Street and Washington Circle. No parking on Massachusetts Avenue between H Street and 1st Street NE.
- Bus service plan with 50 to 65 buses per hour in exclusive busway section.
- Bus stops every two blocks in busway section (between Washington Circle and Mount Vernon Square).
- Proposed bus stops located mid-block between 18th Street and Connecticut Avenue would be relocated east of 18th Street due an eastbound lane shift and tapered median between 18th Street and Connecticut Avenue. Also as a result, the eastbound platform would be shorter than those recommended elsewhere on K Street.

3-5.7. ALTERNATIVE G

Alternative G is a combination of several of the above alternatives. Geometric configurations and parking restrictions are the same as Alternative F. As shown in Figure 3-41, traveling eastbound on K Street, the roadway cross-section is shifted to the north between 18th Street and Connecticut Avenue. A six-lane cross-section is provided between Connecticut Avenue and 17th Street, with one exclusive bus lane in each direction and two non-bus travel lanes in each direction, separated by medians. Continuing eastbound on K Street, the cross-section would shift back to the south in the block between 17th and 16th Streets. No land from Farragut Square would be required to implement Alternative G.

Alternative G has the same transit service plan as Alternative D, with some exceptions. Alternative G does not provide exclusive bus lanes on M Street and Pennsylvania Avenue. The eastbound Circulator route would travel on mixed-traffic lanes on eastbound M Street and Pennsylvania Avenue. Additionally, no Circulator service is provided to Georgetown University. Georgetown University representatives indicated that at this time, they would prefer not to use the Downtown Circulator to provide service to the Georgetown University campus.





Legend

R.O.W.	
New Edge of Pavement	
Existing Sidewalk	
Mid-day Parking	
All Day Parking	
Exclusive Bus Lane	

Note: Existing southern edge of Farragut Square sidewalk (not shown) located under Right-of-Way line.

FIGURE 3-41
Alternative G Alignment

K Street Transitway

The characteristics of Alternative G are as follows:

- Median busway between Washington Circle and Mount Vernon Square.
- Exclusive curbside bus lanes on Massachusetts Avenue between H Street and 1st Street NE.
- Off-peak parking on curb lane of K Street between Washington Circle and Mount Vernon Square. No parking during peak periods (7:00 AM to 9:30 AM and 4:00 PM to 6:30 PM).
- No parking or loading on Massachusetts Avenue between H Street and 1st Street NE.
- Bus service plan with 50 to 65 buses per hour in exclusive busway section.
- Bus stops every two blocks in busway section (between Washington Circle and Mount Vernon Square).
- Convert 17th Street to two-way traffic during the morning peak period.

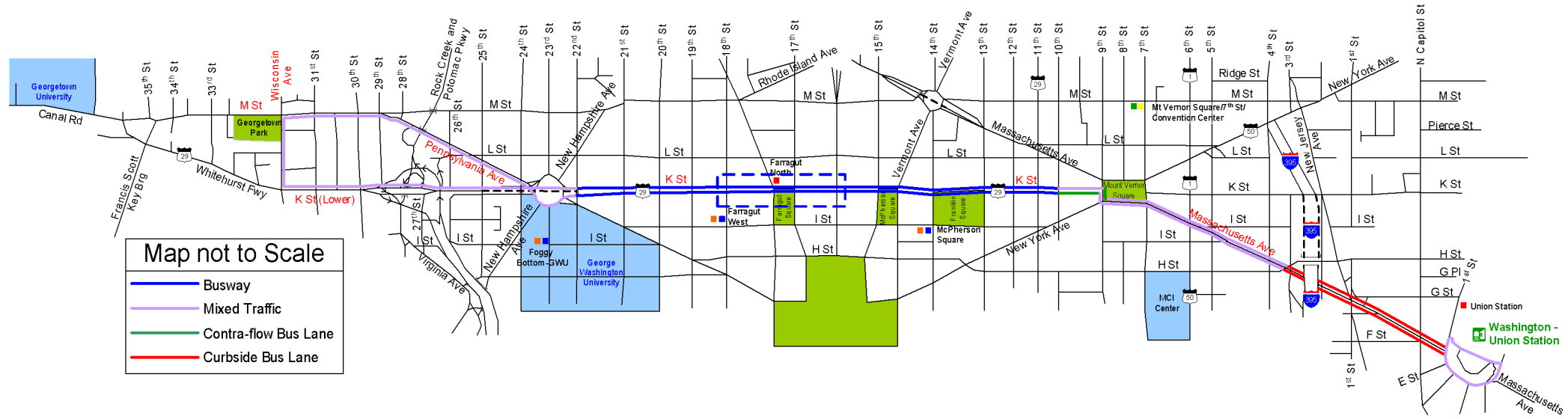
3-5.8. ALTERNATIVE H

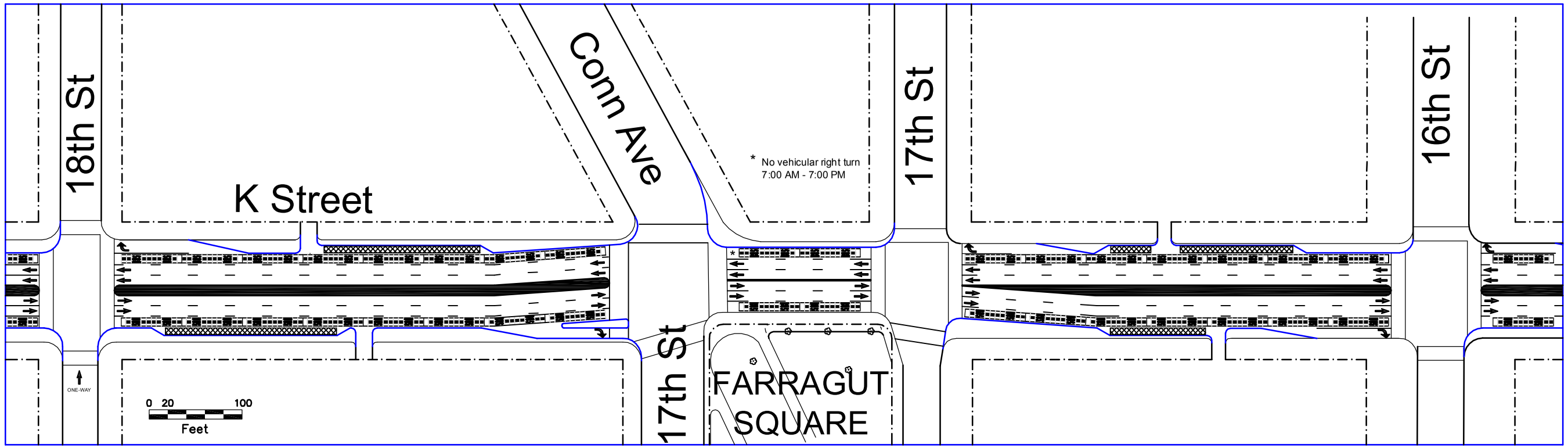
While the previous seven alternatives utilize a center median busway on K Street, Alternative H provides curbside bus lanes along K Street. The transit service plan of Alternative H is that same as that of Alternative G, with 50 to 65 buses per hour in the exclusive busway section of the study area, no exclusive bus lanes on M Street or Pennsylvania Avenue, and no Circulator service to Georgetown University.

Alternative H provides two travel lanes in each direction of K Street, as shown in Figure 3-42. The curb lane would be an exclusive bus lane that may also be shared by vehicles turning right into parking garages and at cross streets. Short right turn bays would be provided at selected intersections. Bus stops would be located curbside, rather than in the median, as proposed in the other studied alternatives. All-day parking is provided throughout most of the K Street corridor. No land from Farragut Square would be required to implement Alternative H. Like Alternatives F and G, right turns from westbound K Street to northbound Connecticut Avenue would be prohibited between the hours of 7:00 AM and 7:00 PM, in order to provide the required cross-section and improve pedestrian safety. As a result, 17th Street would be converted to two-way operation at all times.

The characteristics of Alternative H are as follows:

- Exclusive curbside bus lanes between Washington Circle and Mount Vernon Square.
- Exclusive curbside bus lanes on Massachusetts Avenue between H Street and 1st Street NE.
- All-day parking on curb lane of K Street throughout most of the corridor between Washington Circle and Mount Vernon Square.
- No parking or loading on Massachusetts Avenue between H Street and 1st Street NE.
- Bus service plan with 50 to 65 buses per hour in exclusive busway section.





Legend

R.O.W.	
New Edge of Pavement	
Existing Sidewalk	
Mid-day Parking	
All Day Parking	
Exclusive Bus Lane	

Note: Existing southern edge of Farragut Square sidewalk (not shown) located under Right-of-Way line.

FIGURE 3-42
Alternative H Alignment

K Street Transitway

- Bus stops every two blocks in busway section (between Washington Circle and Mount Vernon Square).
- Convert 17th Street to two-way operation.
- Buses share bus lane with right turning vehicles.
- Short right-turn bays provided at selected intersections.

3-6. EVALUATION OF ALTERNATIVES

The Study Team performed qualitative and quantitative evaluation of the above eight alternatives. The evaluation of alternatives helps assess the expected performance of each of the alternatives and helps select the alternative recommended for implementation. This section describes the process, beginning with the criteria used for evaluation.

3-6.1. EVALUATION CRITERIA

The Study Team selected the following basic criteria for the evaluation of alternatives.

Quantitative Factors	Qualitative Factors
Average non-bus vehicle travel times and speeds	Transit ridership impacts
Average bus travel times and speeds	Transit reliability
Intersection delay and level of service	Transit system clarity
Person throughput	Pedestrian safety
Average delay per person trip	Vehicular safety
Travel times for selected bus routes	Transit access to adjacent land uses
Pedestrian levels of service	Effects on parking and loading
Cost	Compatibility with light rail operations

3-6.2. QUANTITATIVE ASSESSMENT

Using computerized simulation modeling, the Study Team performed a quantitative assessment of each alternative. Quantitative analysis is a standard tool used to determine the performance of a particular alternative, option or scenario. It provides a means of directly comparing two or more alternatives against each other to determine which performs the best. The following section describes the simulation modeling software used by the Study Team, the alternatives / scenarios that were modeled, and an evaluation of measures of effectiveness calculated from the modeling.

3-6.2.1. Modeling of Future Conditions (Use of CORSIM vs. VISSIM)

The Study Team used both VISSIM and CORSIM to model future conditions in the study area. VISSIM and CORSIM are both stochastic microscopic simulation programs capable of modeling individual vehicle interactions on complex roadway networks. Both models use inputs such as lane assignments and geometries, intersection turning movement volumes, vehicle speeds, percentages of vehicles by type, and pre-timed and/or actuated signal timing. Both programs

produce output that contains measures of effectiveness commonly used in the transportation engineering profession, including total delay, stopped delay, and queue lengths.

In general, CORSIM and VISSIM have similar structures and capabilities. There are, however, some differences in terms of the way the network is created, the capability to account for special traffic components or influences and the output of the simulation results. Table 3-4 identifies the significant differences.

VISSIM does not have a traditional link-node structure in comparison to CORSIM. VISSIM relies on links and connectors to build a network. Links are used to define the width and number of lanes for a given roadway segment. The connectors are then used to connect the links at intersections enabling the user to control vehicle paths in an intersection. The lack of nodes provides the user with the flexibility to control traffic operations (e.g., yield conditions) and vehicle paths within an intersection or interchange, which facilitates the analysis of non-standard conditions like a boulevard or median separated busway. However, it should be noted that modeling techniques can be used to approximate features of VISSIM that are not explicitly available in CORSIM.

A primary reason VISSIM was used in this project is the 3-dimensional visualization feature. VISSIM is able to graphically illustrate, in three dimensions, traffic conditions through animation that can provide a sophisticated, realistic portrayal of what the proposed traffic conditions will be.

The analysis of the central portion of the study area during the PM peak hour was seen as most critical for this project. As a result, PM peak-hour conditions in the central area for Alternatives A, C and D were modeled using both CORSIM and VISSIM. All of the alternatives were modeled in CORSIM. VISSIM was used for the central portion of the study area during the PM peak hour because of the special transit treatments it offers, while CORSIM was used for the central portion because the remainder of the study area (Georgetown and Union Station portions) was analyzed with CORSIM. Measures of effectiveness (MOE) reported by each program, and discussed in detail below, yielded similar results.

The eight studied alternatives, as well as the no-build model, were modeled in CORSIM for the 2015 AM, midday and PM peak hours as shown in Table 3-5. Lane configurations were changed to reflect the characteristics of each alternative, and signal splits, phasing and offsets were adjusted where necessary to accommodate changes in traffic patterns. Different transit service plans were modeled for the various alternatives.

Each modeled section of the study area (Georgetown, central, Union Station) was simulated five times and MOEs were developed for each simulation run. The MOEs for each of the five simulation runs were averaged for analysis purposes.

Table 3-4
Characteristics of VISSIM vs. CORSIM

Feature	VISSIM	CORSIM
Network Coding Process	Based on links and connectors; More input parameters	Link-node structure; Shorter set-up time
Transit	Transit vehicles can operate in mixed traffic as well as on dedicated tracks; Can model light rail transit and more bus routes and stops; Can model preemption and priority signal control systems	Can model bus routes within a roadway network; No transit signal priority
On-street parking	No explicit way to assess impact of on-street parking, the effects may be simulated by transit vehicles with dwell times that are consistent with short-term parking characteristics.	Can model interruptions to traffic by parking maneuvers by setting a parameter for parking activity
Pedestrians	Distinct objects in the simulation. VIISSIM designates the right-of-way of conflicting movements with the use of priority rules that can also be set for pedestrians	Provides a parameter for pedestrian delay that describes how pedestrian flows interact with and impede traffic
Vehicle Actuated Signal Control	Provides an external signal state generator including special features (e.g. transit priority)	Uses internal actuated control logic to emulate controller.
Advanced Transit Signal Control	Can model preemption and priority signal control systems; Allows separate signal phases for different vehicle types on the same travel lanes (e.g., for separate bus signal phase in mixed traffic lanes)	No transit signal priority
MOEs	Travel times between two points, approach delay.	Travel times for each link; In addition, provides average control delay
Visualization Features	Three-dimensional animation Provides a realistic perspective on the project	Two-dimensional animation

Table 3-5
CORSIM Modeled Scenarios for 2015 Build Alternatives

Alternative	Service Plan	Section	AM Peak Hour	Midday Peak Hour	PM Peak Hour
No-Build[1]	Existing	Georgetown	ü		ü
		Central	ü		ü
		Union Station	ü		ü
A[2]	Initial	Georgetown			
		Central	ü	ü	ü
		Union Station			
B	Initial	Georgetown	ü	ü	ü
		Central	ü	ü	ü
		Union Station	ü	ü	ü
C	Initial	Georgetown	ü	ü	ü
		Central	ü	ü	ü
		Union Station	ü	ü	ü
D	Reduced buses / stops	Georgetown	ü	ü	ü
		Central	ü	ü	ü
		Union Station	ü	ü	ü
E[3]	Initial	Georgetown	ü		
		Central	ü		
		Union Station	ü		
F	Reduced buses / stops	Georgetown	ü	ü	ü
		Central	ü	ü	ü
		Union Station	ü	ü	ü
G[4]	Reduced buses / stops	Georgetown	ü		ü
		Central	ü		ü
		Union Station	ü		ü
H[4]	Reduced buses / stops	Georgetown	ü		ü
		Central	ü		ü
		Union Station	ü		ü

[1] The scope of work for this study did not require the evaluation of a midday No-Build scenario.
[2] CORSIM and VISSIM analysis indicated the inadequacy of this alternative, so it was not tested in the Georgetown and Union Station sections of the Study area
[3] CORSIM and VISSIM analysis indicated the inadequacy of this alternative, so it was not tested for the midday and PM peak hours.
[4] In the course of modeling the build alternatives, the Study Team concluded that the AM and PM peak hours were the most critical scenarios. Therefore, no midday modeling was done for Alternatives G and H.

3-6.2.2. Measures of Effectiveness

The Study Team selected the following quantitative factors as Measures of Effectiveness (MOEs) to evaluate the alternatives:

- **Average non-bus vehicle travel times** – average time for a vehicle (excluding buses) to traverse a selected corridor
- **Average non-bus vehicle travel speeds** – average speed of a vehicle (excluding buses) traversing a selected corridor
- **Average bus travel times** – average time for all buses to travel a selected corridor
- **Average bus travel speeds** – average speed of all buses traveling a selected corridor
- **Intersection delay and level of service** – Describes operational conditions within a traffic stream, based on service measures such as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience. Appendix J presents an explanation of traffic conditions associated with each of the grades used
- **Person throughput** – the number of people in all vehicles (buses and cars) that cross a specified point in the corridor
- **Average delay per person trip –** average additional travel time experienced per person trip
- **Travel times for selected bus routes** – average time for particular bus routes to travel between two points in a selected corridor
- **Pedestrian levels of service –** Describes operational conditions within a pedestrian stream, based on service measures such as pedestrian speed, flow rate, density, space and platooning.
- **Cost –** Addresses the anticipated operating and maintenance cost savings as well as anticipated capital cost savings associated with the implementation of the alternatives.

The expected performance of each of the alternatives was assessed with the use of these factors. For the evaluation, the Study Team assessed the quantitative performance of each alternative along different sections of the study area. This section of the report presents the results for the most critical segments in the study area. Appendix K presents tables with all of the MOE values calculated for this study.

3-6.2.2.1. Bus Operations and Person Throughput

The measures of effectiveness, summarized in Table 3-6, indicate that bus operations under the build alternatives would be much better than under the No-Build alternative. Alternative D is generally the best performer of the build alternatives during the AM, midday and PM peak hours. However, the performance of buses within the corridor is almost as good under Alternatives G and H.

The implementation of Alternative G, which includes an exclusive median busway on K Street and curbside bus lanes on Massachusetts Avenue as well as a service plan compatible with the operation of the exclusive busway, results in significant reductions in bus travel times and increased person throughput (the number of people that cross a specified point in the corridor) at key locations in the corridor. For example, as Table 3-6 indicates, the travel times of the proposed Circulator are reduced by approximately nine minutes in the peak direction (AM eastbound and PM westbound) during the AM peak hour and by approximately ten minutes during the PM peak hours with the implementation of Alternative G. The person throughput under Alternative G[1] at K Street and Connecticut Avenue is greater than under the No-Build scenario during the AM and PM peak hours.

Similarly, the implementation of Alternative H, which includes curbside bus lanes on K Street and curbside bus lanes on Massachusetts Avenue, results in reductions in bus travel times and increased person throughput at key locations in the corridor. For example, as Table 3-6 indicates, the travel times of the proposed Circulator are reduced by approximately three minutes in the eastbound direction during the AM peak hour and nine minutes in the westbound direction during the PM peak hour with the implementation of Alternative H. The person throughput under Alternative H at K Street and Connecticut Avenue is greater than under the No-Build scenario during the AM peak hour and is approximately the same during the PM peak hour.

The person throughput for the westbound movement at K Street and Connecticut Avenue during the AM peak hour is greater for Alternative H than it is for Alternatives D and G. This indicates that more vehicles – both cars and buses – will travel through this link in the network under Alternative H. An evaluation of the simulation model indicates that the increase in westbound person throughput is primarily the result of more commuter buses reaching this link in the network under Alternative H than under Alternatives D and G. There are 35 MTA commuter buses that make a left turn onto K Street to travel west during the AM peak hour. The signal phasing for the alternatives with median busway – Alternatives D and G – is more complex and requires taking away some of the available green time from the north-south streets. The effect of

[1] Alternatives D and G have different configurations at 17th Street. Under Alternative D, 17th Street is operated as one-way southbound during the AM peak hour (current operations). Under Alternative G, 17th Street is changed to two-way operation during the AM peak hour. As a result of this change, some drivers that currently travel south on 17th Street would divert to other streets such as 19th Street. These diversions explain why the person throughput during the AM peak hour shown in Table 3-6 for eastbound K Street between 18th Street and Connecticut is higher under Alternative G than under Alternative D.

TABLE 3-6. MEASURES OF EFFECTIVENESS FOR K STREET TRANSITWAY - AM PEAK HOUR

				AM PEAK HOUR		2015 BUILD															
ROAD	FROM	TO	DIRECTION	2003 EXISTING	2015 NO BUILD	ALTERNATIVE A with Exclusive Busway in Central and with Parking in Central		ALTERNATIVE B without Exclusive Busway in GT[a] & US[b], with Exclusive Busway in Central, and without Peak Period Parking in Central		ALTERNATIVE C with Exclusive Busway in Central and with Exclusive Busway * (see note below)		ALTERNATIVE D Alternative C with Modified Service Plan		ALTERNATIVE E Farragut Square with Alternative C Bus Service		ALTERNATIVE F Alternative D with no land taking from Farragut Square		ALTERNATIVE G Alternative F with no exclusive bus lanes in Georgetown and with exclusive bus lanes in Union Station		ALTERNATIVE H Curbside Bus Lane and No Bus Lane in Georgetown	
1. Average Non-Bus Vehicle Travel Times (TT) and Travel Speeds (TS)				TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)
M Street	Wisconsin Ave	Pennsylvania Ave	EB	1.6	9.5	1.7	9.3	N/R	N/R	1.8	8.5	2.1	7.3	2.1	7.3	2.1	7.3	2.1	7.3	1.8	8.5	1.8	8.5
Pennsylvania Ave	M St	Washington Cir	EB	2.1	11.4	2.1	11.2	N/R	N/R	2.1	11.3	2.2	10.6	2.2	10.6	2.2	10.6	2.2	10.6	2.1	11.3	2.1	11.3
K Street	20th St	11th St	EB	8.2	7.1	8.6	6.7	21.9	2.8	9.5	6.1	9.5	6.1	9.1	6.3	15.2	3.8	8.3	7.0	8.3	7.0	8.8	6.5
Massachusetts Ave	7th St	New Jersey Ave	EB	4.2	8.0	4.1	8.1	N/R	N/R	4.3	7.7	4.5	7.4	4.5	7.4	4.5	7.4	4.5	7.4	4.5	7.4	4.5	7.4
L Street	23rd St	13th St	EB	5.6	11.0	5.6	10.9	21.9	2.8	12.6	4.9	12.6	4.9	12.2	5.0	23.7	2.6	10.2	6.0	10.2	6.0	12.3	5.0
H Street	18th St	14th St	EB	2.7	11.8	2.7	11.6	4.1	7.8	6.0	5.2	6.0	5.2	6.9	4.6	6.9	4.6	4.5	7.1	4.5	7.1	4.2	7.6
Corridor	M & Wisconsin	Mass. Ave & 1st St	EB	28.1	7.3	29.6	7.0	N/R	N/R	26.6	7.5	27.3	7.3	26.1	7.7	40.7	4.9	26.2	7.6	25.8	7.8	28.9	6.9
Massachusetts Ave	New Jersey Ave	7th St	WB	3.1	11.0	3.9	8.6	N/R	N/R	5.7	5.9	6.0	5.6	6.0	5.6	6.0	5.6	6.0	5.6	6.0	5.6	6.0	5.6
K Street	11th St	20th St	WB	5.6	10.3	5.9	9.7	25.7	2.2	14.1	4.1	14.1	4.1	11.9	4.9	12.1	4.8	11.2	5.2	11.2	5.2	8.5	6.8
Lower K Street	25th St	Wisconsin Ave	WB	3.0	10.1	3.3	9.3	N/R	N/R	3.3	9.1	3.5	8.7	3.5	8.7	3.5	8.7	3.5	8.7	3.3	9.1	3.3	9.1
M Street	15th St	23rd St	WB	3.5	14.4	3.6	14.3	6.0	8.4	7.1	7.2	7.1	7.2	6.5	7.9	5.4	9.4	8.6	5.9	8.6	5.9	7.6	6.7
I(EYE) Street	13th St	Pennsylvania Ave	WB	8.2	6.6	8.3	6.6	18.8	2.9	8.9	6.2	8.9	6.2	13.8	3.9	11.5	4.8	12.3	4.4	12.3	4.4	18.2	3.0
Corridor	Mass. Ave & 1st St	K & Wisconsin	WB	20.9	10.5	22.8	8.8	N/R	N/R	31.0	6.4	31.9	6.3	29.9	6.7	30.8	6.5	29.3	6.8	29.2	6.9	26.2	7.6
2. Average Bus Travel Times (TT) and Travel Speeds (TS)				TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)
M Street	Wisconsin Ave	Pennsylvania Ave	EB	2.1	7.3	2.1	7.3	N/R	N/R	1.9	8.3	1.8	8.6	1.8	8.6	1.8	8.6	1.8	8.6	1.9	8.3	1.9	8.3
Pennsylvania Ave	M St	Washington Cir	EB	3.6	6.6	3.7	6.4	N/R	N/R	3.0	7.8	2.3	10.3	2.3	10.3	2.3	10.3	2.3	10.3	3.0	7.8	3.0	7.8
K Street	20th St	11th St	EB	N/A	N/A	N/A	N/A	9.1	6.4	9.0	6.4	9.0	6.4	9.1	6.3	10.3	5.6	9.9	5.8	9.9	5.8	13.1	4.4
Massachusetts Ave	7th St	New Jersey Ave	EB	N/A	N/A	N/A	N/A	N/R	N/R	5.7	5.9	5.4	6.2	5.4	6.2	5.4	6.2	5.4	6.2	5.4	6.2	5.4	6.2
L Street	23rd St	13th St	EB	N/A	N/A	N/A	N/A	N/R	N/R	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
H Street	18th St	14th St	EB	2.4	7.1	2.4	12.9	3.8	6.4	N/A	N/A	N/A	N/A	7.4	4.2	6.9	4.6	5.0	6.3	5.0	6.3	5.7	5.5
Corridor	M & Wisconsin	Mass. Ave & 1st St	EB	N/A	N/A	N/A	N/A	N/R	N/R	29.0	6.9	27.7	7.2	27.5	7.3	27.8	7.2	28.1	7.1	28.9	6.9	33.6	5.9
Massachusetts Ave	New Jersey Ave	7th St	WB	N/A	N/A	N/A	N/A	N/R	N/R	6.5	5.1	4.6	7.3	4.6	7.3	4.6	7.3	4.6	7.3	4.6	7.3	4.6	7.3
K Street	11th St	20th St	WB	11.2	5.2	11.6	5.0	11.2	5.2	8.9	6.5	8.9	6.5	10.0	5.8	9.7	6.0	8.4	6.9	8.4	6.9	11.4	5.0
Lower K Street	25th St	Wisconsin Ave	WB	N/A	N/A	N/A	N/A	N/R	N/R	3.9	7.9	4.4	7.0	4.4	7.0	4.4	7.0	4.4	7.0	3.9	7.9	3.9	7.9
M Street	15th St	23rd St	WB	N/A	N/A	N/A	N/A	N/R	N/R	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
I(EYE) Street	13th St	Pennsylvania Ave	WB	13.5	4.0	13.9	3.9	N/R	N/R	N/A	N/A	N/A	N/A	13.1	4.2	N/A	N/A	12.0	4.5	12.0	4.5	16.6	3.3
Corridor	Mass. Ave & 1st St	K & Wisconsin	WB	N/A	N/A	N/A	N/A	N/R	N/R	27.9	7.2	26.4	7.6	26.9	7.4	28.2	7.1	25.5	7.8	24.9	8.0	27.7	7.2

[a] GT : Georgetown, [b] US: Union Station
N/R : The Union Station for this Scenario and Georgetown sections of the model were not run because the central portion of the model did not work adequately with parking lanes.
N/A : Not Available
* Exclus

TABLE 3-6. MEASURES OF EFFECTIVENESS FOR K STREET TRANSITWAY - AM PEAK HOUR

				AM PEAK HOUR		2015 BUILD							
ROAD	FROM	TO	DIRECTION	2003 EXISTING	2015 NO BUILD	ALTERNATIVE A with Exclusive Busway in Central and with Parking in Central	ALTERNATIVE B without Exclusive Busway in GT[a] & US[b], with Exclusive Busway in Central, and without Peak Period Parking in Central	ALTERNATIVE C with Exclusive Busway in Central and with Exclusive Busway * (see note below)	ALTERNATIVE D Alternative C with Modified Service Plan	ALTERNATIVE E Farragut Square with Alternative C Bus Service	ALTERNATIVE F Alternative D with no land taking from Farragut Square	ALTERNATIVE G Alternative F with no exclusive bus lanes in Georgetown and with exclusive bus lanes in Union Station	ALTERNATIVE H Curbside Bus Lane and No Bus Lane in Georgetown
3. Intersection Delay and Level of Service				Level of Service	Level of Service	Level of Service	Level of Service	Level of Service	Level of Service	Level of Service	Level of Service	Level of Service	Level of Service
K Street	Wisconsin Ave			B	B	N/R	B	B	B	B	B	B	B
M Street	Wisconsin Ave			D	D	N/R	D	D	D	D	D	D	D
K Street	20th St			D	E	F	E	E	D	E	E	E	E
K Street	Connecticut Ave			E	E	F	F	F	E	E	E	E	F
K Street	14th St			D	D	F	F	F	E	F	E	E	E
Massachusetts Ave	H St			D	D	N/R	D	D	D	D	D	D	D
Massachusetts Ave	North Capitol St			E	E	N/R	E	E	E	E	E	E	E
L Street	Connecticut Ave			D	D	F	E	E	D	F	E	E	D
M Street	Connecticut Ave			D	D	E	F	F	E	E	D	D	E
I(EYE) Street	14th St			C	D	E	F	F	F	F	F	F	F
H Street	17th St			C	C	E	C	C	D	C	C	C	D
4. Person Throughput				Person Throughput	Person Throughput	Person Throughput	Person Throughput	Person Throughput	Person Throughput	Person Throughput	Person Throughput	Person Throughput	Person Throughput
M Street	Wisconsin Ave	31st St	EB	1569	1589	N/R	1977	1929	1929	1929	1929	1977	1977
K Street	18th St	Connecticut Ave	EB	2698	3237	439	3511	3511	3452	2750	3851	3851	3606
Massachusetts Ave	New Jersey Ave	North Capitol St	EB	985	911	N/R	1545	1556	1556	1556	1556	1556	1556
Massachusetts Ave	North Capitol St	New Jersey Ave	WB	939	922	N/R	1775	1623	1623	1623	1623	1623	1623
K Street	Connecticut Ave	18th St	WB	3066	3984	1187	4630	4630	3961	3759	4045	4045	4759
5. Average Delay Per Person-Trip (Minutes)				2.2	2.8	5.8	4.7	4.8	4.9	5.2	4.6	4.5	4.5
6. Travel Times for Selected Bus Routes				TT (minutes)	TT (minutes)	TT(minutes)	TT(minutes)	TT(minutes)	TT(minutes)	TT(minutes)	TT(minutes)	TT(minutes)	TT(minutes)
Circulator A(EB)	Lower K & Wisc.	Union Station	EB	N/A	37.4	N/R	30.4	29.2	29.0	29.3	29.6	29.7	35.1
Circulator A(WB)	Union Station	Lower K & Wisc.	WB	N/A	36.7	N/R	27.9	26.4	26.9	28.2	25.5	24.9	27.7
Circulator B(EB)	GT University Dr	Union Station	EB	N/A	43.2	N/R	36.0	34.8	34.6	34.9	35.2	N/A	N/A
Circulator B(WB)	Union Station	GT University Dr	WB	N/A	43.0	N/R	36.6	35.1	35.5	36.8	34.1	N/A	N/A

[a] GT : Georgetown, [b] US: Union Station
N/R : The Union Station for this Scenario and Georgetown sections of the model were not run because the central portion of the model did not work adequately with parking lanes.
N/A : Not Available
* Exclus

TABLE 3-6. MEASURES OF EFFECTIVENESS FOR K STREET TRANSITWAY - MIDDAY PEAK HOUR

				MIDDAY PEAK HOUR	2015 BUILD									
ROAD	FROM	TO	DIRECTION	2003 EXISTING	ALTERNATIVE A with Exclusive Busway in Central and with Parking in Central	ALTERNATIVE B without Exclusive Busway in GT[a] & US[b], with Exclusive Busway in Central, and without Peak Period Parking in Central	ALTERNATIVE C with Exclusive Busway in Central and with Exclusive Busway * (see note below)	ALTERNATIVE D Alternative C with Modified Service Plan	ALTERNATIVE F Alternative D with no land taking from Farragut Square	ALTERNATIVE G Alternative F with no exclusive bus lanes in Georgetown and with exclusive bus lanes in Union Station					
1. Average Non-Bus Vehicle Travel Times (TT) and Travel Speeds (TS)				TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)
M Street	Wisconsin Ave	Pennsylvania Ave	EB	1.7	9.1	N/R	N/R	1.8	8.5	2.0	7.8	2.0	7.8	2.0	7.8	1.8	8.5
Pennsylvania Ave	M St	Washington Cir	EB	1.6	14.6	N/R	N/R	2.2	10.9	2.2	10.8	2.2	10.8	2.2	10.8	2.2	10.9
K Street	20th St	11th St	EB	7.8	7.1	11.4	5.1	9.1	6.4	9.1	6.4	8.6	6.7	8.8	6.6	8.8	6.6
Massachusetts Ave	7th St	New Jersey Ave	EB	3.4	10.0	N/R	N/R	3.4	9.9	3.3	10.0	3.3	10.0	3.3	10.0	3.3	10.0
L Street	23rd St	13th St	EB	9.8	6.2	7.5	8.1	7.5	8.1	7.5	8.1	7.6	8.0	10.3	5.9	10.3	5.9
H Street	18th St	14th St	EB	5.8	5.5	8.6	3.7	8.3	3.8	8.3	3.8	8.7	3.6	10.7	2.9	10.7	2.9
Corridor	M & Wisconsin	Mass. Ave & 1st St	EB	24.0	8.3	N/R	N/R	25.3	7.9	25.4	7.9	24.8	8.1	25.2	7.9	25.0	8.0
Massachusetts Ave	New Jersey Ave	7th St	WB	3.3	10.2	N/R	N/R	3.5	9.7	3.5	9.6	3.5	9.6	3.5	9.6	3.5	9.6
K Street	11th St	20th St	WB	5.7	8.7	12.8	4.5	7.0	8.2	7.0	8.2	7.0	8.3	7.5	7.7	7.5	7.7
Lower K Street	25th St	Wisconsin Ave	WB	1.8	16.8	N/R	N/R	2.9	10.5	2.1	14.4	2.1	14.4	2.1	14.4	2.9	10.5
M Street	15th St	23rd St	WB	5.1	9.9	4.6	11.0	4.7	10.7	4.7	10.7	4.8	10.6	4.7	10.8	4.7	10.8
I(EYE) Street	13th St	Pennsylvania Ave	WB	8.6	6.4	6.4	8.5	6.1	8.9	6.1	8.9	6.7	8.2	5.7	9.6	5.7	9.6
Corridor	Mass. Ave & 1st St	K & Wisconsin	WB	17.4	11.5	N/R	N/R	20.0	10.0	19.3	10.4	19.1	10.5	19.6	10.5	20.3	9.8
2. Average Bus Travel Times				TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)
M Street	Wisconsin Ave	Pennsylvania Ave	EB	2.6	5.9	N/R	N/R	2.8	5.6	2.9	5.4	2.9	5.4	2.9	5.4	2.8	5.6
Pennsylvania Ave	M St	Washington Cir	EB	3.2	7.4	N/R	N/R	3.3	7.2	2.6	9.2	2.6	9.2	2.6	9.2	3.3	7.2
K Street	20th St	11th St	EB	N/A	N/A	10.1	5.7	9.8	5.9	9.8	5.9	8.7	6.7	9.0	6.4	9.0	6.4
Massachusetts Ave	7th St	New Jersey Ave	EB	N/A	N/A	N/R	N/R	4.8	7.0	4.5	7.4	4.5	7.4	4.5	7.4	4.5	7.4
L Street	23rd St	13th St	EB	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
H Street	18th St	14th St	EB	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Corridor	M & Wisconsin	Mass. Ave & 1st St	EB	N/A	N/A	N/R	N/R	28.2	7.1	27.2	7.4	25.4	7.9	26.2	7.6	26.8	7.5
Massachusetts Ave	1st St	New Jersey Ave	WB	N/A	N/A	N/R	N/R	1.7	9.8	1.6	10.7	1.6	10.7	1.6	10.7	1.6	10.7
Massachusetts Ave	New Jersey Ave	7th St	WB	2.0	8.7	N/R	N/R	4.2	7.9	4.0	8.3	4.0	8.3	4.0	8.3	4.0	8.3
K Street	11th St	20th St	WB	N/A	N/A	9.6	6.0	9.2	6.3	9.2	6.3	8.6	6.7	9.2	6.3	9.2	6.3
Lower K Street	25th St	Wisconsin Ave	WB	N/A	N/A	N/R	N/R	3.7	8.3	3.7	8.3	3.7	8.3	3.7	8.3	3.7	8.3
M Street	15th St	23rd St	WB	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
I(EYE) Street	13th St	Pennsylvania Ave	WB	16.2	3.4	8.7	6.2	8.3	6.6	8.3	6.6	8.6	6.3	7.0	7.7	7.0	7.7
Corridor	Mass. Ave & 1st St	K & Wisconsin	WB	N/A	N/A	N/R	N/R	23.2	8.6	22.9	8.7	22.4	8.9	23.6	8.5	23.6	8.5

[a] GT : Georgetown, [b] US: Union Station
N/R : The Union Station for this Scenario and Georgetown sections of the model were not run because the central portion of the model did not work adequately with parking lanes.
N/A : Not Available
* Exclus

TABLE 3-6. MEASURES OF EFFECTIVENESS FOR K STREET TRANSITWAY - MIDDAY PEAK HOUR

				MIDDAY PEAK HOUR	2015 BUILD					
ROAD	FROM	TO	DIRECTION	2003 EXISTING	ALTERNATIVE A with Exclusive Busway in Central and with Parking in Central	ALTERNATIVE B without Exclusive Busway in GT[a] & US[b], with Exclusive Busway in Central, and without Peak Period Parking in Central	ALTERNATIVE C with Exclusive Busway in Central and with Exclusive Busway * (see note below)	ALTERNATIVE D Alternative C with Modified Service Plan	ALTERNATIVE F Alternative D with no land taking from Farragut Square	ALTERNATIVE G Alternative F with no exclusive bus lanes in Georgetown and with exclusive bus lanes in Union Station
3. Intersection Delay and Level of Service				Level of Service	Level of Service	Level of Service	Level of Service	Level of Service	Level of Service	Level of Service
K Street	Wisconsin Ave			B	N/R	B	B	B	B	B
M Street	Wisconsin Ave			D	N/R	E	E	E	E	E
K Street	20th St			D	D	D	D	C	D	D
K Street	Connecticut Ave			E	F	E	E	D	D	D
K Street	14th St			E	E	E	E	E	E	E
Massachusetts Ave	H St			D	N/R	D	D	D	D	D
Massachusetts Ave	North Capitol St			F	N/R	E	E	E	E	E
L Street	Connecticut Ave			D	D	D	D	D	D	D
L Street	14th St			E	E	C	C	C	D	D
M Street	Connecticut Ave			D	E	E	E	E	E	E
I(EYE) Street	14th St			D	D	D	D	D	E	E
H Street	17th St			D	E	C	C	C	D	D
4. Person Throughput				Person Throughput	Person Throughput	Person Throughput	Person Throughput	Person Throughput	Person Throughput	Person Throughput
M Street	Wisconsin Ave	31st St	EB	1140	N/R	1609	1906	1906	1906	1609
K Street	18th St	Connecticut Ave	EB	2050	2020	2162	2162	2212	2217	2217
Massachusetts Ave	New Jersey Ave	North Capitol St	EB	1025	N/R	1592	1598	1598	1598	1598
Massachusetts Ave	North Capitol St	New Jersey Ave	WB	925	N/R	1218	1240	1240	1240	1240
K Street	Connecticut Ave	18th St	WB	1815	2159	2426	2426	2368	2394	2394
5. Average Delay Per Person-Trip (Minutes)				2.6	4.0	2.9	2.9	2.9	3.1	3.1
6. Travel Times for Selected Bus Routes				TT (minutes)	TT(minutes)	TT(minutes)	TT(minutes)	TT(minutes)	TT(minutes)	TT(minutes)
Circulator A(EB)	Lower K &Wisc.	Union Station	EB	N/A	N/R	29.2	28.2	26.4	27.2	27.8
Circulator A(WB)	Union Station	Lower K & Wisc.	WB	N/A	N/R	23.2	22.9	22.4	23.6	23.6
Circulator B(EB)	GT University Dr	Union Station	EB	N/A	N/R	33.2	32.8	31.0	31.9	N/A
Circulator B(WB)	Union Station	GT University Dr	WB	N/A	N/R	28.3	27.9	27.5	28.8	N/A

[a] GT : Georgetown, [b] US: Union Station
N/R : The Union Station for this Scenario and Georgetown sections of the model were not run because the central portion of the model did not work adequately with parking lanes.
N/A : Not Available
* Exclus

TABLE 3-6. MEASURES OF EFFECTIVENESS FOR K STREET TRANSITWAY - PM PEAK HOUR

				PM PEAK HOUR		2015 BUILD													
ROAD	FROM	TO	DIRECTION	2003 EXISTING	2015 NO BUILD	ALTERNATIVE A with Exclusive Busway in Central and with Parking in Central		ALTERNATIVE B without Exclusive Busway in GT[a] & US[b], with Exclusive Busway in Central, and without Peak Period Parking in Central		ALTERNATIVE C with Exclusive Busway in Central and with Exclusive Busway * (see note below)		ALTERNATIVE D Alternative C with Modified Service Plan		ALTERNATIVE F Alternative D with no land taking from Farragut Square		ALTERNATIVE G Alternative F with no exclusive bus lanes in Georgetown and with exclusive bus lanes in Union Station		ALTERNATIVE H Curbside Bus Lane and No Bus Lane in Georgetown	
1. Average Non-Bus Vehicle Travel Times (TT) and Travel Speeds (TS)				TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)
M Street	Wisconsin Ave	Pennsylvania Ave	EB	2.2	7.1	1.7	9.0	N/R	N/R	1.8	8.5	3.5	4.5	3.5	4.5	3.5	4.5	1.8	8.5	1.8	8.5
Pennsylvania Ave	M St	Washington Cir	EB	2.3	10.5	2.5	9.4	N/R	N/R	2.5	9.4	3.8	6.3	3.8	6.3	3.8	6.3	2.5	9.4	2.5	9.4
K Street	20th St	11th St	EB	9.9	5.5	12.4	4.5	16.9	3.4	8.8	6.3	8.8	6.3	8.8	6.5	8.0	7.3	8.0	7.3	6.9	8.3
Massachusetts Ave	7th St	New Jersey Ave	EB	5.2	6.5	4.8	7.0	N/R	N/R	6.0	5.6	5.2	6.4	5.2	6.4	5.2	6.4	5.2	6.4	5.2	6.4
L Street	23rd St	13th St	EB	5.5	11.2	6.2	9.9	8.3	7.4	8.4	7.3	8.4	7.3	8.9	6.9	7.3	8.4	7.3	8.4	6.0	10.2
H Street	18th St	14th St	EB	3.4	9.2	3.3	9.6	3.1	10.2	3.5	9.1	3.5	9.1	3.2	9.8	3.4	9.3	3.4	9.3	3.9	8.0
Corridor	M & Wisconsin	Mass. Ave & 1st St	EB	30.5	6.6	33.0	6.1	N/R	N/R	29.2	6.9	31.5	6.4	31.1	6.4	29.3	6.8	26.4	7.6	25.0	8.0
Massachusetts Ave	New Jersey Ave	7th St	WB	3.8	8.9	5.2	6.4	N/R	N/R	3.1	11.0	2.9	11.5	2.9	11.5	2.9	11.5	2.9	11.5	2.9	11.5
K Street	11th St	20th St	WB	7.8	7.5	9.9	5.8	16.5	3.4	9.4	6.1	9.4	6.1	9.3	6.2	8.8	6.6	8.8	6.6	5.4	10.8
Lower K Street	25th St	Wisconsin Ave	WB	2.2	13.8	3.9	7.8	N/R	N/R	2.9	10.5	3.0	10.1	3.0	10.1	3.0	10.1	2.9	10.5	2.9	10.5
M Street	15th St	23rd St	WB	3.3	15.6	3.3	15.2	5.7	8.9	4.9	10.4	4.9	10.4	4.8	10.5	4.8	10.6	4.8	10.6	4.9	10.3
I(EYE) Street	13th St	Pennsylvania Ave	WB	4.9	11.1	6.0	9.1	6.0	9.1	6.0	9.1	6.0	9.1	7.0	7.8	5.4	10.1	5.4	10.1	5.8	9.4
Corridor	Mass. Ave & 1st St	K & Wisconsin	WB	23.6	7.8	28.5	6.5	N/R	N/R	27.0	7.4	28.5	7.0	28.3	7.1	28.1	7.1	28.0	7.1	23.6	8.5
2. Average Bus Travel Times				TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)	TT (min)	TS (mph)
M Street	Wisconsin Ave	Pennsylvania Ave	EB	2.8	5.5	2.4	6.4	N/R	N/R	2.9	5.3	2.5	6.3	2.5	6.3	2.5	6.3	2.9	5.3	2.9	5.3
Pennsylvania Ave	M St	Washington Cir	EB	4.0	5.9	3.7	6.3	N/R	N/R	3.4	6.9	2.4	9.9	2.4	9.9	2.4	9.9	3.4	6.9	3.4	6.9
K Street	20th St	11th St	EB	N/A	N/A	17.2	3.4	10.1	5.6	8.2	6.7	8.2	6.7	7.8	7.4	8.4	6.9	8.4	6.9	9.4	6.2
Massachusetts Ave	7th St	New Jersey Ave	EB	N/A	N/A	N/A	N/A	N/R	N/R	8.7	3.9	7.6	4.4	7.6	4.4	7.6	4.4	7.6	4.4	7.6	4.4
L Street	23rd St	13th St	EB	N/A	N/A	N/A	N/A	N/R	N/R	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
H Street	18th St	14th St	EB	3.8	8.4	3.5	7.1	3.8	8.3	4.2	7.6	4.2	7.6	3.6	8.8	3.8	8.3	3.8	8.3	5.2	6.0
Corridor	M & Wisconsin	Mass. Ave & 1st St	EB	N/A	N/A	N/A	N/A	N/R	N/R	33.0	6.1	30.2	6.6	27.2	7.3	27.8	7.2	29.3	6.8	30.7	6.5
Massachusetts Ave	New Jersey Ave	7th St	WB	2.4	7.3	4.1	4.2	N/R	N/R	4.1	8.2	3.7	9.0	3.7	9.0	3.7	9.0	3.7	9.0	3.7	9.0
K Street	11th St	20th St	WB	N/A	N/A	N/A	N/A	11.3	5.1	9.8	5.8	9.8	5.8	9.3	6.2	8.7	6.6	8.7	6.6	9.2	6.3
Lower K Street	25th St	Wisconsin Ave	WB	N/A	N/A	N/A	N/A	N/R	N/R	3.8	8.0	3.7	8.2	3.7	8.2	3.7	8.2	3.8	8.0	3.8	8.0
M Street	15th St	23rd St	WB	N/A	N/A	N/A	N/A	N/R	N/R	N/A	N/A	N/A	N/A	9.3	6.2	8.8	6.6	8.8	6.6	9.2	6.3
I(EYE) Street	13th St	Pennsylvania Ave	WB	8.8	6.2	9.9	5.5	N/R	N/R	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Corridor	Mass. Ave & 1st St	K & Wisconsin	WB	N/A	N/A	N/A	N/A	N/R	N/R	29.7	6.7	28.3	7.1	26.1	7.7	24.9	8.0	25.0	8.0	26.1	7.6

[a] GT : Georgetown, [b] US: Union Station
N/R : The Union Station for this Scenario and Georgetown sections of the model were not run because the central portion of the model did not work adequately with parking lanes.
N/A : Not Available
* Exclus

TABLE 3-6. MEASURES OF EFFECTIVENESS FOR K STREET TRANSITWAY - PM PEAK HOUR

				PM PEAK HOUR		2015 BUILD						
ROAD	FROM	TO	DIRECTION	2003 EXISTING	2015 NO BUILD	ALTERNATIVE A with Exclusive Busway in Central and with Parking in Central	ALTERNATIVE B without Exclusive Busway in GT[a] & US[b], with Exclusive Busway in Central, and without Peak Period Parking in Central	ALTERNATIVE C with Exclusive Busway in Central and with Exclusive Busway * (see note below)	ALTERNATIVE D Alternative C with Modified Service Plan	ALTERNATIVE F Alternative D with no land taking from Farragut Square	ALTERNATIVE G Alternative F with no exclusive bus lanes in Georgetown and with exclusive bus lanes in Union Station	ALTERNATIVE H Curbside Bus Lane and No Bus Lane in Georgetown
3. Intersection Delay and Level of Service				Level of Service	Level of Service	Level of Service	Level of Service	Level of Service	Level of Service	Level of Service	Level of Service	Level of Service
K Street	Wisconsin Ave			B	B	N/R	B	B	B	B	B	B
M Street	Wisconsin Ave			D	D	N/R	D	E	E	E	D	D
K Street	20th St			D	D	F	E	E	D	E	E	C
K Street	Connecticut Ave			E	E	F	D	D	D	C	C	D
K Street	14th St			D	D	F	E	E	E	F	F	E
Massachusetts Ave	H St			D	C	N/R	D	D	D	D	D	D
Massachusetts Ave	North Capitol St			E	E	N/R	E	E	E	E	E	E
L Street	Connecticut Ave			C	C	D	E	E	E	D	D	D
M Street	Connecticut Ave			D	D	C	C	C	C	C	C	C
I(EYE) Street	14th St			C	C	F	C	C	D	E	E	D
H Street	17th St			C	C	D	C	C	B	B	B	C
4. Person Throughput				Person Throughput	Person Throughput	Person Throughput	Person Throughput	Person Throughput	Person Throughput	Person Throughput	Person Throughput	Person Throughput
M Street	Wisconsin Ave	31st St	EB	1115	1210	N/R	1676	1792	1792	1792	1676	1676
K Street	18th St	Connecticut Ave	EB	3194	3987	1198	4665	4665	4231	4364	4364	3617
Massachusetts Ave	New Jersey Ave	North Capitol St	EB	1678	1695	N/R	1878	1922	1922	1922	1922	1922
Massachusetts Ave	North Capitol St	New Jersey Ave	WB	571	745	N/R	1172	956	956	956	956	956
K Street	Connecticut Ave	18th St	WB	2193	2513	2497	3105	3105	2767	2927	2927	2562
5. Average Delay Per Person-Trip (Minutes)				2.4	2.9	4.0**	2.9	3.0	3.0	3.0	3.0	2.8
6. Travel Times for Selected Bus Routes				TT (minutes)	TT (minutes)	TT(minutes)	TT(minutes)	TT(minutes)	TT(minutes)	TT(minutes)	TT(minutes)	TT(minutes)
Circulator A(EB)	Lower K &Wisc.	Union Station	EB	N/A	34.3	N/R	36.3	33.4	30.3	30.8	30.9	33.7
Circulator A(WB)	Union Station	Lower K & Wisc.	WB	N/A	34.9	N/R	29.7	28.4	26.1	24.9	25.0	26.1
Circulator B(EB)	GT University Dr	Union Station	EB	N/A	48.6	N/R	39.2	36.3	33.1	33.6	N/A	N/A
Circulator B(WB)	Union Station	GT University Dr	WB	N/A	43.1	N/R	37.4	36.0	33.8	32.7	N/A	N/A

[a] GT : Georgetown, [b] US: Union Station
N/R : The Union Station for this Scenario and Georgetown sections of the model were not run because the central portion of the model did not work adequately with parking lanes.
N/A : Not Available
* Exclus

taking away some green time from the north-south streets is that approximately 11 of the westbound commuter buses are delayed in the network and do not reach the links of K Street where the person throughput calculations were performed. Fewer westbound buses and somewhat fewer cars result in reduced person throughput in the westbound direction. Adjustments to the signal timing cycle length could be implemented to reduce the effect on the commuter buses under a median busway scenario[1].

3-6.2.2.2. Non-Bus Vehicle Operations

As noted above, the implementation of Alternatives D, G or H will increase person throughput in the K Street corridor. In terms of operations of non-bus vehicles, the increase in person throughput can be illustrated by decreased travel times and increased travel speeds throughout the corridor. The travel time for the eastbound trip across the corridor (via K Street) for non-bus vehicles during the AM peak hour for Alternatives D and G is approximately 3.5 minutes shorter than the trip time for the No-Build scenario. The travel time for Alternative H is approximately the same as the No-Build scenario. During the PM peak hour, the eastbound travel times across the corridor are reduced by approximately 7 minutes under Alternatives G and H.

For the westbound trip, travel times for non-bus vehicles during the AM peak hour are greater under any of the build alternatives than the No-Build scenario; however, the implementation of Alternative H is expected to reduce westbound PM peak hour travel times by approximately five minutes. Westbound PM peak hour travel times for Alternatives D, F and G are approximately the same as the No-Build scenario.

It should be noted that while travel times throughout the corridor can be are decreased by implementing build Alternatives D, G or H, their associated improvements will have an impact on traffic operations throughout the network during the AM peak period. In order to improve travel times and person throughput on K Street, adjustments to traffic signal timing will be necessary. At certain locations, in order to provide special phasing for turns from the K Street Transitway, it will be necessary to reduce the amount of green time given to cross-streets. As a result, when compared to the 2015 No-Build scenario, the level of service of selected intersections throughout the study area is worse under Alternatives D, G and H than under the No-Build alternative. The LOS of some intersections, however, particularly during the PM peak period, is not affected or in some cases is improved with the implementation of the build alternatives. Most notably, the intersection of K Street and Connecticut Avenue improves from LOS E under the 2015 No-Build scenario to LOS C under Alternative G. It is expected that some of the LOS degradation can be mitigated through more extensive signal optimization, including field testing, which is impossible in simulation modeling.

[1] The cycle length for all scenarios was kept at 80 seconds to facilitate the comparison of alternatives. This cycle length was the one being used when most of the analysis for this study was conducted. However, the cycle length on K Street was recently changed to 100 seconds. The change in cycle length provides additional green time that could be used to facilitate the left turns for the MTA buses and minimize the impacts associated with the more complex signal phasing of the median busway options.

3-6.2.2.3. Delays

The average delay per person trip for Alternatives D, G and H is expected to be the same as the delay per person trip under the No-Build scenario during the PM peak hour. This indicates that there will be no detrimental effect on traffic operations during the PM peak hour with the implementation of a curbside or median busway on K Street. However, the implementation of a median or curbside busway on K Street, which would increase person throughput in the corridor, will generate an increase in the average delay per person during the AM peak hour. The implementation of a curbside or a median busway on K Street will result in an increase in delay per person trip of approximately 1.8 minutes during the AM peak hour.

3-6.2.2.4. Pedestrian Levels of Service

The Study Team calculated pedestrian levels of service for key intersections in the study area. This section presents the levels of service for the existing conditions and for 2015 Alternative D. The results of this analysis are expected to be similar for Alternative G. A detailed pedestrian LOS analysis was not performed for Alternative H. However, the improvements associated with Alternative H, most notably reducing the width of K Street and increasing sidewalk widths, are expected to result in improved pedestrian LOS when compared to the No-Build and the other build scenarios.

The Study Team collected the existing pedestrian signal timing data and volumes for selected intersections on the corridor as shown in Table 3-7. The Study Team calculated the Level of Service (LOS) based on the average delay per pedestrian for a crosswalk for the AM, midday and PM peak hours, according to equation 18-5 described for signalized intersections in Chapter 18 (page 18-7) of the 2000 edition of the *Highway Capacity Manual* (HCM 2000). However, for intersections with high pedestrian volumes, including Connecticut Avenue and K Street and 17th Street and K Street, additional parameters such as corner circulation space and crosswalk space were calculated based on the time-space analysis described on pages 18-7 through 18-28 of the HCM2000. Detailed existing and future pedestrian levels of service calculations are shown in Appendix L.

As shown in Table 3-7, most of the intersections operate at an acceptable LOS D or better under existing conditions. However, north-south pedestrian movements at Connecticut Avenue and K Street, and at 17th Street and K Street, operate at level of service F during the AM, Midday and PM peak hours.

Future (2015) levels of service were calculated based on the methodology described above with the Alternative D signal timings. In 2015, with the implementation of the improvements associated with Alternative D, some of the intersections experience degradation of one letter grade, but still operate at an acceptable level of service D or better. However, north-south pedestrian movements at Connecticut Avenue and K Street, and at 17th Street and K Street, still operate at LOS F.

TABLE 3-7
Pedestrian Level of Service

2003 Existing

Intersection	N-S Street: Name	Location	LOS AM	LOS MD	LOS PM	Location	LOS AM	LOS MD	LOS PM	E-W Street: Name	Location	LOS AM	LOS MD	LOS PM	Effective Green	LOS AM	LOS MD	LOS PM
	Peds traveling	West Side				East Side				Peds traveling	North Side				South Side			
Wisconsin Ave and M St	N/S on Wisconsin Ave	West Side	C	C	C	East Side	D	D	C	E/W on M St	North Side	C	C	B	South Side	C	C	B
24th St and Pennsylvania Ave	N/S on 24th St	West Side	C	C	C	East Side	C	C	C	E/W on Penn. Ave	North Side	A	A	A	South Side	A	A	A
20th St and K St	N/S on 20th St	West Side	C	C	C	East Side	C	C	C	E/W on K St	North Side	B	B	B	South Side	B	B	B
19th St and K St	N/S on 19th St	West Side	C	D	C	East Side	C	D	C	E/W on K St	North Side	B	A	B	South Side	B	B	B
18th St and K St	N/S on 18th St	West Side	C	C	C	East Side	C	C	C	E/W on K St	North Side	B	B	B	South Side	B	B	B
Connecticut Ave and K St	Connecticut Avenue	West Side	C	C	C	East Side	B	B	B	E/W on K St	North Side	C	C	C	South Side	B	B	B
Time-Space Analysis	***Peds traveling***	***Location***				***Location***				***Peds traveling***	***Location***				***Location***			
Crosswalk Space on Major/Minor Streets	*Connecticut Avenue*	*West Side*	*F*	*F*	*F*	*East Side*	*C*	*A*	*B*	*K St*	*North Side*	*C*	*D*	*C*	*South Side*	*A*	*A*	*A*
Corner Circulating Space	*Around corners*	*NE*	*B*	*B*	*B*	*SE*	*C*	*C*	*C*	*Around Corners*	*NW*	*A*	*A*	*A*	*SW*	*A*	*A*	*A*
Connecticut Ave and K St (Service Rd)	Connecticut Avenue	N/A	N/A	N/A	N/A	N/A	A	A	A	N/A	North Side	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17th St and K St	N/S on 17th St	West Side	C	C	C	East Side	C	C	C	E/W on K St	North Side	C	C	C	South Side	C	C	C
Time-Space Analysis	***Peds traveling***	***Location***				***Location***				***Peds traveling***	***Location***				***Location***			
Crosswalk Space on Major/Minor Streets	*17th St*	*West Side*	*C*	*B*	*C*	*East Side*	*F*	*F*	*F*	*K St*	*North Side*	*C*	*C*	*C*	*South Side*	*A*	*B*	*B*
Corner Circulating Space	*Around corners*	*NE*	*A*	*A*	*A*	*SE*	*A*	*A*	*A*	*Around Corners*	*NW*	*A*	*A*	*A*	*SW*	*B*	*B*	*A*
16th St and K St	N/S on 16th St	West Side	C	C	C	East Side	C	C	C	E/W on K St	North Side	C	C	C	South Side	C	C	C
14th St and K St	N/S on 14th St	West Side	C	C	B	East Side	B	B	B	E/W on K St	North Side	C	C	C	South Side	C	C	C
N. Capitol St and Massachusetts Ave	N/S on N. Capitol St	West Side	C	C	C	East Side	C	C	C	E/W on Mass. Avenue	North Side	C	C	D	South Side	C	C	C

2015 Future

Intersection	N-S Street: Name	Location	LOS AM	LOS MD	LOS PM	Location	LOS AM	LOS MD	LOS PM	E-W Street: Name	Location	LOS AM	LOS MD	LOS PM	Effective Green	LOS AM	LOS MD	LOS PM
	Peds traveling	West Side				East Side				Peds traveling	North Side				South Side			
Wisconsin Ave and M St	N/S on Wisconsin Ave	West Side	C	C	C	East Side	D	D	C	E/W on M St	North Side	C	C	B	South Side	C	C	B
24th St and Pennsylvania Ave	N/S on 24th St	West Side	C	C	C	East Side	C	C	C	E/W on Penn. Ave	North Side	A	A	A	South Side	A	A	A
20th St and K St	N/S on 20th St	West Side	D	C	C	East Side	D	C	C	E/W on K St	North Side	B	B	B	South Side	B	B	B
19th St and K St	N/S on 19th St	West Side	C	D	C	East Side	C	D	C	E/W on K St	North Side	B	B	B	South Side	B	C	C
18th St and K St	N/S on 18th St	West Side	C	C	C	East Side	C	C	C	E/W on K St	North Side	B	B	B	South Side	B	B	B
Connecticut Ave and K St	Connecticut Avenue	West Side	C	C	C	East Side	B	B	B	E/W on K St	North Side	C	C	C	South Side	B	B	B
Time-Space Analysis	***Peds traveling***	***Location***				***Location***				***Peds traveling***	***Location***				***Location***			
Crosswalk Space on Major/Minor Streets	*Connecticut Avenue*	*West Side*	*F*	*F*	*F*	*East Side*	*C*	*A*	*B*	*K St*	*North Side*	*C*	*D*	*C*	*South Side*	*A*	*A*	*A*
Corner Circulating Space	*Around corners*	*NE*	*B*	*B*	*B*	*SE*	*C*	*C*	*C*	*Around Corners*	*NW*	*A*	*A*	*A*	*SW*	*A*	*A*	*A*
Connecticut Ave and K St (Service Rd)	Connecticut Avenue	N/A	N/A	N/A	N/A	N/A	A	A	A	N/A	North Side	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17th St and K St	N/S on 17th St	West Side	C	C	C	East Side	C	C	C	E/W on K St	North Side	C	C	C	South Side	C	C	C
Time-Space Analysis	***Peds traveling***	***Location***				***Location***				***Peds traveling***	***Location***				***Location***			
Crosswalk Space on Major/Minor Streets	*17th St*	*West Side*	*C*	*B*	*D*	*East Side*	*F*	*F*	*F*	*K St*	*North Side*	*C*	*C*	*C*	*South Side*	*A*	*B*	*B*
Corner Circulating Space	*Around corners*	*NE*	*A*	*A*	*A*	*SE*	*A*	*A*	*A*	*Around Corners*	*NW*	*A*	*A*	*A*	*SW*	*B*	*B*	*A*
16th St and K St	N/S on 16th St	West Side	C	C	C	East Side	C	C	C	E/W on K St	North Side	C	C	C	South Side	C	C	B
14th St and K St	N/S on 14th St	West Side	C	C	C	East Side	B	B	B	E/W on K St	North Side	D	C	C	South Side	B	B	B
N. Capitol St and Massachusetts Ave	N/S on N. Capitol St	West Side	C	C	C	East Side	C	C	C	E/W on Mass. Avenue	North Side	C	C	D	South Side	C	C	C

3-6.3. QUALITATIVE ASSESSMENTS

The evaluation of alternatives was not limited to quantitative analyses. There are a number of issues that cannot be evaluated through the use of a simulation model. In addition to quantitative factors, the following factors were evaluated:

- **Transit Ridership Impacts –** Transit ridership impact is defined as the ability of the alternative to attract new riders to the transit system.

- **Transit Reliability –** Transit reliability is defined as the ability of buses to provide on-time performance. Factors impacting this ability include the number of buses provided in the service plan, length of sections with exclusive right-of-way for transit and interaction between buses and non-bus vehicles.

- **Transit System Clarity –** Transit system clarity is reflected by the ease of use for riders. Factors influencing transit system clarity include the number of bus stops, location and design of bus stations, information provided to passengers, transit vehicular identity and ease of ticketing/boarding.

- **Pedestrian Safety –** Pedestrian safety is impacted by crosswalk location and length, pedestrian WALK time at signalized intersections, interaction with vehicles and median location/placement.

- **Vehicular Safety –** For this study, the main consideration with respect to vehicular safety is interaction of buses and non-bus traffic. The amount of interaction is controlled by exclusive bus facilities. Additional factors influencing vehicular safety include the number of travel lanes provided, the location of parking facilities and preclusion of illegal movements.

- **Transit Access to Adjacent Land Uses –** The convenience of access to adjacent land uses, such as Metro stations, tourist destinations and business destinations is an important evaluation factor in choosing the number of bus stops and their location.

- **Effects on Parking and Loading –** This factor is impacted by the number of parking and loading spaces that will be lost as a result of implementing a particular alternative.

- **Light Rail Operations –** The ability to convert the particular alternative from bus rapid transit to light rail transit and the effectiveness of light rail operations.

As shown in Table 3-8, all of the studied alternatives provide improvement over the No-Build scenario, which maintains current roadway configurations and service. It can be seen that Alternative D ranks highest (or tied for highest) out of the studied alternatives in all categories with the exception of two. The categories where Alternative D does not score the highest mark are transit access to adjacent land uses and effects on parking and loading. Alternative D loses

Table 3-8
Qualitative Evaluation Summary

	2015 NO BUILD	ALTERNATIVE A	ALTERNATIVE B	ALTERNATIVE C	ALTERNATIVE D	ALTERNATIVE E	ALTERNATIVE F	ALTERNATIVE G	ALTERNATIVE H
Transit Ridership Impacts	○	◔	◓	◕	●	◔	◕	◕	◓
Transit Reliability	○	◔	◓	◕	●	◔	●	◕	◓
Transit System Clarity	○	◓	◓	◕	●	◓	◕	◕	◓
Pedestrian Safety	◔	◕	◕	◕	●	◓	●	●	●
Vehicular Safety	◔	◓	◕	●	●	◓	◕	◕	◕
Transit Access to Adjacent Land Uses	○	◓	◓	●	◕	◓	◓	◓	◓
Effects on Parking and Loading	◕	●	◕	○	○	○	○	◓	●
Light Rail Operations	N/A	●	●	●	●	●	●	●	◓

○ Poor → ● Good

points for transit access due to the reduced service plan and number of bus stops along the K Street Transitway. Alternative D also requires the elimination of numerous parking and loading spaces in all three sections of the study area.

Alternatives D and F were found to provide the greatest level of transit reliability of all the alternatives. The reduced service plan involving fewer buses per hour and reduced number of stops, and the provision of exclusive bus lanes in all three sections of the corridor (Georgetown, Central and Union Station) are expected to provide the best opportunity for buses to maintain their scheduled headways. The reduced number of routes and stops will also improve the clarity of the transit system. Alternative G, which has the same service plan and lane configuration in the center section as Alternative F, but eliminates exclusive bus lanes in Georgetown, ranked second in transit reliability and transit system clarity.

The reconfiguration of K Street to introduce curbside or median busway lanes presents an improvement to pedestrian safety. Currently, with the medians/pedestrian refuge islands located where they are, with only the service roadway separating them from the sidewalk, there is a tendency for pedestrians to cross the service road when they do not have a Walk or Flashing Don't Walk signal. With the implementation of a median busway, the medians will be closer to the centerline of K Street, with three lanes of faster-moving traffic (than the existing service roads) separating pedestrians on the median from the sidewalk. Fewer pedestrians will be inclined to cross against the signal under a reconfigured K Street with a median busway. The introduction of curbside lanes would improve safety for pedestrians by reducing the width of K Street that needs to be crossed by pedestrians.

The reduced service plan of Alternatives D, F and G will improve pedestrian safety, as there will be pedestrians in the K Street median in fewer locations than under the original service plan of Alternatives A through C. The placement of the bus stops on the medians for Alternatives A through G is a pedestrian safety concern; as passengers waiting for the bus would have moving traffic behind them. If a median busway alternative were to be selected for implementation, architectural treatments would have to be constructed to protect the bus passengers waiting from the bus from the moving vehicles along K Street. Alternative H reduces the width of K Street and provides bus stops on the sidewalk rather than the median, which is also expected to have a positive impact on pedestrian safety.

With respect to vehicular safety, the Study Team found that Alternatives C and D provide the greatest level. This level of safety is due to the exclusive bus lanes on M Street, Pennsylvania Avenue and Massachusetts Avenue, which remove buses from other traffic lanes. Alternatives G and H rank second in terms of vehicular safety. The implementation of Alternative H, however, with its curbside bus lanes, could potentially result in degradation in vehicular safety as a result of the interaction between vehicles entering and exiting parking garages and alleys and the buses traveling on the bus lanes.

Additionally, existing, illegal left turns from the K Street main roadway into parking garages along K Street would not be possible under any of the studied alternatives. The inability to make

these illegal left turns would affect operations at eight parking garages/alleys along K Street, but would improve pedestrian and vehicular safety. Pedestrian operations and safety would improve because the busway configuration would inhibit U-turns at signalized intersections along K Street.

Alternative H was found to have the least effect on parking and loading, due to providing all-day parking and loading throughout the K Street corridor, as well as maintaining parking on M Street and Pennsylvania Avenue due to not implementing an exclusive bus lane on these streets. Alternatives C through F eliminate most peak period parking on K Street as well as parking on eastbound M Street and Pennsylvania Avenue. Therefore, they would have the most negative effects on parking and loading.

The provision of a dedicated busway across Farragut Square under Alternatives F, G and H improves transit ridership impacts, as well as transit reliability and clarity, while the prohibition of right turns at this location under Alternatives F, G and H improve pedestrian and vehicular safety when compared to Alternative E.

All of the median busway alternatives (Alternatives A through G) would more easily convert to light rail transit (LRT) operation than the curbside bus lanes of Alternative H. These median busway alternatives offer exclusive transit right of way, which is more conducive to LRT operations. The curbside bus lanes of Alternative H do not preclude conversion to LRT operation, however. Some cities allow LRT facilities to share right-of-way with non-transit vehicles, requiring passenger vehicles to yield to LRT vehicles. However, this configuration is viewed as less than optimal for transit and non-transit operations.

3-6.4. 3-D ANIMATION MODEL

As part of this project, the Study Team took the VISSIM simulation for the PM Alternative D scenario and developed a 3-D animation model. The 3-D animation was provided to DDOT and WMATA on DVD. The animation shows how the K Street Transitway is expected to operate during the 2015 PM peak hour under Alternative D. All aspects of the K Street Transitway are shown in the animation, including but not limited to: a reconfigured K Street, exclusive bus lanes, architectural elements of the bus stations, boarding/alighting procedures, pavement markings, traffic operations and interactions between pedestrians and vehicles. The animation follows one bus as it passes east to west through the K Street Transitway. A glimpse of potential future LRT use of the K Street Transitway is also provided in the animation.

3-7. RIDERSHIP FORECASTING

Bus ridership growth in the study area will come from the addition of new bus service as well as growth on existing bus routes. New bus service in the corridor will be provided by the proposed Downtown Circulator. Upon implementation, this service is anticipated to add approximately 9,200 weekday riders across each of the four study screenlines shown in Figure 3-43. Half of

this ridership would be split between the morning and evening peak periods, with the other half occurring during the remainder of the service day.

Ridership growth between 2003 and 2015 was estimated based on projected changes in population and employment in and near the study area. Data on population and employment is compiled by the Metropolitan Washington Council of Governments (MWCOG) based on geographic units called transportation analysis zones (TAZs). MWCOG compiles this data for use in travel demand forecasting for the region. Existing population and employment data is based on US Census data, while future year data is cooperatively developed by planning staff from all of the jurisdictions in the metropolitan area.

A subset of TAZs in and near the K Street Transitway study area was identified for purposes of determining appropriate growth rates. The subset of TAZs used for the analysis performed for this study is highlighted in yellow in Figure 3-44. Table 3-9 summarizes the population and employment for these TAZs for the years 2000 and 2025. As Table 3-9 shows, total growth for both population and employment for the TAZs in and near the study area is anticipated to be approximately 23 percent between 2000 and 2025. This represents an annual growth rate of approximately 0.9 percent per year with compounding.

Figure 3-43
Screenline Locations

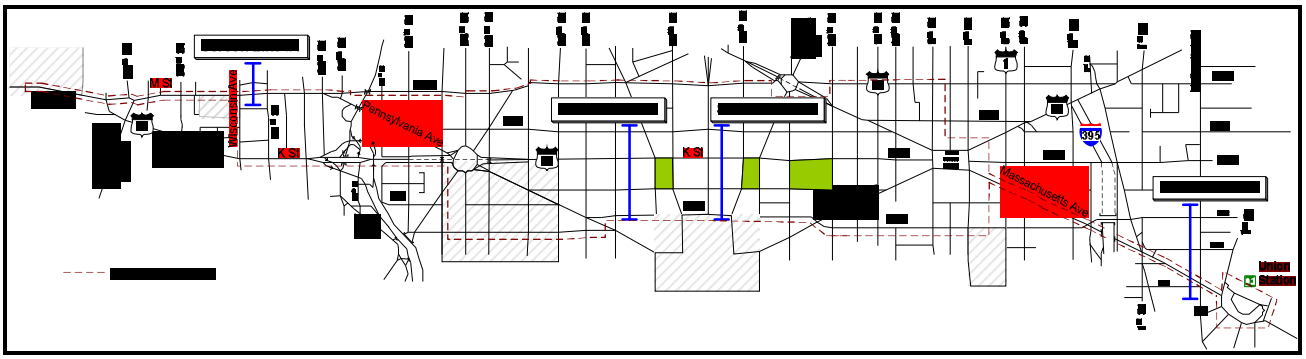


Figure 3-44
MWCOG Transportation Analysis Zones Used in Analysis

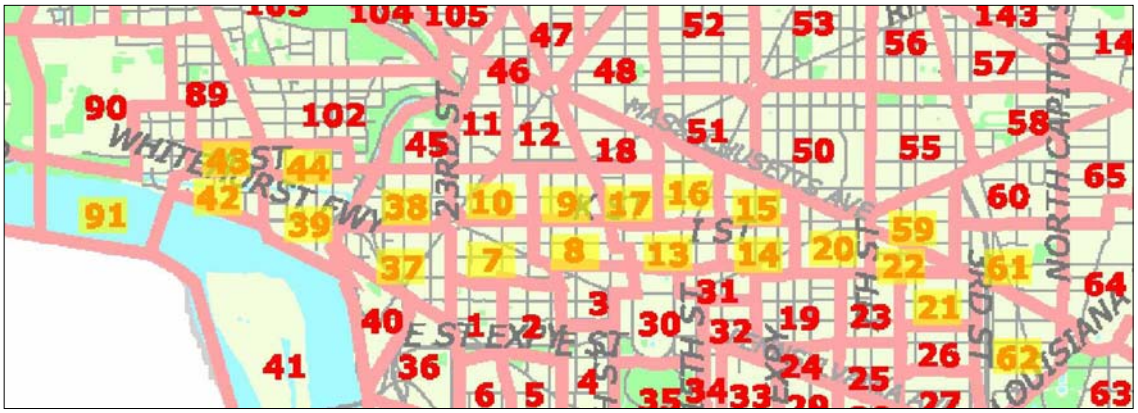


Table 3-9
2000 and 2025 Population and Employment In and Near Study Area

Transportation Analysis Zone	Population				Employment			
	2000	2025	Absolute Growth	Growth Ratio	2000	2025	Absolute Growth	Growth Ratio
7	1,678	1,906	228	1.14	7,732	8,622	890	1.12
8	0	0	0	N/A	18,322	18,322	0	1.00
9	4	5	1	1.25	23,735	23,735	0	1.00
10	1,038	1,329	291	1.28	10,391	10,391	0	1.00
13	0	0	0	N/A	16,882	16,882	0	1.00
14	0	0	0	N/A	5,308	8,067	2,759	1.52
15	1,211	1,483	272	1.22	8,081	10,330	2,249	1.28
16	954	1,216	262	1.27	20,436	21,436	1,000	1.05
17	46	64	18	1.39	15,581	15,581	0	1.00
20	134	132	-2	0.99	2,302	12,234	9,932	5.31
21	237	295	58	1.24	5,786	8,590	2,804	1.48
22	1,131	1,380	249	1.22	446	4,350	3,904	9.75
37	3,275	4,164	889	1.27	725	1,381	656	1.90
38	1,746	2,194	448	1.26	3,627	3,627	0	1.00
39	310	393	83	1.27	5,212	5,615	403	1.08
42	531	683	152	1.29	3,208	3,842	634	1.20
43	403	510	107	1.27	1,254	1,254	0	1.00
44	374	481	107	1.29	1,358	1,358	0	1.00
59	700	862	162	1.23	2,209	7,530	5,321	3.41
61	906	1,084	178	1.20	6,991	10,566	3,575	1.51
62	1,321	1,469	148	1.11	9,266	14,789	5,523	1.60
91	593	745	152	1.26	497	497	0	1.00
TOTALS	**16,592**	**20,395**	**3,803**	**1.23**	**169,349**	**208,999**	**39,650**	**1.23**

Source: Metropolitan Washington Council of Governments

3-7.1. INCREASED RIDERSHIP FROM SERVICE IMPROVEMENTS

The service improvements that the K Street Transitway would provide will increase bus ridership in the K Street Corridor. Changes in ridership based on changes in either transit fares or services are often calculated at a planning-level using the concept of elasticity of demand. Using this concept, the percent changes in ridership can be related to the percent changes in service change using a numeric constant that is determined based on actual data from transit services around the world. This numeric constant is termed a transit service elasticity. A full discussion of transit elasticities and their application is in **Patronage Impacts of Changes in Transit Fares and Services** (prepared for the Urban Mass Transportation Administration by Ecosometrics, Inc.).

Elasticities for transit service improvements are inelastic, meaning, for example, that a 10 percent increase in service will result in an increase in ridership of less than 10 percent. Travel time elasticities vary by type of service (bus, rapid rail, etc.), time of day, and numerous other variables. Ridership elasticities (from Table S-2 in **Patronage Impacts of Changes in Transit Fares and Services)** range from 0.68 ± 0.32 to 0.29 ± 0.13 based on in-vehicle travel times, from 0.26 to 0.14 based on walk times, and from 0.21 to 0.54 based on wait-times.

Implementing service changes on K Street will improve transit travel times (for most routes) and will also affect walking times and wait times. For purposes of this planning-level analysis a single elasticity was used based on estimates of changes in in-vehicle travel times. The elasticity value used was 0.75, which, given the wide range of trip purposes and lengths of the origin-destination movements that would use the facility, was judged to provide estimates that would be somewhat aggressive. This elasticity indicates that for every 1 percent improvement in service time, a ridership increase of 0.75 percent could be expected.

Bus travel times were calculated using computerized micro-simulation techniques that account for many operational variables, including bus operations, traffic congestion, and traffic signal operations (this analysis process is documented elsewhere). These travel times were calculated for both AM and PM peak conditions in the year 2015 for both a no-build scenario where no busway improvements are assumed as well as two build conditions (Build Alternatives G and H). Table 3-10 shows the estimated change in travel time between the no-build and build conditions for each of the 17 WMATA bus routes as well as the Georgetown Shuttle and the proposed Downtown Circulator.

3-7.2. INCREASED RIDERSHIP FROM AMENITIES AND IDENTITY/IMAGE

Apart from service improvements, passenger amenities, both at transit stops and on vehicles also increase transit ridership. For example, amenities that enhance the waiting environment are seating, attractive shelters, lighting of shelter and adjacent areas and special features for people with disabilities. In addition, the passenger information resources at stops (e.g. maps, schedules, bus arrival variable message signs and the identity and image of the facility and stations) can be expected to add ridership.

Table 3-10
Estimated Changes in Travel Time and Ridership by Bus Route

Bus Route	Percent Improvement in Travel Time						Estimated Change in Percent Ridership					
	Alternative G			Alternative H			Alternative G			Alternative H		
	AM	PM	Off-Peak	AM	PM	Off-Peak	AM	PM	Off-Peak	AM	PM	Off-Peak
11Y	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
16Y	4.20%	13.53%	2.66%	1.46%	11.08%	1.88%	3.15%	10.15%	1.99%	1.09%	8.31%	1.41%
30,32,34,35,36	25.98%	26.92%	7.94%	15.96%	22.83%	5.82%	19.49%	20.19%	5.95%	11.97%	17.12%	4.36%
38B (extended)	11.96%	2.38%	2.15%	6.63%	1.12%	1.16%	8.97%	1.79%	1.61%	4.97%	0.84%	0.87%
42	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
80	6.51%	7.99%	2.18%	3.08%	5.99%	1.36%	4.88%	5.99%	1.63%	2.31%	4.49%	1.02%
96	3.00% *	3.00% *	0.90% *	3.00% *	3.00% *	0.90% *	2.25%	2.25%	0.68%	2.25%	2.25%	0.68%
D1,D3,D6	6.60%	12.32%	2.84%	6.06%	9.35%	2.31%	4.95%	9.24%	2.13%	4.54%	7.01%	1.73%
D5	14.36% *	24.19% *	5.78% *	14.65% *	21.10% *	5.36% *	10.77%	18.15%	4.34%	10.99%	15.82%	4.02%
G8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
L2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
N7[1]	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
P17,P19	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
S1	3.00% *	3.00% *	0.90% *	3.00% *	3.00% *	0.90% *	2.25%	2.25%	0.68%	2.25%	2.25%	0.68%
S2,S4	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
W13	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
X2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Downtown Circulator	26.46%	28.72%	8.28%	15.43%	23.49%	5.84%	19.84%	21.54%	6.21%	11.58%	17.62%	4.38%
Georgetown Shuttle	5.37%	4.47%	1.47%	2.80%	2.71%	0.83%	4.02%	3.35%	1.11%	2.10%	2.03%	0.62%

* Generalized estimates in travel time changes; travel time simulations were not performed for these routes.

[1] Route N7 was eliminated on December 28, 2003. The analyses for this study were completed prior to the elimination of this route.

Similarly, the vehicle environment (e.g. low floor, multiple double-stream doors, premium seating, on-vehicle information displays, and security cameras) can also be expected to add ridership.

The image and identity of the K Street Transitway and ancillary equipment and facilities are particularly important in increasing ridership for non-home-based visitor (e.g. tourists, convention attendees) trip most prevalent on the Circulator.

Based on review of nationwide studies conducted on the impact of amenities on transit ridership, the Study Team concluded that these amenities, identity, image, and information advantages should result in a ten percent increase compared to 2015 No Build for the circulator[1] with a two percent gain in transit ridership for other routes using the busway[2].

3-7.3. INCREASED RIDERSHIP FROM EXTENSION OF SERVICE

The transit service plan, under the preferred alternative includes an extension of Route 38B from its existing terminus to the new Convention Center. This route extension will generate additional ridership on this route. Because the Convention Center is a large trip generator, and because of the additional service to the eastern part of the CBD, the Study Team factored 38B ridership upward by 15 percent to reflect the additional CBD destinations with improved 38B access[3].

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[1] Metro-Dade Transit Agency (from Part 2 of **The Role of Transit Amenities and Vehicle Characteristics in Building Transit Ridership: Amenities for Transit Handbook and The Transit Design Game Workbook, TRB, 1999**) in Miami experienced a 9.6% increase in ridership between 1991 and 1993. This was attributed to increasing "customer service orientation" (walkways, shelters, safer pedestrian access, new benches, etc.) and use of mini-buses to provide more "cost effective and comfortable service".

SCAT System, Sarasota, FL (from Figure 2 of **TCRP Research Results Digest, No. 4, February 1995, TRB**) experienced 9.4% increase in transit ridership between 1991and 1993 due to changes in service routes, schedule adjustments, and vehicle improvements.

[2] Based on the research provided in the Transit Design Game Workbook (**The Role of Transit Amenities and Vehicle Characteristics in Building Transit Ridership: Amenities for Transit Handbook and The Transit Design Game Workbook, TRB, 1999**) it was calculated amenities increased ridership in the case study cities by about 1.5 to 3 percent. Case Studies studied the effect of Low Floor Buses, Commuter Buses, Transit Mall Shelters and Main Street Transit Shelters.

Metro-North System, New York, NY (from Figure 2 of **TCRP Research Results Digest, No. 4, February 1995, TRB**) experienced 3.7% increase in transit ridership between 1991 and 1993 due to better reliability, amenities, increased LOS, feeder service and expanded parking services.

[3] After the completion of the analyses for this study, a decision was made not to extend Route 38B to the Convention Center.

3-7.4. TOTAL RIDERSHIP

Expected ridership by bus route is shown in Table 3-11[1,2]. The 2015 No-Build ridership is based on expected growth in ridership between 2003 and 2015 of 0.9 percent per year compounded (this growth rate is based on the anticipated changes in population and employment described previously). Year 2015 Build ridership estimates anticipate further increases in ridership based on improved transit service, amenities and extension of service. These estimates were calculated taking into consideration the effects of travel time savings, the impacts of improved amenities and extension of service for selected routes. The travel time differences used a transit service elasticity of 0.75. The transit ridership adjustment to account for better amenities was 10 percent for the circulator and 2 percent for other buses on the busway.

[1] Detailed bus ridership calculations are presented in Appendix M.
[2] Route N7 was eliminated on December 28, 2003. This route is shown in Table 3-11 because the analyses for this study were completed prior to the elimination of this route.

Table 3-11
Estimated Year 2015 No-Build and Build Ridership

Bus Route(s)	Street	Year 2015 No-Build Ridership AM	PM	Off-Peak	Total	2015 Alternative G Ridership AM	PM	Off-Peak	Total	2015 Alternative H Ridership AM	PM	Off-Peak	Total
Screenline 1: M Street just east of Wisconsin Avenue													
30,32,34,35,36	M St	1,009	764	4,117	5,890	1,226	934	4,444	6,604	1,150	910	4,379	6,439
38B	M St	120	118	812	1,050	151	140	963	1,254	146	139	957	1,243
D5	M St	101	62	67	230	108	66	68	242	108	66	68	242
Georgetown Shuttle	M St	504	840	336	1,680	524	868	340	1,732	515	857	338	1,710
Downtown Circulator	M St	2,576	2,576	5,152	10,304	3,345	3,388	5,987	12,720	3,132	3,287	5,893	12,312
Total Screenline 1:		4,310	4,360	10,484	19,154	5,354	5,396	11,802	22,553	5,051	5,260	11,635	21,945
Screenline 2: H, I, K, and L Streets just west of Connecticut Avenue/17th Street													
11Y	H&I St	17	11	25	53	17	11	25	53	17	11	25	53
D5	H&I St	97	48	56	201	104	51	57	212	104	51	57	212
L2	I&L St	116	90	320	526	116	90	320	526	116	90	320	526
N7	I&L St	41	34	48	123	41	34	48	123	41	34	48	123
16Y	K St	27	40	111	178	28	45	115	189	28	44	115	187
30,32,34,35,36	K St	1,068	851	4,375	6,294	1,297	1,040	4,723	7,060	1,217	1,014	4,653	6,884
38B(extends to Conv Ctr)	K St	113	139	566	818	142	165	671	979	138	164	667	969
80	K St	296	318	1,145	1,759	316	343	1,187	1,846	309	339	1,180	1,827
D1,D3,D6	K St	622	493	1,820	2,935	665	548	1,895	3,109	663	537	1,888	3,088
Downtown Circulator	K St	2,576	2,576	5,152	10,304	3,345	3,388	5,987	12,720	3,132	3,287	5,893	12,312
S1	K&L St	533	209	232	974	556	218	239	1,012	556	218	239	1,012
Total Screenline 2:		5,506	4,809	13,850	24,165	6,628	5,934	15,267	27,830	6,320	5,789	15,084	27,194
Screenline 3: H, I, K, and L Streets just west of 15th Street/Vermont Avenue													
11Y	H&I St	34	28	54	116	34	28	54	116	34	28	54	116
42	H&I St	87	130	1,328	1,545	87	130	1,328	1,545	87	130	1,328	1,545
D5	H&I St	97	48	56	201	107	57	58	223	108	56	58	222
G8	H&I St	188	220	242	650	188	220	242	650	188	220	242	650
L2	H&I St	116	90	320	526	116	90	320	526	116	90	320	526
P17,P19	H&I St	67	62	202	331	67	62	202	331	67	62	202	331
S2,S4	H&I St	1,085	1,072	1,483	3,640	1,085	1,072	1,483	3,640	1,085	1,072	1,483	3,640
W13	H&I St	39	34	57	130	39	34	57	130	39	34	57	130
X2	H&I St	215	217	625	1,057	215	217	625	1,057	215	217	625	1,057
N7	I&L St	41	34	48	123	41	34	48	123	41	34	48	123
16Y	K St	8	19	75	102	8	21	78	108	8	21	78	107
30,32,34,35,36	K St	1,068	851	4,375	6,294	1,297	1,040	4,723	7,060	1,217	1,014	4,653	6,884
38B(extends to Conv Ctr)	K St	113	139	566	818	142	165	671	979	138	164	667	969
80	K St	296	318	1,145	1,759	316	343	1,187	1,846	309	339	1180	1,827
D1,D3,D6	K St	622	493	1,820	2,935	665	548	1,895	3,109	663	537	1888	3,088
Downtown Circulator	K St	2,576	2,576	5,152	10,304	3,345	3,388	5,987	12,720	3,132	3,287	5,893	12,312
Total Screenline 3:		6,652	6,331	17,548	30,531	7,754	7,450	18,958	34,163	7,446	7,305	18,776	33,527
Screenline 4: Massachusetts Avenue and H Street just west of North Capitol Street													
D1,D3,D6	E St	391	373	2,165	2,929	418	415	2,254	3,087	417	407	2,246	3,069
X2	H St	673	788	6,336	7,797	673	788	6,336	7,797	673	788	6,336	7,797
80	Mass Ave	361	344	1,557	2,262	386	371	1,614	2,371	377	366	1,604	2,347
96	Mass Ave	119	81	815	1,015	122	83	823	1,028	122	83	823	1,028
Downtown Circulator	Mass Ave	2,576	2,576	5,152	10,304	3,345	3,388	5,987	12,720	3,132	3,287	5,893	12,312
Total Screenline 4:		4,120	4,162	16,025	24,307	4,944	5,046	17,014	27,004	4,720	4,931	16,902	26,553

4. SUMMARY OF FINDINGS AND RECOMMENDATIONS

This section of the report summarizes the primary findings and recommendations of the study[1]. The two feasible alternatives are Alternatives G and H. These alternatives require no land to be obtained from Farragut Square. Alternative G provides a center-median busway along K Street, while Alternative H provides curbside exclusive bus lanes along K Street. Both feasible alternatives provide exclusive bus lanes in each direction of Massachusetts Avenue between H Street and 1st Street NE. Neither feasible alternative provides exclusive bus lanes on eastbound M Street or Pennsylvania Avenue.

4-1. RIDERSHIP ESTIMATES FOR FEASIBLE ALTERNATIVES

Existing ridership at the four screenline locations in the study area, described in Table 4-1, ranges from 7,900 passengers per day on M Street at Screenline 1 to over 17,000 passengers per day at Screenline 3. With growth in ridership on existing lines plus the addition of the Downtown Circulator, the No-Build scenario is expected to experience ridership levels of between 19,000 and 30,500 passengers per day in 2015. Under Alternatives G and H, travel time improvements, along with better amenities and extension of service resulting from implementing the busway, ridership is expected to further increase to between 22,000 and 34,000 passengers per day, approximately doubling transit ridership in the corridor over existing levels.

Table 4-1
Summary of Ridership at Screenline Locations

Location		Weekday Ridership Estimates					
		2003 Existing Conditions	2015 No-Build	2015 Alternative G		2015 Alternative H	
				Ridership	Percentage Increase vs No-Build	Ridership	Percentage Increase vs No-Build
Screenline 1: M Street just east of Wisconsin Avenue	M St	7,901	19,154	22,253		21,945	
	TOTAL	7,901	19,154	22,253	16%	21,945	15%
Screenline 2: H, I, K, and L Streets just west of Connecticut Avenue / 17th Street	K St	11,569	23,262	26,916		26,280	
	H,I,L Sts	807	903	914		914	
	TOTAL	12,376	24,165	27,830	15%	27,194	13%
Screenline 3: H, I, K, and L Streets just west of 15th Street / Vermont Avenue	K St	9,901	22,212	25,822		25,187	
	H,I,L Sts	7,248	8,319	8,341		8,340	
	TOTAL	17,149	30,531	34,163	12%	33,527	10%
Screenline 4: Massachusetts Avenue, E Street, and H Street just west of North Capitol Street	Mass Ave	2,925	13,581	16,119		15,687	
	E,H Sts	9,577	10,726	10,884		10,866	
	TOTAL	12,502	24,307	27,003	11%	26,553	9%

[1] The Study Team presented preliminary findings and recommendations of the study to citizens during public meetings held on December 8 and 11, 2003. Meeting minutes and material used in the meetings are presented in Appendix N.

4-2. BUSWAY/BUS LANE ALIGNMENTS/ROADWAY MODIFICATIONS

The Study Team found Alternatives G and H to be the most feasible alternatives for implementation. These alternatives require no land to be obtained from Farragut Square. Alternative G provides a center-median busway along K Street, while Alternative H provides curbside exclusive bus lanes along K Street. Both feasible alternatives provide exclusive bus lanes in each direction of Massachusetts Avenue between H Street and 1st Street NE. Neither feasible alternative provides exclusive bus lanes on eastbound M Street or Pennsylvania Avenue.

Roadway modifications required for the implementation of either feasible alternative are:

- Contra-flow eastbound bus lane between 10th and 9th Streets.
- Contra-flow northbound bus lanes on K Street between New York Avenue and Massachusetts Avenue or convert 10th Street between K Street and Massachusetts Avenue to two-way operations.
- Contra-flow bus lane on 15th Street between K and H Streets.
- Two-Way 17th Street north of K Street during all times of the day.
- Prohibit right turns from westbound K Street to northbound Connecticut Avenue between 7:00 AM and 7:00 PM on weekdays.
- Change the westbound right turn lane of K Street at Connecticut Avenue to a shared through/right lane.
- Prohibit parking on the westbound curb lane of K Street (north side of the street) between Connecticut Avenue and 18th Street between 7:00 AM and 7:00 PM on weekdays to provide a receiving lane for the through movements on westbound K Street[1].
- Convert the westbound curb lane on K Street (north side of the street) between Connecticut Avenue and 18th Street from a through-right lane to an exclusive right turn lane (right turn only at 18th Street).

4-2.1. FEASIBLE MEDIAN BUSWAY ALTERNATIVE: ALTERNATIVE G

Alternative G, as shown in Figure 3-41, provides an exclusive median busway in the central section of the study area. Alternative G provides one center-median bus lane in each direction between 9th and 21st Streets. Alternative G generally provides three peak period general traffic travel lanes and one bus lane in each direction of K Street between 21st Street and Connecticut Avenue. Due to the reduced width of K Street at Farragut Square, K Street is shifted to the north between 18th Street and Connecticut Avenue. A six-lane cross-section is provided between Connecticut Avenue and 17th Street, with one exclusive bus lane in each direction and two non-bus travel lanes in each direction, separated by medians. Continuing eastbound on K Street, the cross-section would shift back to the south in the block between 17th and 16th Streets.

In order to provide this cross-section on K Street, and to improve pedestrian safety, the existing westbound exclusive right turn lane at Connecticut Avenue would be converted into a shared through/right lane. Due to the high existing right turn volume at this intersection, right turns

from westbound K Street to Connecticut Avenue would be prohibited between the hours of 7:00 AM and 7:00 PM. As a result, 17th Street would be converted to two-way operation at all times. This alternative requires no land to be acquired from Farragut Square. Detailed lane configurations and cross sections of Alternative G are presented in Appendix O.

In the Central Section of the study area, parking during the AM peak and PM peak periods is provided on K Street only between 9th and 10th Street (north side); between 12th and 13th Street (both sides); between 14th Street and Vermont Avenue (both sides); between Vermont Avenue and 15th Street (north side); between 16th and 17th Streets (south side); and between Connecticut Avenue and 18th Street (south side). Off-peak parking and unloading is provided throughout most of the corridor. Alternative G has the reduced transit service plan shown in Figure 3-20.

Under this alternative, an exclusive all-day bus lane would be provided in both directions of Massachusetts Avenue between H Street and 1st Street NE. The bus lane would be a curbside bus lane which would be shared with right turning vehicles at intersections. The provision of the all-day bus lane would require the elimination of 53 parking spaces. Alternative G provides no exclusive bus lanes on M Street or Pennsylvania Avenue, and no Circulator service to Georgetown University.

Thus, the characteristics of this alternative are as follows:

- Median busway between Washington Circle and Mount Vernon Square.
- No widening at Farragut Square, precluding the need to acquire an eight-foot strip of land from the National Park Service.
- No right turns allowed from westbound K Street to northbound Connecticut Avenue between the hours of 7:00 AM and 7:00 PM.
- Convert 17th Street to two-way operation.
- Exclusive curbside bus lanes on Massachusetts Avenue between H Street and 1st Street NE.
- Midday/evening/night parking on curb lane of K Street between Washington Circle and Mount Vernon Square. No parking during peak periods (7 AM to 9:30 AM and 4 PM to 6:30 PM) except where described above.
- No parking or loading on Massachusetts Avenue between H Street and 1st Street NE
- Bus service plan with 50 to 65 buses per hour in exclusive busway section.
- Bus stops every two blocks in busway section (between Washington Circle and Mount Vernon Square).
- Proposed bus stops located mid-block between 18th Street and Connecticut Avenue would be relocated east of 18th Street due to an eastbound lane shift and tapered median between 18th Street and Connecticut Avenue. Also as a result, the eastbound platform would be shorter than those recommended elsewhere on K Street.
- No exclusive bus lanes on the south side of M Street and Pennsylvania Avenue.
- No Circulator service to Georgetown University.

Alternative G was considered feasible and Alternative D was not considered feasible because of the significant impact Alternative D would have on the limited supply of parking in Georgetown[1] and its impact on National Park Service park land in Farragut Square. Alternatives G and D have similar characteristics. The main differences between these two alternatives are:

- Alternative D includes exclusive bus lanes on the south side of M Street and Pennsylvania Avenue while Alternative G does not include these lanes.
- Alternative D requires the elimination of 35 parking spaces on the south side of M Street and Pennsylvania Avenue and Alternative G does not eliminate these parking spaces.
- Alternative D requires widening of K Street at Farragut Square and Alternative G does not include this widening.
- Alternative D provides Circulator service to Georgetown University and Alternative G does not provide Circulator service to Georgetown University.

MOEs for Alternatives D and G generally yield similar results. Differences in travel times for buses and non-bus vehicles are generally negligible. LOS is generally the same, varying by one letter grade at the most. Average delay per person-trip is slightly greater under Alternative D. As shown in Table 4-2, Alternative D would have a greater impact on Farragut Square. However, because of the geometric modifications needed to avoid Farragut Square under Alternative G, the bus stop between 18th Street and Connecticut Avenue would have to be placed further from the Farragut North Metro station than under Alternative D.

4-2.2. FEASIBLE CURBSIDE BUS LANE ALTERNATIVE: ALTERNATIVE H

The Study Team found Alternative H, shown in Figure 3-42, to be a feasible alternative. Alternative H has similar characteristics to Alternative G but instead of providing a center median busway on K Street, Alternative H provides curbside bus lanes along K Street between Washington Circle and Mount Vernon Square. The transit service plan of Alternative H is the same as that of Alternative G, with 50 to 65 buses per hour in the exclusive busway section of the study area, no exclusive bus lanes on M Street or Pennsylvania Avenue, and no Circulator service to Georgetown University.

Alternative H provides two travel lanes in each direction of K Street, as shown in Figure 3-42. The curbside lane would be an exclusive bus lane that may also be shared by vehicles turning right into parking garages and at cross streets. Short right turn bays would be provided at selected intersections. Bus stops would be located curbside, rather than in the median. All-day parking is provided throughout most of the K Street corridor. No land from Farragut Square would be required to implement Alternative H.

[1] Georgetown residents and business owners stated, through the public participation process of the study, their opposition to the elimination of parking on the south side of M Street and Pennsylvania Avenue. Residents and business owners noted that the supply of parking in Georgetown is limited and the elimination of parking spaces could have significant impacts on businesses.

Table 4-2
Comparison of Alternatives D and G on K Street at Farragut Square.

	Alternative D	Alternative G
Park Land Taken	1,600 square feet of Farragut Square is needed	No land of Farragut Square is needed
Trees Taken	4 in median 3 in park	4 in median 0 in park
Eastbound Travel Lanes	1 bus lane 2 through general traffic lanes	1 bus lane 2 through general traffic lanes
Westbound Travel Lanes[1]	1 bus lane 2 through general traffic lanes and 1 right turn lane	1 bus lane 2 through general traffic lanes
K Street Crossings by Pedestrians	84 feet to cross K Street	76 feet to cross K Street
Street Design	Straight lanes - better design	Shifted lanes
Bus Operations	12 foot bus lane in eastbound and westbound directions	13' bus lane in eastbound and westbound directions Lane shifting affects passenger comfort
Ability to Provide Stations at Desired Locations	Mid block station between 18th St and Connecticut Ave can be provided	Mid block station between 18th St and Connecticut Ave cannot be provided. Station has to be provided at 18th Street.

Like Alternative G, right turns from westbound K Street to northbound Connecticut Avenue would be prohibited between the hours of 7:00 AM and 7:00 PM, in order to provide the required cross-section across Farragut Square and improve pedestrian safety. As a result, 17th Street would be converted to two-way operation at all times. Detailed lane configurations and cross sections of Alternative H are presented in Appendix P.

The characteristics of Alternative H are as follows:

- Exclusive curbside bus lanes between Washington Circle and Mount Vernon Square.
- Buses using the curbside bus lane share the lane with right turning vehicles.
- Short right turn bays provided at selected intersections.
- No widening at Farragut Square precluding the need to acquire an eight-foot strip of land from the National Park Service.
- No right turns allowed from westbound K Street to northbound Connecticut Avenue between the hours of 7:00 AM and 7:00 PM.
- Convert 17th Street to two-way operation.
- All-day parking on curb lane of K Street throughout most of the corridor between Washington Circle and Mount Vernon Square.

- Exclusive curbside bus lanes on Massachusetts Avenue between H Street and 1st Street NE.
- All-day parking on curb lane throughout most of the K Street corridor between Washington Circle and Mount Vernon Square.
- No parking or loading on Massachusetts Avenue between H Street and 1st Street NE
- Bus service plan with 50 to 65 buses per hour in exclusive busway section.
- Bus stops every two blocks in busway section (between Washington Circle and Mount Vernon Square).
- No exclusive bus lanes on the south side of M Street and Pennsylvania Avenue.
- No Circulator service to Georgetown University.

4-3. SERVICE PLAN

The recommended service plan progressed from an initial service plan that underwent a moderately detailed level of analysis through several iterations based on significantly more detailed proof-of-concept simulation analyses. Along the way, certain initial assumptions, such as the need for separate bus rapid transit (BRT) and Downtown Circulator routes, and the role of the K Street Transitway in the regional transit system, were revisited.

4-3.1. PROPOSED CHANGES TO BUS ROUTING

As a result of the implementation of the K Street Transitway, the Study Team recommends the following changes to existing bus routing:

4-3.1.1. Routes to Use the K Street Transitway

- **Downtown Circulator –** described in depth below
- **16Y –** No changes are recommended for Route 16Y. It currently uses K Street in both directions between 14th and 19th Streets and should continue to do so after the implementation of the K Street Transitway.
- **30, 32, 34, 35 and 36 –** Currently, these routes travel eastbound on H Street and westbound on I Street. In the future, the Study Team recommends that these routes use the busway eastbound between Washington Circle and 15th Street. Westbound, these routes will use the busway between 14th Street and Washington Circle
- **38B –** This route will use the busway between Washington Circle and Mount Vernon Square. Additionally, this route is now recommended to terminate at the Convention Center, rather than its current terminus at Farragut Square[1].

[1] After the completion of the analyses for this study, a decision was made to maintain the terminus of Route 38B at Farragut Square and not to extend the route to the Convention Center.

- **80 –** No changes are recommended for Route 80. It currently uses K Street in both directions between 13th and 19th Streets and should continue to do so after the implementation of the K Street busway.
- **D1, D3 and D6 –** These routes currently use K Street and are recommended to use the busway between 13th and 21st Streets.
- **S1 –** Currently, the S1 travels K Street in both directions. In the future, the S1 is recommended to use the busway westbound between 16th and 19th Streets. The eastbound trip should be relocated to L Street.

4-3.1.2. Routes Removed from K Street

- **D5 –** Currently, this route travels K Street between Farragut Square and Washington Circle. In the future, the Study Team recommends that this route be relocated to Pennsylvania Avenue / H Street for the eastbound trip, and I Street / Pennsylvania Avenue for the westbound trip. Additionally, the eastern terminus should be relocated from Farragut Square to McPherson Square. This route will travel the K Street Transitway for one block, between the two legs of 15th Street.
- **L2 –** Currently, the L2 travels K Street in each direction between 15th Street and 21st Street. The Study Team recommends that the eastbound L2 be moved to L Street between 17th and 21st Streets and the westbound L2 be moved to I Street between 15th and 20th Streets.
- **N2, N4 and N6 –** These routes currently use eastbound K Street for one block, between Connecticut Avenue and 17th Street. After busway implementation, the Study Team recommends that the one-block eastbound section be moved to L Street. These routes would travel south on Connecticut Avenue and turn left to L Street and then right to 17th Street. The rest of the route would remain unchanged.
- **N7 –** The N7[1] traveled in both directions of K Street between 14th and 21st Streets until December 28, 2003. Prior to the elimination of this route, the Study Team recommended that the eastbound N7 be moved to L Street and the westbound N7 be moved to I Street. This route, however, was eliminated on December 28, 2003. Therefore, the Study Team does not recommend its inclusion in the K Street Transitway service plan.

4-3.2. CIRCULATOR

The Study Team recommends the implementation of the proposed Downtown Circulator bus route, between Union Station and Georgetown.

4-3.2.1. Alignment

The Circulator should run on the alignment shown in Figure 3-9. Westbound, the Circulator will start at Union Station and travel on Massachusetts Avenue to Mount Vernon Square. The portion of this alignment between 1st Street NE and H Street will be on exclusive curbside bus lanes. The

[1] Route N7 was eliminated on December 28, 2003. The analyses for this study were completed prior to the elimination of this route.

Circulator will travel across the south side of Mount Vernon Square and turn right on 9th Street[1]. It will travel on a contra-flow bus lane on 9th Street, turn left on K Street and travel to 10th Street, where the K Street Transitway begins.[2]

The Circulator will continue westbound on K Street to the end of the busway at Washington Circle. The Circulator will travel on K Street under Washington Circle and continue onto Lower K Street at 27th Street. It will then turn right onto Wisconsin Avenue and travel to M Street in Georgetown, turning right again on M Street, the starting point of the eastbound return trip.

From the intersection of Wisconsin Avenue and M Street, the Circulator will travel eastbound on M Street and Pennsylvania Avenue to 24th Street. It will pass through Washington Circle to the K Street Service Road, joining the K Street Transitway at 21st Street. It will travel the length of the busway to 9th Street, where it will turn right. The Circulator will then turn left to travel across the south side of Mount Vernon Square to Massachusetts Avenue, which it will use to return to Union Station. The portion of the alignment on Massachusetts Avenue between H Street and 1st Street NE will be on exclusive curbside bus lanes.

4-3.2.2. Headway and Hours of Operation

A service span departing Union Station of 6:00 AM to 11:40 PM is recommended to accommodate all potential users of the Downtown Circulator. The original Downtown Circulator plan called for a service oriented towards visitors and downtown employees making midday trips, and the proposed service span reflected that market: 8:00 AM to 9:00 PM However, the K Street Circulator will also be serving a commuter market and customers with late-evening dining or entertainment plans in Georgetown or along K Street who would not be adequately served by the original service span.

The recommended frequency between Union Station and central Georgetown is 10 minutes from 6:00 AM to 7:00 AM, five minutes from 7:00 AM to 7:00 PM, 10 minutes from 7:00 PM to 11:00 PM, and 20 minutes from 11:00 PM to 11:40 PM All times reflect departures from Union Station.

[1] After the completion of the analyses for this study, a decision was made to operate the westbound Circulator across the north side of Mount Vernon Square, turn left on 9th Street and right on K Street.

[2] If, during the engineering design stage of this project, it is determined that insufficient stacking space is available on 9th Street, the Study Team recommends that westbound Circulators travel the following route through Mount Vernon Square: Westbound on Massachusetts Avenue, westbound on K Street, turn right to travel north on 9th Street, turn left to westbound Massachusetts Avenue, left to southbound 10th Street, right to westbound K Street.

4-3.2.3. Fleet Requirements

A total of 16 buses will be required in maximum service on the K Street route. Including an allowance for 3 spares, a fleet of 19 buses would be required.[1] Appendix H includes an example schedule for the route.

4-3.2.4. Service Branding

The Study Team recommends that a program be implemented to provide distinctive branding to the vehicles and physical facilities associated with the K Street Transitway. The process of establishing distinctive branding for the buses should begin with the circulator and should eventually be extended to the other routes of regional significance that use the K Street Transitway. It is important to develop distinctive colors and graphics to be used on all elements of the bus rapid transit system including buses, stations, running ways, schedules, printed informational material and on-line information. All physical facilities should have consistent brand identity. Stations should be constructed with similar features and should be named with a consistent naming scheme.

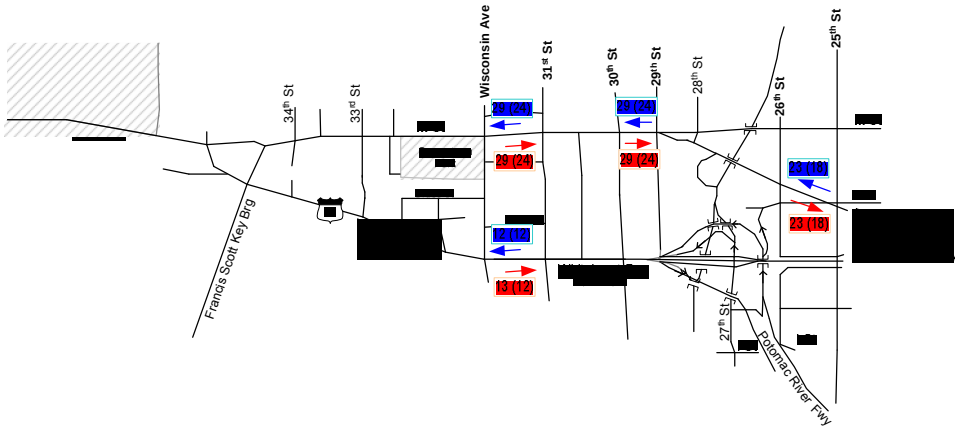
4-4. BUS VOLUMES

Implementation of either Alternative G or Alternative H will increase the number of buses traveling through the study corridor. As Figure 4-1 shows, there will be an increase of 12 buses during the AM and PM peak hours on eastbound M Street and Pennsylvania Avenue. Westbound bus traffic will not increase, because the Circulator will be routed through Lower K Street. Twelve more buses will use westbound Lower K Street during the AM and PM peak hours under Alternatives G or H than are currently using it today. Eastbound bus traffic on Lower K will not change from current levels. Between Mount Vernon Square and North Capitol Street, Massachusetts Avenue will experience an increase of 12 buses in each direction during both the AM and PM peak hours.

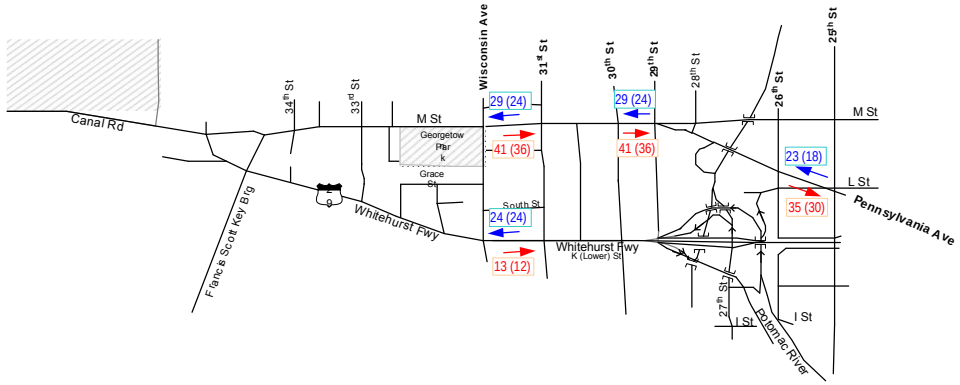
As shown in Figures 4-2 and 4-3, K Street will experience an increase in the amount of bus traffic when comparing Alternatives G or H to existing conditions. The busway will handle a maximum of 116 buses (bi-directional) during the AM peak hour and 86 buses (bi-directional) during the PM peak hour. This volume will occur between 16th and 18th Streets during the AM peak and between 15th and 18th Streets during the PM peak. Ninth Street to 13th Street will be the least-used section of the busway, with a total of 32 buses (bi-directional) during both the AM and PM peak hours. Charter and commuter buses will not use the K Street Transitway. A maximum of 31 charter/commuter buses will use K Street during the AM peak hour, and a maximum of 34 will use K Street during the PM peak hour.

[1] The number of required buses was calculated assuming that every fourth Circulator bus would service Georgetown University. However, at the conclusion of the study, the university indicated that at this time, they would prefer to continue providing their own transit services rather than those of outside providers. The number of buses may be reduced if no service is provided to Georgetown University.

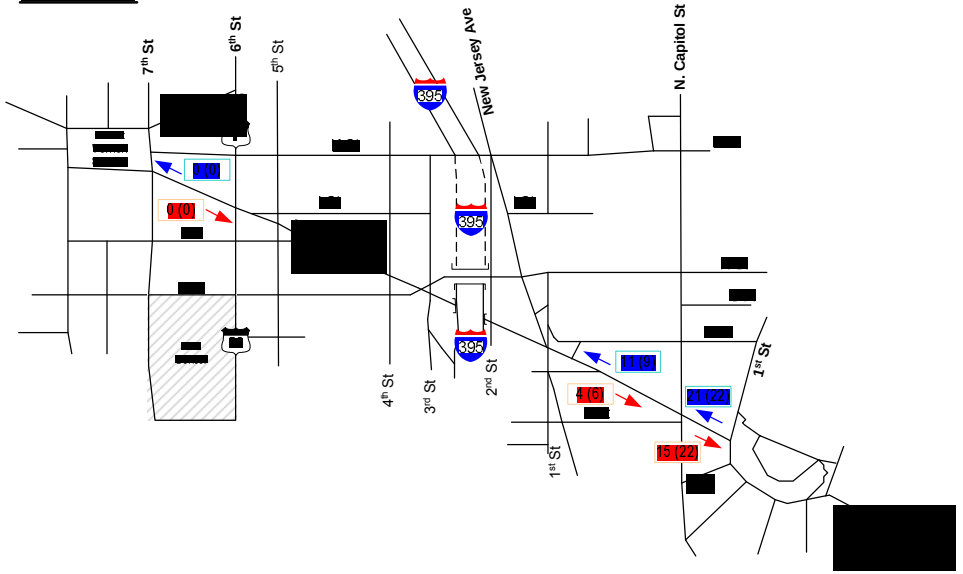
Georgetown Section



FUTURE: 2015



Union Station Section



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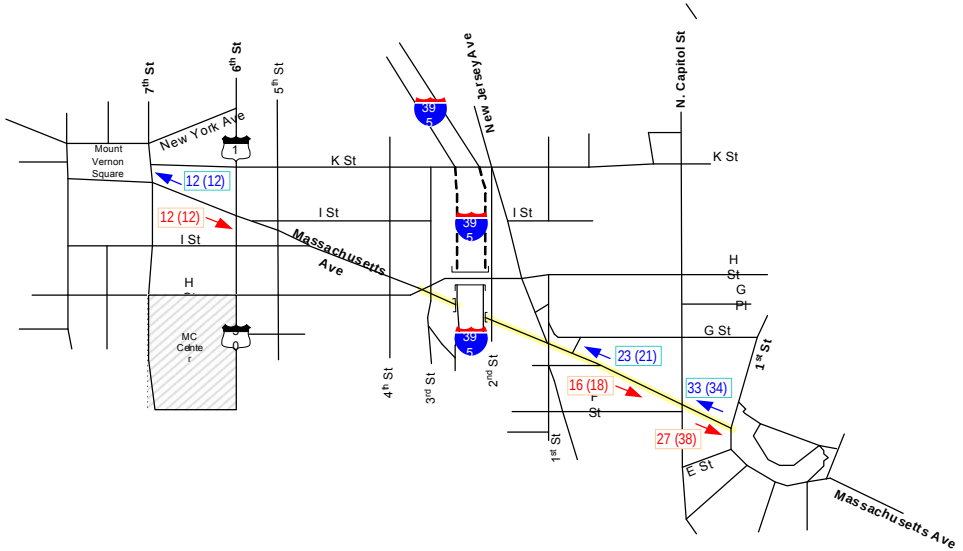
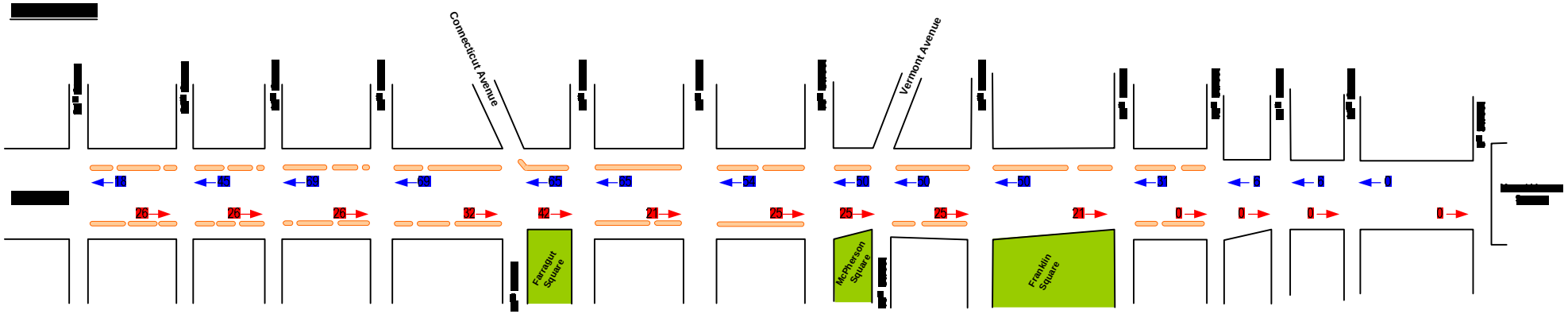


LEGEND

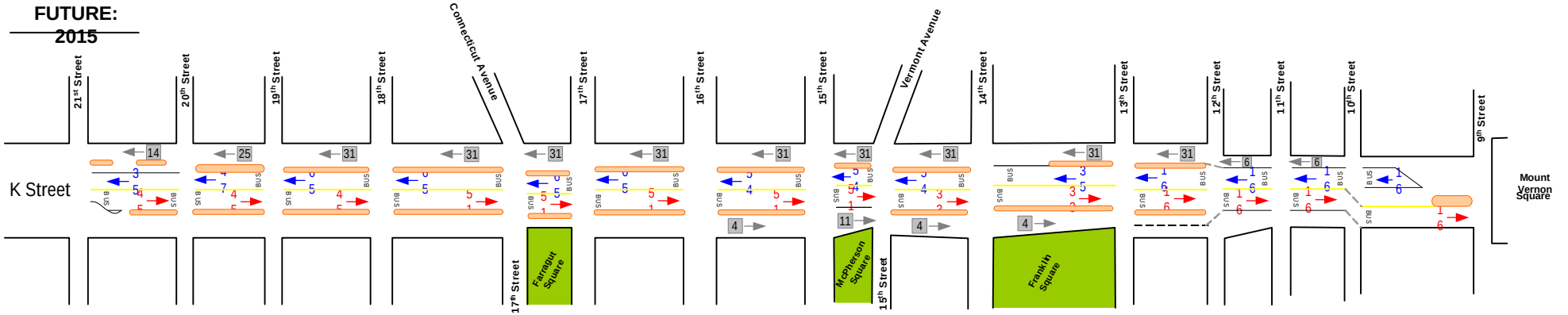
- 29 (24) AM (PM) Eastbound Buses
- 29 (24) AM (PM) Westbound Buses
- Curbside Bus Lane

Page 4-10	Not to Scale May 2005	N	K Street Transitway	Number of Buses in Georgetown and Union Station Sections of the Study Area During AM and PM Peak Hour	FIGURE 4-1



Note: Existing bus totals include WMATA and commuter buses.

FUTURE: 2015

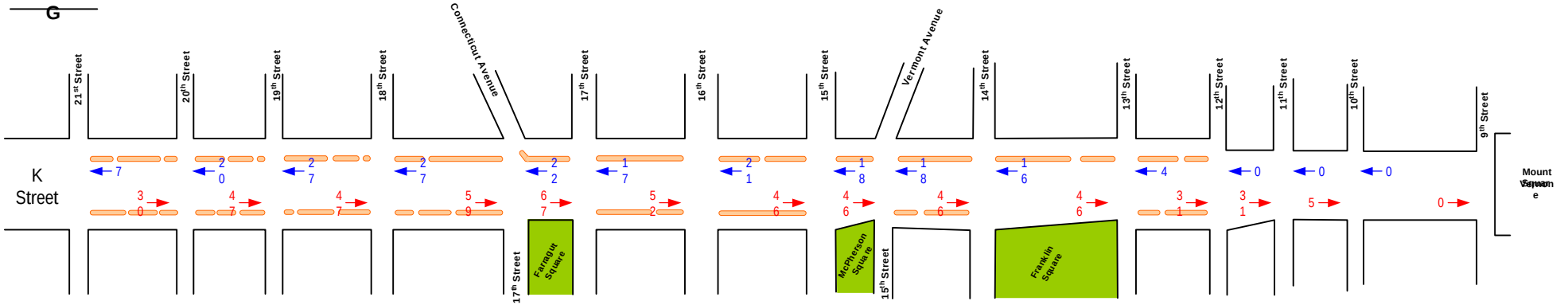


LEGEND

14	Commuter buses (outside Transitway)
	Raised Median

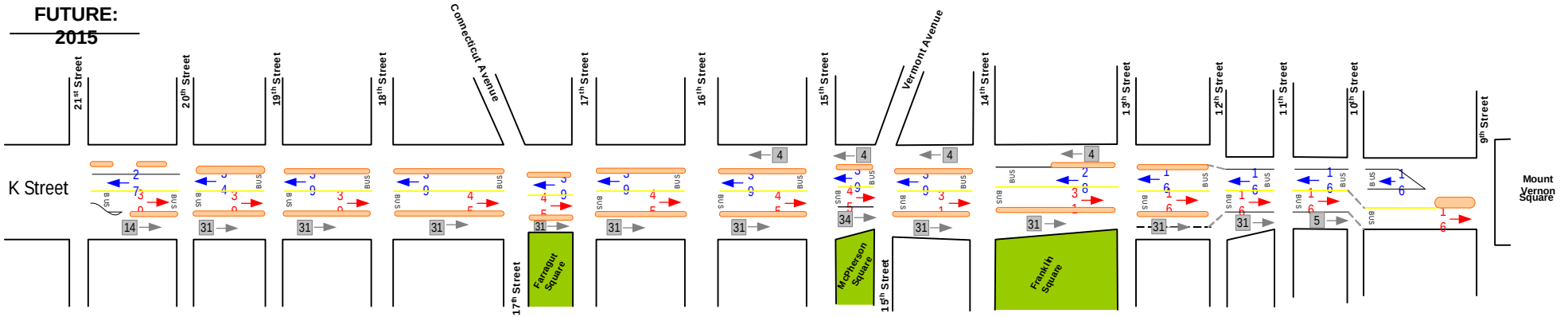
Page 4-11	Not to Scale May 2005	N	K Street Transitway	**Number of Buses on K Street During AM Peak Hour**	**FIGURE 4-2**

EXISTING



Note: Existing bus totals include WMATA and commuter buses.

FUTURE: 2015



LEGEND

14	Commuter buses (outside Transitway)
	Raised Median

Page 4-12	Not to Scale May 2005	N	K Street Transitway	**Number of Buses on K Street During PM Peak Hour**	**FIGURE 4-3**

4-5. BUS STATIONS

Under Alternative G, all stations in the busway would be located in the median of K Street. Transit riders would access the stations by crossing to the medians at signalized intersections on K Street. As shown in Figure 4-4, barrier-free access would be provided between crosswalks on K Street and new passenger stations on the median[1]. Subject to review and approval by the District of Columbia, crosswalks on K Street may be constructed of pavers, or use another distinctive color and/or pattern to complement the platform treatment and to enhance the pedestrian environment. Busway stops would be designed to support a positive perception of the transit service, with a distinctive, upscale look as shown in Figure 4-5. Stations would be equipped with a ticket vending machine so that riders are able to purchase SmarTrip® cards and/or add fare to SmarTrip® cards prior to boarding the vehicle. This will speed boarding and decrease dwell times by allowing passengers to board via all doors of the vehicle.

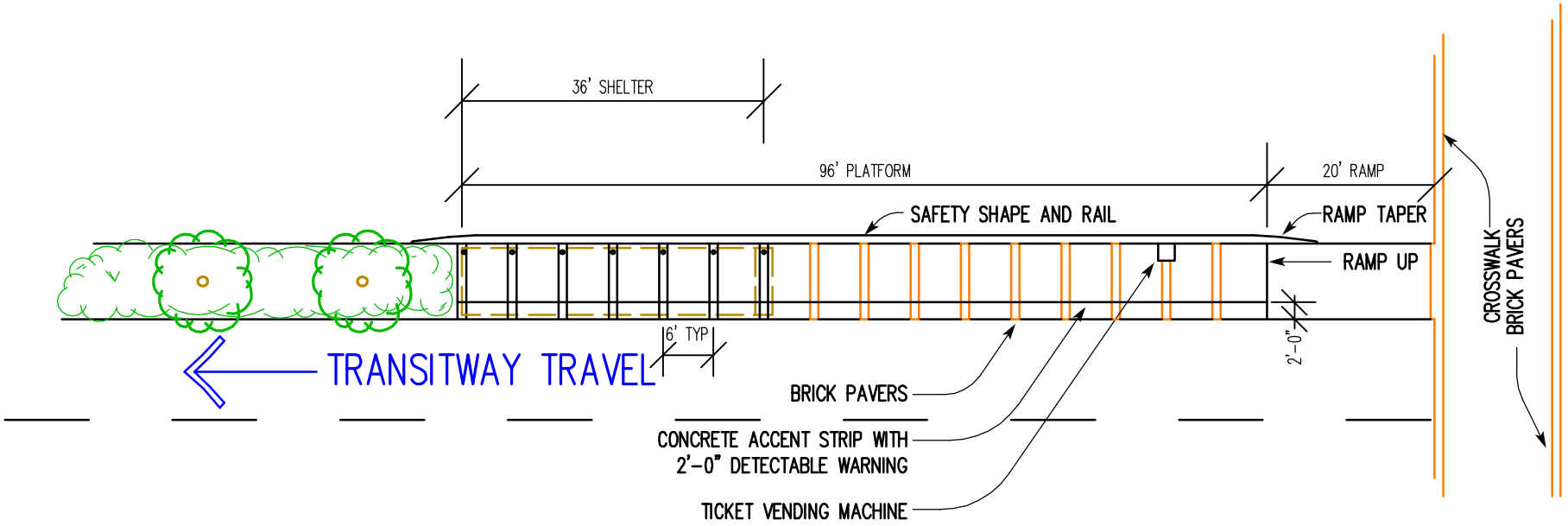
Each busway station would comprise two, 96-foot side platforms (in order for the station to accommodate two, 40-foot buses in each direction). Each platform would have a 36-foot shelter to encourage use of all doors of the first vehicle for passenger boarding. Because of limited space available in the median, some platforms would have a width of 9 feet, however this is to be considered the absolute minimum to provide adequate access for persons with disabilities. In most of the blocks, the available width for the platform is 10 feet. A concrete safety barrier topped by a handrail will separate the platform from the travel lanes of K Street. This would increase safety for passengers waiting for the bus.

Each busway station will contain a variable message sign (VMS) alerting riders to the destination and arrival time of the next bus serving that station. Signage and graphics are deliberately related to Metrorail stations, with a system map as well as a detailed map of the area immediately surrounding each station, showing the locations of area landmarks and attractions.

The platforms and guideways would be designed to accommodate future conversion to Light Rail Transit (LRT). An important design consideration will be a platform height to support both BRT and LRT vehicles.

Under Alternative H, busway stations would be designed as described above to the extent possible. The bus stations would be located on the sidewalk rather than in the median of K Street. However, this curb-side running option would limit the opportunities of placing bus stops/stations at desirable locations. Right turn lanes and curb parking would reduce the availability of curb space for bus stops/stations.

[1] Additional bus platform / shelter graphics are presented in Appendix Q.



0 5 25

Feet

FIGURE 4-4

Plan View of Bus Platform

K Street Transitway

May 2005

Figure 4-5
Artist's Rendering of Bus Platform

4-6. FARE COLLECTION

In order to improve the operational efficiency of the bus rapid transit system, the Study Team recommends the implementation of enhancements to the fare collection mechanisms used by the buses that utilize the K Street Transitway. Improved efficiency of bus operations can be achieved by reducing the number of cash transactions that occur at the busway stations. One potential option to improve the overall service speeds and increase the capacity of the busway facility is to provide vending machines at each of the busway stations that would dispense SmarTrip® cards and/or add value to SmarTrip® cards held by riders and allow multiple door boarding. The buses would be equipped with SmarTrip® card readers at the front and back doors. Passengers with SmarTrip® cards would be able to board through the back door and use their card for payment upon entering the bus. Passengers who do not have SmarTrip® cards would pay the fare entering through the front door. The implementation of this fare collection mechanism will be done in phases, starting with the circulator buses and continuing with other routes of regional significance. This would significantly reduce bus boarding times and would improve bus circulation.

An alternative fare collection mechanism that may be used instead of the use of SmarTrip® cards through the back door is to allow passengers to pay upon boarding during the AM peak period and pay prior to alighting during the PM peak period. This would reduce delays on the busway as most of the trips during the AM peak period are destined to the Central Business District (CBD) and most of the trips during the PM peak period originate in the CBD. This approach would help minimize the number of cash payments that take place at the K Street Transitway stations.

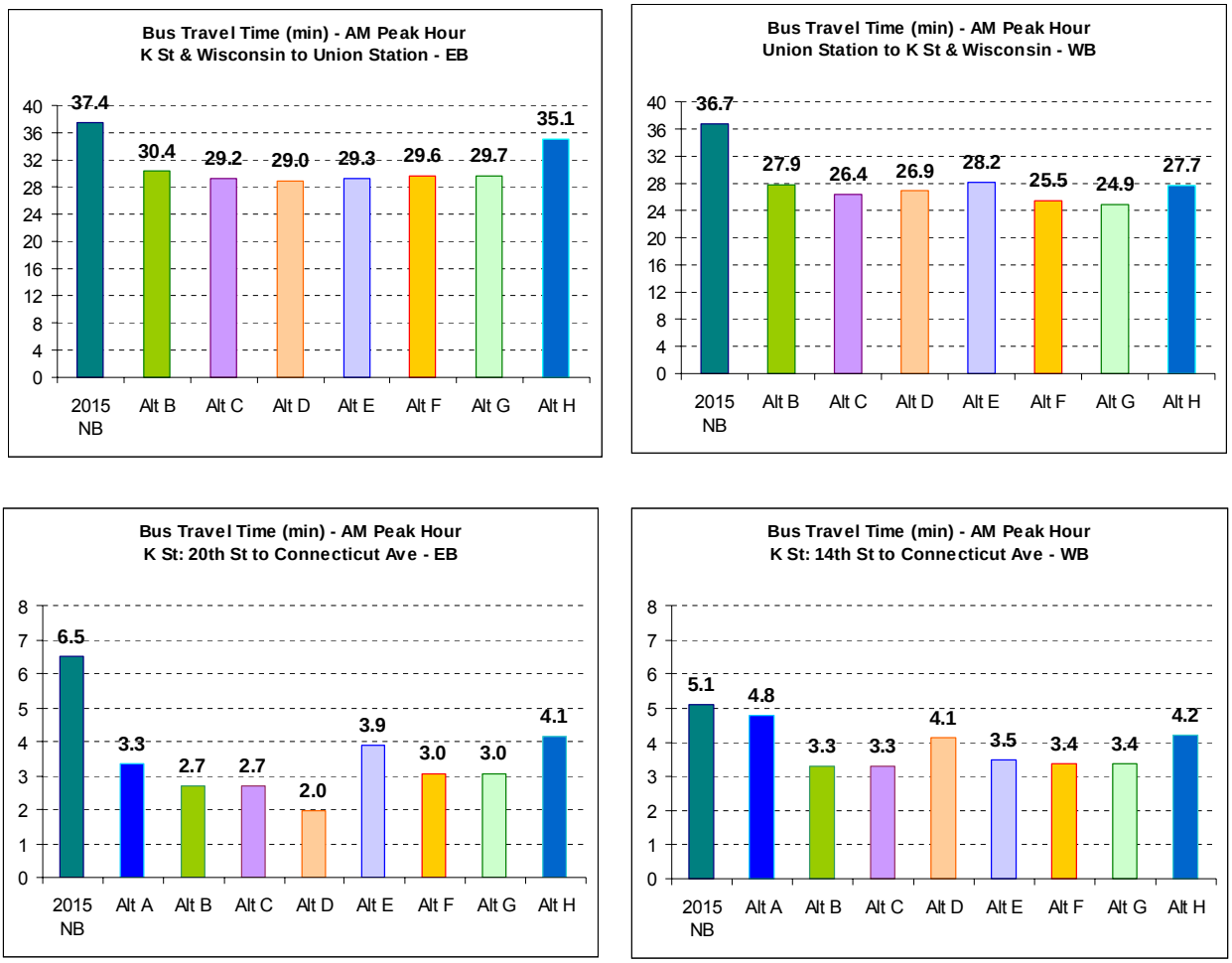
4-7. TRAVEL TIMES

The implementation of either of the feasible alternatives, Alternative G or H, will result in significant reductions in bus travel times compared to the 2015 No-Build alternative. As Figure 4-6 shows, buses traversing the corridor from Georgetown to Union Station (approximately 3.5 miles) can save considerable time in both directions during the AM peak hour. Similar savings are expected during the PM peak hour. In general, travel times for buses are better under Alternative G than Alternative H[1].

With respect to general traffic, as shown in Figure 4-7, both of the feasible alternatives reduce travel time on K Street during the PM peak hour[1]. Differences in travel times of eastbound non-bus traffic on K Street are negligible during the AM peak when comparing the No-Build scenario with Alternatives G and H. Westbound travel times during the AM peak period are higher under both of the feasible alternatives than the No-Build scenario. The higher travel times can be attributed to right-turning vehicles sharing the exclusive bus lane under Alternative H, and the special phasing required for bus turning movements under Alternative G which reduces the amount of green time available to non-bus vehicles. Levels of service are comparable between the two alternatives.

[1] A complete table with all of the calculated travel times for buses and general traffic is included in Appendix K

Figure 4-6
K Street Future Bus Travel Times

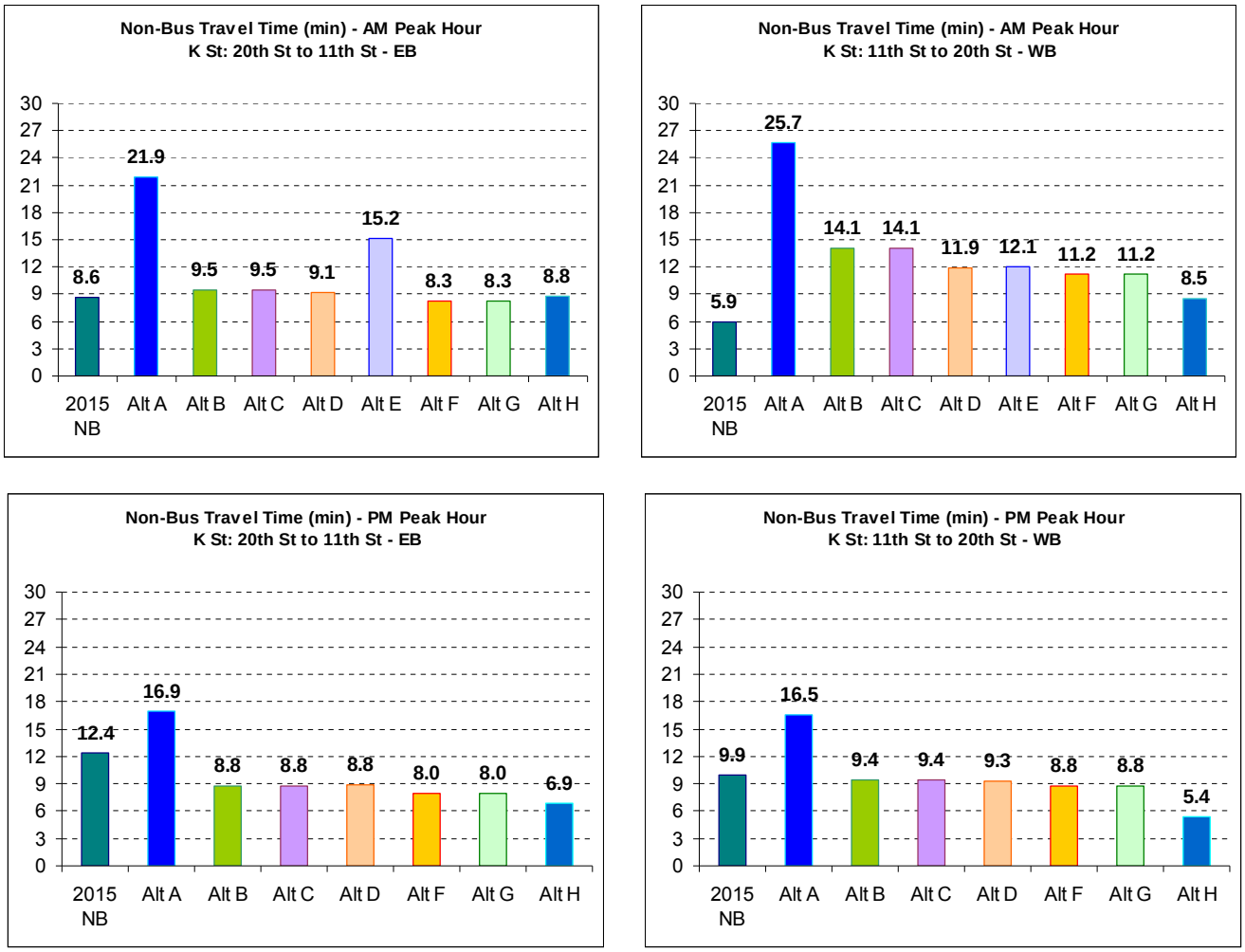


4-8. CAPITAL COST, OPERATION AND MAINTENANCE COST SAVINGS, REVENUE AND SUBSIDY

DMJM HARRIS | AECOM

The Study Team calculated capital cost and capital cost savings, operation and maintenance cost savings, revenue and subsidy for the implementation of the feasible alternatives for the K Street Transitway, exclusive bus lanes on Massachusetts Avenue and the implementation of the transit service plan described above.

Figure 4-7
K Street Future General Traffic Travel Times



4-8.1. CAPITAL COST

As shown in Table 4-3, the capital cost of constructing the K Street Transitway is expected to be in the range of $30 to $35 million for either Alternative G or Alternative H. The construction cost of Alternative G was estimated to be approximately $2 million more than Alternative H. This is a preliminary, planning-level cost estimate and should only be used to estimate the range of capital costs.

Table 4-4 shows that the capital cost of constructing additional infrastructure necessary for the implementation of either feasible alternatives is expected to be approximately $1.0 million. As with the K Street Transitway portion of the cost estimate, the cost of the exclusive bus lanes is a preliminary, planning-level estimate.

Table 4-3
K Street Transitway Construction from Washington Circle to Mount Vernon Square

No.	Item	Unit Cost	Feasible Alternative 1 Alternative G		Feasible Alternative 2 Alternative H	
			Quantity	Cost	Quantity	Cost
1.0	Paving	$7.50	800,000 sf	$6,000,000	700,000 sf	$5,250,000
2.0	Signalization	$150,000.00	16 intersections	$2,400,000	16	$2,400,000
3.0	Sidewalks Adjacent to Buildings or Parks	$25.00	284,000 sf	$7,100,000	340,000 sf	$8,500,000
4.0	Medians/Islands	$35.00	154,000 sf	$5,390,000	77,000 sf	$2,695,000
5.0	Bus Stations	$60,000.00	13	$780,000	13	$780,000
6.0	Crosswalk Treatments (per intersection)	$31,250.00	16	$500,000	16	$500,000
7.0	Utilities					
	Relocation and Reconstruction	$200.00	15,500 lf	$3,100,000	15,500 lf	$3,100,000
	Modification to Existing Private Utilities	$100.00	16,000 lf	$1,600,000	16,000 lf	$1,600,000
8.0	Markings	$2.00	100,000 lf	$200,000	70,000 lf	$140,000
9.0	Signings	$1,000.00	320	$320,000	320	$320,000
10.0	Maintenance of Traffic	$500,000.00	1	$500,000	1	$500,000
			Sub-Total:	$27,890,000		$25,785,000
			Planning and Design (6%):	$1,673,400		$1,547,100
			Construction Management (5%):	$1,394,500		$1,289,250
			Agency Management/Oversight (4%):	$1,115,600		$1,031,400
			Contingencies (included in unit costs):	$0		$0
			Reserves (1%):	$278,900		$257,850
			Total:	$32,352,400		$29,910,600
			Range:	$30-$35 Million		$30-$35 Million

Table 4-4
Preliminary/Sketch Planning Cost Estimate
Additional Infrastructure Required for the Implementation of the Feasible Alternatives

Location	Description	Unit	Qty	Unit Price	Total
M Street from Wisconsin Avenue to Pennsylvania Avenue	Bus Stations	EA	3	$ 60,000.00	$ 180,000
eastbound only	Signs	EA	12	$ 1,000.00	$ 12,000
				Location Subtotal:	$ 192,000
Pennsylvania Avenue from M Street to 24th Street	Bus Stations	EA	1	$ 60,000.00	$ 60,000
eastbound only	Signs	EA	15	$ 1,000.00	$ 15,000
				Location Subtotal:	$ 75,000
K Street from 10th Street to 9th Street	Pavement Milling	SF	6,240	$ 0.33	$ 2,059
eastbound only	Treated Asphalt Pavement (colored)	SF	6,240	$ 2.00	$ 12,480
	Pavement Markings	LF	480	$ 2.00	$ 960
	Pavement Letter	EA	7	$ 71.00	$ 497
	Signal Priority System	EA	1	$ 7,324.00	$ 7,324
	Signs	EA	3	$ 1,000.00	$ 3,000
				Location Subtotal:	$ 26,320
9th Street from New York Avenue to Massachusetts Avenue	Pavement Milling	SF	2,280	$ 0.33	$ 752
northbound only	Treated Asphalt Pavement (colored)	SF	2,280	$ 2.00	$ 4,560
	Pavement Markings	LF	190	$ 2.00	$ 380
	Pavement Letter	EA	7	$ 71.00	$ 497
	Signal Modification / Priority System	EA	1	$ 25,000.00	$ 25,000
	Signs	EA	3	$ 1,000.00	$ 3,000
				Location Subtotal:	$ 34,189
Massachusetts Avenue from H Street NW to 1st Street NE	Pavement Milling	SF	36,960	$ 0.33	$ 12,197
both directions	Treated Asphalt Pavement (colored)	SF	36,960	$ 2.00	$ 73,920
	Pavement Markings	LF	3,360	$ 2.00	$ 6,720
	Pavement Letter	EA	84	$ 71.00	$ 5,964
	Bus Stations	EA	2	$ 60,000.00	$ 120,000
	Signal Priority System	EA	12	$ 7,324.00	$ 87,888
	Signs	EA	36	$ 1,000.00	$ 36,000
				Location Subtotal:	$ 342,689
Bus Hardware Upgrades	Circulator	EA	19	$ 1,848.00	$ 35,112
	All other Buses	EA	68	$ 1,848.00	$ 125,664
				Subtotal:	$ 160,776
				Subtotal:	$ 830,974
			15%	Engineering & Design:	$ 124,646
			10%	Contingency:	$ 83,097
				Total:	$ 1,038,718

Reduced bus travel times under Alternative G will reduce the required number of Circulator buses by four and regular buses by seven. The implementation of Alternative H will reduce the required number of Circulator buses by four and regular buses by six. The reduced vehicle requirement is based upon the difference between the Alternative and providing the same services without exclusive facilities. Detailed calculations of the reductions in the number of required buses are included in Appendix R.

Table 4-5 compares the capital cost savings associated with operating the service plan on exclusive bus facilities, compared to providing the same service without exclusive facilities. The table shows that the implementation of Alternative G would result in a one-time capital cost savings of $4,050,000 while the implementation of Alternative H would result in a one-time savings of $2,200,000.

Table 4-5
Capital Cost Savings Associated with Exclusive Bus Facilities

Bus Type	Unit cost	Alternative G		Alternative H	
		Reduced No. of Buses	Total	Reduced No. of Buses	Total
Circulator	$400,000	4	$1,600,000	2	$800,000
Regular	$350,000	7	$2,450,000	4	$1,400,000
		Total:	$4,050,000	Total:	$2,200,000

4-8.2. OPERATION AND MAINTENANCE COST SAVINGS

The implementation of either of the feasible alternatives will result in significant reductions in bus travel times and a corresponding reduction in number of buses needed to provide the required levels of transit service. As shown in Table 4-6, the Study Team estimated that an annual operation and maintenance savings of $1.3 million can be expected with the implementation of Alternative G. An annual operation and maintenance savings of $940,000 can be expected with the implementation of the Alternative H. Detailed calculations of AM, midday and PM peak hour operation and maintenance savings are provided in Appendix R.

4-8.3. REVENUE

Additional annual revenue of approximately $730,000 can be expected with the implementation of Alternative G, exclusive bus lanes on Massachusetts Avenue, and the recommended transit service plan described above. This figure was estimated based on a comparison of 2015 No-Build ridership with 2015 Alternative D ridership. Daily revenue was calculated using a base fare of $1.20 for non-Circulator buses[1], a Circulator fare of $0.50, and assuming that 10

[1] After the completion of the analyses for this study, the base fare for Metrobus was changed from $1.20 to $1.25.

percent of all passengers would pay a Metro transfer fare of $0.35. If Alternative H is implemented, the estimated additional annual revenue is $600,000.

Table 4-6
Annual Operation and Maintenance Cost Savings Estimation

Route	Annual Operation and Maintenance Savings							
	Alternative G				Alternative H			
	AM Peak Hour	Mid-day Peak Hour	PM Peak Hour	Total	AM Peak Hour	Midday Peak Hour	PM Peak Hour	Total
30,32,34,35,36	$243,750	$0	$243,750	$487,500	$146,250	$0	$195,000	$341,250
38B	$48,750	$0	$0	$48,750	$0	$0	$0	$0
D1,D3,D6	$48,750	$0	$48,750	$97,500	$48,750	$0	$48,750	$97,500
80	$48,750	$0	$48,750	$97,500	$0	$0	$48,750	$48,750
Circulator	$195,000	$162,500	$243,750	$601,250	$97,500	$162,500	$195,000	$455,000
Total Annual O/M Saving	$585,000	$162,500	$585,000	$1,332,500	$292,500	$162,500	$487,500	$942,500

4-8.4. SUBSIDY

A reduction in annual subsidy can be calculated by combining the annual cost savings and additional revenue generated by implementing the K Street Transitway, exclusive bus lanes and recommended service plan. Based on an annual cost savings of $1.3 million for Alternative G and additional yearly revenue of $730,000, the annual subsidy can be reduced by $2.0 million. The implementation of Alternative H would result in an annual cost savings of $940,000 and additional yearly revenue of $600,000, for an annual subsidy reduction of $1.5 million.

4-9. PEDESTRIANS

The implementation of the K Street Transitway in general and Alternatives G and H in particular will improve pedestrian operations along K Street. Existing, illegal left turns from the K Street main roadway into parking garages along K Street will no longer be possible after construction of the busway. The inability to make these illegal left turns will affect operations at eight parking garages/alleys along K Street, but it will improve pedestrian safety. Additionally, pedestrian operations and safety will improve because the busway configuration will inhibit U-turns at signalized intersections along K Street.

Finally, the reconfiguration of K Street itself presents an improvement to pedestrian safety. Currently, with the medians/pedestrian refuge islands located where they are, with only the service roadway separating them from the sidewalk, there is a tendency for pedestrians to cross the service road when they do not have a walk or flashing don't walk signal. Under Alternative G, the medians will be closer to the centerline of K Street, with three lanes of faster-moving

traffic (than the existing service roads) separating pedestrians on the median from the sidewalk. Fewer pedestrians will be inclined to cross against the signal under a reconfigured K Street.

Under Alternative H, the width of K Street will be reduced, resulting in a shorter distance for pedestrians to cross, thereby increasing pedestrian safety. Additionally, the reduced width of K Street will result in wider sidewalks with more standing room at corners.

4-10. PARKING AND LOADING/UNLOADING

Implementation of Alternative G will have an effect on peak hour parking throughout the studied corridor. Alternative G will create three additional peak period parking spaces on K Street, and cause the loss of 53 spaces on Massachusetts. The implementation of Alterative H will create 41 parking spaces on K Street, and cause the loss of 53 spaces on Massachusetts Avenue. Because the exclusive bus lanes will be used by buses during most hours of the day and night, the Study Team recommends the complete elimination of parking and loading on the proposed curbside bus lanes on both sides of Massachusetts Avenue between H Street and 1st Street NE.

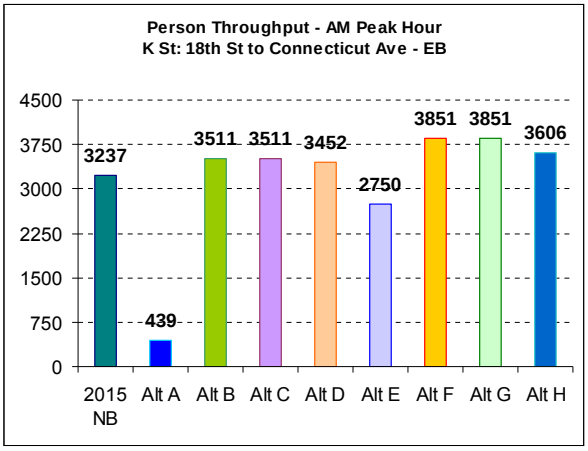
Implementation of any of the build alternatives would impact access to eight parking garages/ alleys on K Street. Under existing conditions, drivers can turn left across the main K Street roadway to access the service roadways. They then turn left onto the service road to access the parking garages. These left turn maneuvers are illegal, but the Study Team observed them on numerous occasions. Implementation of any of the build alternatives will separate the travel lanes in each direction by medians and exclusive bus lanes. Motorists will no longer be able to access parking garages on K Street in this manner. Instead, motorists wishing to access parking garages on the opposite side of K Street from their direction of travel will need to find alternate means of access, such as circling the block. Safety and traffic operations will improve due to these left turns no longer being possible.

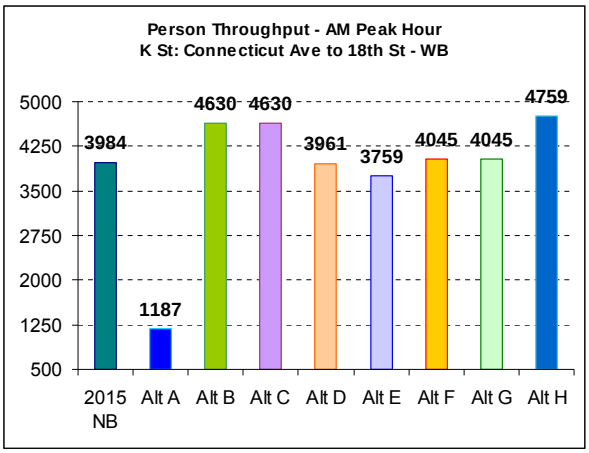
4-11. TRAFFIC OPERATIONS/PERSON THROUGHPUT

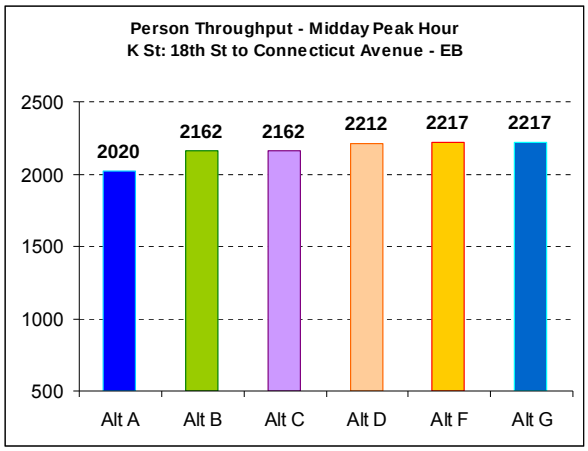
Implementation of any of the build alternatives will restrict left turns from K Street to cross streets. Currently, eastbound left turns from K Street are permitted during some periods of the day at 15th Street, Vermont Avenue, 14th Street, 13th Street, 12th Street and 11th Street. Westbound left turns from K Street are permitted at 11th Street, 13th Street, 14th Street, 15th Street, 19th Street and 21st Street. Due to bus lane operations, conflicting movements and the separation of the travel lanes of K Street, left turns under Alternatives G and H will be restricted to the following: eastbound at 14th Street and 12th Street, westbound at 10th Street and 14th Street. Left turns at these locations will be provided from exclusive left turn lanes under protected signal phasing. There will be no permitted signal phasing for left turns. Motorists wishing to make left turns from K Street at other locations will find it necessary to take alternate routes.

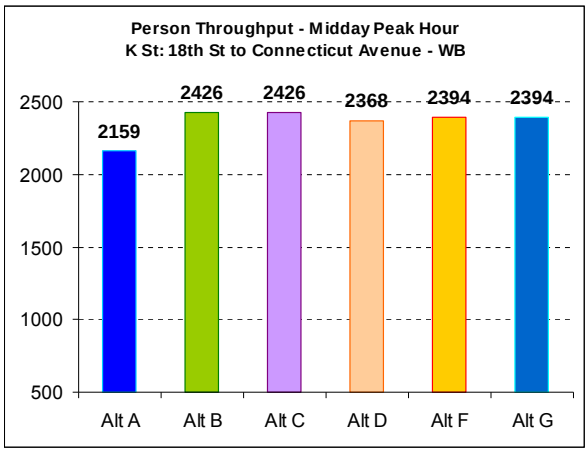
As Figure 4-8 indicates, the person throughput (the number of people that cross a specified point in the corridor) of Alternatives G and H in each direction of K Street between 18th Street and Connecticut Avenue is greater than the person throughput for the No Build scenario, with the exception of eastbound traffic under Alternative H during the PM peak hour. Alternatives G and

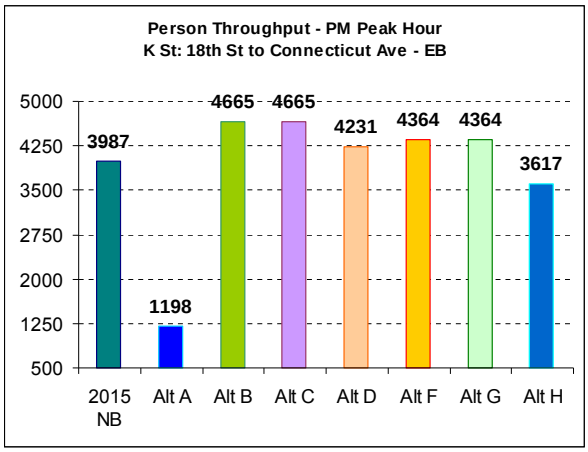
Figure 4-8
Person Throughput – K Street between Connecticut Avenue and 18th Street

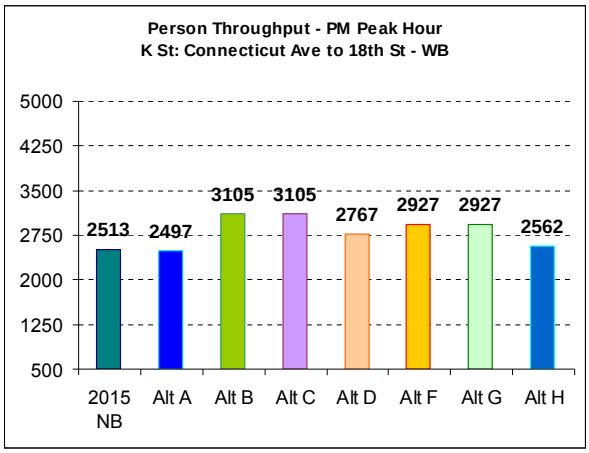








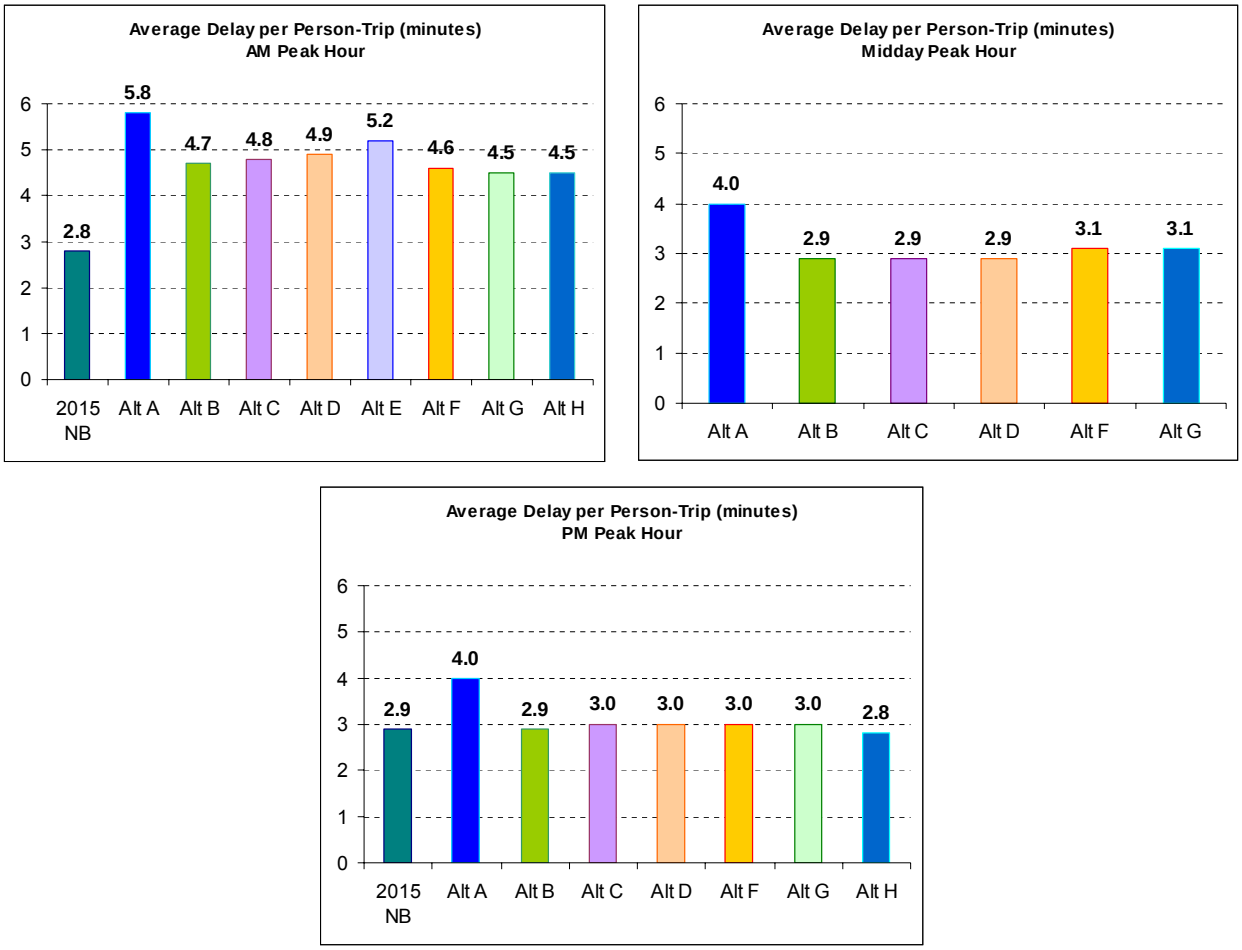




H are not always the highest of the studied alternatives. This is due in large part to shifting of some bus routes from K Street to parallel streets under the service plan for Alternatives G and H. Person throughput is largely a function of the number of buses passing through a particular point, and fewer buses on K Street can lead to lower person throughput under Alternatives G and H.

Figure 4-9 shows that with the exception of Alternative A, delay per person-trip differences between the alternatives and the no-build scenario are negligible during the PM peak hour. However, the implementation of a median curbside busway on K Street, which would increase person throughput in the corridor, will generate an increase in the average delay per person during the AM peak hour. The implementation of a curbside or a median busway on K Street will result in an increase in delay per person trip of approximately 1.7 minutes during the AM peak hour.

Figure 4-9
Average Delay per Person-Trip



4-12. SIGNAL PRIORITY AND SPECIAL PHASING

The Study Team recommends the installation of a signal priority system in the exclusive bus lane sections of the study area (Massachusetts Avenue between H Street and 1st Street NE). Signal priority serves to reduce signal delays to buses (thus improving bus speeds) and helps improve schedule reliability. If provided at the capacity-controlling stop (typically the stop with the longest average dwell times), signal priority can also provide a modest capacity benefit. At these signalized intersections, the traffic signal controller will react to the presence of a bus to extend the green time for the bus movement or to return to the green phase sooner.

In the K Street Transitway section of the study area, the Study Team does not recommend the installation of active signal priority measures. Due to the volume of buses in the corridor, the result would be a priority call virtually every cycle. Consequently, it would be more efficient to permanently retime the signals to replicate the benefit of active priority. Passive strategies that adjust signal timing whether or not a bus is present have wider potential application in the busway corridor. The Study Team recommends changing signal offsets on K Street to provide better progression for buses and providing additional green time for K Street (to accommodate longer bus dwells, for instance). However, since K Street is part of a broader downtown signal system, signal timing modifications along K Street will have impacts on signal progression on the cross streets that must also be considered.

The Study Team also recommends special bus phases to accommodate bus turns from the busway under Alternative G. These special phases will have a smaller impact on general traffic operations if the special bus phase is activated only when a turning bus was present, as opposed to being activated on every cycle or when any bus was present. Figures 4-10 and 4-11 illustrate how left and right turns out of the busway can be accomplished under Alternative G through the use of special phasing.

Under Alternative H, no special phasing would be required for buses turning left and right from K Street. Buses would already be traveling in a right turn lane, so right turns can be made without difficulty or need for special phasing or priority. Buses turning left would merge with general traffic and enter a left turn bay. Buses would be permitted to make left turns from K Street only at the locations where non-bus traffic may turn left, with one exception: a special bus-only left turn lane is recommended to be constructed on the westbound K Street approach to 19th Street. Since only buses would be permitted to turn left at this location, a signal priority system, as described above, is recommended to be installed.

4-13. FARRAGUT SQUARE

Alternatives G and H assume no widening on K Street at Farragut Square. The acquisition of eight feet of right-of-way from Farragut Square, which is owned by the National Park Service (NPS), would allow for the provision of one extra lane of traffic which would help improve traffic and transit operations. Without the eight-foot strip from Farragut Square (Alternatives G and H), the geometric configurations and parking restrictions on K Street generally would be the

Figure 4-10
Example of Special Bus Phasing for Left Turns out of Busway Under Alternative G

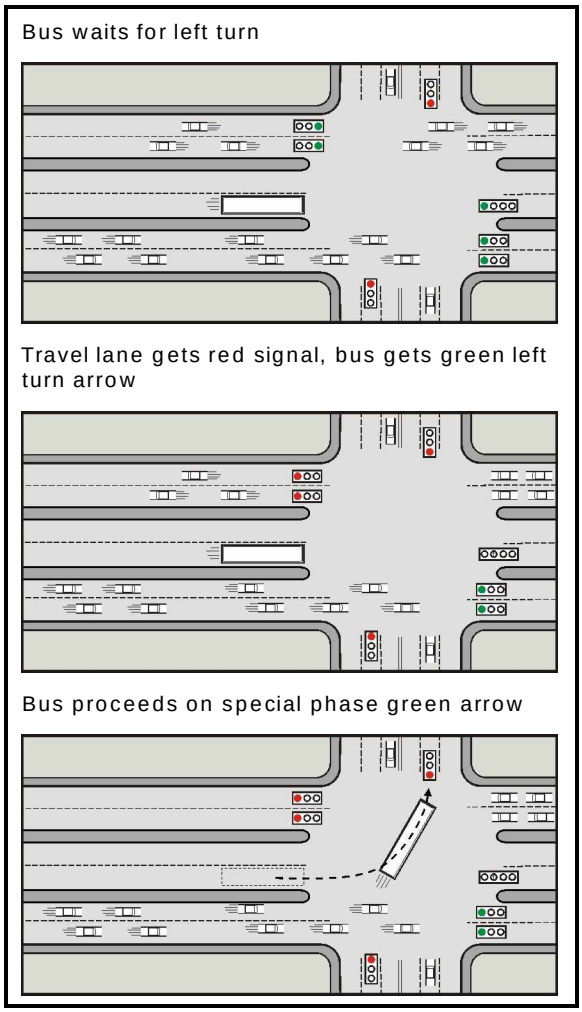
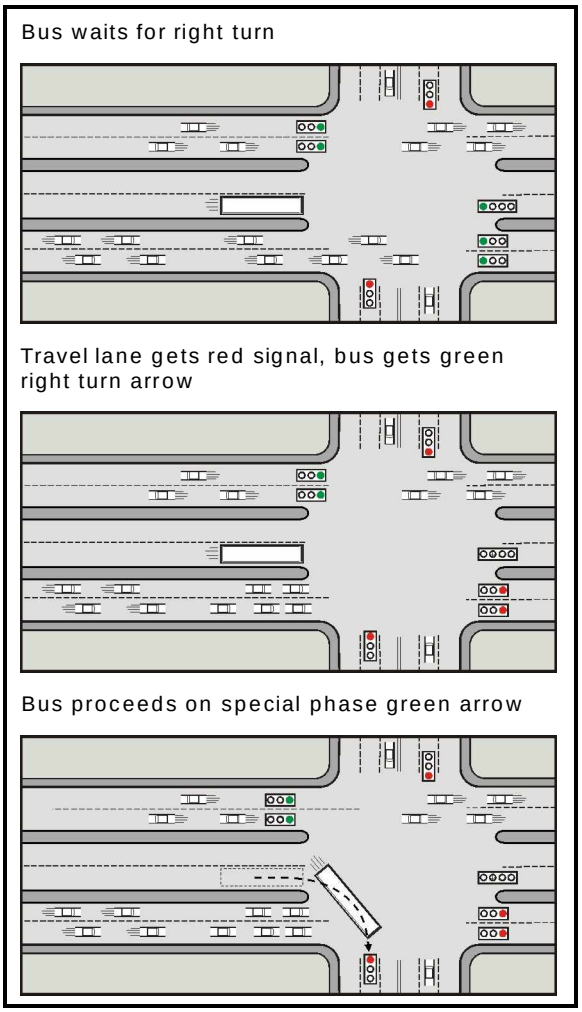


Figure 4-11
Example of Special Bus Phasing for Right Turns out of Busway Under Alternative G



same except between 16th and 18th Streets. Traveling eastbound on K Street, the roadway cross-section would be shifted to the north between 18th Street and Connecticut Avenue. A six-lane cross-section would be provided between Connecticut Avenue and 17th Street, with one exclusive bus lane in each direction and two non-bus travel lanes in each direction. Continuing eastbound on K Street, the cross-section would shift back to the south in the block between 17th and 16th Streets.

4-14. BUS SERVICE TO GEORGETOWN UNIVERSITY CAMPUS

At the completion of this study, Georgetown University informed the Study Team that at this time, they would prefer to provide their own transit services, rather than those of outside

providers. This section is a summary of findings and recommendations for bus service on Georgetown University, should the university decide to extend Downtown Circulator service to its campus.

The Study Team recommends that the Circulator serve Georgetown University. Every third Circulator will travel to Georgetown University. Rather than turning right from Wisconsin Avenue to M Street to begin the eastbound trip to Union Station, Circulators serving Georgetown University will turn left onto M Street, continue straight to Canal Road and access Georgetown University via the Canal Road driveway. The Circulator will follow the routes within campus shown in Figures 3-20 and 3-21. The bus stop would be provided in the vicinity of the Intercultural Center. Prior to construction of the McDonough School of Business, the bus stop would be placed at the parking lot which is the future site of the McDonough School of Business. After completion of the McDonough School of Business, the turnaround and bus stop facilities would be provided along the border between the McDonough School of Business and the football field south of this site.

Due to current prohibition of left turns from the Georgetown University driveway to Canal Road between the hours of 6:00 AM to 10:15 AM, the Study Team recommends an alternative routing during these times. During these times, the westbound Circulator should enter campus via the Canal Road driveway. The eastbound Circulator should exit campus via Prospect Street. It should travel east on Prospect Street, turn right to southbound 34th Street and left onto eastbound M Street. Travel time runs conducted by the Study Team show that routing the eastbound Circulator via Prospect Street rather than Canal Road will add 45 to 60 seconds between Georgetown University and the intersection of Wisconsin Avenue and M Street.

The final Georgetown University routing decisions will be made with input from Georgetown University. If the above AM route is found to be undesirable by the university, a secondary alternative recommended by the Study Team would be for the Circulator to leave campus between 6:00 AM and 10:15 AM by turning right at the Reservoir Road driveway. It should travel east on Reservoir Road, turn right to southbound 35th Street, left to eastbound Q Street, right to southbound Wisconsin Avenue, and left onto eastbound M Street. Travel times runs conducted by the Study Team show that routing the eastbound Circulator via Reservoir Road rather than Canal Road will add 60 to 90 seconds between Georgetown University and the intersection of Wisconsin Avenue and M Street. Additionally, this routing would require the elimination of two eastbound Circulator stops on M Street between the Key Bridge and Wisconsin Avenue during the hours of 6:00 AM to 10:15 AM. These stops would be operational at all other times of the day.

4-15. OPERATIONS AT UNION STATION

The Study Team recommends that transit service to Union Station be provided, with bus service operating on the second lane in front of Union Station, because it results in adequate traffic operations and improved bus operations to reach the layover deck, and has no negative effects on taxi operations. It is important to note that the implementation of Union Station service would

require that the bus lane be constructed with a width of 24 or 25 feet (24 feet minimum/25 feet recommended) to allow departing buses to pass parked buses. The existing Union Station Redevelopment Corporation (USRC) plan does not provide the recommended 25 feet. It provides 20 feet of width for all three lanes. The widening of the second lane would require a reduction in the width of the first and third lanes to accommodate the recommended 25 feet of width on the second lane. Reducing the width of the first (northernmost) lane would improve the geometry for buses maneuvering from the east ramp to the second lane and from the second lane to the west ramp.

WMATA buses, including the circulator would pick up and drop off passengers in front of Union Station and would layover on the deck behind Union Station. The buses will access the deck via the ramp located on the western side of the building and will travel from the deck to the front of the station via the ramp located on the eastern side of the building. Figure 3-32 shows the recommended plan for the layover deck behind Union Station that would accommodate the recommended WMATA bus operations at Union Station.

5. SKETCH PLANNING IMPLEMENTATION PLAN

This plan has been prepared to assist the District Department of Transportation (DDOT) and the Washington Metropolitan Area Transit Authority (WMATA) in implementing a series of transportation improvements through the core of the District of Columbia connecting Georgetown to Union Station. The feasible alternatives and recommended improvements intended to enhance east-west mobility and transportation safety are described in the previous section of this final report. This section describes the specific steps that need to be taken to further assess the feasible alternatives and implement the improvements, and provides information on the anticipated duration of the implementation tasks. Figure 5-1 lists the tasks necessary to further assess the feasible alternatives and implement the recommended improvements and identifies the suggested sequencing of these tasks.

5-1. TASK 1 – COMPLETION OF K STREET TRANSITWAY PLANNING STUDY

The K Street Transitway planning study will be completed in May 2005. The feasible alternatives and recommendations are described in the previous section of this report. The tasks described in this implementation plan are those that would be needed to further assess the feasible alternatives and implement the recommendations of the K Street Transitway Study.

5.2. TASK 2 – CONDUCT K STREET ADDITIONAL PUBLIC/STAKEHOLDER MEETINGS

After the completion of the K Street Transitway planning study, DDOT will hold a series of public and stakeholder meetings to enhance the public participation process and provide additional input for the selection of a preferred option for a reconfigured K Street.

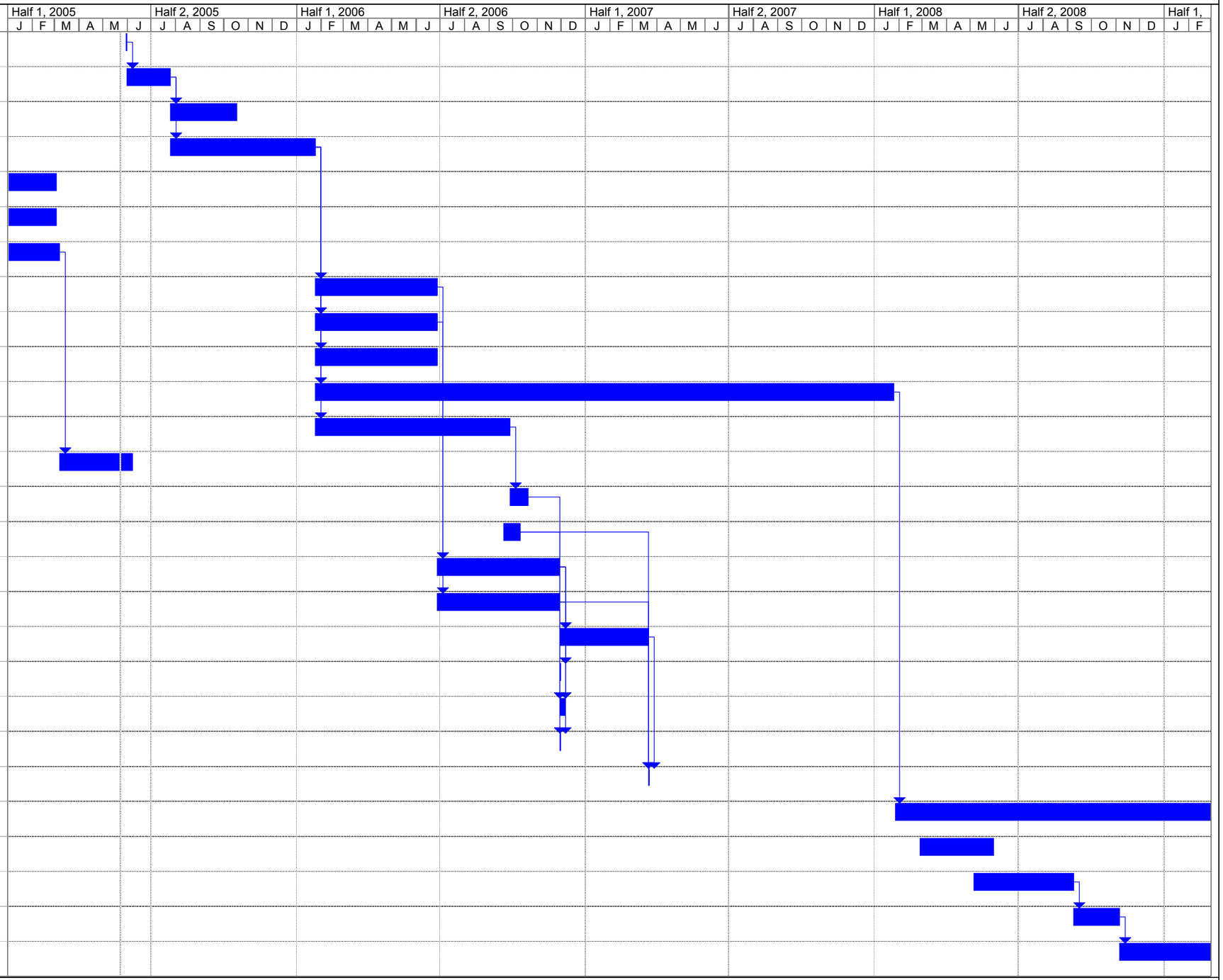
5-3. TASK 3 – DEVELOPMENT OF A FINANCING PLAN

The K Street Transitway planning study was funded through a combination of FHWA Economic Development program funds and local DC funds passed through to WMATA for project planning and development. The next step needed for further assessment of feasible alternatives and implementation of the recommended improvements is the development of a financial plan covering each element of the project. Activities to be financed include further assessment of feasible alternatives, preliminary design/engineering, environmental clearance and construction.

The identification of funding sources will be undertaken during the first half of 2005. While the District Department of Transportation will be responsible for developing the overall plan in cooperation with WMATA, it will be responsible for directly financing some of the recommended improvements. Other institutions, both public and private, will be required to provide funding for the remaining elements of the project. Table 5-1 provides a general

Figure 5-1
Implementation Plan Schedule

ID	Task Name
1	K Street Busway Planning Study Completed
2	Conduct Additional Public/Stakeholder Meetings
3	Identify Potential Funding Sources
4	Environmental Assessment
5	Acquire Circulator Buses
6	Develop Branding Concept for Circulator, Bus Lanes and Busway
7	Develop Detailed Plan for Fare Collection System
8	Bus Lane Design on I and L Streets
9	Bus Lane Design on Massachusetts Avenue
10	Design Signal Priority for Massachusetts Avenue
11	Design K Street Transitway
12	Finalize Interim Service Plan with Routes on I and L Streets
13	Make Modifications to Vehicles to Implement Modified Fare Collection
14	Conduct Public Meetings to Discuss Route Changes to I and L Streets
15	Prepare Regulation/Notices for Elimination of Parking Spaces
16	Construct Bus Lanes on I and L Streets
17	Construct Bus Lanes on Massachusetts Avenue
18	Construct and Implement Signal Priority for Massachusetts Avenue
19	Begin Circulator Service Using I and L Streets
20	Implement Route Changes to I and L Streets
21	Begin Operation of Curbside Bus Lanes on I and L Street
22	Begin Operation of Curbside Bus Lanes on Massachusetts Avenue
23	Construct K Street Transitway
24	Design Removal of Curbside Bus Lanes on I and L Streets
25	Finalize K Street Transitway Service Plan
26	Conduct Public Meetings to Discuss Route Changes to K Street Busway
27	Open K Street Transitway and Implement Transitway Service Plan



assessment of the financial responsibility for implementation of each project element. Revisions and adjustments to the information shown in Table 5-1 will be made throughout the implementation process as refinements are made to the financing plan.

Table 5-1
Entities Responsible for Funding the Different Elements of the Project

Task	Imp. Plan Task #	Entity Responsible for Funding
K Street Transitway Study	1	DDOT, WMATA
Conduct K Street Additional Public/Stakeholder Meetings	2	DDOT, NCPC
Development of Financing Plan	3	DDOT, WMATA
Engineering Design for K Street Reconstruction Including All Transit and ITS elements		DDOT, WMATA
Environmental Assessment	4	DDOT
Design Interim Bus Lanes on I and L Streets	8	DDOT
Develop K Street Reconstruction Period Service Plan with Buses Using the I and L Street Bus Lanes, and Conduct Public Meetings	12, 14	DDOT, WMATA
Develop Detailed Plan for Fare Collection System	7	DDOT, WMATA
Design Bus Lanes on Massachusetts Avenue	9	DDOT
Design Signal Priority and Timing Plans for Massachusetts Avenue	10	DDOT, WMATA
Design Reconfigured K Street Including Roadway Geometry, ITS, Traffic Signals and Passenger Information Systems	11	DDOT, WMATA
Develop Curbside Management Plan and Related Regulations	15	DDOT
Development of Branding Concept for Circulator, Bus Lanes and K Street Transitway	6	DDOT, WMATA, Circulator Partners
Acquisition of Circulator Buses, Modification of Other WMATA Vehicles to Permit Multi-Door Boarding	5, 13	DDOT, WMATA, Circulator Partners
Construction of Curbside Bus Lanes		DDOT
Construct Bus Lanes on I and L Streets	16	DDOT
Construct Bus Lanes on Massachusetts Avenue Including Signal Priority Elements	17, 18	DDOT, WMATA
Implement Interim Bus Service on I and L Street Bus Lanes Including Circulator Service	19, 20, 21	DDOT, WMATA
Implement Bus Lanes on Massachusetts Avenue Including Signal Priority and Circulator Service	22	DDOT, WMATA
Reconstruct K Street Including Construction of K Street Transitway	23	DDOT
Design Removal of Curbside Bus Lanes on I and L Streets	24	DDOT
Finalize K Street Transitway Service Plan and Conduct Public Meetings	25, 26	DDOT, WMATA
Open K Street Transitway and Implement Final Service Plan	27	DDOT, WMATA, Circulator Partners

A variety of funding sources are available for all the elements of the K Street Transitway project. This project is eligible for a range of federal highway and transit financial assistance programs. These include:

- Federal Transit New Start Program
- Federal Highway National Highway Program
- Federal Transit Section 5307 Urbanized Area Formula Grant program
- Federal Transit Section 5309 Bus Capital Program
- Federal Highway Surface Transportation Program ("flexed" from FHWA to FTA)
- Federal Highway Congestion Management and Air Quality ("flexed" from FHWA to FTA) Program

Surface Transportation Program
Congestion Management and Air Quality
National Highway Program
All of these programs, using funds moved or flexed from Federal Highway to Federal Transit Administration, have been used to finance transitway projects in the past. For example, Surface Transportation Program funds were used to construct the South-Dade Busway in Miami, including the running way, systems and stations.

National Highway Program
If it can be demonstrated that a transit project has a positive effect on congestion on a segment of the National Highway System, such as K Street, funds from that program can be used to fund virtually all aspects of the project. This funding source can be used for running ways and station improvements.

New Start Funds
In the past, New Start funds were only available for projects with dedicated running ways. Many Bus Rapid Transit (BRT) projects received financial assistance from this source, including the Pittsburgh West Busway, a number of the transitways in Houston and Boston's Silver Line. There is significant competition for limited funds, but the many benefits derived from this project and its modest cost are sure to make it highly competitive for this program both within the Administration and in Congress. In fact, the U.S. Department of Transportation proposed making all transit capacity and performance enhancements eligible for the program, with an emphasis on "Small Start" projects of under $75 million.

Section 5307 Urbanized Area Formula Grant Program
Though the resources of this program, formula-allocated to the Washington Metropolitan Area, are also over-prescribed, certain elements of the K Street Transitway Project, such as quality vehicles for routes of District and Regional significance that would use it, or an ITS-driven passenger information system, could well receive financial support.

Section 5309 Bus Capital Program
Entire projects similar to the K Street Transitway Project (e.g., Denver Mall) have been funded from this source. However, as is the case for the 5307 Program above, certain elements of the project (e.g., vehicles, stations, ITS) of this highly over-subscribed discretionary program could receive financial assistance here.

While New Start or Surface Transportation funds could be used to finance the entire K Street Transitway project, many projects similar to the K Street Transitway project receive Federal funding from a variety of the programs noted above. For example, the running way could be financed from the National Highway Program, while vehicles and the ITS system could be funded from the Section 5307 Bus Capital Program.

5-4. TASK 4 – ENVIRONMENTAL ASSESSMENT

The environmental assessment task should start in the second half of 2005, provided funding could be identified to develop the environmental assessment documents. As shown in Figure 5-1, this task is expected to last approximately six months. Two environmental assessment documents may need to be prepared for this project – one to address the requirements of Section 4F and one to address the requirements of Section 106. At the conclusion of the environmental process, a preferred alternative will be selected for implementation.

5-4.1. SECTION 4F ENVIRONMENTAL ASSESSMENT

A Section 4F environmental assessment would address impacts on historic resources. The Section 4F assessment process will develop an inventory of potential historic resources, will identify potential impacts on historic resources, and will result in a sign-off on the project from the historic preservation office.

5-4.2. SECTION 106 ENVIRONMENTAL ASSESSMENT

The Section 106 environmental assessment will look at the potential impacts on cultural and historic resources as well as impacts on park land. Some of the key issues that will be addressed in the development of the Section 106 documentation are noise, vibration, air quality and traffic impacts.

5-5. TASK 5 – ACQUISITION OF CIRCULATOR VEHICLES

The process for acquiring the Circulator buses required the assessment of the number of buses needed to operate the system, development of functional requirements for the vehicles, selection of vehicles, development of vehicle specifications, identification of funding sources for the acquisition of vehicles, ordering of the vehicles, and delivery by the vehicle manufacturer. The Circulator buses have already been acquired.

The major source of funding for the Circulator vehicles will likely be the District of Columbia, utilizing financial resources from the Riders Trust Fund. Key functional requirements for the Circulator buses include:

- Provision of multiple doors to reduce dwell times
- Ability to accommodate improved fare collection systems (i.e., multiple SmarTrip® reader/writers) in order to support multiple door boarding on K Street
- Ability to accommodate advanced passenger information systems
- Low floor design with quick-deploying ramp

The process of acquiring the Circulator buses included the following steps:

1. Estimation of the number of buses needed to operate the system, based on the proposed service plan and system characteristics (the Service Plan section of this final report includes information on the number of buses needed for the recommended Circulator service)
2. Development of detailed functional requirements for the vehicles
3. Development of vehicle selection approach and criteria
4. Vehicle manufacturer solicitation
5. Evaluation of manufacturer responses
6. Selection of vehicles
7. Evaluation of adequacy of maintenance facilities to accommodate increased number of vehicles and design and construction of additional maintenance facilities if necessary
8. Development of vehicle contract terms specifications
9. Ordering of vehicles
10. Supervision during manufacturing
11. Delivery by the vehicle manufacturer and acceptance testing

5-6. TASK 6 – DEVELOPMENT OF BRANDING CONCEPT FOR CIRCULATOR, BUS LANES AND BUSWAY

This task required the development of a comprehensive branding/marketing strategy including both hard and soft elements for the CBD Circulator/K Street Transitway System. Activities under this task ensure that the results of that exercise are absorbed into all systems development activities. Work included:

- Preparing for and attending all branding coordination meetings
- Proving review comments on all branding products
- Implementing the results of the branding exercise on an ongoing basis in all detailed planning/design efforts

5-7. TASK 7 – DEVELOPMENT OF DETAILED PLAN FOR FARE COLLECTION SYSTEM

In order for the K Street busway and connecting bus lanes to function with the highest efficiency and effectiveness, a fare collection mechanism that minimizes passenger service and hence dwell times must be incorporated into the system mix. This fare collection system must be compatible

and integrated with the fare collection mechanism for the rest of the MetroBus and MetroRail system and facilitate multiple door boarding. Accordingly, vehicles serving the CBD circulator and other routes using the facilities should be equipped with SmarTrip® smart card readers at both the front and rear (or middle) doors.

The purpose of this task is to develop a detailed plan for the development of this fare collection approach. Work includes:

- Developing functional specifications for all on-board and stop/station hardware (fare card sales, smart-card revaluing, readers, validation) and supporting software
- Developing revenue handling, customer service and data reporting procedures
- Developing "proof of payment" inspection procedures
- Coordination with Maryland MTA, Virginia Railway Express, OmniTrans, Loudon County Transit and other transit operators on fare collection policies

5-8. TASK 8 – DESIGN OF BUS LANES ON I AND L STREETS

In order to mitigate the effects on bus and vehicular flow associated with construction of the busway on K Street, the Study Team recommends the provision of exclusive curbside bus lanes on I and L Streets until the K Street Transitway is fully operational. Design of exclusive curbside bus lanes on I and L Streets is expected to begin in January 2006 and take approximately five months to complete. These exclusive bus lanes are intended to serve some of the bus routes that currently use K Street while its reconfiguration is under way. The Study Team recommends the operation of these exclusive bus lanes with the following characteristics:

- The exclusive bus lanes should operate Monday through Friday on a 24-hour basis.
- General traffic making right turns from I and L Streets should be allowed to use the exclusive bus lanes.
- Right turns into parking facilities and alleys should be allowed.
- Taxi pick up and drop off should be allowed.
- Loading and unloading for commercial vehicles should not be allowed on the bus lanes.
- Bicycles should be allowed on the bus lanes. If possible, a 13-foot bus lane should be provided to facilitate the use of the bus lanes by bicycle riders.
- The development of an effective enforcement plan is essential for the adequate operation of the exclusive bus lanes.

On I Street, an exclusive bus lane will be provided in the right curb lane between New York Avenue/11th Street and Pennsylvania Avenue/21st Street. On L Street, an exclusive bus lane will be provided in the right curb lane between 26th Street and 11th Street.

Design elements of these exclusive bus facilities include the following:

- Proper signing and markings related to the lanes
- Pavement markings and striping, including pavement legends and a distinctive line separating the bus lanes from regular travel lanes
- Pavement color and type with a treated asphalt pavement with a different color than the non-bus lanes is recommended for the exclusive bus lanes
- The number of parking spaces that will be lost to the bus lanes
- Location and design of bus stops/stations

Necessary permitting, contract preparation, bidding and awarding are included in this task.

The Study Team conducted a full evaluation of traffic operations of this interim condition using the CORSIM traffic simulation model. The traffic simulation models indicate that operating I and L Streets with exclusive curbside bus lanes would have a marginal detrimental effect on traffic operations. Therefore, the Study Team recommends the implementation of curbside bus lanes on I and L Streets as interim measures until the K Street Transitway is fully operational. More complete discussion of the effects of implementing exclusive bus lanes on I and L Streets is provided in Appendix S.

5-9. TASK 9 – DESIGN OF BUS LANES ON MASSACHUSETTS AVENUE

Design of exclusive curbside bus lanes on Massachusetts Avenue is expected to begin in January 2006 and take approximately five months to complete. These exclusive bus lanes will serve the Downtown Circulator and other bus routes of regional significance as described in this study. Non-bus traffic making right turns from Massachusetts Avenue will also use these lanes. On Massachusetts Avenue, an exclusive bus lane will be provided in the both directions in the right curb lane between Union Station and H Street.

The Study Team recommends the operation of these exclusive bus lanes with the following characteristics:

- The exclusive bus lanes should operate Monday through Saturday on a 24-hour basis.
- General traffic making right turns from Massachusetts Avenue should be allowed to use the exclusive bus lanes.
- Right turns into parking facilities and alleys should be allowed.
- Taxi pick up and drop off should be allowed.
- Loading and unloading for commercial vehicles should not be allowed on the bus lanes
- Bicycles should be allowed on the bus lanes. Where possible, a 13-foot bus lane should be provided to facilitate the use of the bus lanes by bicycle riders.
- The development of an effective enforcement plan is essential for the adequate operation of the exclusive bus lanes.

Design elements of these exclusive bus facilities include the following:

- Proper signing and markings related to the lanes
- Pavement markings and striping, including pavement legends and a distinctive line separating the bus lanes from regular travel lanes
- Pavement type with a treated asphalt pavement with a different color than the non-bus lanes is recommended for the exclusive bus lanes
- Modifications to signing to address the elimination of parking and loading spaces.
- Location and design of bus stops/stations

Necessary permitting, contract preparation, bidding and awarding are included in this task.

5-10. TASK 10 – DESIGN SIGNAL PRIORITY FOR MASSACHUSETTS AVENUE

The Study Team recommends that the exclusive bus lanes on Massachusetts Avenue be equipped with a transit signal priority system. The traffic signal priority control strategy will likely be an early green / extended green bus priority control strategy. In the early green bus priority control strategy, a bus preempt shall cause the traffic signal controller to terminate the non-bus phase(s) as soon as safe minimum times are completed to provide an early green for the bus. If a bus signal phase is active when the bus preempt call is received, then the phase shall extend the green time until the bus is served or until a preset maximum time has elapsed. Design of this system is expected to begin in January 2006 and take approximately five months to complete.

Design elements of the transit signal priority system include the following:

- Development of engineering plans for each intersection. Base maps will be prepared using available information such as aerial photographs, traffic signal drawings, utility drawings and right-of-way drawings.
- Field verification of all above ground features including but not limited to type and location of signal poles and light poles, location of controllers, detection system, trees, manholes, fire hydrants, drainage inlets, handicapped ramps, parking lanes and other traffic signs and pavement marking data, including bus stop locations.
- Development of engineering plans for each intersection showing the above-ground work necessary to install the preemption system. These plans will include proposed changes, if any, to the traffic signal phasing and timing.
- Sequence of operation and quantity drawings, along with cost estimate and specifications.

5-11. TASK 11 – DESIGN OF RECONFIGURED K STREET INCLUDING TRANSITWAY

The K Street Transitway is the most critical element of the entire project. The design of the K Street Transitway is expected to start in January 2006 and will take approximately two years to complete. The design of the facility includes developing design plans and specifications for the following:

- Exclusive busway between 21st Street and 9th Street
- Contra-flow eastbound bus lane between 10th and 9th Streets[1].
- Contra-flow northbound bus lanes on K Street between New York Avenue and Massachusetts Avenue
- Contra-flow bus lane on 15th Street between K and H Streets.
- Two-way 17th Street north of K Street during all times of the day.

The design plans and specifications will address the following elements:

- Roadway geometry
- Paving
- Signalization
- Medians
- Islands
- Bus stops and stations
- Crosswalks
- Utility relocation and reconstruction
- Markings
- Signing and markings
- Sidewalks
- Crosswalks
- Streetscape
- Plantings
- Maintenance of traffic

The Summary of Findings and Recommendations section of this report and Appendices O and P provide information on the cross-sections of the feasible alternatives, lane configurations, turn lanes, parking, location of medians, placement of bus stops/stations, lane widths, median widths and location of islands. These elements will be refined at the final engineering design stage of the process.

[1] If the Circulator route is changed and no contra-flow lane is provided for the eastbound bus movement between 10th and 9th Street, no design plans will need to be developed for this section of roadway.

5-12. TASK 12 – FINALIZE INTERIM SERVICE PLAN FOR ROUTES ON I AND L STREET

The Study Team recommends that several bus routes that currently use K Street or are proposed to use K Street in the future (Circulator) be shifted to the exclusive bus lanes of I and L Streets during construction of the K Street Transitway. WMATA and DDOT will make refinements to the interim service plan described in this section of the implementation plan prior to implementation. As previously shown in Figure 5-1, the development of the refined Service Plan is expected to begin in January 2006.

The existing bus routes in the Central Section of the K Street Transitway study area are shown in Figure 5-2. The Study Team's recommended route changes are described below and are shown in Figure 5-3.

Circulator[1]

Eastbound

Turn from Pennsylvania Avenue to L Street. Travel east on L Street to Massachusetts Avenue. Continue eastbound on Massachusetts Avenue to 9th Street. Turn right to southbound 9th Street. Turn left across the southern side of Mount Vernon Square. Continue eastbound on Massachusetts Avenue. Massachusetts Avenue between H Street and Union Station would have an exclusive curbside bus lane.

Westbound

From Union Station travel on Massachusetts to Mount Vernon Square. Travel across the southern side of Mount Vernon Square to New York Avenue. Follow New York Avenue to I Street. Turn right on I Street to 20th Street. Travel north on 20th Street to K Street. Continue westbound on K Street.

Routes D1, D3 and D6

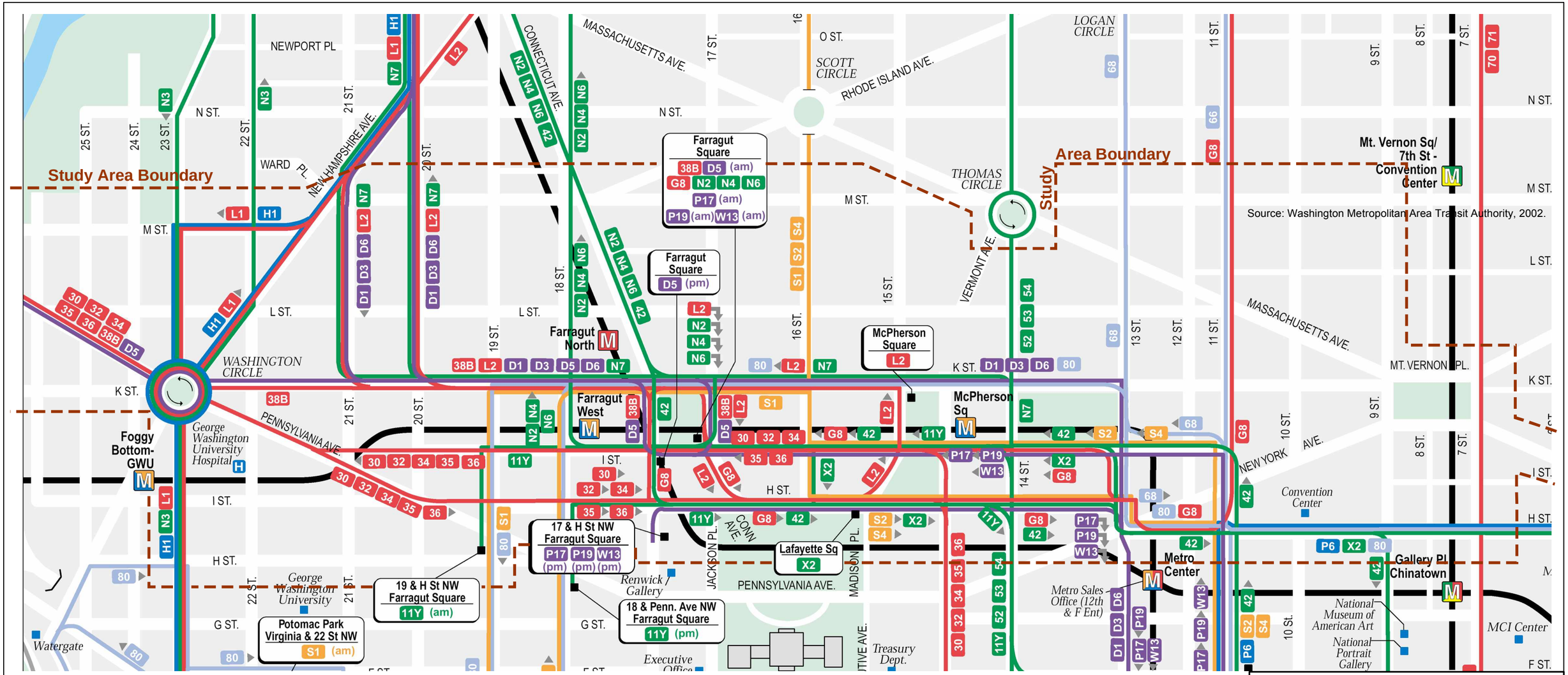
Eastbound

From 21st and L Streets turn left on L Street. Travel on L Street to 13th Street. Turn right on 13th Street. Resume existing route.

Westbound

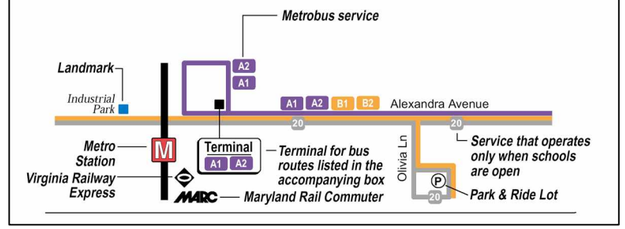
From 13th and H Streets, travel north on 13th Street. Turn left on I Street. Travel on I Street to 20th Street. Turn right on 20th Street. Resume existing route.

[1] The interim routing for the Circulator recommended by the K Street Transitway Study Team is described in this section of the report. However, after the analyses for the K Street Transitway project were completed, the operators of the Circulator modified the interim eastbound and westbound circulator routes. In the interim, the eastbound Circulator will travel eastbound on Massachusetts Avenue, east on Mount Vernon Place, south on 7th Street and east on Massachusetts Avenue. The westbound circulator will travel west on Massachusetts Avenue, north on 7th Street, west on Mount Vernon Place, south on 9th Street and west on New York Avenue.



Note:
Route N7 was eliminated on December 28, 2003. This route is shown in this figure because the analyses for this study were completed prior to the elimination of this route.

LEGEND



Source: Washington Metropolitan Area Transit Authority, 2002.

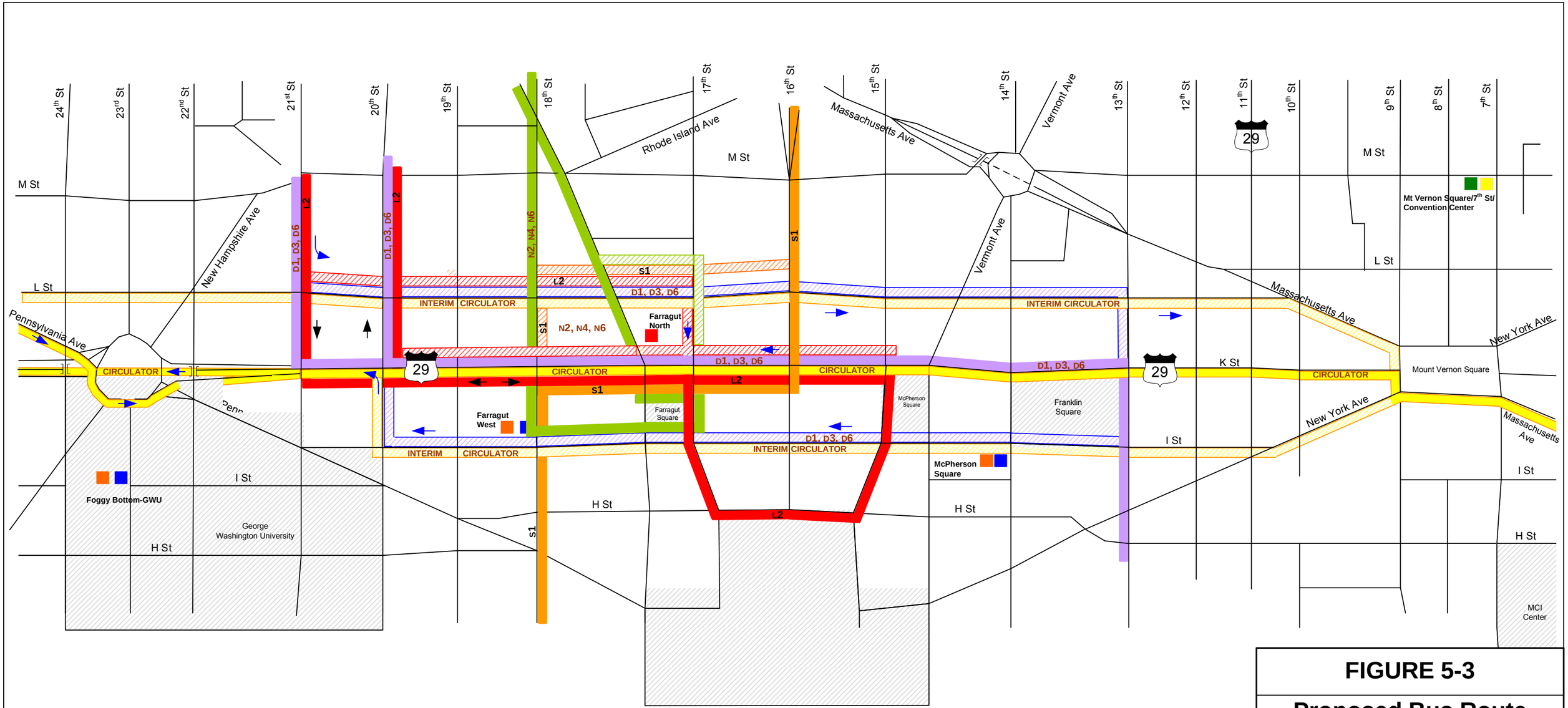
FIGURE 5-2

Existing Bus Routes in the Central Section of the Study Area

Not to Scale

K Street Transitway

May 2005



* The interim routing for the Circulator recommended by the K Street Transitway Study Team is shown in this graphic. However, after the analyses for the K Street Transitway project were completed, the operators of the Circulator modified the interim eastbound and westbound circulator routes. In the interim, the eastbound Circulator will travel eastbound on Massachusetts Avenue, east on Mount Vernon Place, south on 7th Street and east on Massachusetts Avenue. The westbound circulator will travel west on Massachusetts Avenue, north on 7th Street, west on Mount Vernon Place, south on 9th Street and west on New York Avenue.

LEGEND

- Existing N2, N4, N6
- Existing D1, D3, D6
- Existing L2
- Existing S1 (PM)
- Interim N2, N4, N6
- Interim D1, D3, D6
- Interim L2
- Interim S1
- Proposed 2015 Downtown Circulator
- Proposed Interim Downtown Circulator*

FIGURE 5-3

Proposed Bus Route Changes for Interim Bus Lane Operations on I (EYE) and L Streets

Not to Scale

K Street Transitway

May 2005

Route L2

Eastbound
From 21st and L Streets turn left on L Street. Travel on L Street to 17th Street. Turn right on 17th Street. Resume existing route.

Westbound
Maintain existing route.

Routes N2, N4 and N6

Eastbound
From the intersection of Connecticut Avenue and L Street turn left on L Street and right on 17th Street. Resume existing route.

Westbound
Maintain existing route.

Route S1 (PM)

Eastbound
From 18th and K Streets continue north on 18th Street (instead of turning right on K Street). Travel north on 18th Street to L Street. Turn right on L Street to 16th Street. Resume existing route.

5-13. TASK 13 – MAKE MODIFICATIONS TO VEHICLES TO IMPLEMENT IMPROVED FARE COLLECTION SYSTEM

The recommendations developed in Task 7 with respect to the implementation of an improved fare collection system will likely be implemented in stages. Vehicles serving different routes will be upgraded throughout a nine-month period of time. This will require coordination with WMATA Office of Bus Services. The fare collection system will be compatible and integrated with the fare collection mechanism for the rest of the MetroBus and MetroRail and will facilitate multiple door boarding. The vehicles will be equipped with SmarTrip® smart card readers at both the front and rear doors.

5-14. TASK 14 – CONDUCT PUBLIC MEETINGS TO DISCUSS INTERIM SERVICE PLAN WITH ROUTE CHANGES ON I AND L STREETS

Prior to opening the bus lanes on I and L Streets and prior to implementing the bus route changes described in Task 12, WMATA should conduct public meetings to inform the public about the modifications to the existing bus routes. Based on the schedule for the implementation tasks, presented in Figure 5-1, these meetings are likely to be held during the second half of 2006.

5-15. TASK 15 – PREPARE REGULATIONS/NOTICES FOR ELIMINATION/ MODIFICATION OF PARKING AND COMMERCIAL LOADING SPACES

The design of bus lanes on I and L Streets, and Massachusetts Avenue will identify the number and location of parking and commercial loading spaces that will need to be removed for the construction and implementation of the exclusive curbside bus lanes. Prior to the beginning of construction on these roads, approximately second half of 2006, the District Department of Transportation will prepare regulations/notices regarding the elimination/modification of the parking and commercial loading spaces.

5-16. TASK 16 – CONSTRUCT BUS LANES ON I AND L STREETS

The construction of exclusive bus lanes on I and L Streets is expected to begin in the second half of 2006 and take five months to complete. The bus lanes should be constructed as designed. Proper maintenance and protection of traffic should be provided during the construction period.

These exclusive bus facilities include the following:

- Proper signing including parking prohibitions and information on vehicles permitted on the bus lanes
- Pavement markings and striping, including pavement legends and a distinctive line separating the bus lanes from regular travel lanes
- A treated asphalt pavement with a different color than the non-bus lanes is recommended for the exclusive bus lanes
- Bus stops consistent with the branding scheme developed for the operation of the circulator routes

5-17. TASK 17 - CONSTRUCT BUS LANES ON MASSACHUSETTS AVENUE

The construction of exclusive bus lanes on Massachusetts Avenue is expected to begin in the second half of 2006 and take five months to complete. The bus lanes should be constructed as designed. Proper maintenance and protection of traffic should be provided during the construction period.

These exclusive bus facilities include the following:

- Proper signing including parking prohibitions and information on vehicles permitted on the bus lanes
- Pavement markings and striping, including pavement legends and a distinctive line separating the bus lanes from regular travel lanes
- A treated asphalt pavement with a different color than the non-bus lanes is recommended for the exclusive bus lanes
- Bus stops consistent with the branding scheme developed for the operation of the circulator routes

5-18. TASK 18 – CONSTRUCT AND IMPLEMENT SIGNAL PRIORITY FOR MASSACHUSETTS AVENUE

Construction of the transit signal priority system described in Task 10 is expected to begin in the second half of 2006 and take approximately three months to complete.

The transit signal priority system should be constructed and implemented as designed, using equipment listed in the project specifications. Traffic signal controllers, mounting hardware and accessories, cables, mast arms, traffic signal poles, vehicular and pedestrian signal heads, emitters and emitter disable switches should be installed as shown in the traffic signal plans. One detector will be required for each exclusive busway approach to a signalized intersection within the limits of the exclusive bus lanes on Massachusetts Avenue.

Emitters will be installed on all buses that will use the exclusive bus lanes. Proper maintenance and protection of traffic shall be provided during the construction period. Coordination with PEPCO will be required for access to manholes. Training materials and manuals, as well as system training for DDOT and WMATA personnel, will be provided.

The transit signal priority system will be tested by performing travel time runs on the corridors prior to implementation of the system. In-ground vehicle detectors will record the travel times of the buses without use of the priority system. Following this "before" test, a selected number of equipped transit vehicles will drive the corridors to verify priority activation. After-condition travel time runs, using the priority system as designed, will provide data for optimization of the system. Following system verification, a 60-day operational test will begin. Upon successful completion of the operational test, the transit signal priority system will be ready for general use.

5-19. TASK 19 – BEGIN CIRCULATOR SERVICE USING I AND L STREETS

After the vehicles are acquired and outfitted with the necessary equipment, the K Street Circulator service can begin operations on I and L Streets. The routing for the Circulator east of Mount Vernon Square and West of Washington Circle should be as described in the Service Plan section of this final report. The interim routing in the central portion of the study area, until the construction of the K Street Transitway is completed, should be as described in Task 12. The Circulator service is scheduled to start in the spring of 2005. Once the K Street Transitway construction is completed, the Circulator route should be changed to reflect the recommended route shown in the Service Plan section of this final report.

5-20. TASK 20 – IMPLEMENT INTERIM SERVICE PLAN WITH ROUTE CHANGES ON I AND L STREETS

As described in Task 12, several routes will be modified to make use of the exclusive curbside bus lanes on I and L Streets. This route modifications will take place after the exclusive curbside bus lanes are fully constructed or approximately on the spring of 2006.

5-21. TASK 21 – BEGIN OPERATION OF CURBSIDE BUS LANES ON I AND L STREETS

The curbside bus lanes on I and L Streets are expected to begin operations in November 2006. These bus lanes will serve the Circulator and the other east-west bus routes described in Task 12. Prior to opening the bus lanes, press releases should be prepared and flyers should be produced to educate the public about the intended operations of the exclusive curbside bus lanes.

5-22. TASK 22 – BEGIN OPERATION OF CURBSIDE BUS LANES ON MASSACHUSETTS AVENUE

The curbside bus lanes on Massachusetts Avenue are expected to begin operations in the second half of 2006. These bus lanes will serve the Circulator as well as the other routes described in the Service Plan section of this final report. Prior to opening the bus lanes, press releases should be prepared and flyers should be produced to educate the public about the intended operations of the exclusive curbside bus lanes.

5-23. TASK 23 – RECONSTRUCT K STREET INCLUDING CONSTRUCTION OF K STREET TRANSITWAY

The reconstruction of K Street, including the construction of the K Street Transitway, is expected to begin in the first half of 2008 and take approximately one year to complete. The K Street Transitway should be constructed as designed. Proper maintenance and protection of traffic should be provided during the construction period.

The construction of the facility will include changes to the following elements:

- Roadway geometry
- Paving
- Signalization
- Medians
- Islands
- Bus stations
- Crosswalks
- Utilities
- Markings
- Signing and markings
- Sidewalks
- Streetscape
- Plantings

The anticipated busway construction staging under a median busway configuration is as follows:

1. Eradicate existing medians on K Street. Replace with asphalt.
2. Begin constructing westbound median of K Street. Three eastbound lanes should be provided in the three southernmost lanes of K Street. The two lanes immediately adjacent to the new median location can be used for construction operations, leaving four lanes in which to provide three westbound travel lanes.
3. Begin constructing eastbound median. Three westbound lanes should be provided in the three northernmost lanes of K Street. The two lanes immediately adjacent to the new median location can be used for construction operations, leaving three lanes for eastbound traffic operations.
4. Construct exclusive bus lanes on K Street.
5. Perform remaining construction tasks including the construction of bus stations, signing, sidewalk improvements, crosswalks, streetscape and markings.

The anticipated busway construction staging under a median curbside configuration is as follows:

1. Eradicate existing medians on K Street. Replace with asphalt.
2. Construct one of the ultimate eastbound lanes of traffic and one of the ultimate westbound lanes in the center of the road.
3. Construct the two eastbound ultimate southernmost lanes of traffic of K Street. Reroute eastbound traffic during this phase to the lanes constructed during stage 1.
4. Construct the two westbound ultimate northernmost lanes of traffic of K Street. Reroute eastbound traffic during this phase to the lanes constructed during stage 2. Reroute westbound traffic during this phase to the lanes constructed during stage 1.
5. Construct center median. Reroute eastbound traffic to the three southernmost lanes of traffic. Reroute westbound traffic to the three northernmost lanes of traffic.
6. Construct sidewalk modifications on the south side of the street.
7. Construct sidewalk modifications on the north side of the street.
8. Perform remaining construction tasks including the construction of bus stations, signing, crosswalks, streetscape and markings.

5-24. TASK 24 – DESIGN REMOVAL OF CURBSIDE BUS LANES ON I AND L STREETS

The Study Team recommends that prior to finalizing the construction of the K Street Transitway, a plan to remove the exclusive bus lanes on I and L Street be developed. Consideration of removal of the curbside bus lanes should be conducted after the K Street Transitway is fully operational.

5-25. TASK 25 – FINALIZE K STREET TRANSITWAY SERVICE PLAN

Prior to opening the K Street Transitway, the K Street Transitway service plan, described in the service plan section of this report and presented graphically in Figure 3-20, should be finalized by WMATA and DDOT. As shown in Figure 5-1, finalization of the service plan is expected to

begin in the spring of 2008. Some bus routes that were shifted to I and L Streets during construction of the K Street Transitway should to be shifted to K Street, including the Downtown Circulator.

5-26. TASK 26 – CONDUCT PUBLIC MEETINGS TO DISCUSS ROUTE CHANGES TO K STREET TRANSITWAY

Prior to opening the K Street Transitway and prior to implementing the bus route changes described in Task 25, WMATA should conduct public meetings to inform the public about the modifications bus routes. Based on the schedule for the implementation tasks presented in Figure 5-1, these meetings are likely to be held during the fall of 2008.

5-27. TASK 27 – OPEN K STREET TRANSITWAY AND IMPLEMENT TRANSITWAY SERVICE PLAN

The construction of the K Street Transitway is expected to be completed during the spring of 2009. After the facility is constructed, the Study Team recommends the implementation of the transit service plan described in the Service Plan section of this final report. Therefore, the K Street Transitway is expected to be fully operational during the spring of 2009.