District Department of Transportation

Eastern Downtown Protected Bike Lane Feasibility Study

February, 2017

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1 Executive Summary

The purpose of this study is to identify a specific, continuous north-south route on the eastern side of Downtown Washington, D.C. for protected bicycle lanes and to develop a corresponding conceptual design. The study area is bounded by 4th Street NW to the east, 9th Street NW to the west, Florida Avenue NW to the north, and Constitution Avenue to the south.

Cycling has increasingly become a transportation mode of choice for residents within the District of Columbia, and the number of cyclists commuting north-south into and out of the Central Business District represents a significant percentage of roadway users – despite the lack of protected bike lanes that would attract a broader population.

This study selected and evaluated 4 alternatives and a no-build option. Existing operations were analyzed across all transportation modes – biking, walking, traffic, parking, loading, and bus operations – to develop baseline metrics to which the remaining four alternatives were compared. The preliminary build alternatives included:

1. Alternative 1: a one-way, northbound, partially-protected bike lane on the east side of 5th Street, coupled with a one-way, southbound, protected bike lane on the west side of 6th Street.
2. Alternative 2: a northbound protected bike lane on the east side of 6th Street and a southbound protected bike lane on the west side of 6th Street.
3. Alternative 3: two-way protected bike lanes on the east side of 6th Street.
4. Alternative 4: two-way protected bike lanes on the east side of 9th Street.

The preliminary alternatives emphasized mainline and intersection-related protection for cyclists through physical separation between cars and bikes and also through the use of protected or prohibited turn movements at intersections. Examples of protection evaluated for cyclists included bike phases, protected-only turn movements, and vehicle turn restrictions. Public and stakeholder input was requested and received for all alternatives. Feedback was used to modify the alternatives.

Retrofitting each preliminary alternative into an existing roadway involves trade-offs, such as replacing travel lanes, parking lanes, or portions of both. These changes affect traffic congestion, residential and RPP parking spaces, commercial and loading spaces, and bus on-time performance. Iteratively modifying each preliminary alternative allowed for refinement of concepts in an attempt to address public concerns and to minimize the effects on traffic, bus operations, and parking, while still maintaining the vision of a protected bike facility.

As the study shows, each alternative affects the transportation network to varying degrees. However, based on the results of the feasibility analysis herein, **Alternative 3** and **Alternative 4** have the smallest aggregate effect on all transportation modes, including parking, while also maintaining a high degree of mainline and intersection-related protection for cyclists. **Alternatives 3 and 4 are recommended for advancement to a 30% design level in order to more fully define effects and provide stakeholders with a more clear view of these effects.**

2 Introduction

2.1 Study Purpose & Need

The purpose of this study is to identify a specific, continuous north-south route on the eastern side of Downtown Washington, D.C. for protected bicycle lanes and to develop a corresponding conceptual design. The selected route and design is expected to fill a gap in the cycling grid network, while minimizing its effects on bus operations, parking, loading, and vehicle traffic.

Cycling has increasingly become a transportation mode of choice for residents in the District. The increase from less than three (3) miles of bicycle lanes in 2000 to over 70 miles today, as well as the installation of over 3,000 bicycle racks and the successful implementation of Capital Bikeshare, has made D.C. a model bicycle-friendly city. *moveDC*, the District's Multimodal Long-Range Transportation Plan, identified the eastern side of Downtown D.C. as lacking a north-south cycling route and recommended the addition of protected bike lanes to complement the multiple existing east-west routes. These protected lanes would enhance the grid network of cycling infrastructure by adding a continuous north-south protected bike lane route midway between the 15th Street protected bike lanes and the Metropolitan Branch Trail, where no other comparable low-stress bicycling facility exists. Protected bike lanes have been shown to have vastly higher usage than unprotected lanes, and will provide a vital and safe bicycle connection from growing residential neighborhoods and the Howard University campus to retail, employment and institutional centers in the District's Central Business District (CBD), as well as the heavily-used Pennsylvania Ave bike lanes.

2.1.1 Study Area Boundary

As illustrated in Figure 1, the project area for this study is defined as the eastern side of Downtown D.C., bounded by 4th Street NW to the east, 9th Street NW to the west, Florida Avenue NW to the north, and Constitution Avenue NW to the south. Accordingly, there are six potential candidate north-south study streets:

- 4th Street NW
- 5th Street NW
- 6th Street NW
- 7th Street NW
- 8th Street NW
- 9th Street NW

2.2 Study Area Neighborhoods

Five (5) neighborhoods fall partially within the study area: Shaw, Chinatown, Mt. Vernon Square, Penn Quarter, and Judiciary Square. New York Avenue, NW broadly divides these neighborhoods into two regions: the northern primarily residential portion of the study area, and the southern central business district.

The Shaw neighborhood occupies most of the northern portion of the study area, from M Street NW to Florida Avenue NW. While the neighborhood is mostly residential, with the housing type predominately rowhomes, there are several areas of the neighborhood that are undergoing a transformation to provide higher-density housing, restaurants, bars, and independent retail stores. Mount Vernon is another primarily residential neighborhood, as well as one of the city's historic districts. This neighborhood, like Shaw, has seen a lot of growth in the past few years with new developments for housing, recreation, and employment planned for the future. The Walter E. Washington Convention Center abuts the neighborhood.

Directly south of Shaw and Mt. Vernon are the Chinatown and Penn Quarter neighborhoods, which are commercial, and home to many restaurants, retail stores, hotels, and museums, as well as the Verizon Center and CityCenter, an upscale retail and housing development. Housing within these neighborhoods often consists of apartments above ground-floor retail. To the east of Penn Quarter is Judiciary Square, a neighborhood named for its high concentration of federal and municipal courthouses. Judiciary Square also includes many other employment centers, including primarily office buildings, as well as some restaurants and some residential housing.

EASTERN DOWNTOWN PROTECTED BIKE LANES

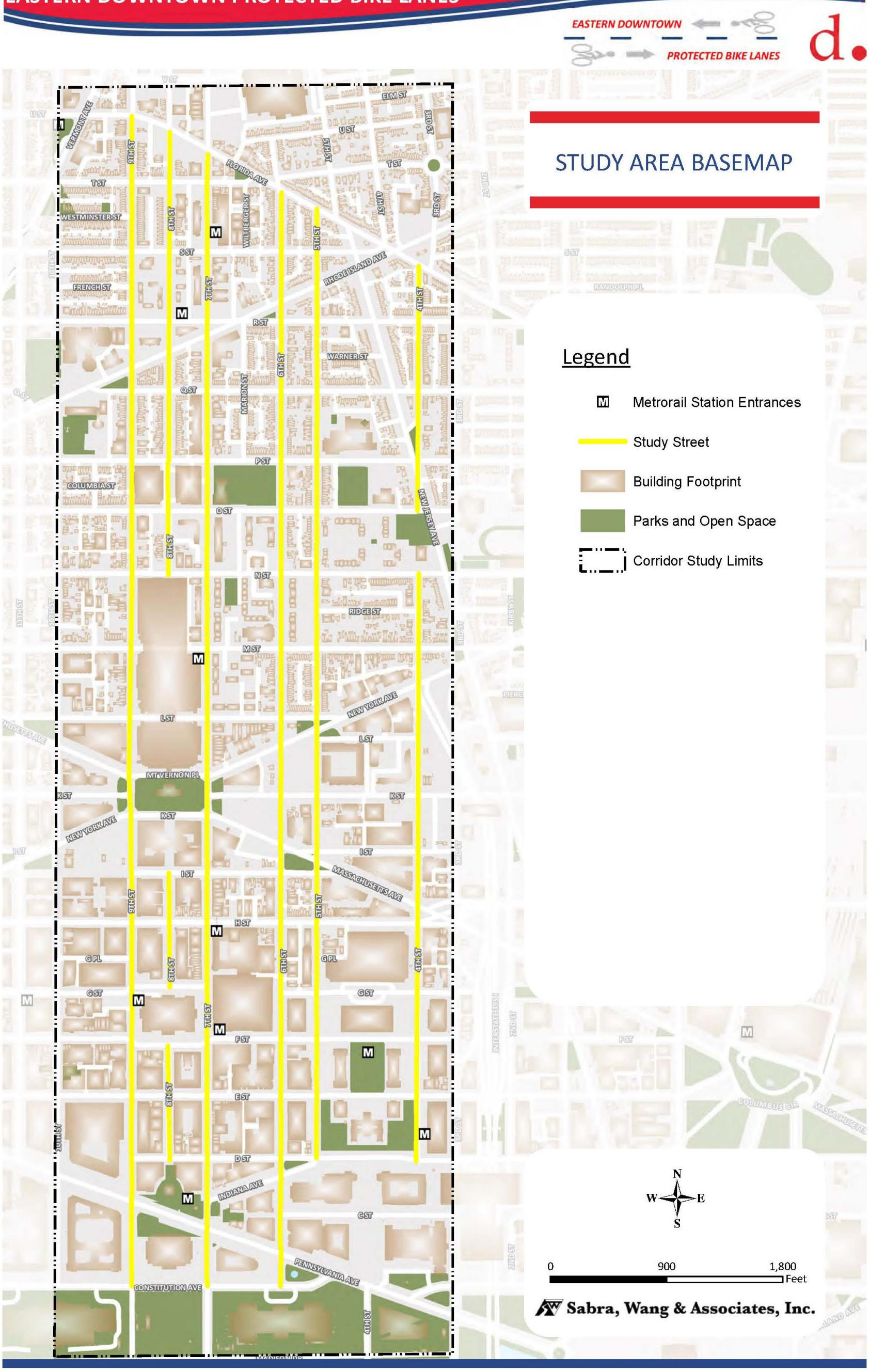

Figure 1: Study Area

2.3 Study Process

The study process, shown in Figure 2, began with identifying the universe of applicable protected bike facility designs and the available north-south streets. The six north-south streets listed previously allow multiple protected bike facility designs (shown in Figure 3). An initial screening process, described in the following report section, reduced the universe of design options to four preliminary alternatives. Public and institutional stakeholders provided input into each alternative. This study then conducted a rigorous analysis of transportation metrics and qualitative effects of each alternative – including a no-build option. Finally, the study recommended an alternative and a subsequent conceptual design.

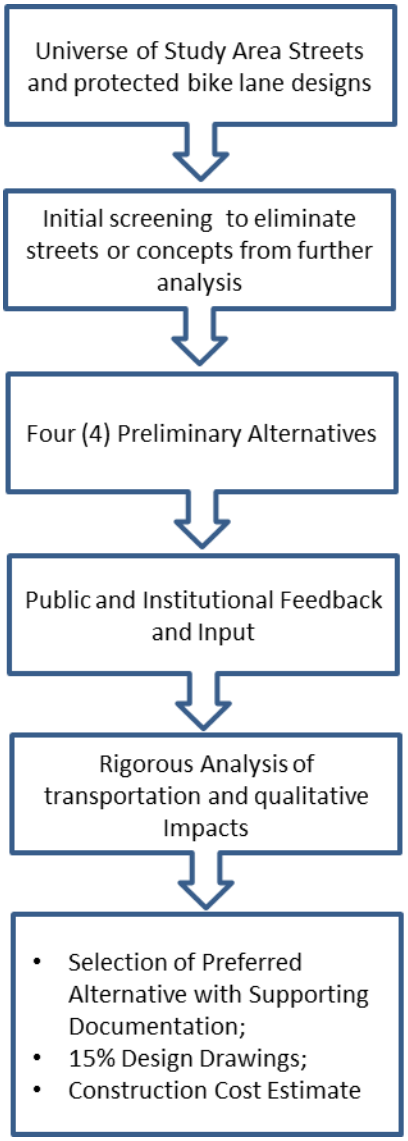

Figure 2: Study Process

2.3.1 Initial Screening Process

To eliminate streets and designs that would *not* be feasible (and therefore would not go through a rigorous analytical study of parking, traffic, loading, etc.), the study identified two "fatal flaws" that would make a protected bike lane route/design impractical:

1. <u>Discontinuity of route</u>
    - A north-south route that would require cyclists to jog over and back along east-west streets one or multiple times is undesirable as it would decrease safety, increase potential conflict points, and add to travel time and complexity. Because 4th Street NW is discontinuous between O and N Streets, and 8th Street NW is discontinuous from N to I Streets and again from F to G Streets, *4th Street, and 8th Street were removed from further consideration and analysis.*

2. <u>Existing heavy curbside WMATA bus boarding/alighting</u>
    - Streets with heavy bus loading (in terms of both number of boardings and number of routes/stops) would result in buses obstructing the bike lanes in a near-continuous fashion, negating the safety and comfort benefits of protection – particularly during the commuting hours when biking in the CBD is highest. Heavy bus operations (i.e., every 3-5 minutes) and heavy boarding (100+

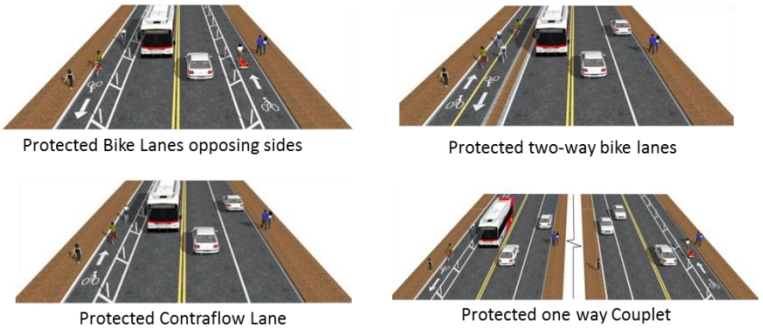

Figure 3: Potential Designs for Protected Bike lanes

boardings per hour) can be found along the southbound (west curbside) direction of 9th Street and both northbound and southbound 7th Street.

Accordingly, the remaining streets/sides available to incorporate curbside bike lanes include:

- Both sides of 5th Street;
- Both sides of 6th Street; and
- The northbound direction/east curbside of 9th Street.

As a result of the initial evaluation process, and eliminating several design alternatives on the streets listed above, *four preliminary alternatives* were developed to be further evaluated and compared against existing no-build transportation conditions, measuring effects on:

- Cyclist Safety
- Parking
    - Sunday Diagonal Parking
- Loading and Events
- Traffic
- Pedestrian Travel
- Bus Operations
- Emergency Vehicle Access

Other non-transportation metrics evaluated include effects on:

- Social/Community
- Local Economy
- Historic Preservation
- Streetscape Aesthetics
- Construction Costs and Staging

The four design options evaluated include:

1. **Alternative 1**: Northbound protected bike lane on the east side of 5th Street and southbound protected bike lane on the west side of 6th Street.
2. **Alternative 2**: Northbound protected bike lane on the east side of 6th Street and southbound protected bike lane on the west side of 6th Street.
3. **Alternative 3:** Two-way protected bikes lanes on the east side of 6th Street.
4. **Alternative 4**: Two-way protected bikes lanes on the east side of 9th Street.

Additionally, a no-build option (**Alternative 0**) was evaluated to provide a baseline comparison for four preliminary build alternatives, described in detail after the *existing conditions* section of this report. The remaining report sections include: a review of the existing transportation conditions within the study area; a description of preliminary alternatives; an analysis of the effect of the alternatives on the transportation network; a summary of public input and commentary; and a recommended alternative design.

3 Existing Conditions for Study Area Streets

The study analyzed following roadway[1] characteristics

- Roadway Geometry and Functional Classification
- On-road Bicycle Network
- Vehicle Traffic Data and Traffic Operations
- On-street Parking & Loading
- Safety
- Bus Operations

Analysis results are summarized below:

3.1 Roadway Geometry and Functional Classification

Within the study area, there is one (1) principal arterial running north-south, and six (6) principal arterials running east-west:

- 7th Street NW (north-south)
- Florida Avenue NW
- Rhode Island Avenue NW
- Massachusetts Avenue NW
- New York Avenue NW
- K Street NW
- Pennsylvania Avenue NW

All remaining roads in the study area are either minor arterials or collector roads. Of the three candidate north-south streets, 5th Street is a collector road, while 6th Street and 9th Street are classified as minor arterials. Of the 119 intersections located on the study streets, 87 are signalized, with the remaining 32 unsignalized – found predominantly on 8th Street, 5th Street, and 4th Street.

The curb-to-curb roadway width for the candidate north-south study streets is shown in Table 1, where 9th Street and 5th Street have been divided to show their change from two-way streets to one-way.

[1] References to the study area streets for the remainder of this report will refer to 5th, 6th, and 9th Streets NW only, as all other study streets have been eliminated as alternatives.

Table 1: Roadway Geometry

Street Name	Typical Curb to Curb Width*	Peak Hour Travel Lanes	Additional Features
9th Street (Florida Ave to Mt Vernon Pl)	56’	4-5	• Taxi Stand • Convention Center Loading Zone • Select Sunday Angled Parking
9th Street (Mt Vernon Pl to Pennsylvania Ave)	50’	3-5 southbound only	• Full-time parking
6th Street	56’	4-6	• Verizon Center Loading Zone • Sunday Angled Parking on some blocks • DC Fire Department Driveway Access • Hotel Entrance
5th Street (Florida Ave to L St)	32’	1 northbound only	• Full-time parking
5th Street (L St to Pennsylvania Ave)	44’	2-3	• Back-in curbside parking between G St. and H. St

*Road widths vary slightly from block to block.

3.2 On-road Bicycle Network

Existing north-south bicycle lanes on study-area streets are limited, and none are protected. Figure 4 shows all existing bike lanes, on-street bike parking locations, and Capital Bikeshare stations. On-street bike facilities include:

- A southbound bicycle lane on 9th Street, from G Place to Pennsylvania Avenue,
- A northbound lane on 5th Street from L Street to Rhode Island Avenue.
- A partial shared bus/bike lane along northbound 7th Street downtown,
- Bike lanes along 7th Street from Florida Avenue to N Street.

While these lanes provide some connectivity to the north and south portions of the bicycle network, the center of the study area shows little bicycle network connectivity, and none offer the user perceptions of safety of a protected facility.

Cycling on the sidewalk is prohibited in the DC’s Central Business District (south of Massachusetts Avenue NW). Accordingly, cyclists are required to use a travel lane on the portion of each study street south of Massachusetts Avenue NW.

Figure 4: Existing Bicycle Network

3.3 Bike and Vehicle Traffic Data and Operations

Vehicle and bike volumes were collected during the AM and PM peak commuting hours at select locations, with vehicle classification determined along the north-south study area routes. This study also identified intersections with significant vehicle turning volumes in order to help determine where additional cyclist protection may be needed.

3.3.1 Existing Peak Hour Vehicle Volumes

Morning and Evening peak hour vehicle volumes were collected in 2013, as a part of DDOT's *Traffic Signal Optimization Project* to refresh the timing of traffic signals District-wide. To verify that these data were still valid, Average Daily Traffic (ADT) counts, in hourly increments, were conducted on north-south study area streets in 2015. The ADT counts showed very similar peak hour volumes at all locations, indicating that no significant vehicle traffic growth has occurred. The heaviest north-south volumes within the study area occur along 9th Street, both in the AM and PM peak hours, as shown in Figure 5.

Hourly vehicle volume *per travel lane* during the AM and PM peak hours is an indication of the level of demand relative to available capacity for each north-south route. Capacity constraints were divided into the following three categories, based on downtown's short blocks, closely-spaced signalized intersections, and heavy pedestrian and bus volumes:

- Available capacity: Less than 300 vehicles per hour per travel lane
- Approaching capacity limits: 300 to 450 vehicles per hour per travel lane
- At or near capacity limits: 450+ vehicles per hour per travel lane

For example, as shown in Figure 6 and Figure 7, 7th Street is generally at capacity heading into the CBD in the morning commuting period, while 9th Street is at capacity leaving the CBD in the evening commuting period. Other roads and segments within the study area have varying levels of available capacity.

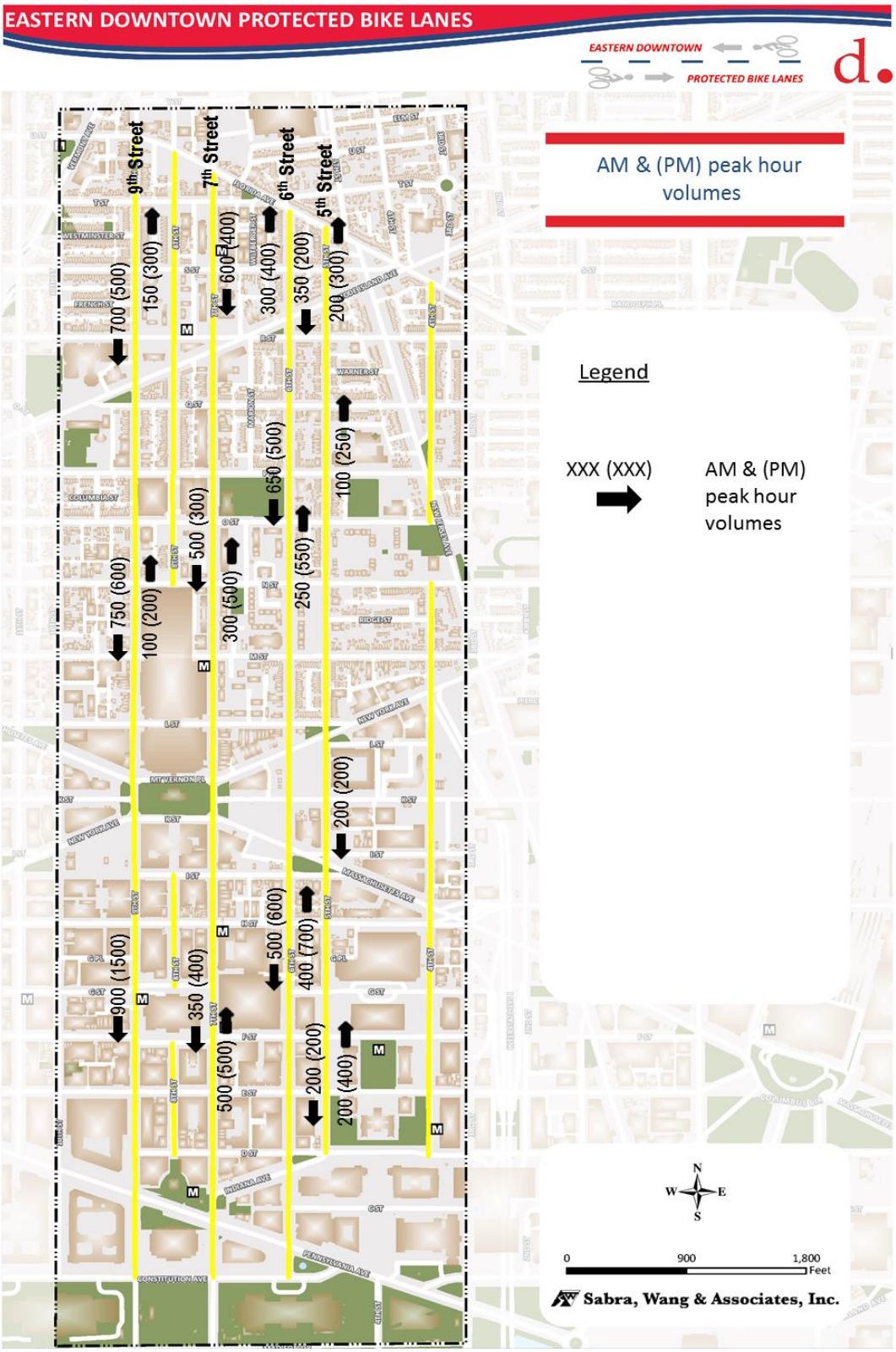

Figure 5: AM & (PM) peak hour volumes throughout the corridor.

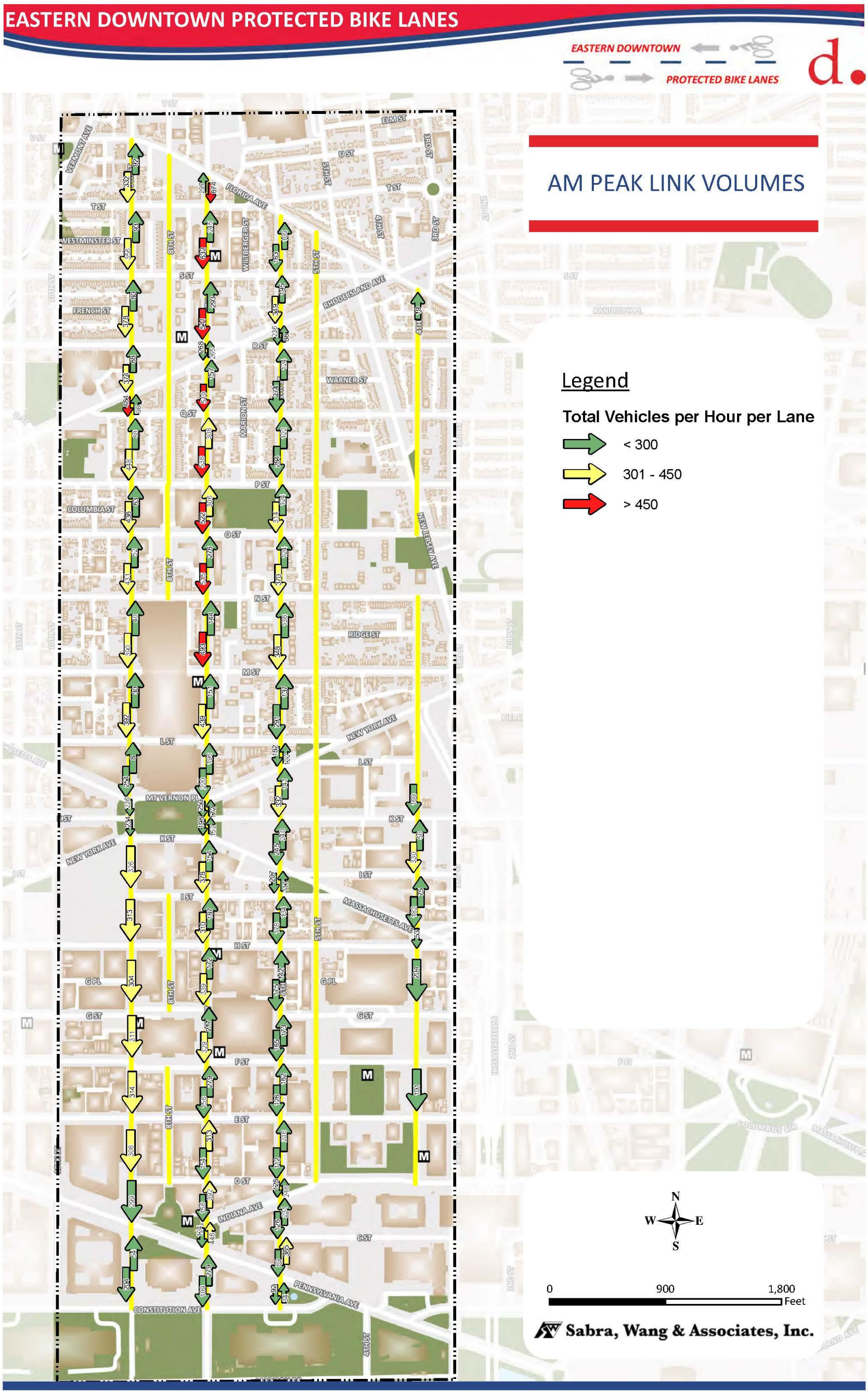

Figure 6: AM Peak Link Vehicle Volume per Travel Lane

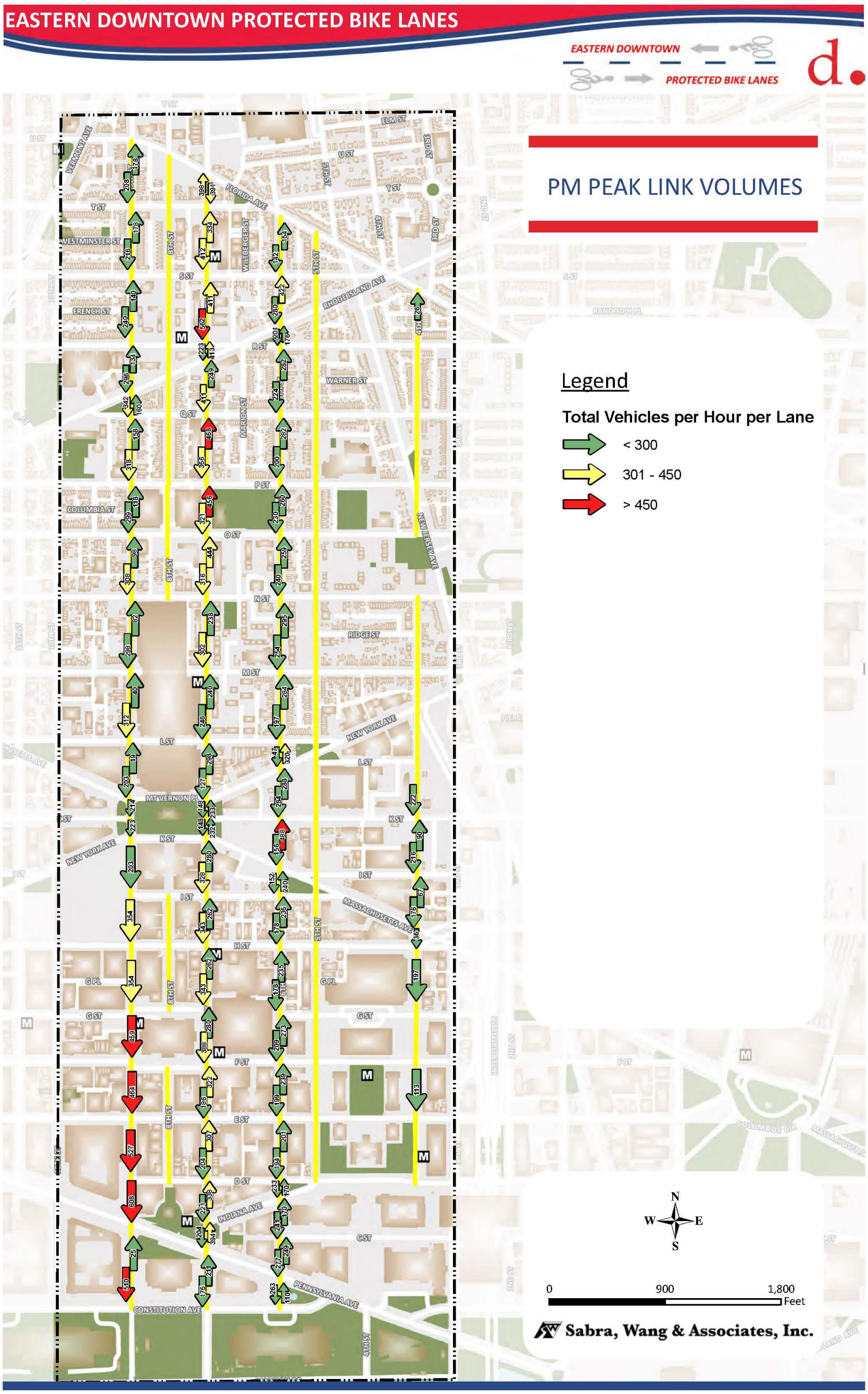

Figure 7: PM Peak Link Vehicle Volume per Travel Lane

3.3.2 Intersections with Heavy Turning Movements

Identifying intersections with heavy turn movements is critical for designing protected bike lanes, as large numbers of unrestricted turn movements create additional conflicts with cyclists and can lead to aggressive actions by drivers. Several intersections within the study area have large left- or right-turning movements (>100 turning vehicles per peak commuting hour) from the northbound and southbound corridor streets, as shown in Table 2.

Table 2: Intersections with Heavy Turn Movements in either the AM or PM Peak Commuting Hour

Intersection	Heavy Turn Movement in AM or PM?			
	NBL	SBL	NBR	SBR
6th Street & S Street	x		x	
6th Street & Rhode Island Avenue			x	
6th Street & M Street		x		
6th Street & New York Avenue		x	x	
6th Street & K Street		x	x	
6th Street & Massachusetts Avenue				x
6th Street & F Street				x
6th Street & E Street	x			x
6th Street & Pennsylvania Avenue		x		x
5th Street & New York Avenue	x		x	
5th Street & L Street (S)		x		
5th Street & K Street			x	
5th Street & H Street			x	
5th Street & D Street				x
5th Street & I Street (S)				x
9th Street & Florida Avenue		x		
9th Street & K Street		x		
9th Street & I Street		x		
9th Street & H Street				x
9th Street & D Street		x		
9th Street & Pennsylvania Avenue		x		

*NBL=Northbound Left, SBL=Southbound Left, NBR=Northbound Right, SBR=Southbound Right

3.3.3 Bicycle Peak Hour Volumes

Bicycle counts were conducted for the morning and evening commuting peak periods along screenlines at several places along 9th Street, 7th Street, 6th Street, and 5th Street during the Spring of 2015. As shown in Figure 8 and Figure 9, there is a heavy volume of cyclists heading southward into the CBD in the morning commuting period and then northbound away from the CBD in the evening, mirroring vehicle traffic patterns. Combining north-south vehicle and cycling volumes within the study area streets reveals that up to 8% of all vehicles entering/exiting the CBD during the commuting hours are cyclists

(Figure 10). On aggregate, the northern section of the study area has a higher percentage of cyclists in the commuting periods than the southern section. This aligns with the ACS commuting map that shows large concentrations of cycling commuting just north of study area, as shown in Figure 11.

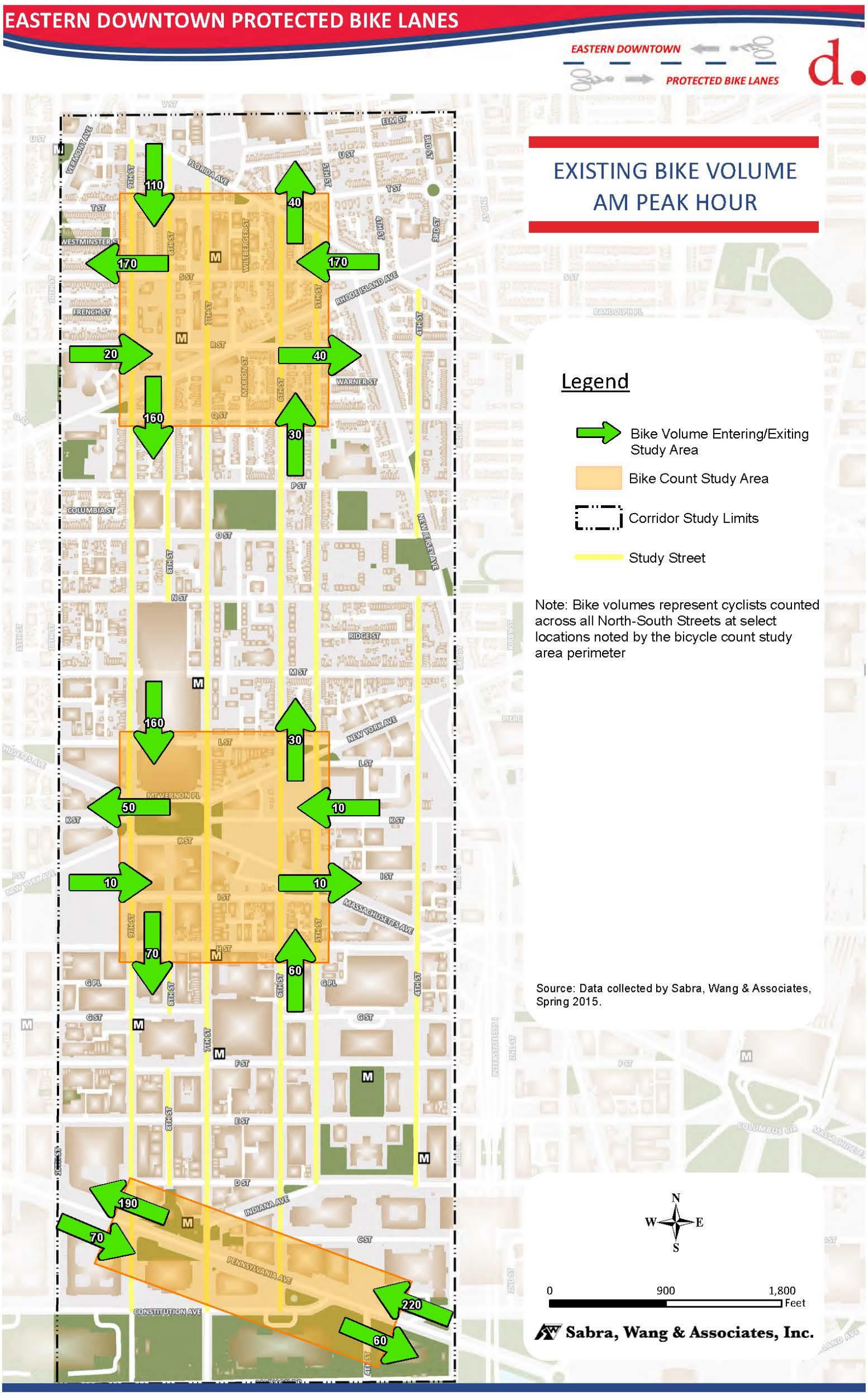

Figure 8: AM Peak Hour Bicycle Volume

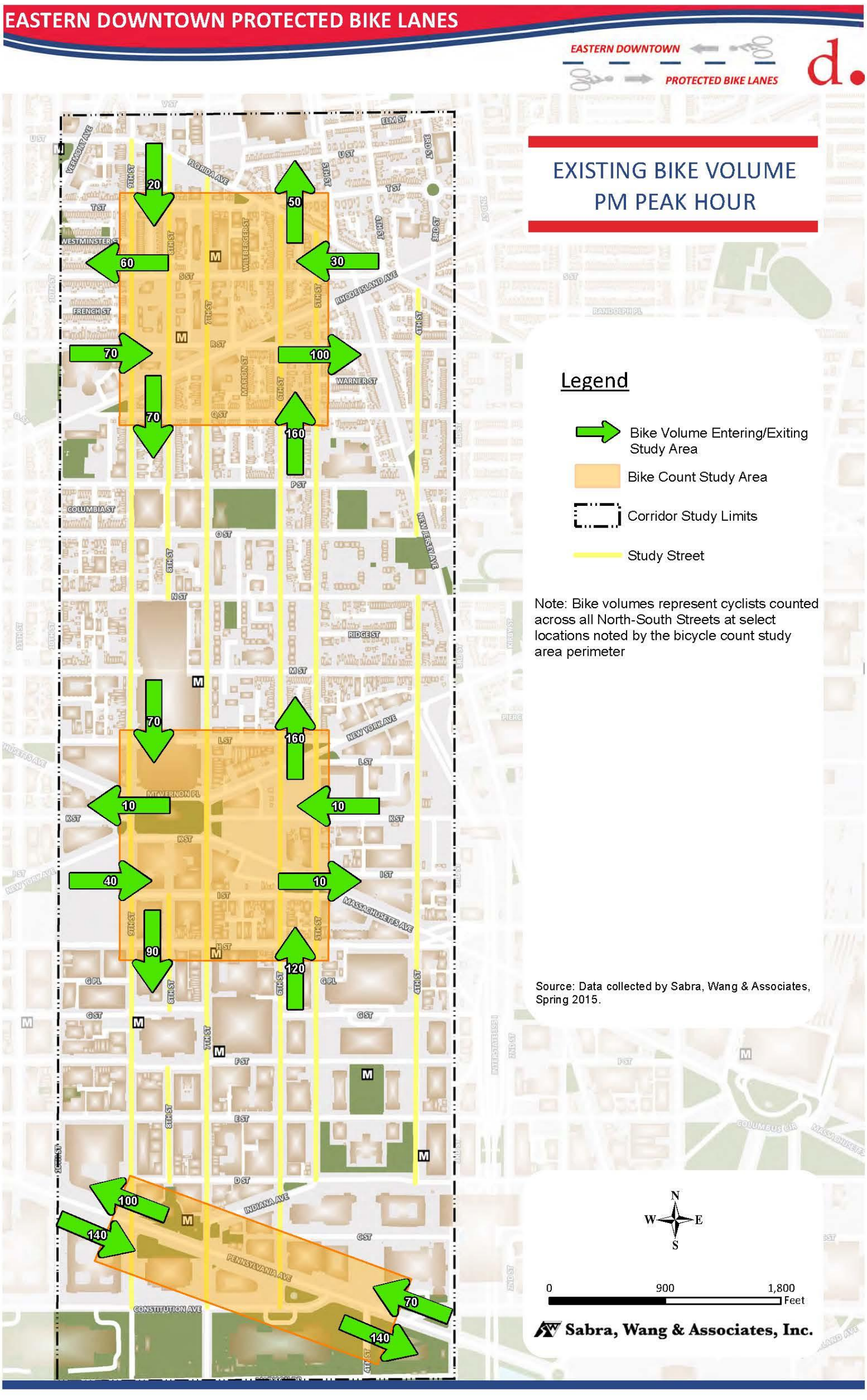

Figure 9: PM Peak Hour Bicycle Volume

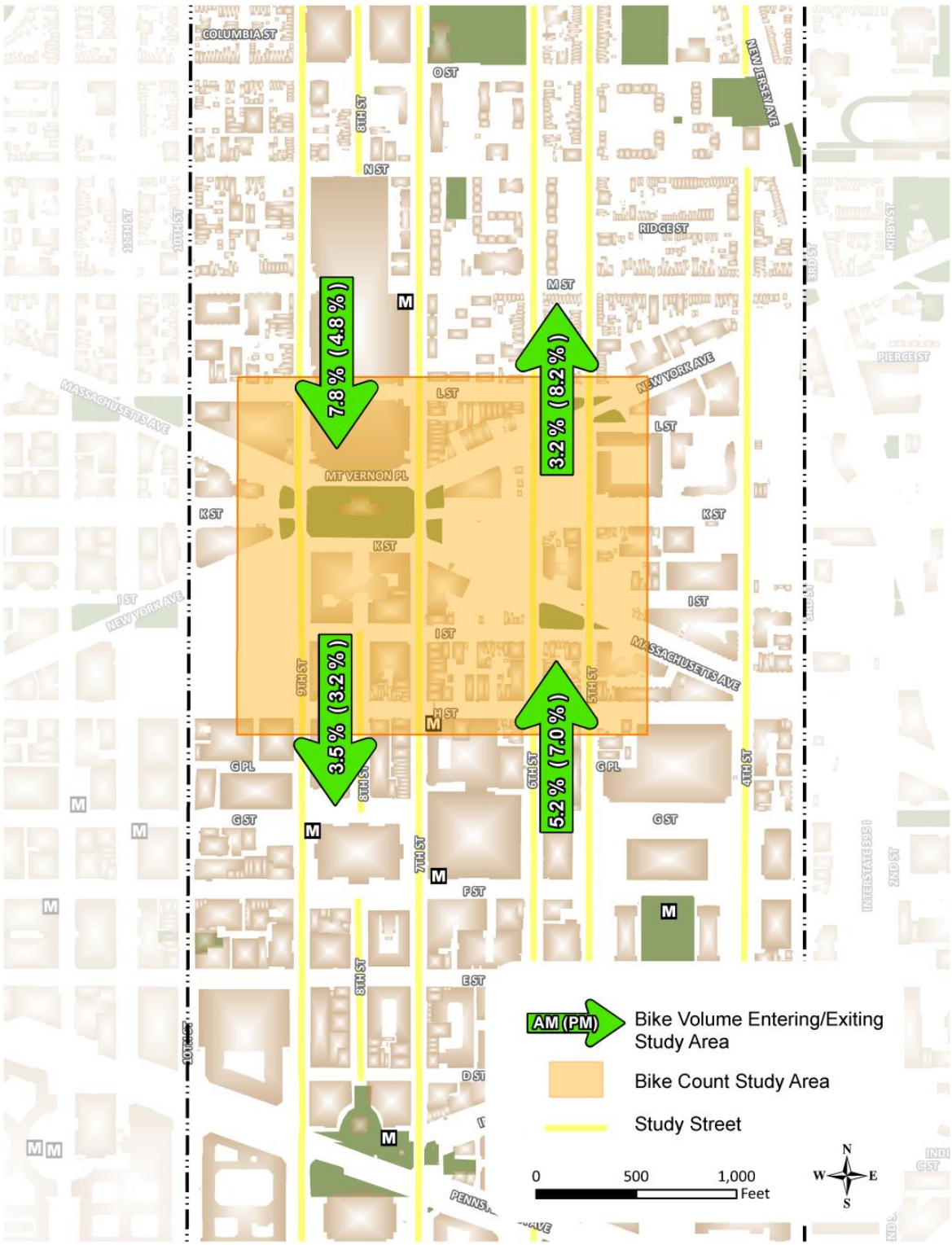

Figure 10: Percentage of Vehicles that are Cyclists Entering/exiting the CBD in the AM & (PM)

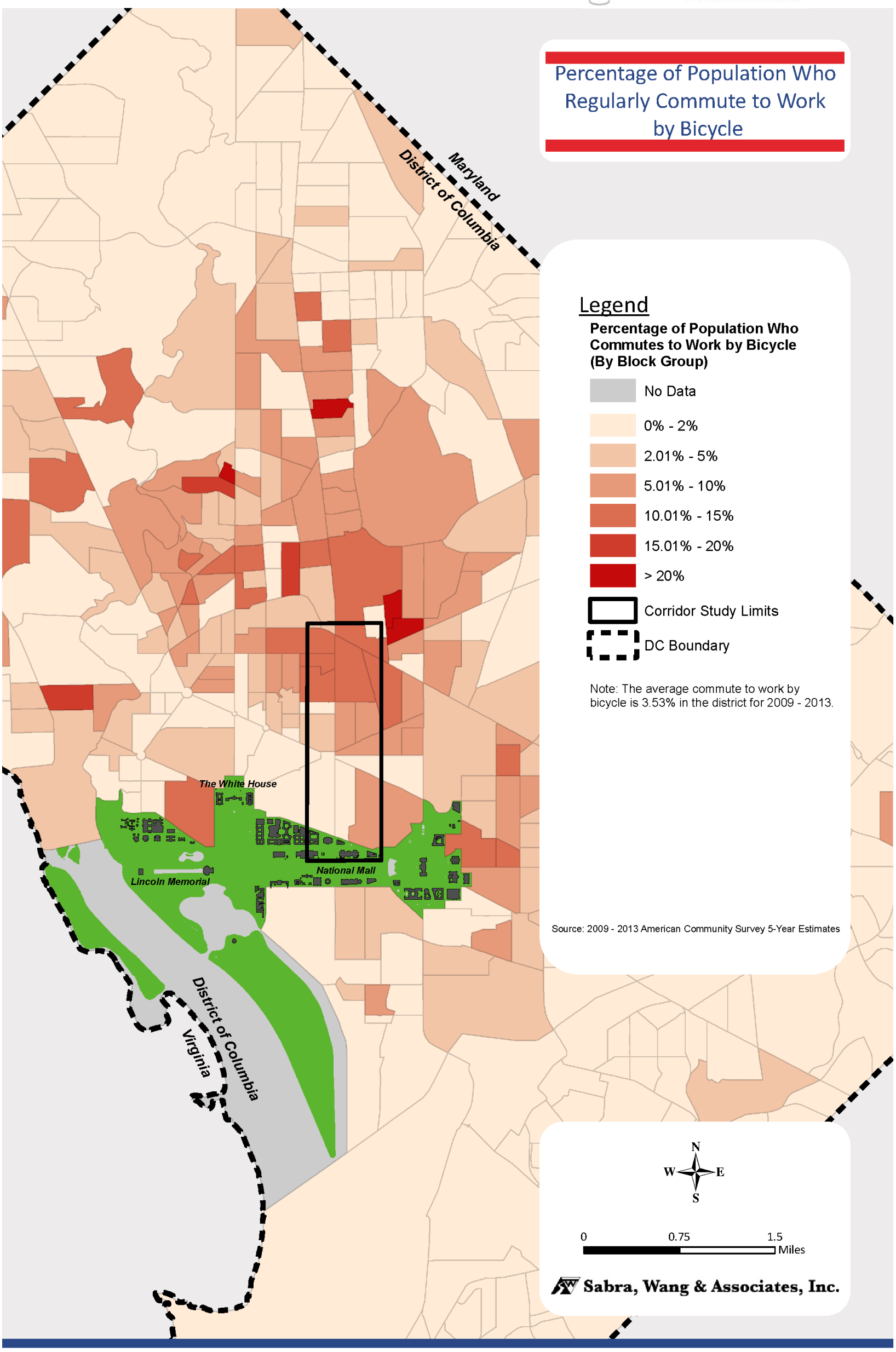

Figure 11: Percentage of Residents who Bike to Work

3.3.4 Existing Average Daily Traffic (ADT) and Vehicle Classification

Vehicle classification data (Figure 12) was collected in spring 2015 along the 5th Street, 6th Street, 7th Street, and 9th Street, north and south of Mt Vernon Square. Vehicles were tallied using Federal Highway Administration (FHWA) classification and grouped into:

- Passenger cars (including motorcycles and pickup trucks)
- All buses
- Box trucks
- Tractor trailers

Classification data provided insight into preferred trucking/delivery routes, as well as which streets carry the most buses.

Notable observations include:

- 90% to 95% of all motor vehicles in the study area are passenger cars
- 6th Street and 9th Street have the highest percentage of delivery trucks, north of Mt Vernon Square, with about 10% of vehicles counted being box trucks or tractor trailers. The percentage of truck traffic drops dramatically south of Mt Vernon Square for both streets.
- 7th Street has the highest percentage of buses, with about 4.5% of all vehicles, followed by 9th Street at 2.3% buses.

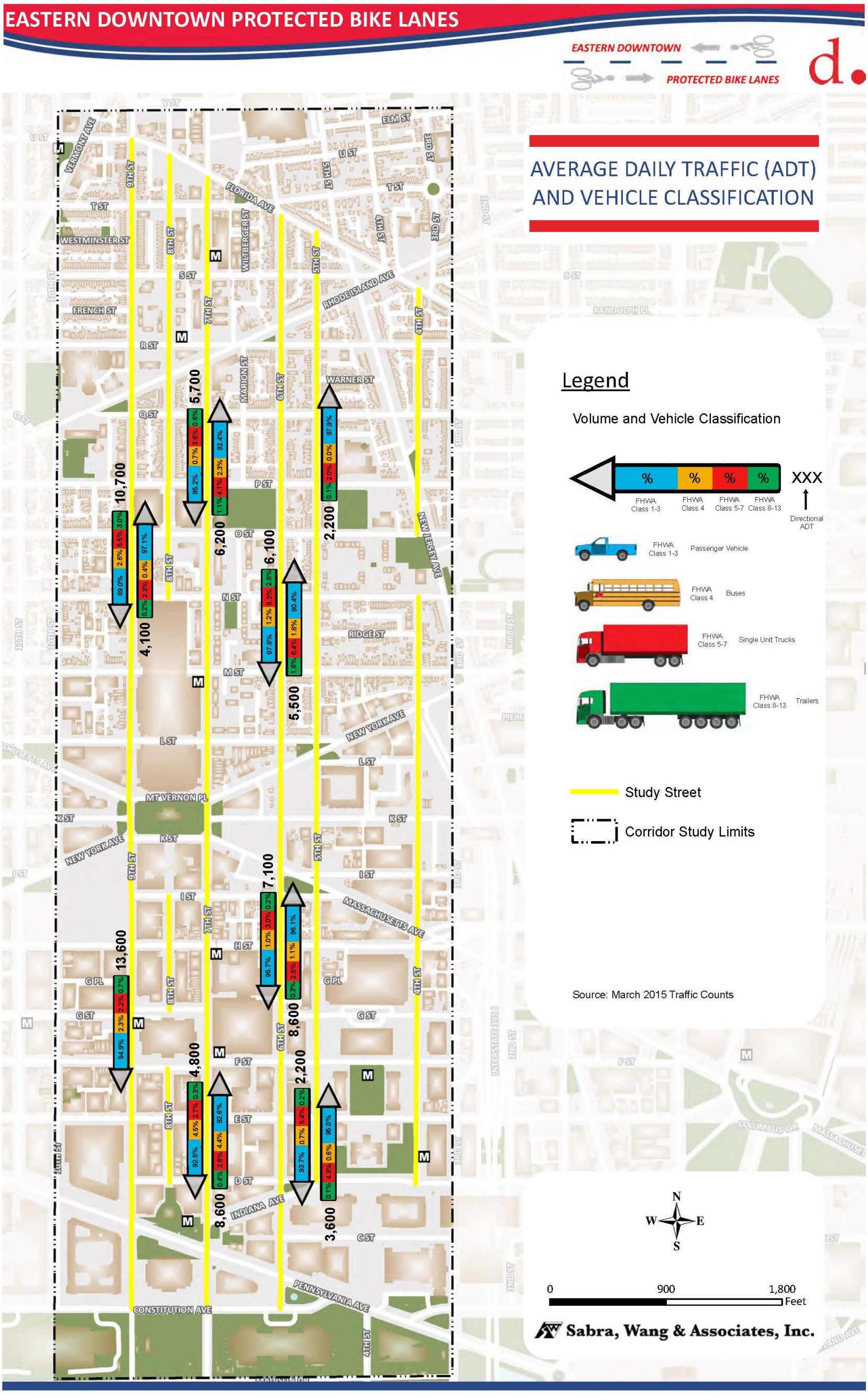

Figure 12: ADT and Vehicle Classification

3.3.5 Existing Traffic Signal Operations

Traffic signal timings were optimized in the study area in 2015, with signals retimed to have increased cycle lengths. All signals along the study area streets are now pre-timed at 110-second cycle lengths, with a pedestrian walk phase for crossing of every leg at every intersection[2]. Almost all turn movements are permitted-only, meaning there is no dedicated turn arrow that allows a fully-protected turn movement. However, a few locations protect turn movements at locations with a large number of peak hour turns or a large number of pedestrian crossings. Existing protected northbound and southbound turns include:

- 9th Street
  - Southbound left at Florida Ave
  - Southbound left at New York Ave
- 7th Street
  - Southbound left at Florida Ave
  - Northbound left at L Street
  - Northbound left at New York Ave
  - Northbound left at Pennsylvania Ave
- 6th Street
  - Northbound left at L Street
  - Southbound left at Indiana Ave

Additionally, a few intersections are very closely-spaced and have traffic signals that operate in a coordinated fashion. Examples of these clusters include 6th & R Streets and 6th Street & Rhode Island Ave, where crosswalks are only 80 feet apart.

3.3.6 Intersection Level of Service

All intersections, signal timings, turn-movement volumes and pedestrian volumes within the study area were coded into a Synchro network to perform a capacity analysis and travel time analysis. Synchro™ is a deterministic and macroscopic signal analysis computer software program that models street networks and traffic signal systems. Geometric data such as number of lanes, lane configuration, storage lengths, tapers, and distances between intersections were input into Synchro. Intersection capacity analyses were performed using the industry standard National Academy of Sciences Transportation Research Board's Highway Capacity Manual (HCM) methodology for all study intersections. Performance measures of effectiveness include level of service (LOS), volume-to-capacity (v/c) ratio, and average vehicle delay.

Level of Service (LOS) is a qualitative measure describing operational conditions of an intersection or any other transportation facility. It measures the quality of traffic service, and may be determined for intersections, roadway segments, or arterial corridors on the basis of delay, congested speed, volume to

[2] At the southern end of the study area, there is no crosswalk to cross the west leg of Constitution Ave at 6th Street.

capacity (v/c) ratio, or vehicle density by functional class. At intersections, LOS is a letter designation that corresponds to a certain range of roadway operating conditions. Overall delay can be categorized into deceleration delay, stopped delay, and acceleration delay. The levels of service range from 'A' to 'F', with 'A' indicating the best operating conditions and 'F' indicating the worst, or a failing, operating condition (Table 3). While several approaches within the study area show failing LOS, no intersections fail overall[3] (Table 4).

Table 3: Intersection Level of Service Delay Ranges

	Signalized intersections	Unsignalized intersections
Level of service	Delay range (sec)	Delay range (sec)
A	≤10	≤10
B	>10 and ≤20	>10 and ≤15
C	>20 and ≤35	>15 and ≤25
D	>35 and ≤55	>25 and ≤35
E	>55 and ≤80	>35 and ≤50
F	>80	>50

[3] "overall" refers to average of each intersection approach LOS, weighted by the approach's traffic volume.

Table 4: AM and PM Level of Service for the Study Area

5th Street Intersections	Approach	Level of Service	
		AM	PM
5th Street & L Street (N)	**Overall**	**A**	**A**
	Westbound	B	B
	Northbound	A	A
5th Street & New York Avenue	**Overall**	**C**	**D**
	Eastbound	D	E
	Westbound	C	C
	Northbound	A	A
5th Street & L Street (S)	**Overall**	**B**	**D**
	Westbound	D	F
	Northbound	C	D
	Southbound	A	A
5th Street & K Street	**Overall**	**B**	**C**
	Eastbound	C	C
	Westbound	B	C
	Northbound	B	B
	Southbound	B	B
5th Street & I Street (N)	**Overall**	**C**	**B**
	Westbound	D	D
	Northbound	A	A
	Southbound	D	C
5th Street & Massachusetts Avenue	**Overall**	**C**	**C**
	Eastbound	C	B
	Westbound	D	E
	Northbound	A	A
	Southbound	A	A
5th Street & I Street (S)	**Overall**	**E**	**C**
	Eastbound	F	D
	Northbound	E	D
	Southbound	A	A
5th Street & H Street	**Overall**	**C**	**B**
	Eastbound	A	B
	Westbound	B	C
	Northbound	D	B
	Southbound	D	B
5th Street & G Street	**Overall**	**C**	**B**
	Eastbound	D	C
	Westbound	C	B
	Northbound	B	B
	Southbound	C	B
5th Street & F Street	**Overall**	**A**	**A**
	Eastbound	A	A
	Westbound	A	A
	Northbound	A	A
	Southbound	A	A
5th Street & E Street	**Overall**	**B**	**B**
	Eastbound	B	A
	Westbound	B	B
	Northbound	D	C
	Southbound	C	C
5th Street & D Street & Indiana Avenue	**Overall**	**C**	**C**
	Westbound	B	B
	Northbound	E	B
	Southbound	C	D

6th Street Intersections	Approach	Level of Service	
		AM	PM
6th Street & Florida Avenue	**Overall**	**B**	**C**
	Eastbound	B	C
	Westbound	B	B
	Northbound	A	D
6th Street & S Street	**Overall**	**B**	**B**
	Eastbound	B	C
	Westbound	C	C
	Northbound	A	B
	Southbound	B	B
6th Street & Rhode Island Avenue	**Overall**	**C**	**B**
	Eastbound	D	A
	Westbound	C	C
	Northbound	A	A
	Southbound	D	D
6th Street & R Street	**Overall**	**B**	**C**
	Westbound	B	B
	Northbound	C	D
	Southbound	A	A
6th Street & Q Street	**Overall**	**B**	**A**
	Eastbound	F	A
	Northbound	B	B
	Southbound	A	A
6th Street & P Street	**Overall**	**A**	**B**
	Eastbound	B	C
	Westbound	C	C
	Northbound	A	A
	Southbound	A	A
6th Street & O Street	**Overall**	**A**	**B**
	Eastbound	C	E
	Westbound	C	C
	Northbound	A	A
	Southbound	A	A
6th Street & N Street	**Overall**	**B**	**A**
	Eastbound	C	C
	Westbound	C	D
	Northbound	C	A
	Southbound	A	A
6th Street & M Street	**Overall**	**A**	**A**
	Eastbound	B	C
	Westbound	C	C
	Northbound	A	A
	Southbound	A	A
6th Street & L Street	**Overall**	**B**	**B**
	Eastbound	A	F
	Westbound	B	B
	Northbound	A	A
	Southbound	B	C
6th Street & New York Avenue	**Overall**	**B**	**B**
	Eastbound	A	A
	Westbound	B	B
	Northbound	B	B
	Southbound	B	B
6th Street & K Street	**Overall**	**A**	**A**
	Eastbound	C	D
	Westbound	C	C
	Northbound	A	A
	Southbound	A	A
6th Street & Massachusetts Avenue	**Overall**	**B**	**C**
	Eastbound	B	C
	Westbound	A	B
	Northbound	B	C
	Southbound	C	D
6th Street & I Street	**Overall**	**A**	**B**
	Eastbound	B	D
	Westbound	C	C
	Northbound	A	B
	Southbound	A	A
6th Street & H Street	**Overall**	**A**	**B**
	Eastbound	A	B
	Westbound	B	B
	Northbound	B	A
	Southbound	A	C
6th Street & G Street	**Overall**	**A**	**A**
	Eastbound	D	D
	Westbound	B	B
	Northbound	A	A
	Southbound	A	A
6th Street & F Street	**Overall**	**A**	**A**
	Eastbound	C	C
	Westbound	C	C
	Northbound	A	A
	Southbound	B	A
6th Street & Rescue Squad (Half Signal)	**Overall**	-	-
	Northbound	-	-
	Southbound	-	-
6th Street & E Street	**Overall**	**C**	**C**
	Eastbound	C	B
	Westbound	C	B
	Northbound	C	D
	Southbound	A	B
6th Street & D Street	**Overall**	**B**	**C**
	Eastbound	D	F
	Westbound	D	D
	Northbound	A	A
	Southbound	C	C
6th Street & Indiana Avenue	**Overall**	**B**	**A**
	Eastbound	D	C
	Northbound	B	B
	Southbound	A	A
6th Street & C Street	**Overall**	**C**	**B**
	Westbound	D	C
	Northbound	A	B
	Southbound	A	A
6th Street & Pennsylvania Avenue	**Overall**	**B**	**C**
	Eastbound	B	E
	Westbound	B	B
	Northbound	B	A
	Southbound	D	D
6th Street & Constitution Avenue	**Overall**	**A**	**C**
	Eastbound	B	A
	Westbound	A	E
	Southbound	A	A

9th Street Intersections	Approach	Level of Service	
		AM	PM
9th Street & Florida Avenue	**Overall**	**B**	**B**
	Eastbound	B	C
	Westbound	A	A
	Northbound	C	C
	Southbound	C	B
9th Street & T Street	**Overall**	**A**	**B**
	Eastbound	D	D
	Northbound	A	B
	Southbound	A	A
9th Street & S Street	**Overall**	**B**	**B**
	Eastbound	C	D
	Westbound	D	D
	Northbound	A	B
	Southbound	A	A
9th Street & R Street	**Overall**	**A**	**B**
	Westbound	B	B
	Northbound	A	A
	Southbound	A	B
9th Street & Rhode Island Avenue	**Overall**	**B**	**C**
	Eastbound	C	C
	Westbound	A	C
	Northbound	B	B
	Southbound	B	B
9th Street & Q Street	**Overall**	**A**	**B**
	Eastbound	D	C
	Northbound	B	B
	Southbound	A	A
9th Street & P Street	**Overall**	**A**	**B**
	Eastbound	C	C
	Westbound	B	C
	Northbound	A	A
	Southbound	A	A
9th Street & O Street	**Overall**	**A**	**A**
	Eastbound	C	C
	Westbound	A	D
	Northbound	A	A
	Southbound	A	A
9th Street & N Street	**Overall**	**A**	**B**
	Eastbound	C	C
	Westbound	C	C
	Northbound	A	B
	Southbound	A	A
9th Street & M Street	**Overall**	**B**	**B**
	Eastbound	C	C
	Westbound	C	C
	Northbound	B	B
	Southbound	A	A
9th Street & L Street	**Overall**	**B**	**B**
	Westbound	B	D
	Northbound	C	B
	Southbound	B	B
9th Street & Massachusetts Avenue & Mount Vernon Place	**Overall**	**D**	**E**
	Eastbound	E	F
	Westbound	A	A
	Southbound	D	D
9th Street & New York Avenue / K Street	**Overall**	**D**	**D**
	Eastbound	C	D
	Westbound	B	F
	Southbound	F	C
9th Street & I Street	**Overall**	**B**	**B**
	Eastbound	C	A
	Westbound	C	D
	Southbound	B	A
9th Street & H Street	**Overall**	**C**	**C**
	Eastbound	C	D
	Westbound	D	B
	Southbound	B	D
9th Street & G Street	**Overall**	**B**	**B**
	Eastbound	D	D
	Westbound	E	C
	Southbound	A	B
9th Street & F Street	**Overall**	**A**	**B**
	Eastbound	B	C
	Westbound	C	C
	Southbound	A	A
9th Street & E Street	**Overall**	**B**	**B**
	Eastbound	B	C
	Westbound	B	B
	Southbound	A	B
9th Street & D Street	**Overall**	**A**	**A**
	Westbound	C	C
	Southbound	A	A
9th Street & Pennsylvania Avenue	**Overall**	**B**	**D**
	Eastbound	B	D
	Westbound	A	D
	Northbound	C	B
	Southbound	B	D
9th Street & Constitution Avenue	**Overall**	**B**	**C**
	Eastbound	C	C
	Westbound	A	A
	Southbound	B	C

3.3.7 Corridor Travel Times

Level of service measures the delay for the amount of vehicle traffic that can traverse through an intersection, but does not always capture the full demand where there are compact city blocks and closely-spaced signalized intersections, like those found Downtown. Accordingly, travel times were also modeled to determine the approximate vehicle speeds through the corridor, and to determine critical intersections where north-south vehicle delay is excessive. Travel times were modeled for 5th Street[4], 6th Street, and 9th Street in both the north and south directions in the AM and PM peak commuting hours from Florida Ave NW to Constitution Ave. Travel times and average corridor speeds are shown in Table 5 and Table 6 below. Measurements of travel time and average corridor speeds incorporate motorist time spent idling at red traffic signals. Inrix™ vehicle probe data from Spring of 2016 was used to validate the traffic simulation model.

Table 5: North-south Travel Times in the Study Area

Street	Travel Time (in minutes)			
	Northbound AM*	Southbound AM	Northbound PM*	Southbound PM
5th Street from D Street to L Street	7.1	6.7	9.6	12.2
6th Street from Constitution to Florida Ave	7.9	11.1	13.2	11.1
9th Street from Constitution to Florida Ave	4.0	10.4	4.5	8.2

*Northbound 9th Street is from Massachusetts Ave to Florida Ave

Table 6: North-south Average Corridor Speeds in the Peak Hours

Street	Average Speed through Corridor (mph)			
	Northbound AM*	Southbound AM	Northbound PM*	Southbound PM
5th Street from D Street to L Street	5	6	4	3
6th Street from Constitution to Florida Ave	12	9	7	9
9th Street from Constitution to Florida Ave	15	10	13	13

*Northbound 9th Street is from Massachusetts Ave to Florida Ave

3.4 On-street Parking & Loading

3.4.1 On-street Inventory and Supply

The majority of full time on-street parking within the study area is 2-hour time restricted. Peak hour restricted and metered curbside parking can be found on 5th, 6th, 7th, and 8th Streets, primarily south of New York Avenue. 9th Street also has *full-time* metered parking.

On east-west streets such as L, M, and N Streets, and north of P Street, there are several blocks of Residential Permit Parking (RPP). Of all available on-street curbside space, about 40% is designated to restrict parking/stopping; these areas include bus stops, laybys, driveways, fire hydrants, and school zones. Each of the study area streets have the following parking characteristics:

[4] 5th Street was modeled from D Street in the South to L Street in the North. North of L Street, 5th narrows to a one-lane northbound-only stop-controlled roadway and no preliminary alternative proposes any changes to this segment.

- 5th Street:
    - Of the 390 total curbside spaces, 150 are metered and 240 are residential unmetered spaces.
    - 60 of the 240 residential spaces are for residential permit owners.
    - All metered spaces are south of New York Avenue.
- 6th Street:
    - Of the 450 total curbside spaces, 160 are metered and 290 unmetered residential unmetered spaces.
    - Of the 290 residential spaces, 80 are reserved for residential permit owners.
    - All metered spaces are south of New York Avenue.
    - The west side of the block between F and G Streets is reserved for Verizon Center loading.
- 9th Street:
    - Of the 390 total curbside spaces, 120 are metered spaces and 260 are unmetered residential parking.
    - 70 of the 260 residential spaces are for residential permit owners.
    - All metered spaces are south of New York Avenue.

Figure 13 shows the parking inventory, by restriction, for the study area.

3.4.2 On-street Loading

In addition to general delivery loading zones, shown in orange on Figure 13, there are some additional loading zones in the study area that should be noted. Within the study area, there are approximately 445 locations that are reserved for the Metro Bus, and an additional 14 locations reserved for other transit service loading and unloading, including the DC Circulator, the DC Government Employees Shuttle, and tour buses. Approximately 11 spaces are utilized on New York Avenue for hotel valet parking. Loading zones for the Verizon Center are found on the east side of 7th Street, between F Street and H Street, as well as on the west side 6th Street, between F Street and G Street. Additionally, for national events, Verizon Center utilizes the outside southbound travel lane between F and G streets for media mobilization, police staging, and other event uses. Loading zones for the Walter E. Washington Convention Center are located on the east side 9th Street, between L Street and Mt. Vernon Place. A taxi stand is on the same segment of 9th Street, on the west side of the road.

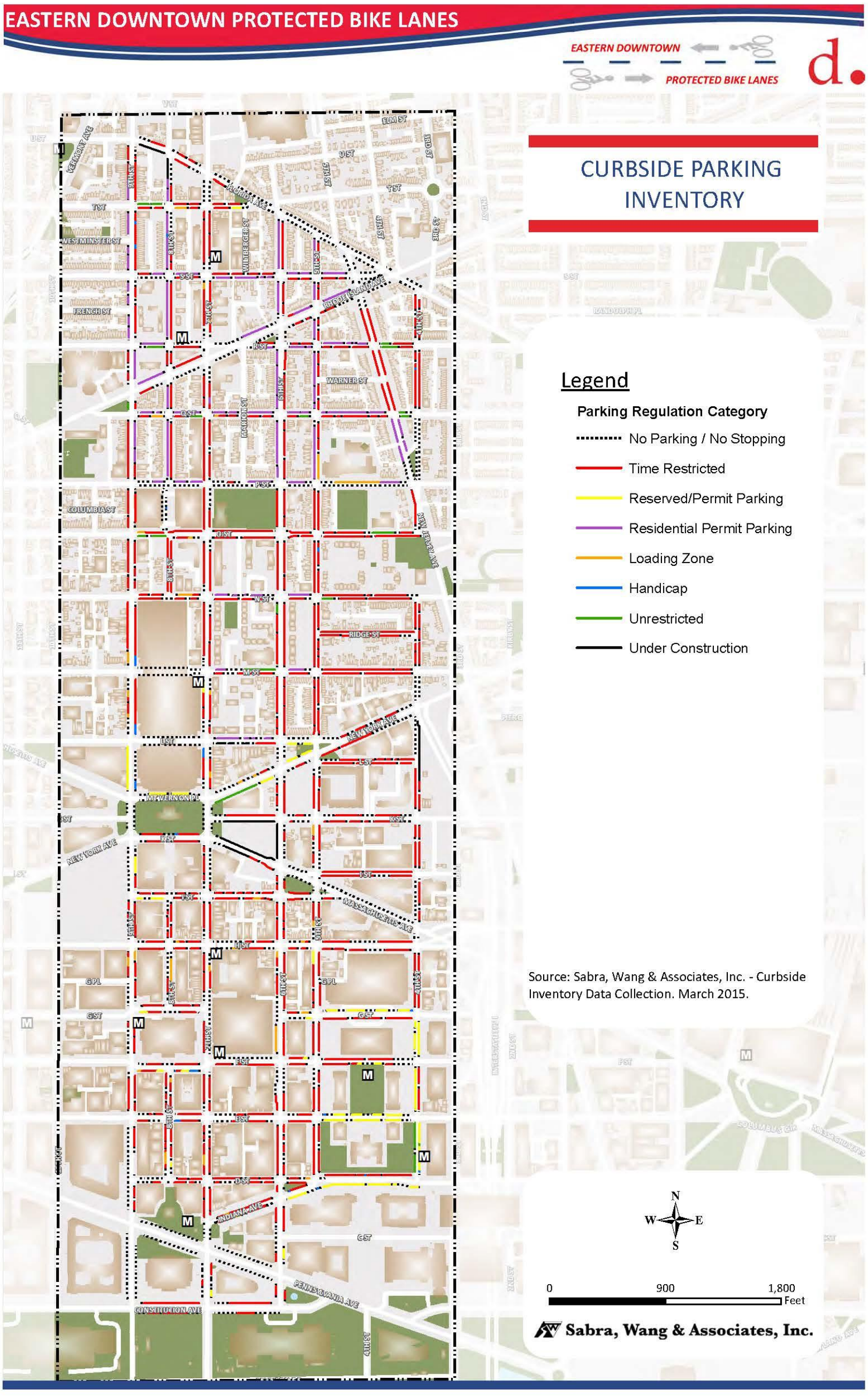

Figure 13: Curbside Parking Inventory

3.4.3 On-street Parking Utilization

Parking utilization rates provide the percentage of available curbside spaces that are occupied with parked vehicles. The utilization of on-street parking varies by time and day. This data was manually collected for approximately 5,000 available on-street parking spaces within the study area for the following days and times: weekday midday 10:00AM-2:00PM (Figure 14); weekday evening 6:30PM-10:00PM (Figure 15); Saturday 12:00PM-4:00PM (Figure 16); Sunday 10:00AM-2:00PM (Figure 17). Notable observations include:

- During midweek midday:
  - Parking utilization rates on all study streets show an overall increase traveling south towards Pennsylvania Ave.
  - 56% of available block faces have > 75% utilization
  - 20% of available block faces have 50%-75% utilization
- During midweek evening:
  - Utilization shows high occupancy rates on north-south streets, particularly north of New York Avenue.
  - 9th Street has the highest utilization rates of the three study streets.
  - 40% of available block faces have > 75% utilization
  - 21% of available block faces have 50%-75% utilization
- Saturday mid-day:
  - High utilization rates observed across the study area
  - Rates were highest on 7th, 6th, and 5th Streets north of New York Avenue, and on 9th Street south of New York Avenue.
  - 51% of available block faces have > 75% utilization
  - 27% of available block faces have 50%-75% utilization
- Sunday late morning:
  - Highest utilization rates of all four time periods.
  - All three study streets show rates of 75% or greater utilization through most of the study area.
  - 71% of available block faces have > 75% utilization
  - 14% of available block faces have 50%-75% utilization

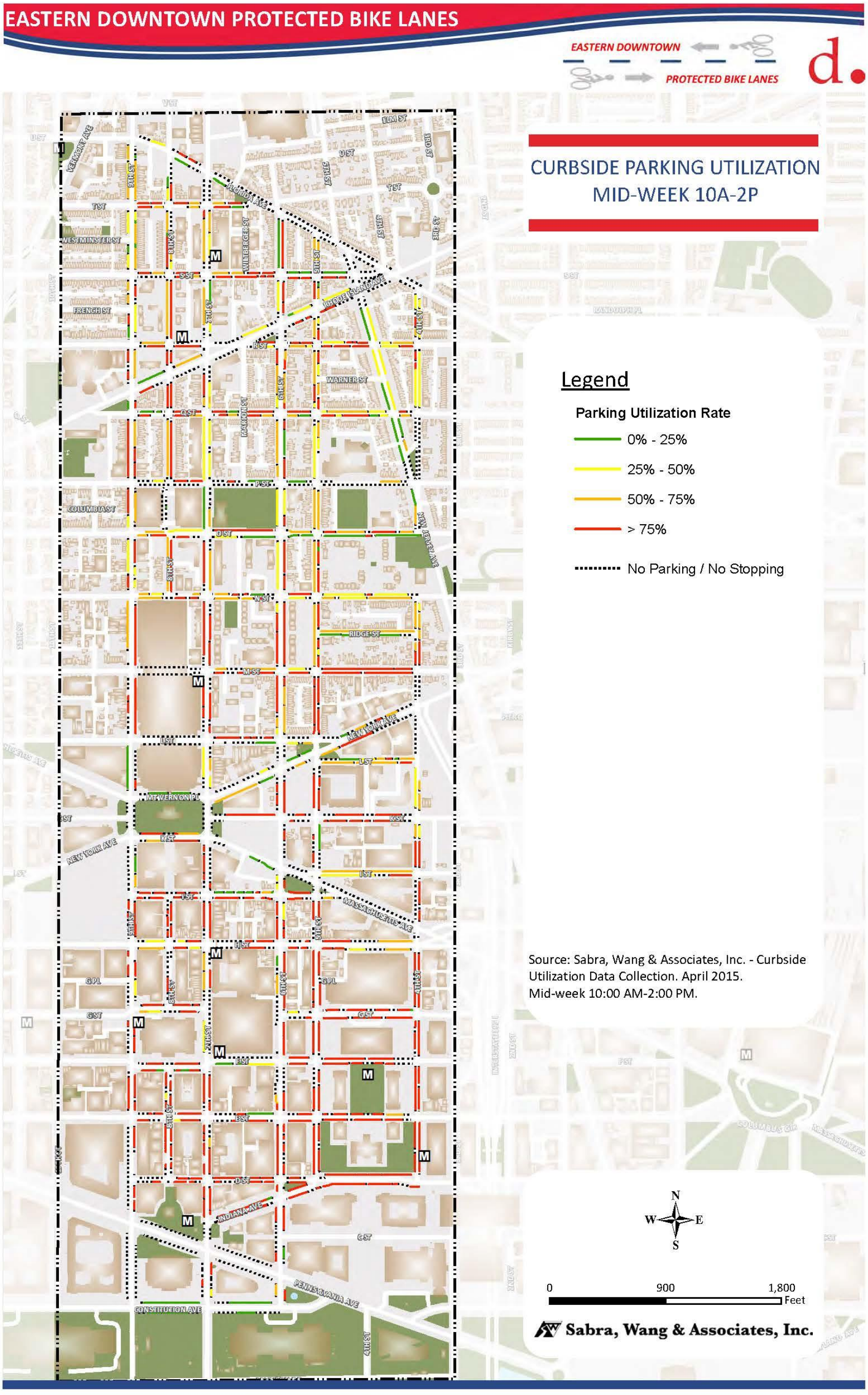

Figure 14: Midweek Daytime Parking Utilization

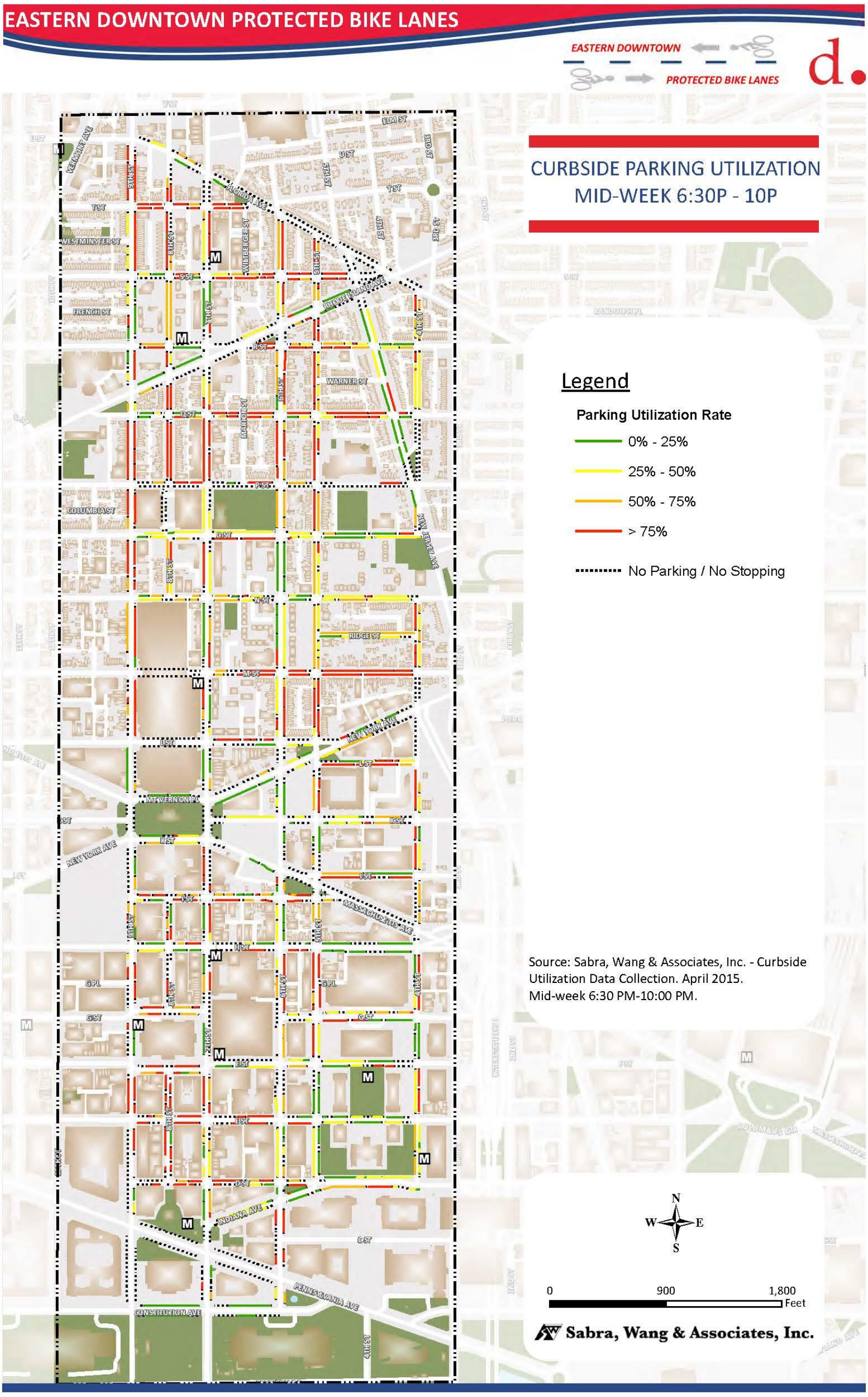

Figure 15: Midweek Evening Parking Utilization

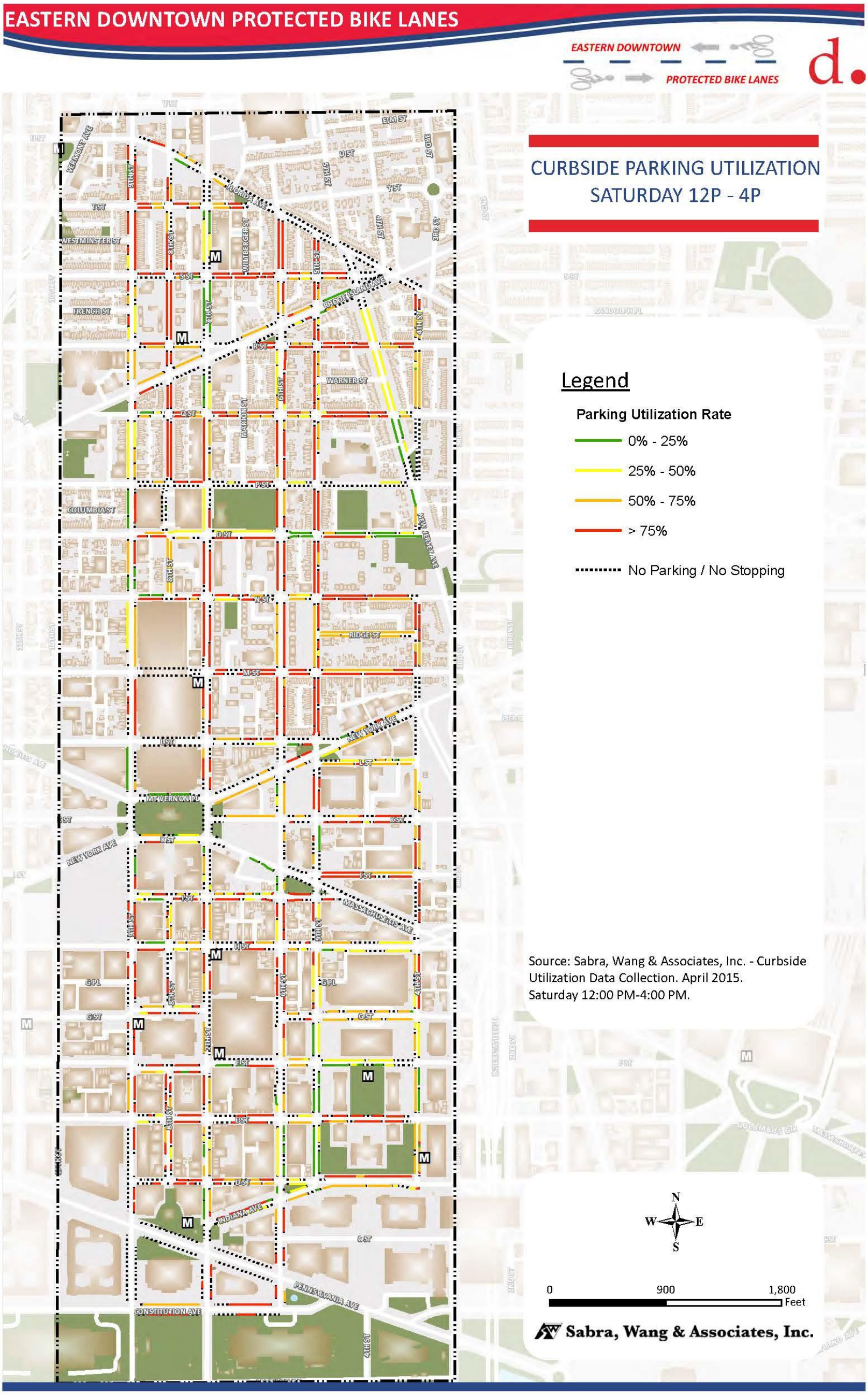

Figure 16: Saturday Parking Utilization

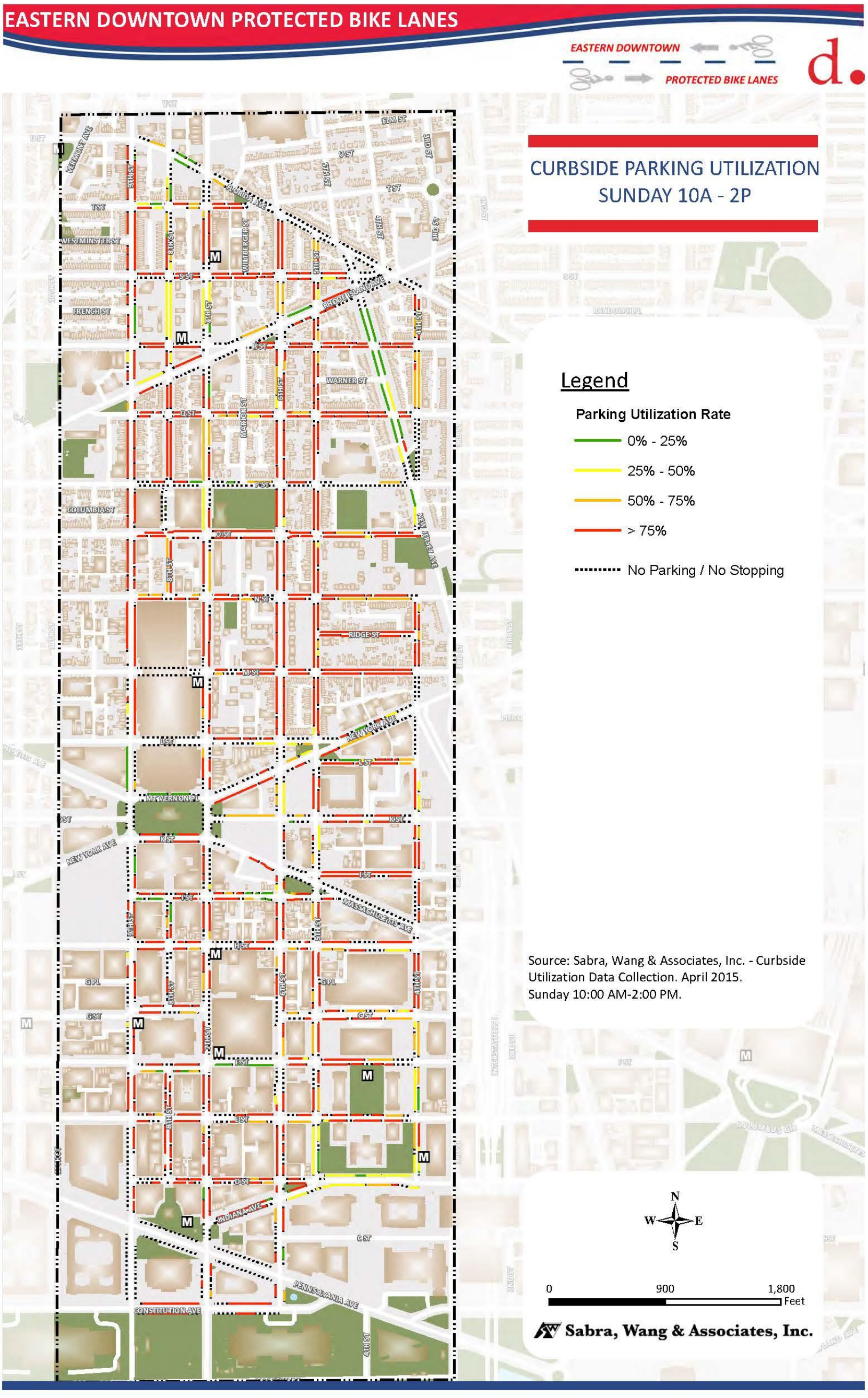

Figure 17: Sunday Parking Utilization

3.4.4 Sunday Diagonal Parking Operations

The District permits back-in angled parking along select signed block faces within the study area (Figure 18). This type of parking is permitted on Sundays only, and is open to all users (i.e., diagonal parking is not permitted to a single institution or property owner). Diagonal parking time periods vary within the study area, to accommodate the needs of various congregations. This parking typically has a utilization rate approaching 100% on Sundays. The following street block faces allow diagonal parking on Sundays:

- 6th Street, west side, from L Street to P Street
- 9th Street, east side, from R Street to S Street
- 9th Street, east side, from O Street to N Street
- 9th Street, west side, from P Street to Q Street
- 9th Street, west side, from R Street to Rhode Island Ave

In addition to Sunday diagonal parking, churches in the area often host large gatherings for funerals or other special events that have special parking demands on the streets in the study area.

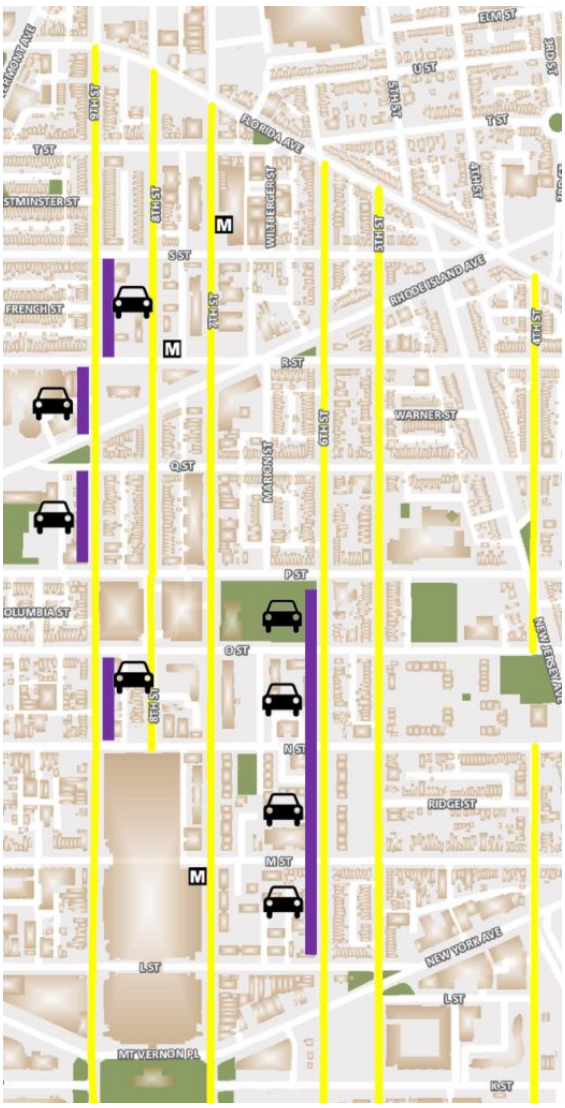

Figure 18: Locations with Diagonal Parking on Sundays within the Study area

3.5 Safety

3.5.1 Pedestrian and Bicycle Crashes

Pedestrian and bicycle crash data for intersections within the study area were collected and analyzed for a three (3) year period, from 2010 to 2012 (Figure 19).

Of the three (3) study streets, 5th Street has the lowest number of crashes, with a total of 35 crashes in three years, and an average of about 12 crashes per year. All but 14% of the total crashes occur south of New York Avenue. 6th Street has a yearly crash average of 19, with the highest concentration of crashes occurring at Massachusetts Avenue (13 crashes total). Similar to 5th Street, the majority of crashes occurred south of New York Avenue, with only 17% of crashes (10 total) in the northern portion of the study area.

The highest number of pedestrian and bicycle crashes occurred along 7th Street and 9th Street, with a total of 109 crashes and 70 crashes, respectively, from 2010 to 2012. Unlike 5th and 6th Streets, the number of crashes along 7th and 9th streets is geographically dispersed, with about half of crashes occurring north and south of New York Avenue. The greatest number of crashes at a given intersection in the study area occurs on 9th Street, with a total of 19 crashes in three years at Florida Avenue.

In general, bicycle crash locations correlate closely with where bicyclists are currently traveling in unprotected bike lanes and general purpose lanes within the study area. By concentrating and encouraging bicycle travel in a protected facility, the severity and rate of bicycle crashes should improve.

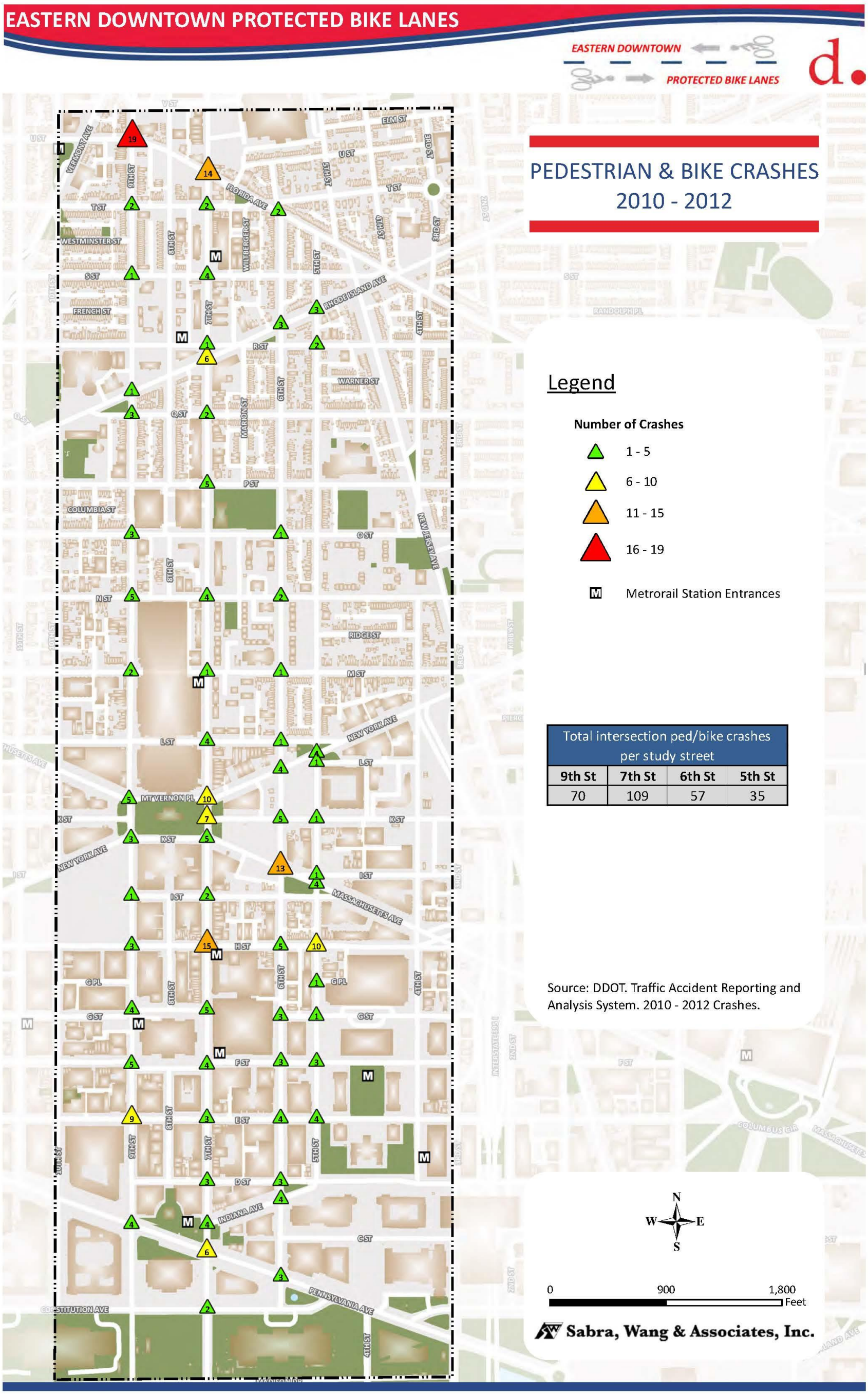

Figure 19: Pedestrian and Bicycle Crashes 2010-2012

3.5.2 Vehicle Crashes

Vehicle crash data were collected for each intersection in the study area from 2010 to 2012 (Figure 20). Similar to the pedestrian and bicycle crash data, there is a heavy concentration of crashes south of New York Avenue, although it should be noted that intersections along Florida Avenue shows high crash volume as well.

- 5th Street:
  - Between 2010 and 2012, the 5th Street corridor had 214 crashes
  - Highest number of crashes over this period was found at its intersection with H Street, with a total of 33 crashes.
- 6th Street:
  - Between 2010 and 2012, the 6th Street corridor had 541 crashes
  - The highest number of crashes over this period occurred at H Street and New York Avenue, with 60 and 71 crashes, respectively.
- 7th Street:
  - Between 2010 and 2012, the 7th Street corridor had 745 crashes
  - The highest number of crashes over this period occurred at H Street and Florida Avenue, with 96 and 108 crashes, respectively.
- 9th Street:
  - Between 2010 and 2012, the 9th Street corridor had 564 crashes
  - The three (3) intersections that had the highest number of crashes were at Florida Avenue, Mt. Vernon Place, and K Street with 64, 62, and 57 crashes, respectively.

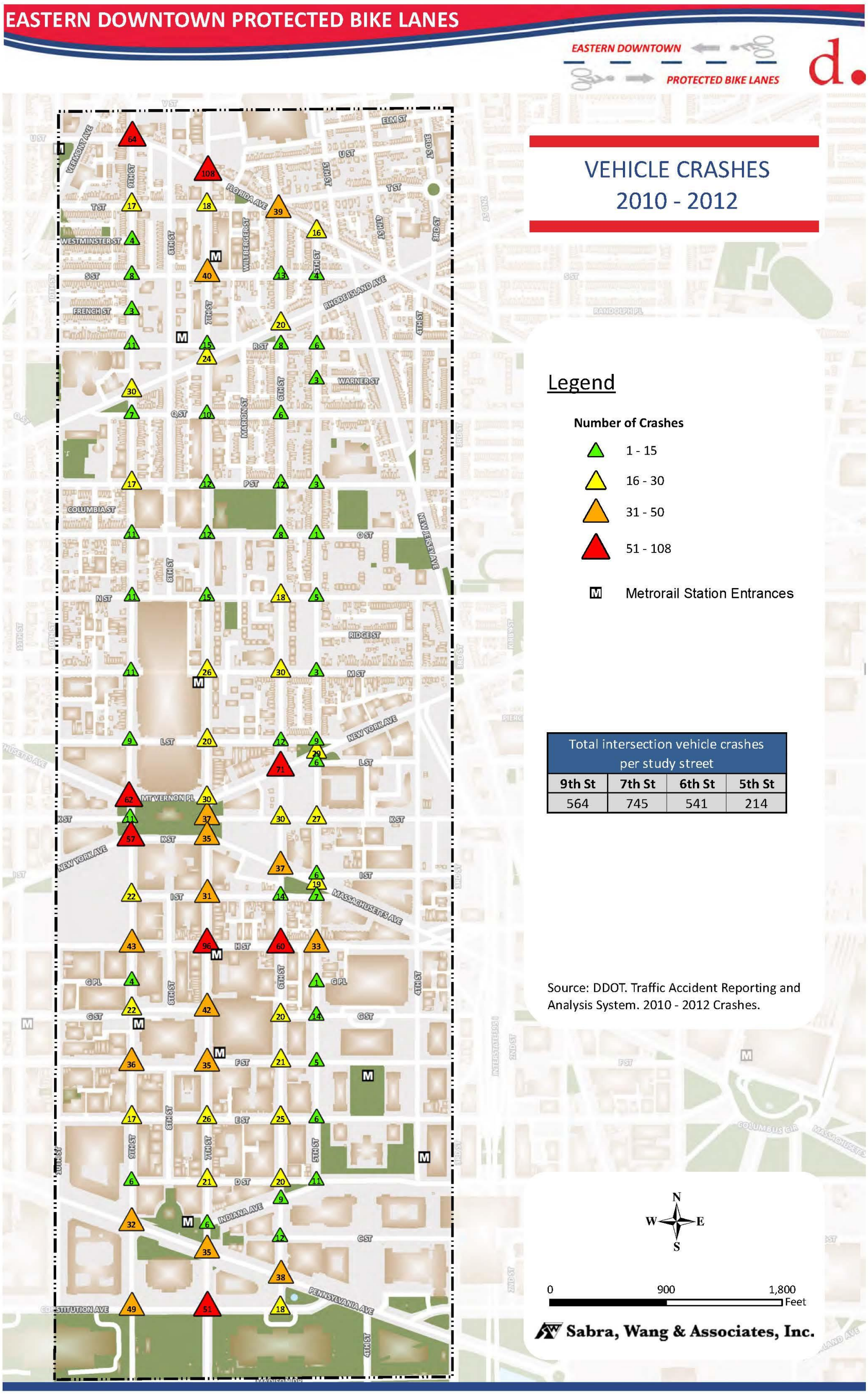

Figure 20: Vehicle Crashes 2010-2012

3.6 Bus Operations

3.6.1 Bus Operators

Several local, commuter, and tourist-oriented transit services operate within the study area. Local and commuter services include WMATA, MTA commuter bus, PRTC OmniRide, and the DC Circulator, among others. Numerous tour services also operate in Downtown DC, including but not limited to Big Bus Tours, Old Town Trolley Tours, and City Sights.

3.6.2 Bus Route Density and Ridership

Route density during the morning and evening peaks shows that local and commuter surface transit services are heaviest on Pennsylvania Avenue, H Street, Florida Avenue, and 7th Street (Figure 21 and Figure 22). Of the three (3) study streets, 9th Street has the largest number of buses in the peak commuting hours, although all services are only southbound. Bus service on 6th Street operates from E Street to F Street and from I Street to K Street, while 5th Street only has bus service from H Street to K Street. Peak hour tour services primarily operate on east-west streets, with the exception of 7th Street, south of New York Avenue.

AM and PM peak hour transit ridership is highest along 7th Street throughout the study area (Figure 23 and Figure 24). Bus stops adjacent to or on study streets average less than 25 passengers during both peaks.

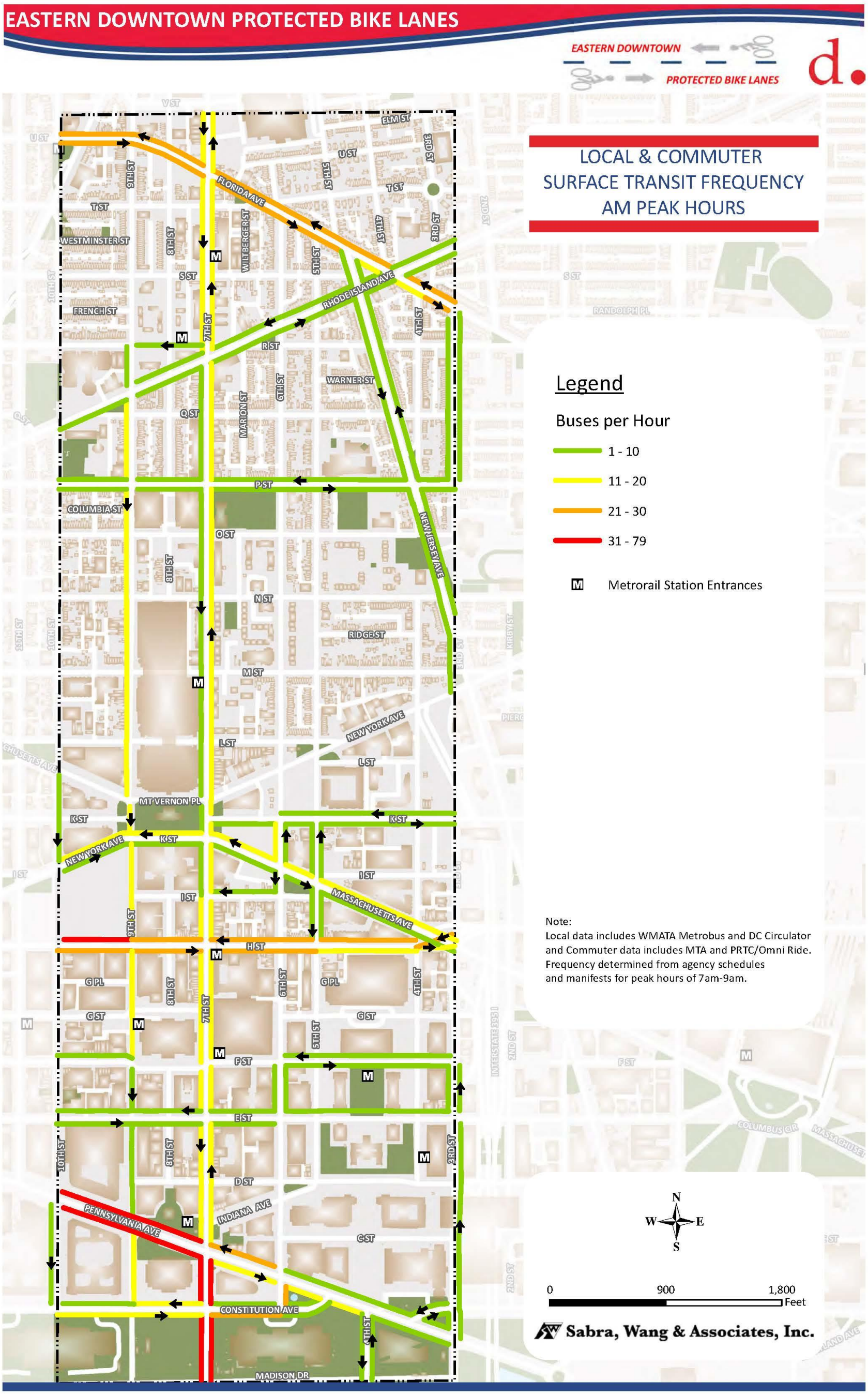

Figure 21: Surface Transit Frequency, AM Peak

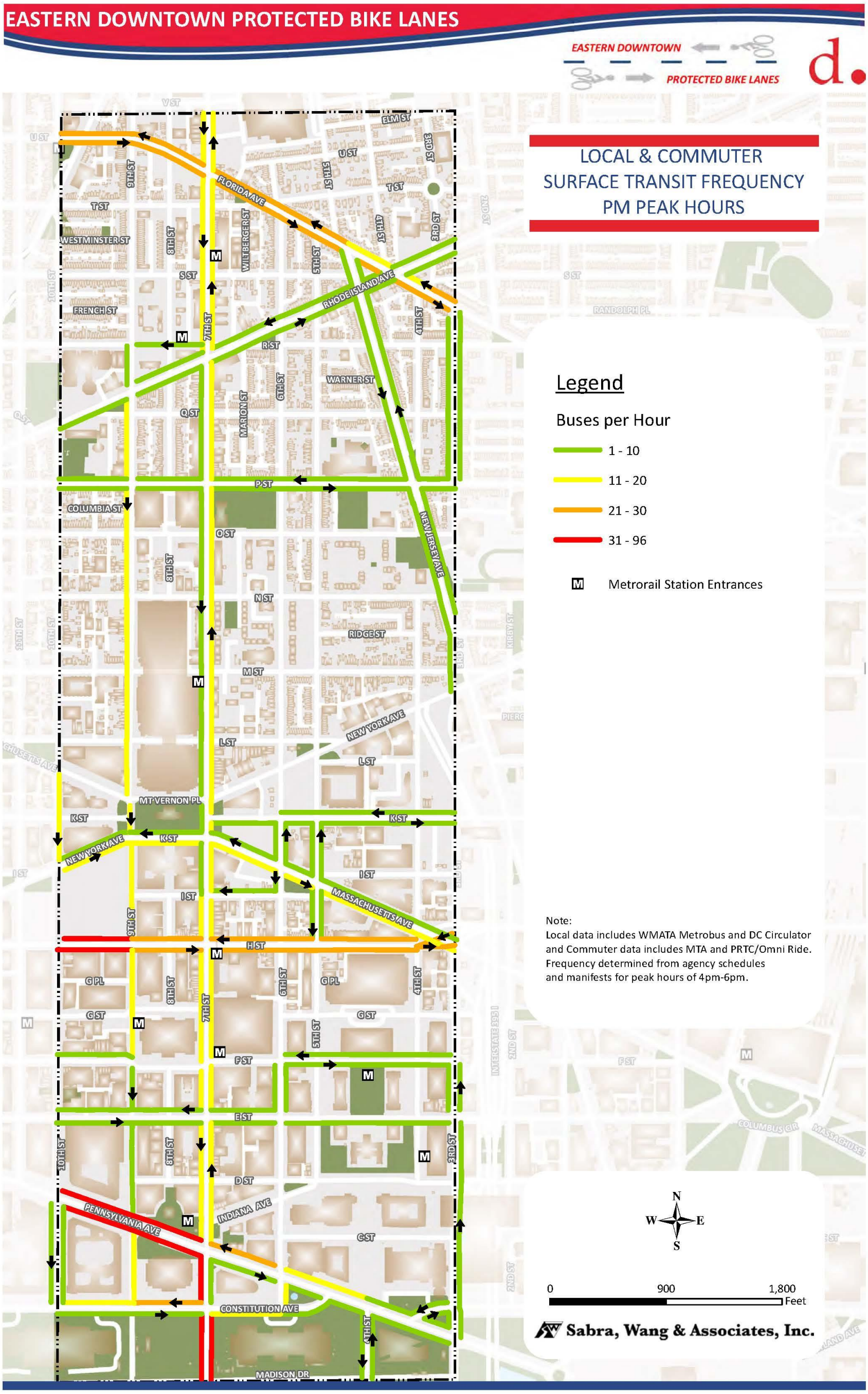

Figure 22: Surface Transit Frequency, PM Peak

Figure 23: WMATA Bus Ridership AM Peak

Figure 24: WMATA Bus Ridership, PM Peak

4 Preliminary Alternatives

Four preliminary build alternatives, along with a No-Build option, were developed and evaluated to determine which would best achieve the project's purpose and need. These five preliminary alternatives were chosen for a rigorous evaluation for feasibility and quantifying transportation effects on other modes. These five preliminary alternatives include:

- **Alternative 0** (no-build option): this option leaves the existing roadways in the study area as-is.
- **Alternative 1** provides a one-way, northbound, partially-protected bike lane on the east side of 5th Street, coupled with a one-way, southbound, protected bike lane on the west side of 6th Street.
- **Alternative 2** provides a northbound protected bike lane on the east side of 6th Street and a southbound protected bike lane on the west side of 6th Street.
- **Alternative 3** provides two-way protected bike lanes on the east side of 6th Street.
- **Alternative 4** provides two-way protected bike lanes on the east side of 9th Street.

Since the potentially affected streets only include 5th, 6th, and 9th, descriptions of each alternative and the subsequent analysis will focus on these three streets. A detailed description of each alternative follows. The descriptions for each street are separated into two parts – *North* and *South* of New York Ave, since it represents an approximate dividing line between the land use and/or roadway width on 5th, 6th, and 9th Streets.

4.1 Alternative 0 (No-Build)

Alternative 0 represents the existing conditions along 5th, 6th, and 9th Street, with no roadway changes made to the street network. Alternative 0 was analyzed in an attempt to set a baseline scenario against which all other alternatives would be measured.

4.1.1 5th Street

South of New York Avenue, 5th Street is approximately 44 feet wide with full time parking allowed southbound, while northbound curbside parking is restricted during the PM peak period. Northbound parking restrictions allow for two northbound travel lanes during the PM peak period, while off-peak and AM Peak periods have one travel lane in each direction. Cyclists utilizing 5th Street are currently required to ride in the general travel lanes. AM and PM vehicle speeds are generally low, between 5-10 mph. A typical cross-section of 5th Street south of New York Avenue under the No-Build condition is shown below in Figure 25.

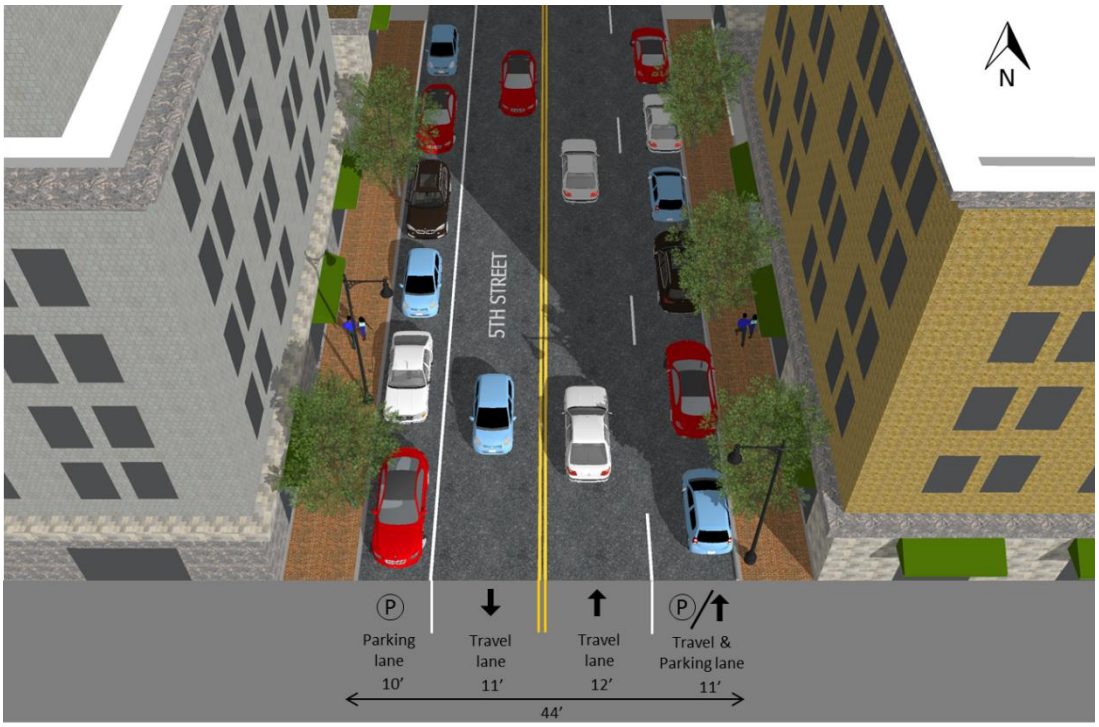

Figure 25: No-build (Alternative 0), 5th Street South of New York Ave

North of New York Avenue, 5th Street is one-way with an approximate roadway width of 30-32 feet. Full time parking is allowed on both sides of 5th Street, with one northbound travel lane where speeds during the AM and PM peak hour average about 10 and 15 mph. Many of the blocks north of New York Ave are Residential Permit Parking (RPP) blocks. Cyclists can utilize either the dedicated unprotected bike lane, located between the travel lane and east curbside parking, or the travel lane itself. A typical cross-section of 5th Street north of New York Avenue under the No-Build condition is shown below in Figure 26.

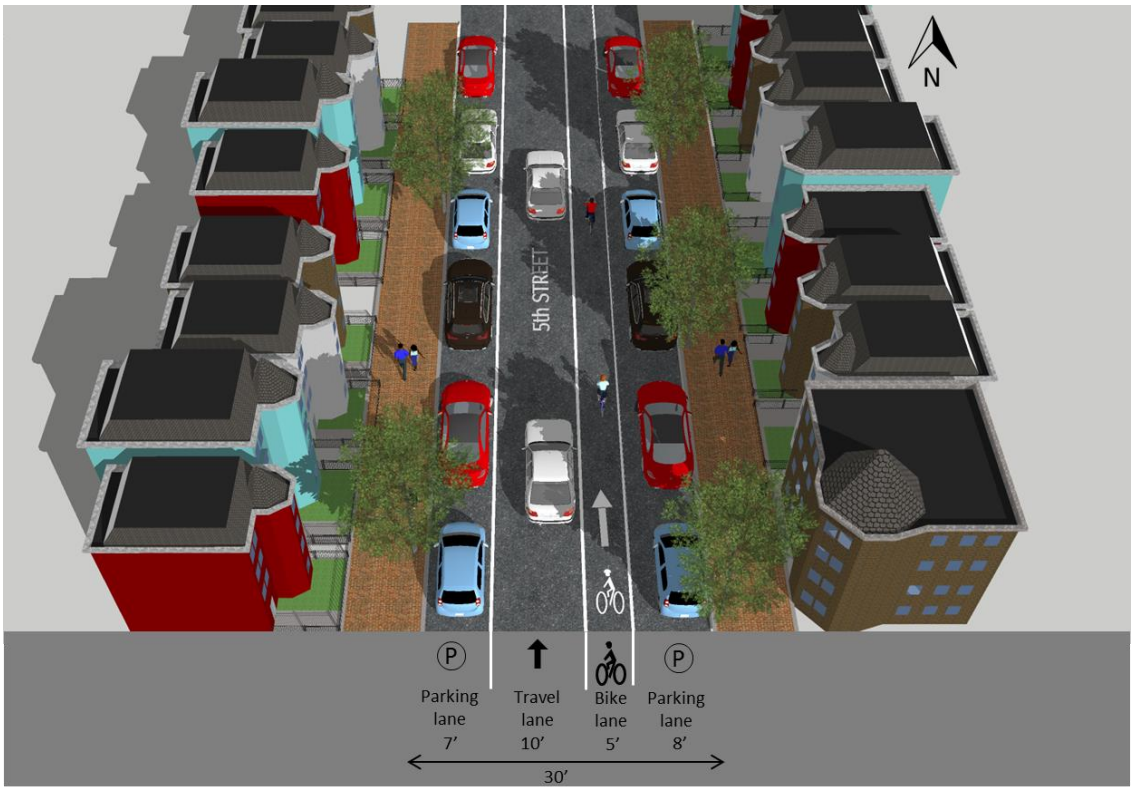

Figure 26: No-build (Alternative 0), 5th Street North of New York Ave

4.1.2 6th Street

6th Street has a typical roadway width of about 56 feet north and south of New York Avenue with two full-time travel lanes in each direction and parking along both sides of the street. Several block faces north of New York Ave are RPP. South of New York Avenue, parking along 6th Street is restricted during both the AM and PM peak periods allowing for a six lane cross-section with three travel lanes in each direction. The absence of bike infrastructure on 6th Street requires cyclists to use general-purpose travel lanes. Vehicle travel speeds average 10-15 mph during the AM and PM peak periods. Figure 27 and Figure 28 show the approximate existing cross-sections of 6th Street south and north of New York Avenue, respectively.

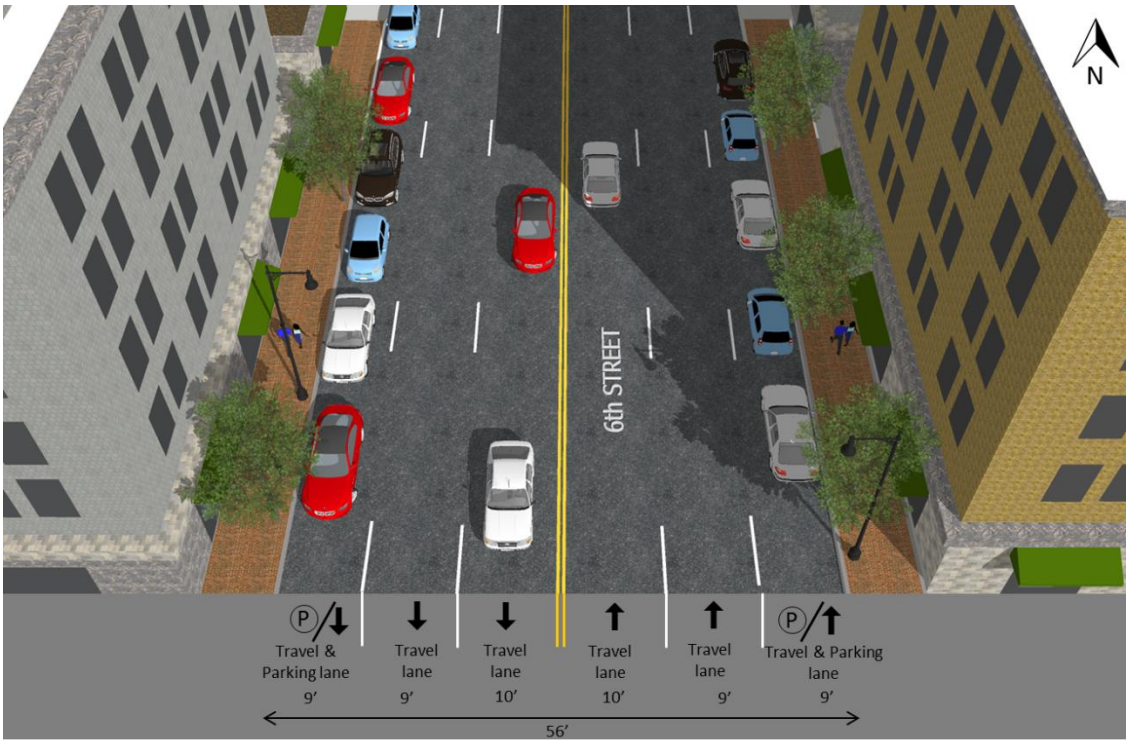

Figure 27: Alternative 0, 6th Street South of New York Ave

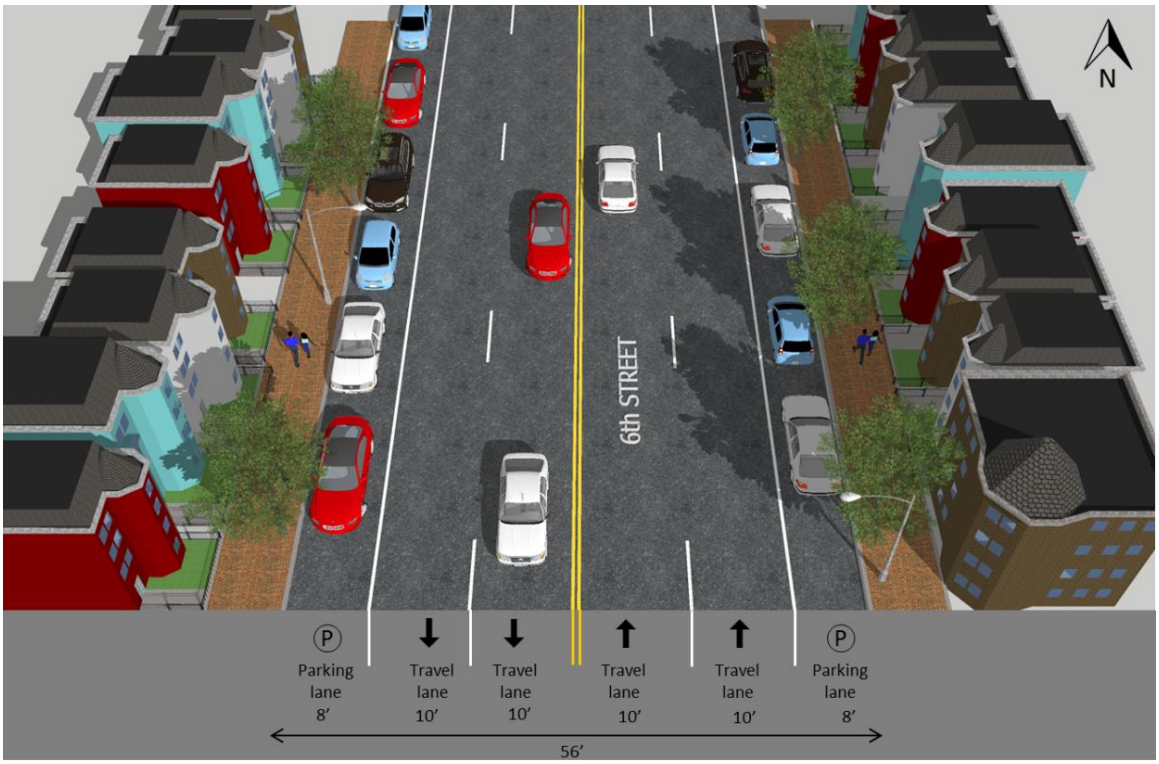

Figure 28: Alternative 0, 6th Street North of New York Ave

4.1.3 9th Street

South of Massachusetts Avenue, 9th Street is approximately 50 feet wide. Full time parking is allowed on the east side and on approximately half of the west side of 9th Street, south of Massachusetts Avenue. 9th Street is currently one-way south of Massachusetts with three travel lanes. Cyclists are required to ride in the travel lanes except for a short segment between G Street to Pennsylvania Avenue where there is an unprotected, dedicated bike lane. Average peak hour vehicle speeds range from 10-15 mph. A typical cross-section of 9th Street south of Massachusetts Avenue under the No-Build condition is shown below in Figure 29.

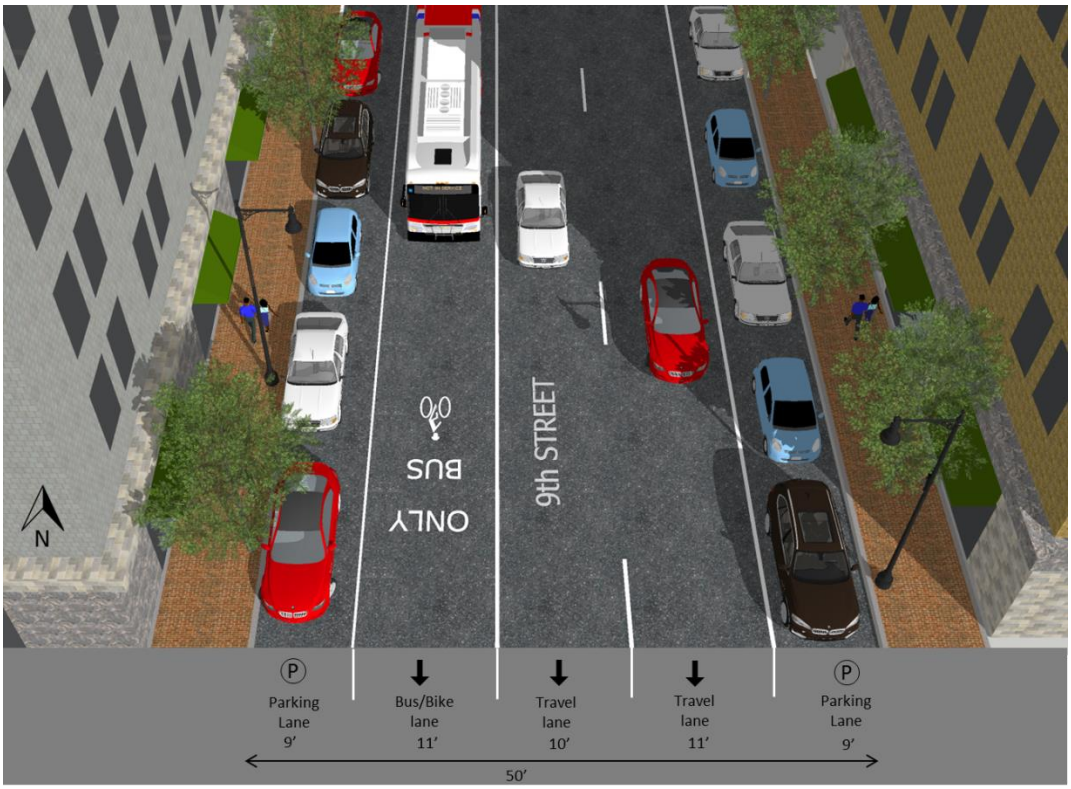

Figure 29: Alternative 0, 9th Street South of Massachusetts Ave

North of Massachusetts Avenue, 9th Street is approximately 56 feet wide with full time parking allowed on both sides of the street and two full time travel lanes in both directions. Several block faces north of New York Ave are designated RPP. Cyclists are required to use general purpose travel lanes, where vehicle speeds average 10-15 mph during both the AM and PM Peak hours. A typical cross-section of 9th Street north of Massachusetts Avenue under the No-Build condition is shown in Figure 30.

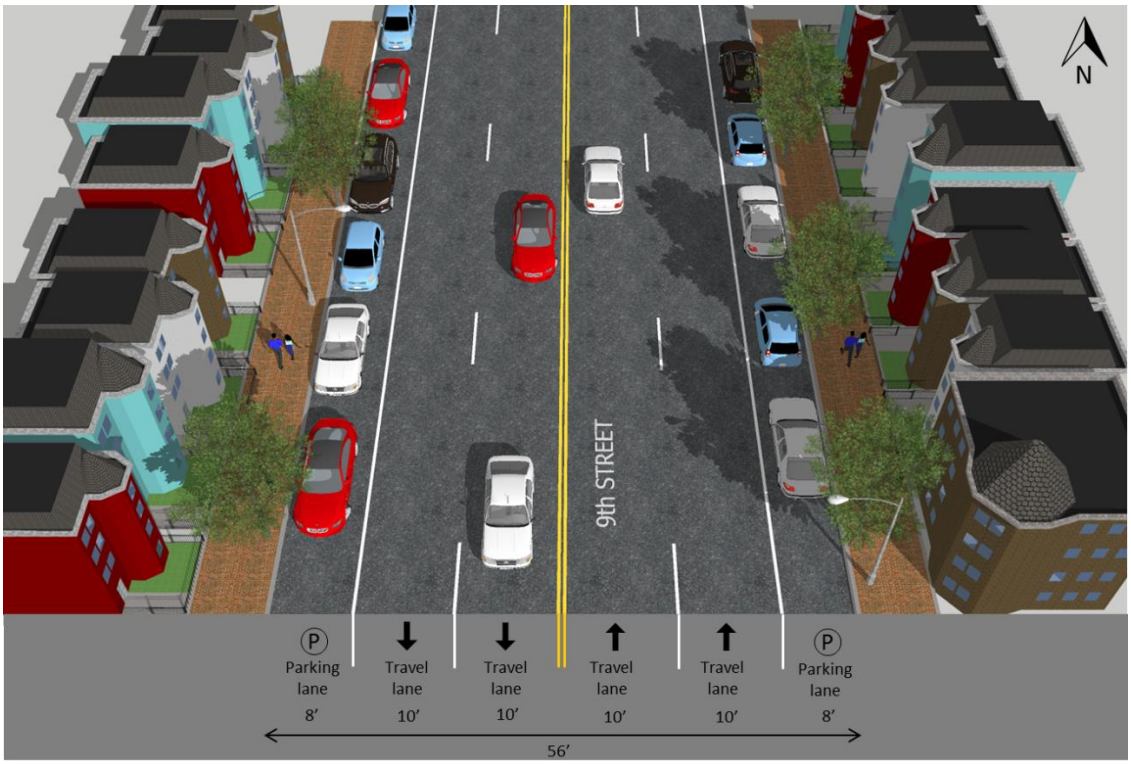

Figure 30: Alternative 0, 9th Street North of Massachusetts Ave

4.2 Alternative 1 - 5th/6th Street Protected Bike Couplets

This option consists of a one-way, northbound bike lane (with protected and unprotected sections) on the east side of 5th, coupled with one-way, southbound, protected bike lane on the west side of 6th Street. Because 5th Street does not go through to Florida Ave or Pennsylvania Ave, the limits are D Street to the south and Rhode Island Ave to the north. A future separate project would extend 5th St NW through Rhode Island Avenue, enabling a connection to Florida Avenue, but the timeline of this project is uncertain. Between New York Avenue and Rhode Island Avenue, the northbound bike lane will utilize the existing 5th Street unprotected bike lane. From D Street north to New York Avenue, Alternative 1 proposes the removal of a metered 5th Street parking/travel lane along the east curb for conversion to a protected northbound bike lane.

The 6th Street southbound bike lane limits are Florida Ave to Pennsylvania Ave; however, the protected portion of the 6th Street southbound lane is from S Street to Pennsylvania Ave. An unprotected, southbound bike lane is proposed from Florida Avenue to S Street, and shared lane markings (sharrows) will designate the travelway as shared for vehicles and cyclists from S Street to Florida Ave. On 6th Street, from R Street to L Street, the southbound protected bike lane will be located between the southbound parking lane and the curb. Additionally, the relocated parking lane is proposed to be peak hour restricted, instead of full-time. On 6th Street, south of L Street, a peak-hour restricted parking lane is removed and replaced with a protected bike lane; the adjacent southbound travel lane is converted to allow parking during off-peak hours only. A comparison between the existing roadway configuration and

the proposed configuration for 5th Street and 6th Street north and south of New York Avenue is shown in Figure 31 and Figure 32, respectively.

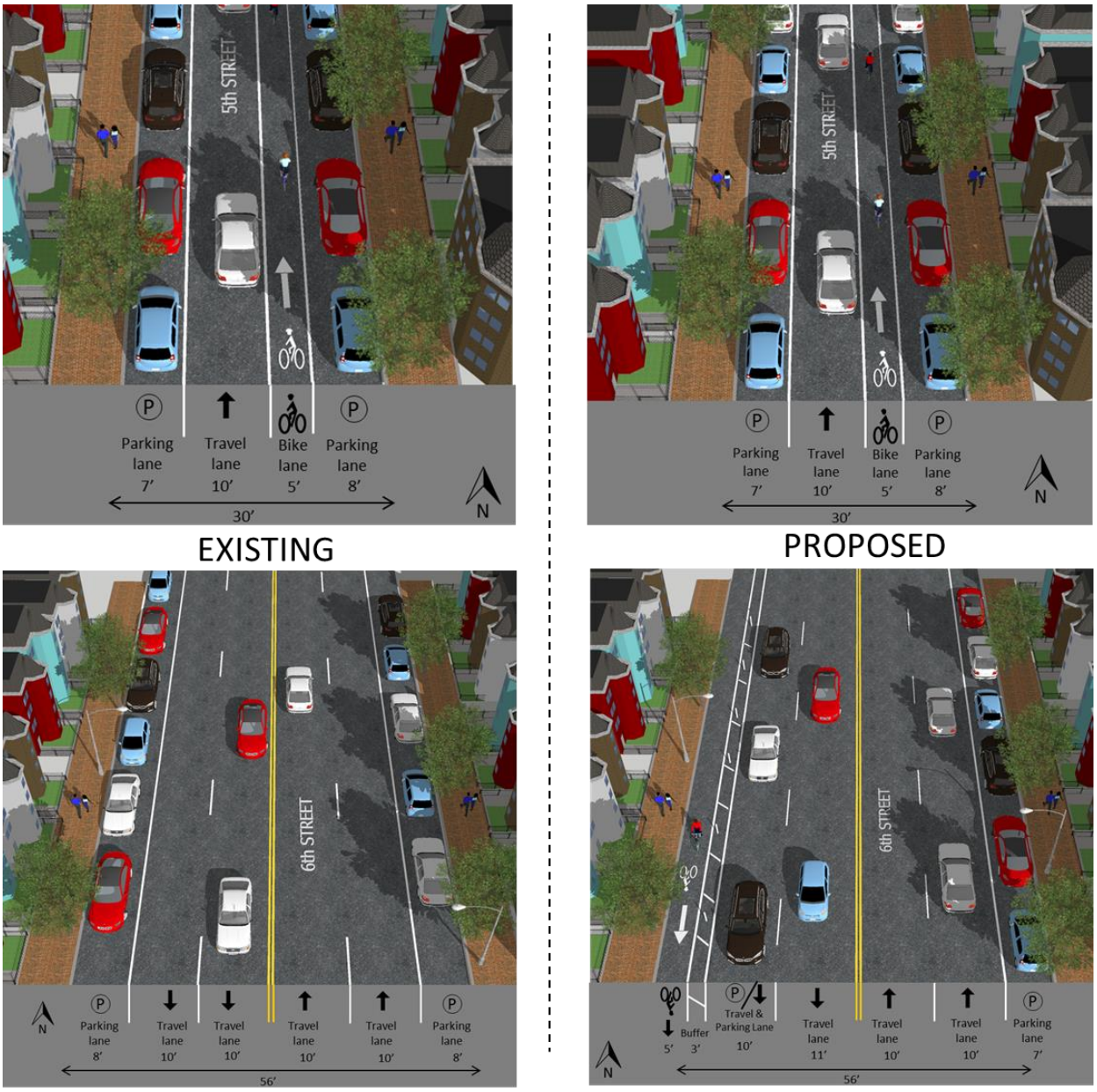

Figure 31: Existing and Proposed Roadway Cross-Sections for Alternative 1 along 5th Street and 6th Street North of New York Avenue

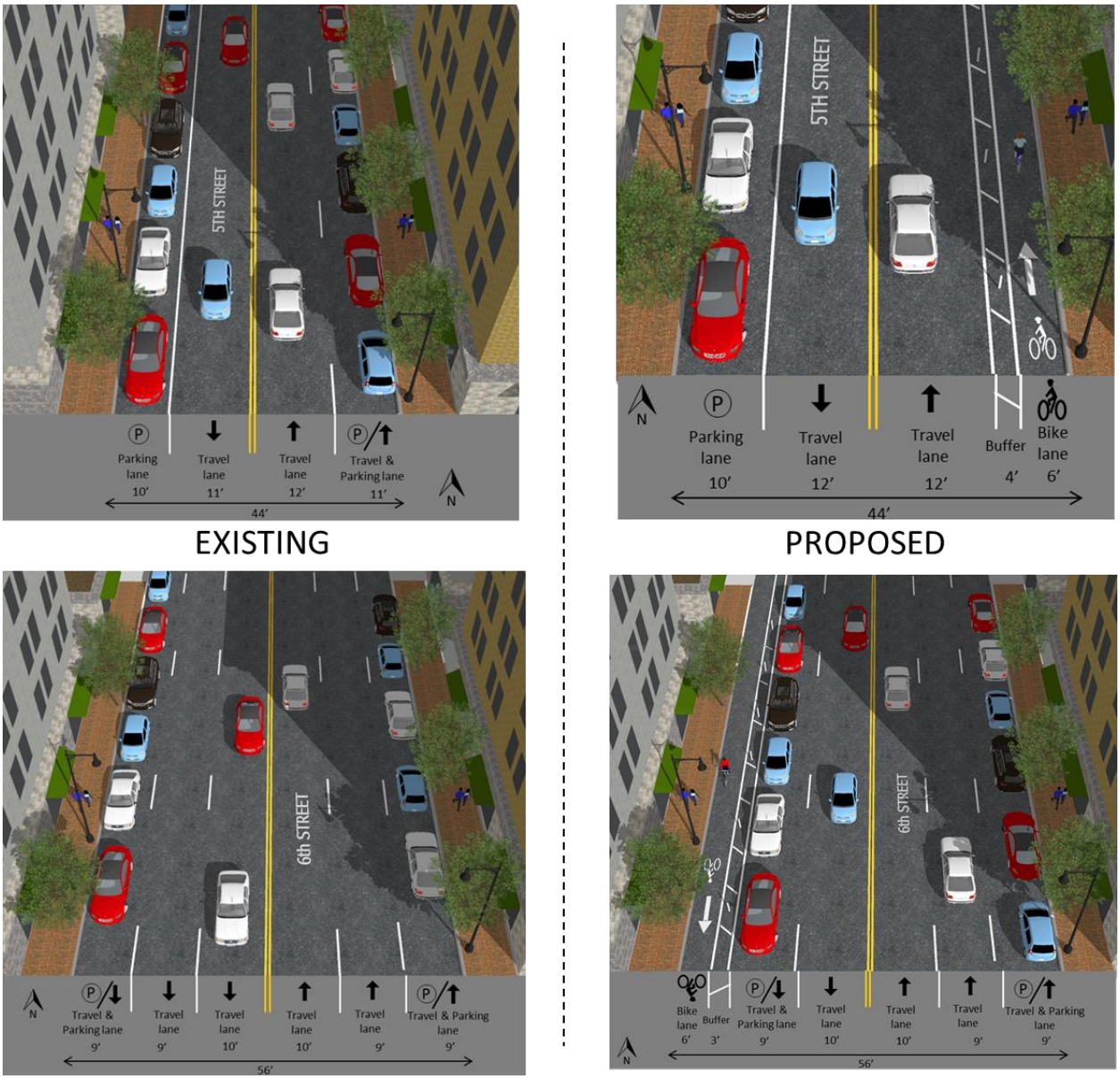

Figure 32: Existing and Proposed Roadway Cross-Section for Alternative 1 along 5th Street and 6th Street South of New York Avenue

4.3 Alternative 2 – Protected Curbside Bike Lanes on each side of 6th Street

Alternative 2 proposes one-way protected bike lanes on the east and west sides of 6th Street. Protected lanes will replace an existing travel lane in each direction. The limits of Alternative 2 are from Pennsylvania Ave in the south to Florida Ave in the north; however, the protected portion is from Rhode Island Avenue to Pennsylvania Ave. Unprotected bike lanes are proposed from Rhode Island Avenue to S Street, and sharrows will designate that the lane is shared for vehicles and cyclists from S Street to Florida Ave. A comparison between the existing roadway configuration and the proposed configuration for 6th Street under Alternative 2 is shown in Figure 33. The top two images in Figure 33 represent cross-

sections north of New York Avenue, while the bottom two show typical cross-section south of New York Avenue.

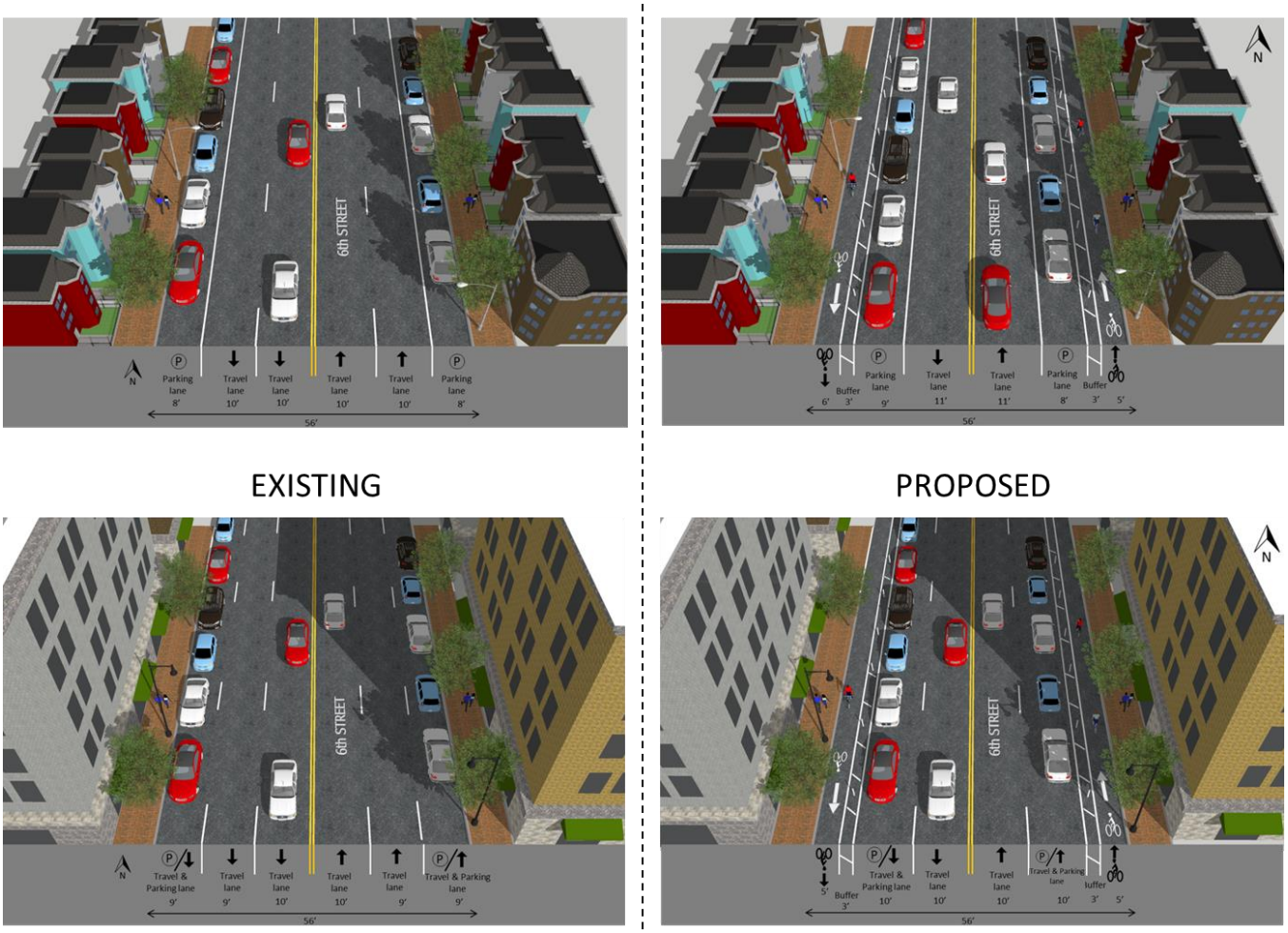

Figure 33: Existing and Proposed Roadway Cross-Section for Alternative 2 along 6th Street

4.4 Alternative 3 – Two-way Protected Bike Lanes on the East Side of 6th Street

This option consists of two-way protected bike lanes on the east side of 6th Street that will replace a single northbound travel lane. Similar to Alternative 2, the protected bike lanes will traverse the east side of 6th Street from Pennsylvania Ave to S Street. From S Street to Florida Ave, 6th Street will be a shared-used roadway.

North of New York Ave, Alternative 3 would reduce the number of northbound 6th Street travel lanes from 2 to 1, with new northbound left turn bays introduced. Southbound travel lanes are proposed to be reduced from 2 travel lanes to 1 travel lane and 1 dedicated left-only lane. South of New York Avenue, a parking lane is proposed to be removed, and the adjacent northbound travel lane is converted to allow parking only after the evening peak commuting period. Southbound travel lanes along 6th Street will generally be reduced to one through lane and one protected left turn lane. Full-time southbound curbside parking will be introduced to replace the current peak-hour restricted parking,

with parking removed from intersections approaches to allow for short right-turn pocket lanes, as needed. A comparison between the existing roadway configuration and the proposed configuration for 6th Street under Alternative 3 is shown in Figure 34, with the top two images representing cross-sections north of New York Avenue while the bottom two show typical cross-section south of New York Avenue.

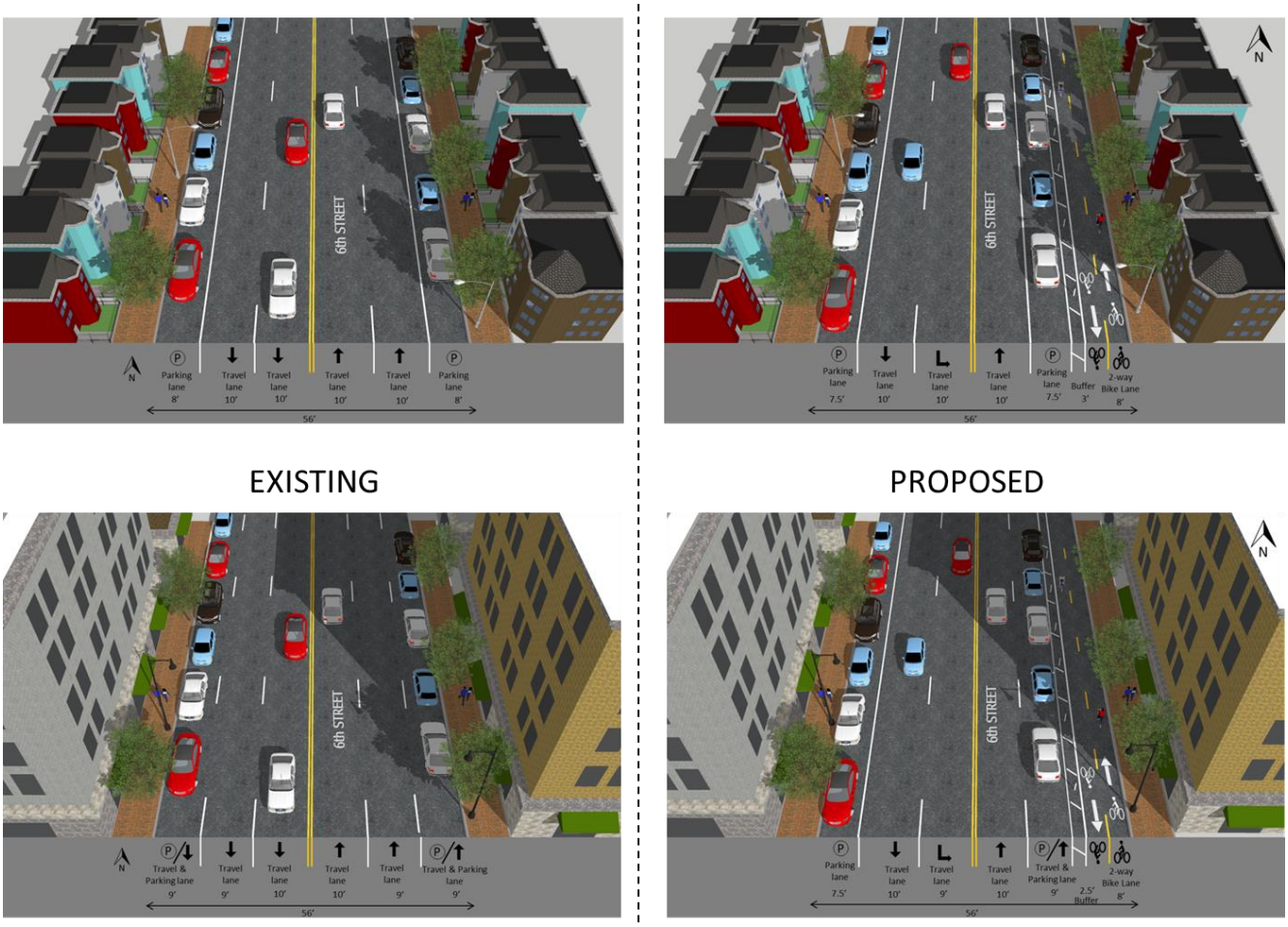

Figure 34: Existing and Proposed Roadway Cross-Section for Alternative 3 along 6th Street

4.5 Alternative 4 – Two-way Protected Bike Lanes on the East Side of 9th Street

Alternative 4 consists of two-way protected bike lanes on the east side of 9th Street. The protected bike lanes will traverse 9th Street from Pennsylvania Ave to Florida Ave. To accommodate the lanes, this option removes a northbound travel lane north of Massachusetts Avenue. The existing parking lane is relocated to the adjacent travel lane, such that northbound direction consists of a single travel lane, a single full-time parking lane, and the curbside protected two-way bike lanes. South of Massachusetts Avenue, a full-time parking lane on the west side of the street – between H Street and E Street – is replaced with a travel lane, with peak hour parking allowed. Additionally, existing lanes are narrowed and the east-side full-time parking lane is shifted west to allow for curbside two-way bike lanes. A

portion of the relocated east-side parking is replaced with southbound left turn pockets[5]. The short existing bus-only lane will be converted into a travel lane for all vehicles in order to maintain three southbound travel lanes during peak hours. A comparison between the existing roadway configuration and the proposed configuration for 9th Street under Alternative 4 is shown in Figure 35, with the top two images representing cross-sections north of Massachusetts Avenue, while the bottom two show a typical cross-section south of Massachusetts Avenue.

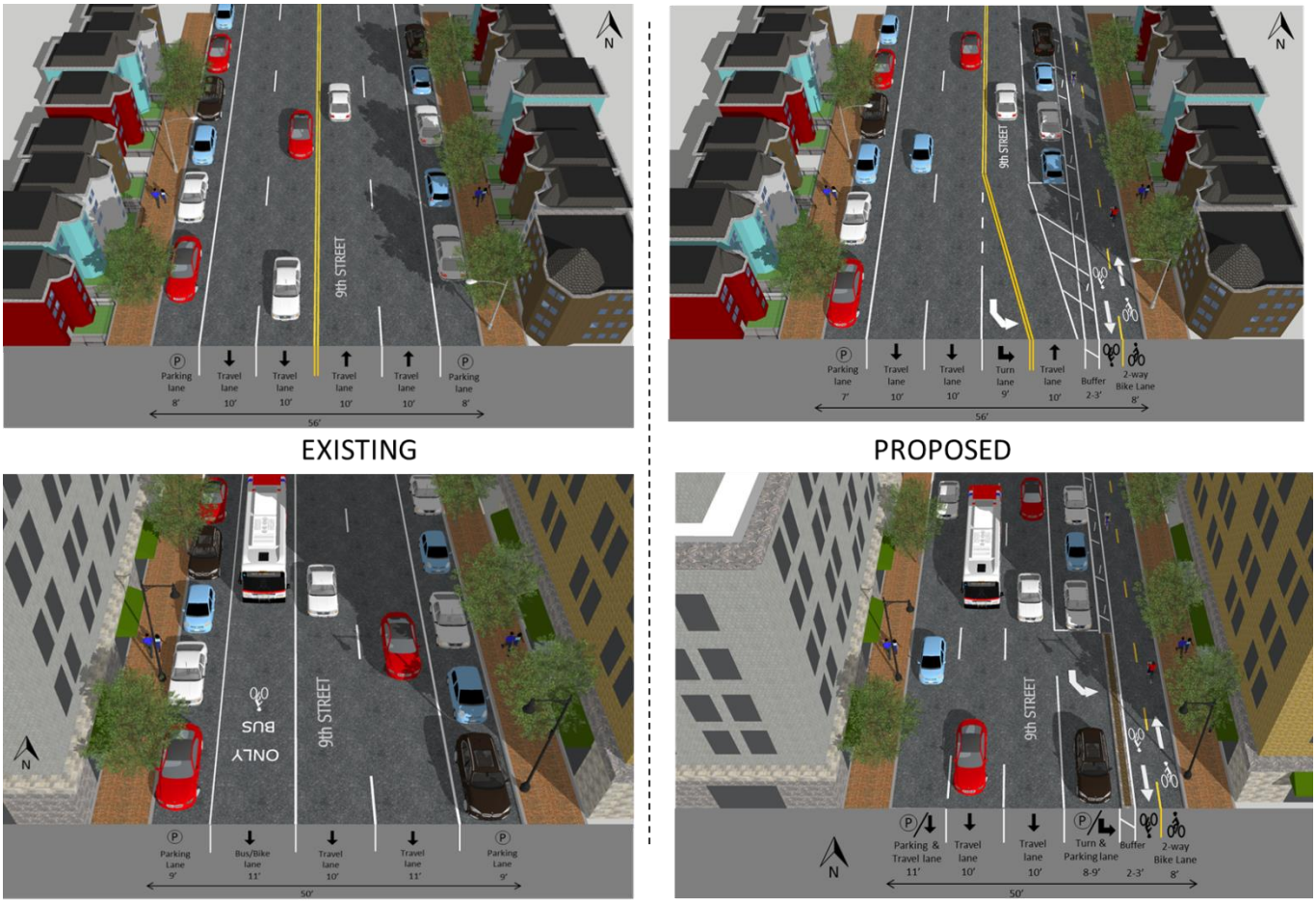

Figure 35: Existing and Proposed Cross-Section for Alternative 4 along 9th Street

[5] The short left-turn only pockets were added to the proposed design subsequent to the public meetings, to attempt to mitigate traffic congestion.

4.6 Signal Timing and Intersection Approach Configurations for each Alternative

The proposed alternatives 1 through 4 also evaluated modifications to existing signal timings to: 1) adjust for loss of a travel lane when it was replaced by a protected bike lane; and 2) to attempt to protect cyclists from heavy turning movements and blind left turn movements[6] at certain intersections.

The District's Central Business District (CBD) intersections were re-timed in 2015, with cycle lengths increasing from 100 to 110 seconds. Because many east-west streets carry a large number of vehicles, similar to north-south streets, attempts were made to generally keep signal timings relatively unchanged, with only modest adjustments, as needed. Also, the proposed cycle length remained at 110 seconds in each alternative and care was taken to ensure that east-west and north-signal coordination remained intact[7]. In addition to general changes to signal timing to aid north-south movement, specific proposed modifications to signal phasing and/or lane configuration at certain intersections include the following:

- Alternative 1:
  - Southbound left turns from 6th to New York Ave are proposed to be made from a dedicated left turn lane with a protected-only signal phase.
  - Eastbound left turns from Massachusetts to northbound 5th are proposed to be peak hour-restricted.
  - Southbound left turns from 6th to Pennsylvania Ave were restricted, with vehicles accessing eastbound Pennsylvania via a left-turn onto Constitution Ave.
- Alternative 2:
  - Permanent restriction of northbound left turns at New York Ave and 6th Street.
  - Eastbound left turns from Massachusetts to Northbound 5th are proposed to be peak hour-restricted.
  - Southbound left turns from 6th to Pennsylvania Ave were restricted, with the vehicles accessing eastbound Pennsylvania via a left onto Constitution Ave.
  - Reconfigure northbound 6th Street at L to 1 left turn lane and 1 through only lane.
  - Southbound 6th Street from New York Ave to K Street is proposed as peak hour-restricted parking.
  - Southbound left turns from 6th Street to M Street are proposed as protected-only movements (i.e., a vehicle can only turn when given a green arrow).
- Alternative 3:
  - Southbound left turns from 6th Street are protected-only movements.

[6] A "blind" left turn is one where a motorist is turning left and conflicts with a cyclist that is approaching the intersection from the same direction, but along the motorist's left side.

[7] Closely-spaced signalized intersections often operate as one signalized intersection, so as to maintain efficiency of vehicle movement though them.

- Northbound right turns from 6th Street to New York Ave westbound are protected-only movements.
- Northbound left turns at New York Ave and 6th Street are restricted to off-peak periods only.
- Southbound left turns from 6th to Pennsylvania Ave are restricted, with the vehicles accessing eastbound Pennsylvania via proposed protected-only double-left turn lanes onto eastbound Constitution Ave. This proposed configuration will require modifying the signal head from a permissive green ball signal head to a protected 3-arrow signal head.
    - A design option was explored that provided a dedicated southbound left turn lane from 6th Street directly onto Pennsylvania Ave; however this option comes at the expense of west side full-time parking from C Street to Pennsylvania. While this option showed similarly-acceptable overall traffic operations as the double-left turn onto Constitution, it is the latter option that is recommended for this design alternative to best protect cyclists and maintain traffic flow along Pennsylvania Ave and along 6th Street.
- Reconfigure northbound 6th Street at L to one left-turn lane and one through-only lane.
- Southbound 6th Street from New York Ave to K Street is proposed as peak hour-restricted parking.
- Southbound left turns from 6th Street to M Street are proposed as protected-only movements.
- Southbound left-turn movement from 6th to Eastbound Massachusetts is prohibited (it is currently prohibited in the AM and PM peak hours). Eastbound traffic from 6th Street utilizes the protected lefts at Eye Street to access Massachusetts Ave.
- Northbound 6th Street right-turns onto eastbound Rhode Island Ave would be protected-only movements (currently right-turners have a protected phase and a permitted phase that occurs during the WALK phase to cross Rhode Island Ave).
    - This would require two different signal phases at Rhode Island and R Street – one sign for through traffic and one signal for traffic turning onto eastbound Rhode Island.

- Alternative 4[8]:
    - Introduce a 20 second bike-only phase at 9th and Rhode Island Ave
    - Southbound left-turn at 9th and U Street is modified from a protected and permitted movement to a protected-only movement.
    - Southbound left turns are prohibited at:
        - S Street,
        - P Street,

[8] The proposed signal timing was modified subsequent to initial public meetings in order to attempt to mitigate traffic congestion. The original signalization presented for Alternative 4 included bike-only phases at *all* intersections.

        - N Street, and
        - Mt Vernon Place
    - Permitted southbound left turns are replaced with protected-only left-turn movements and dedicated left-turn lanes at:
        - T Street,
        - Q Street,
        - O Street,
        - M Street,
        - L Street,
        - I Street,
        - H Street,
        - G Street,
        - F Street,
        - E Street, and
        - D Street

Corresponding geometric changes to accommodate many of the signal phasing changes will be discussed in a subsequent subsection.

5 How Each Alternative affects the Transportation Network

The preliminary alternatives were evaluated for multiple metrics. The analysis included both transportation-related effects as well as less quantitative effects. Transportation-related metrics evaluated include:

- Cyclist Safety
- Parking
- Sunday Diagonal Parking
- Loading and Events
- Traffic
- Bus Operations
- Pedestrian safety
- Emergency Vehicle Access

Non-transportation metrics evaluated include the alternatives' effect on:

- Social/Community
- Local Economy
- Historic Preservation
- Visual aesthetics
- Construction Costs and Staging

5.1 Cyclist Safety

Two aspects of cyclist safety were evaluated: 1) safety from vehicles traveling in same direction; and 2) safety at intersections, where turning vehicles share spaces with cyclists.

5.1.1 Cyclist Protection from Main-line Travel

While the actual type of protection provided between the bike lane and travel/parking lanes (e.g. flexible posts, poured concrete median, preformed curb, etc.) has not been determined as this stage, all preliminary alternatives offer some level of protected separation from main-line vehicle traffic, as shown in Table 7. The form that protection takes will be determined during the final design phase of the project.

Table 7: Bike Lane Protection from Main Line Travel

Alternatives	Percent of Corridor Protected	Unprotected Segments
0	None	Entire Study Area
1	70%	5th Street: L to Florida Avenue 6th Street: S to Florida Avenue
2	90%	6th Street: S to Florida Avenue
3	90%	6th Street: S to Florida Avenue
4	100%	All Locations Protected

5.1.2 Protection from Turning Vehicles

All alternatives attempt to protect cyclists from many of the heavy turn vehicles, either through design (placement of the protected bike lanes on a certain side of the street) or signal timing (protecting cyclists with a bike-only phase or allowing protected-only vehicle turning movements to eliminate potential conflicts). Table 8, Table 9, Table 10, and Table 11 show, for each build alternative, the degree to which cyclists are protected from the heavy turn movements highlighted earlier in Table 2. Protection from heavy turns is also summarized below:

- **Alternative 1 (Table 8)**
  - Placement of the southbound protected bike lane on the west side of 6th Street eliminates the need to protect southbound left turns and northbound right turns for vehicles (as shown by “n/a” in Table 8).
  - Placement of the northbound protected bike lane on the east side of 5th Street eliminates the need to protect northbound lefts and southbound rights (as shown by “n/a” in Table 8).
  - Cyclists do not have protection from all other heavy turn movements listed.
- **Alternative 2 (Table 9)**
  - Cyclists are protected from northbound right turns at the intersection of 6th and New York Ave, as shown in Table 9.

- Cyclists do not have protection from all other heavy turn movements listed.

- **Alternative 3 (Table 10)**
  - Placement of the two-way protected bike lane on the east side of 6th Street eliminates the need to protect northbound lefts and southbound rights (as shown by "n/a" in Table 10).
  - Cyclists are protected from all southbound left turn movements.
  - Cyclists are protected from the heavy northbound right turn movement at:
    - 6th and New York Ave
    - 6th and Rhode Island Ave
  - Cyclists do not have protection from all other heavy turn movements listed.
- **Alternative 4 (Table 11)**
  - Placement of the two-way protected bike lane on the east side of 9th Street eliminates the need to protect northbound lefts and southbound rights (as shown by "n/a" in Table 11).
  - Cyclists are protected from all southbound left turn movements.
  - A bike phase is introduced at Rhode Island Ave to protect cyclists from all turn movements.

Table 8: Locations where cyclists are protected from high-volume vehicle turns in Alternative 1

Alternative 1 Impact to Intersection	Is Heavy Turn Movement Protected?			
	NBL	SBL	NBR	SBR
6th Street & S Street	no		n/a	
6th Street & Rhode Island Avenue			n/a	
6th Street & M Street		n/a		
6th Street & New York Avenue		n/a	n/a	
6th Street & K Street		n/a	n/a	
6th Street & Massachusetts Avenue				no
6th Street & F Street				no
6th Street & E Street	no			no
6th Street & Pennsylvania Avenue		n/a		no
5th Street & New York Avenue	n/a		no	
5th Street & L Street (S)		no		
5th Street & K Street			no	
5th Street & H Street			no	
5th Street & D Street				n/a
5th Street & I Street (S)				n/a

Table 9: Locations where cyclists are protected from high-volume vehicle turns in Alternative 2

Alternative 2 Impact to Intersection	Is Heavy Turn Movement Protected?			
	NBL	SBL	NBR	SBR
6th Street & S Street	no		no	
6th Street & Rhode Island Avenue			no	
6th Street & M Street		no		
6th Street & New York Avenue		no	yes	
6th Street & K Street		no	no	
6th Street & Massachusetts Avenue				no
6th Street & F Street				no
6th Street & E Street	no			no
6th Street & Pennsylvania Avenue		no		no

Table 10: Locations where cyclists are protected from high-volume vehicle turns in Alternative 3

Alternative 3 Impact to Intersection	Is Heavy Turn Movement Protected?			
	NBL	SBL	NBR	SBR
6th Street & S Street	n/a		no	
6th Street & Rhode Island Avenue			yes	
6th Street & M Street		yes		
6th Street & New York Avenue		yes	yes	
6th Street & K Street		yes	no	
6th Street & Massachusetts Avenue				n/a
6th Street & F Street				n/a
6th Street & E Street	n/a			n/a
6th Street & Pennsylvania Avenue		yes		n/a

Table 11: Locations where cyclists are protected from high-volume vehicle turns in Alternative 4

Alternative 4 Impact to Intersection	Is Heavy Turn Movement Protected?			
	NBL	SBL	NBR	SBR
9th Street & Florida Avenue		yes		
9th Street & K Street		yes		
9th Street & I Street		yes		
9th Street & H Street				n/a
9th Street & D Street		yes		
9th Street & Pennsylvania Avenue		n/a		

5.2 Parking

As shown in Table 12, the number of curbside parking spaces affected or replaced varies greatly based on each alternative. On aggregate, Alternative 4 has the smallest overall effect on commercial and residential spaces, while Alternative 1 has the largest effect on both. Alternative 3 has the least effect on residential parking spaces; while Alternative 4 has the least effect on metered commercial parking.

Table 12: Effects on Curbside Parking from each Alternative

Alternative	Curbside Parking Spaces Affected					
	5th Street		6th Street		9th Street	
	Commercial Spaces	Residential Spaces	Commercial Spaces	Residential Spaces	Commercial Spaces	Residential Spaces
ALT 1	70 northbound metered spaces, between D Street and New York Ave will be replaced with a protected bike lane. Spaces are currently restricted in the PM only.	No Effect	5 commercial southbound spaces (between L St and New York Ave) are replaced with a protected bike lane. These spaces are restricted in the PM only. An additional 30 spaces removed to provide right turn mixing zones.	114 Southbound full-time parking spaces, between R Street and L Street, become peak hour restricted. An additional 30 spaces (including 9 RPP) removed to provide right turn mixing zones.	-	-
Alt 2	-	-	9 commercial curbside spaces, that are restricted in the PM only are replaced with a protected bike lane (Northbound and Southbound 6th Streetbetween L St and New York Ave). An additional 58 spaces removed to provide right turn mixing zones.	58 spaces (including 9 RPP) are removed to provide right turn mixing zones.	-	-
Alt 3	-	-	4 commercial curbside spaces, that are restricted in the PM only are replaced with a protected bike lane (from northbound 6th Street between L St and New York Ave). 40 peak-hour restricted spaces along southbound 6th Street become full-time spaces between I Street and D Street. 72 spaces along northbound 6th Street that currently allow parking between 9:30 AM and 4:00 PM, will be parking prohibited during this time; parking will be allowed after 6:30 PM. East side parking from Eye Street to L Street, that is peak hour restricted, will be prohibited (loss of 15 spaces).	5 spaces removed along east side at approach to R Street.	-	-
Alt 4	-	-	-	-	South of New York Ave, 20 metered spaces converted from Full-time to peak-hour restricted, while an additional 17 metered spaces are lost permanently. Additionally 8 taxi standing spaces are lost between L Street and Mt Vernon Ave.	35 -45 residential spaces lost (including 7 RPP spaces), with the final number to be determined in final design

5.2.1 Sunday Diagonal Parking

Diagonal back-in parking is currently allowed on Sunday for four noncontiguous blocks along 9th Street and for four contiguous blocks along 6th Street. Diagonal parking allows for more vehicles to park on a block face, resulting in an increase in available spots; 76 additional spaces are provided on 9th Street by allowing diagonal parking, and 81 additional spaces are provided on 6th Street.

Effects of 6th Street Diagonal Parking on Alternatives 1, 2, and 3:

The Sunday diagonal parking on 6th Street currently utilizes one full time parking lane on the west side of the road and one southbound travel lane. Under the proposed Alternatives 1, 2, and 3, continued allowance of diagonal parking is proposed to result in the following travel conditions:

- Alternative 1 - Diagonal parking would block one parking lane and the southbound protected bike lane (Figure 36).
    - At intersection approaches, a mixing zone for cyclists and right-turning vehicles prevent parking of any kind. The mixing zone is about 100 feet long at each approach, removing both parallel and diagonal back-in parking along 6th Street.
- Alternative 2 - Diagonal parking would block one parking lane and the southbound protected bike lane (Figure 37)
    - At intersection approaches, a mixing zone for cyclists and right-turning vehicles prevent parking of any kind. The mixing zone is about 100 feet long at each approach, removing both parallel and diagonal back-in parking along 6th Street.
- Alternative 3 - Diagonal parking would block one parking lane and the southbound travel lane (Figure 38).

In Alternatives 1 and 2, cyclists would be required to share one southbound travel lane with vehicles on Sundays, as they do under existing conditions on 6th Street. Alternative 3 would still restrict southbound vehicle travel to one lane, but would not affect cyclists as the two-way protected bike lanes area proposed on the east side of 6th Street. However, Alternative 3 requires two southbound travel lanes at each intersection approach (one left-turn only lane and one through-right lane). Accordingly, diagonal parking will have to be replaced with curbside parking for a short distance before and after each intersection approach. Table 13 shows the current increase in curbside parking along 6th Street from normal operations to Sunday operations as well as the effect of Alternatives 1, 2, and 3 on Sunday parking. As shown in Table 13, the mixing zone design for Alternatives 1 and 2 reduces the number of new back-in spaces by 28, while Alternative 3 removes 16 of the 81 extra spaces that diagonal parking provides.

Figure 36: Proposed Diagonal Parking on 6th Street under Alternative 1

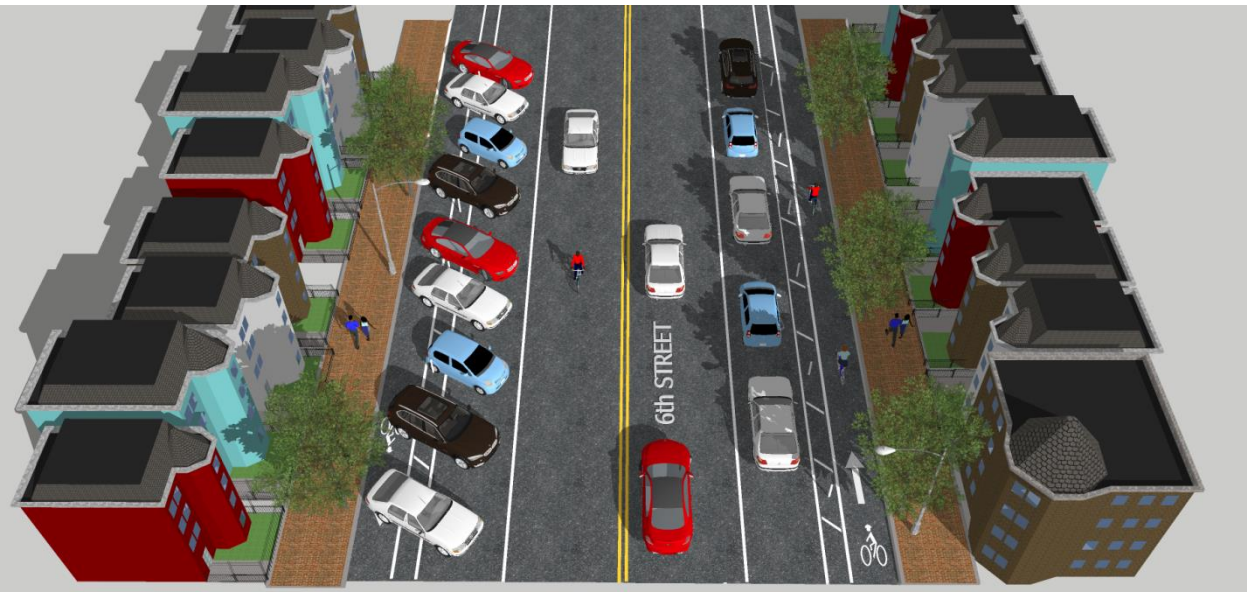

Figure 37: Proposed Diagonal Parking on 6th Street under Alternative 2

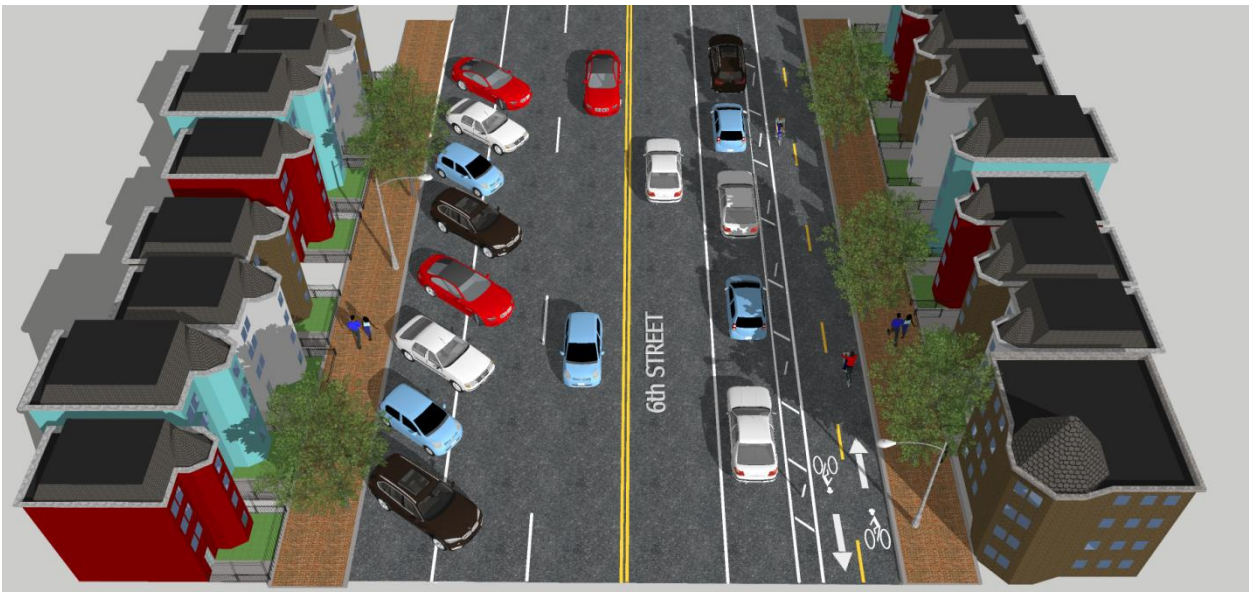

Figure 38: Proposed Diagonal Parking on 6th Street under Alternative 3

Table 13: Change in Available Diagonal Parking on 6th Street and for Alternatives 1, 2, and 3

Street and Block	Available curb space (linear ft)	parallel spaces	Existing Sunday angled spaces	Alternative 1	Alternative 2	Alternative 3
6th, P to O, west side	290	13	28	21	21	25
6th, O to N, west side	380	17	37	30	30	32
6th, N to M, west side	460	21	45	38	38	40
6th, M to L, west side	430	20	42	35	35	39
6th Total	**-**	**71**	**152**	**124**	**124**	**136**
			+81 spaces	+53 spaces	+53 spaces	+65 spaces

For Alternatives 1 and 2, Table 13 reflects permanent removal of west-side parking (parallel *or* diagonal) due to the creation of right-turn mixing zone of approximately 100 feet at each intersection approach. Alternative 3 requires two southbound travel lanes (one left turn only and one through lane) and one receiving lane at each intersection approach; accordingly, for about 125 feet north and south of the 4 intersections in Table 13, diagonal parking will have to be replaced with curbside parking.

9th Street:

Similar to 6th Street, Sunday diagonal parking on 9th Street occupies one full time parking lane and one travel lane under existing conditions. However, unlike 6th Street, 9th Street has diagonal parking on both the east and west sides of the street for a total of two blocks on each side. Alternative 4 recommends switching all diagonal parking block faces to the west side of 9th Street, allowing for continuous unobstructed bike lanes. Figure 39 shows the typical roadway configuration for angled Sunday parking on 9th Street under Alternative 4.

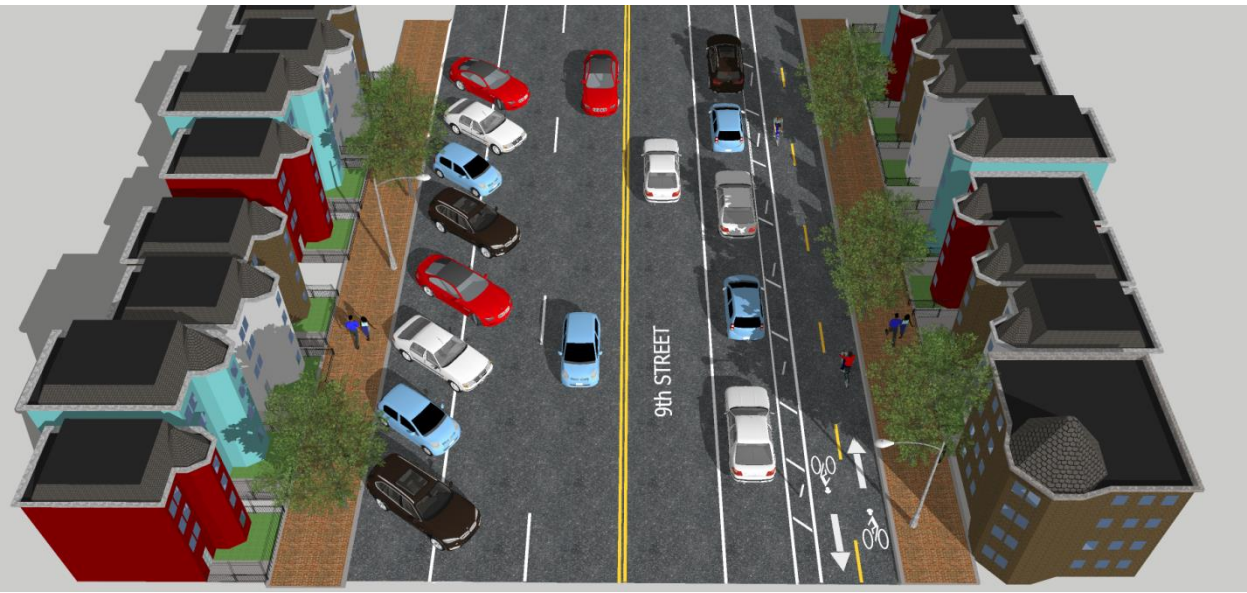

Figure 39: Proposed Diagonal Parking on 9th Street under Alternative 4

As shown in Table 14, Alternative 4 retains all 76 extra spaces that diagonal parking provides[9], and all parallel parking spots are retained.

Table 14: Change in Available Diagonal Parking on 9th Street and for Alternative 4

Street and Block	Available curb space (linear ft)	Existing Conditions		Alternative 4 condititions	
		Parallel spaces	Sunday angled spaces	Parallel spaces	Sunday angled spaces
9th, S to R, east side	360	16	35	16	35
9th, R to Q, west side	280	12	27	12	27
9th, Q to P, west side	400	18	39	**18**	39
9th, O to N, east side	400	18	39	18	39
9th Total	**-**	**64**	**140**	**64**	**140**
			+76 spaces		+76 spaces

5.3 Loading and Special Events

The effect of each alternative on events – particularly loading and deliveries – varies. On 9th Street and 6th Street, there are dedicated loading areas for the Convention Center and the Verizon Center, respectively. Additionally, there are delivery zones, hotel laybys, taxi stands, and a school drop zone in the study area. Changes to loading and special events for each alternative include:

[9] The church at O Street and 9th Street has relocated; accordingly, the diagonal parking on the block face from O to N streets adjacent to that church will no longer be needed.

- Alternative 0:
  - No effect on loading or special events
- Alternative 1:
  - 5th Street:
    - School drop-off loading is located at 5th & P Street; however, the bike lanes are unprotected and currently exist at this location, so no changes are expected
    - Effects on church loading include Saint Mary Mother of God at 5th and H Street.
  - 6th Street:
    - A 40' west-side loading zone is located just south of H Street. This loading zone would have to be relocated or removed.
    - The Verizon Center utilizes west outside travel lane along 6th Street for Metropolitan Police Department (MPD) staging during national events.
    - Effects on church loading include:
      - First Rising Mt Zion Baptist, 6th and N Street
      - United House of Prayer, 6th and M Street
      - Galbraith African Methodist Episcopal Zion Church, 6th and L Street
      - Sixth & I Historic Synagogue, 6th and I Street
    - 170-foot layby on the west side between E and F Streets. Bike lane will have to be unprotected.
- Alternative 2:
  - 6th Street:
    - A 40' west-side loading zone is located just south of H St. This Loading zone would have to be relocated or eliminated.
    - One 170' loading zone (layby) for the Verizon Center.
    - Verizon Center utilizes west outside travel lane for MPD staging during national events.
    - Effects on church loading:
      - First Rising Mt Zion Baptist, 6th and N Street
      - United House of Prayer, 6th and M Street
      - Galbraith African Methodist Episcopal Zion Church, 6th and L Street
      - Sixth & I Historic Synagogue, 6th and I Street
      - Springfield Baptist Church, 6th and P Street.
    - 50-foot eastside layby for Hampton Inn:
      - Northbound bike lane would have to be unprotected at this location or the layby would have to be removed.
    - 170-foot layby on west side between E and F Streets. Bike lane will have to be unprotected.
    - 190-foot almost-continuous driveway for parking garages and for the DC Fire Department (DCFD) on the west side between E and F Streets. Bike lane will have to be unprotected.

- Alternative 3:
  - 6th Street:
    - Effects on loading to Springfield Baptist Church at 6th and P Street.
    - 50-foot eastside layby for Hampton Inn.
      - Northbound bike lane would have to be unprotected at this location or the layby would have to be removed.
    - 190-foot near-continuous driveway for parking garages and the District of Columbia Fire Department on the west side between E and F Streets. Bike lanes will have to be unprotected for this segment of 6th Street.
- Alternative 4:
  - 9th Street:
    - One 50' loading zone on east side, south of H St., would shift away from the curb but could still remain.
    - One 25' loading zone on the west side would need to be removed or relocated.
    - Effects on loading to New Bethel Baptist Church at 9th and S Street.
    - Renaissance Hotel driveways, between K and I Streets, would require short unprotected bike facilities.
    - Sunday back-in angled parking for east-side block faces would switch to the west side.
    - Convention Center operations load along the east side of 9th between L Street and Massachusetts Ave[10].

5.4 Traffic and Travel Times

Due to lane reconfigurations and/or signal timing changes, each alternative alters traffic level of service (LOS) to varying degrees. The changes in *intersection* and *approach-level* LOS for Alternatives 1 through 4 are shown in Table 15, Table 16, Table 17, and Table 18, respectively[11]. Intersections or approaches with failing LOS[12] resulting from the proposed alternatives are listed below:

- Alternative 1
  - Overall failing *intersection* LOS
    - The intersection of L Street and 5th
    - The intersection of New York Ave and 5th
  - Failing *approach* LOS
    - The westbound approach of L Street and 5th

[10] 70 days in 2016 and 95 days in 2017 are projected to use some portion of the 1100-1100 blocks of 9th Street NW for shuttles. About 20 Priority 1 events are scheduled for the next three years, with an average convention visit of about 10 days, including freight and shuttle support.

[11] LOS was determined using validated traffic counts for the CBD and Synchro™ traffic software with imbedded Highway Capacity Manual methodology.

[12] Intersections or approaches that are considered failing were ones that degraded to an LOS F, due to a proposed alternative's changes in lane-use and/or signal timing/phasing.

        - The northbound approach of L Street and 5th
        - The eastbound approach of New York Ave and 5th
        - The westbound approach of Massachusetts Ave and 5th
        - The northbound approach of Eye Street and 5th
- Alternative 2
    - Overall failing *intersection* LOS
        - None
    - Failing *approach* LOS
        - The westbound approach of New York Ave and 5th
- Alternative 3
    - Overall failing *intersection* LOS
        - None
    - Failing *approach* LOS
        - The eastbound approach of O street and 6th
        - The westbound approach of G Street and 6th
        - The eastbound approach of D Street and 6th
- Alternative 4
    - Overall failing *intersection* LOS
        - None
    - Failing *approach* LOS
        - The eastbound approach of Q Street and 9th

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Table 15: Comparison of Existing LOS and Alternative 1 LOS

5th Street Existing Conditions (Alt 0) / Alt 1

5th Street Intersections	Approach	Level of Service AM	Level of Service PM	Alt 1 Level of Service AM	Alt 1 Level of Service PM
5th Street & L Street (N)	**Overall**	**A**	**A**	**A**	**A**
	Westbound	B	B	B	B
	Northbound	A	A	A	A
5th Street & New York Avenue	**Overall**	**C**	**D**	**C**	**F**
	Eastbound	D	E	C	F
	Westbound	C	C	C	C
	Northbound	A	A	A	A
5th Street & L Street (S)	**Overall**	**B**	**D**	**E**	**F**
	Westbound	D	F	F	F
	Northbound	C	D	E	F
	Southbound	A	A	A	A
5th Street & K Street	**Overall**	**B**	**C**	**C**	**C**
	Eastbound	C	C	C	D
	Westbound	B	C	B	C
	Northbound	B	B	B	B
	Southbound	B	B	C	C
5th Street & I Street (N)	**Overall**	**C**	**B**	**C**	**B**
	Westbound	D	D	D	D
	Northbound	A	A	A	A
	Southbound	D	C	D	C
5th Street & Massachusetts Avenue	**Overall**	**C**	**C**	**C**	**D**
	Eastbound	C	B	D	B
	Westbound	D	E	C	F
	Northbound	A	A	A	B
	Southbound	A	A	A	A
5th Street & I Street (S)	**Overall**	**E**	**C**	**B**	**D**
	Eastbound	F	D	D	D
	Northbound	E	D	C	F
	Southbound	A	A	A	A
5th Street & H Street	**Overall**	**C**	**B**	**C**	**B**
	Eastbound	A	B	A	B
	Westbound	B	C	B	C
	Northbound	D	B	D	B
	Southbound	D	B	D	B
5th Street & G Street	**Overall**	**C**	**B**	**C**	**B**
	Eastbound	D	C	D	C
	Westbound	C	B	C	B
	Northbound	B	B	B	B
	Southbound	C	B	C	B
5th Street & F Street	**Overall**	**A**	**A**	**A**	**B**
	Eastbound	A	A	A	B
	Westbound	A	A	A	B
	Northbound	A	A	A	B
	Southbound	A	A	A	B
5th Street & E Street	**Overall**	**B**	**B**	**B**	**B**
	Eastbound	B	A	B	A
	Westbound	B	B	B	B
	Northbound	D	C	D	C
	Southbound	C	C	C	C
5th Street & D Street & Indiana Avenue	**Overall**	**C**	**C**	**C**	**C**
	Westbound	B	B	B	B
	Northbound	E	B	E	C
	Southbound	C	D	D	D

6th Street Existing Conditions (Alt 0) / Alt 1

6th Street Intersections	Approach	Level of Service AM	Level of Service PM	Alt 1 Level of Service AM	Alt 1 Level of Service PM
6th Street & Florida Avenue	**Overall**	**B**	**C**	**B**	**C**
	Eastbound	B	C	B	C
	Westbound	B	B	B	B
	Northbound	A	D	A	D
6th Street & S Street	**Overall**	**B**	**B**	**B**	**B**
	Eastbound	B	C	B	C
	Westbound	C	C	C	C
	Northbound	A	B	A	A
	Southbound	B	B	B	C
6th Street & Rhode Island Avenue	**Overall**	**C**	**B**	**C**	**C**
	Eastbound	D	A	D	C
	Westbound	C	C	C	C
	Northbound	A	A	A	A
	Southbound	D	D	D	D
6th Street & R Street	**Overall**	**B**	**C**	**B**	**D**
	Westbound	B	B	B	B
	Northbound	C	D	C	E
	Southbound	A	A	A	A
6th Street & Q Street	**Overall**	**B**	**A**	**B**	**A**
	Eastbound	F	A	F	A
	Northbound	B	B	B	B
	Southbound	A	A	A	A
6th Street & P Street	**Overall**	**A**	**B**	**A**	**B**
	Eastbound	B	C	B	C
	Westbound	C	C	C	C
	Northbound	A	A	A	A
	Southbound	A	A	A	B
6th Street & O Street	**Overall**	**A**	**B**	**A**	**B**
	Eastbound	C	E	C	E
	Westbound	C	C	C	C
	Northbound	A	A	A	A
	Southbound	A	A	A	A
6th Street & N Street	**Overall**	**B**	**A**	**B**	**A**
	Eastbound	C	C	C	C
	Westbound	C	D	C	D
	Northbound	C	A	B	A
	Southbound	A	A	A	A
6th Street & M Street	**Overall**	**A**	**A**	**A**	**A**
	Eastbound	B	C	B	C
	Westbound	C	C	C	C
	Northbound	A	A	A	A
	Southbound	A	A	A	A
6th Street & L Street	**Overall**	**B**	**B**	**B**	**B**
	Eastbound	A	F	B	F
	Westbound	B	B	B	B
	Northbound	A	A	A	A
	Southbound	B	C	B	C
6th Street & New York Avenue	**Overall**	**B**	**B**	**B**	**B**
	Eastbound	A	A	A	A
	Westbound	B	B	A	A
	Northbound	B	B	C	B
	Southbound	B	B	A	B
6th Street & K Street	**Overall**	**A**	**A**	**B**	**B**
	Eastbound	C	D	C	D
	Westbound	C	C	C	C
	Northbound	A	A	A	A
	Southbound	A	A	A	A
6th Street & Massachusetts Avenue	**Overall**	**B**	**C**	**C**	**C**
	Eastbound	B	C	B	C
	Westbound	A	B	A	B
	Northbound	B	C	B	B
	Southbound	C	D	E	D
6th Street & I Street	**Overall**	**A**	**B**	**A**	**B**
	Eastbound	B	D	B	D
	Westbound	C	C	C	C
	Northbound	A	B	A	B
	Southbound	A	A	A	A
6th Street & H Street	**Overall**	**A**	**B**	**B**	**B**
	Eastbound	A	B	A	B
	Westbound	B	B	B	B
	Northbound	B	A	B	A
	Southbound	A	C	A	C
6th Street & G Street	**Overall**	**A**	**A**	**A**	**A**
	Eastbound	D	D	D	D
	Westbound	B	B	B	B
	Northbound	A	A	A	A
	Southbound	A	A	A	A
6th Street & F Street	**Overall**	**A**	**A**	**A**	**B**
	Eastbound	C	C	C	D
	Westbound	C	C	C	C
	Northbound	A	A	A	A
	Southbound	B	A	B	B
6th Street & Rescue Squad (Half Signal)	**Overall**	-	-	**A**	**A**
	Northbound	-	-	A	A
	Southbound	-	-	A	A
6th Street & E Street	**Overall**	**C**	**C**	**C**	**C**
	Eastbound	C	B	C	B
	Westbound	C	B	C	B
	Northbound	C	D	C	D
	Southbound	A	B	A	C
6th Street & D Street	**Overall**	**B**	**C**	**B**	**C**
	Eastbound	D	F	D	F
	Westbound	D	D	D	D
	Northbound	A	A	A	A
	Southbound	C	C	C	B
6th Street & Indiana Avenue	**Overall**	**B**	**A**	**B**	**A**
	Eastbound	D	C	D	C
	Northbound	B	B	B	B
	Southbound	A	A	A	A
6th Street & C Street	**Overall**	**C**	**B**	**A**	**B**
	Westbound	D	C	D	C
	Northbound	A	B	A	B
	Southbound	A	A	A	A
6th Street & Pennsylvania Avenue	**Overall**	**B**	**C**	**B**	**C**
	Eastbound	B	E	B	E
	Westbound	B	B	C	B
	Northbound	B	A	A	A
	Southbound	D	D	A	B
6th Street & Constitution Avenue	**Overall**	**A**	**C**	**A**	**C**
	Eastbound	B	A	A	A
	Westbound	A	E	B	E
	Southbound	A	A	B	B

Table 16: Comparison of Existing LOS with Alternative 2 LOS

6th Street Existing Conditions (Alt 0)				Alt 2	
6th Street Intersections	Approach	Level of Service		Level of Service	
		AM	PM	AM	PM
6th Street & Florida Avenue	**Overall**	**B**	**C**	**B**	**C**
	Eastbound	B	C	A	C
	Westbound	B	B	B	B
	Northbound	A	D	B	B
6th Street & S Street	**Overall**	**B**	**B**	**B**	**B**
	Eastbound	B	C	B	C
	Westbound	C	C	B	C
	Northbound	A	B	A	A
	Southbound	B	B	C	B
6th Street & Rhode Island Avenue	**Overall**	**C**	**B**	**C**	**C**
	Eastbound	D	A	D	C
	Westbound	C	C	C	D
	Northbound	A	A	A	A
	Southbound	D	D	D	C
6th Street & R Street	**Overall**	**B**	**C**	**C**	**D**
	Westbound	B	B	B	C
	Northbound	C	D	D	E
	Southbound	A	A	A	A
6th Street & Q Street	**Overall**	**B**	**A**	**C**	**B**
	Eastbound	F	A	F	B
	Northbound	B	B	B	B
	Southbound	A	A	A	B
6th Street & P Street	**Overall**	**A**	**B**	**B**	**C**
	Eastbound	B	C	D	E
	Westbound	C	C	D	D
	Northbound	A	A	A	B
	Southbound	A	A	A	A
6th Street & O Street	**Overall**	**A**	**B**	**B**	**B**
	Eastbound	C	E	E	E
	Westbound	C	C	D	D
	Northbound	A	A	A	A
	Southbound	A	A	A	A
6th Street & N Street	**Overall**	**B**	**A**	**B**	**B**
	Eastbound	C	C	E	E
	Westbound	C	D	D	D
	Northbound	C	A	A	A
	Southbound	A	A	A	A
6th Street & M Street	**Overall**	**A**	**A**	**D**	**C**
	Eastbound	B	C	D	C
	Westbound	C	C	D	C
	Northbound	A	A	D	C
	Southbound	A	A	D	C
6th Street & L Street	**Overall**	**B**	**B**	**C**	**B**
	Eastbound	A	F	A	E
	Westbound	B	B	C	C
	Northbound	A	A	A	A
	Southbound	B	C	C	B
6th Street & New York Avenue	**Overall**	**B**	**B**	**E**	**D**
	Eastbound	A	A	D	E
	Westbound	B	B	F	F
	Northbound	B	B	A	C
	Southbound	B	B	A	B
6th Street & K Street	**Overall**	**A**	**A**	**B**	**B**
	Eastbound	C	D	C	D
	Westbound	C	C	B	C
	Northbound	A	A	B	B
	Southbound	A	A	B	B
6th Street & Massachusetts Avenue	**Overall**	**B**	**C**	**B**	**C**
	Eastbound	B	C	C	C
	Westbound	A	B	A	A
	Northbound	B	C	A	D
	Southbound	C	D	C	C
6th Street & I Street	**Overall**	**A**	**B**	**A**	**C**
	Eastbound	B	D	B	C
	Westbound	C	C	C	C
	Northbound	A	B	A	A
	Southbound	A	A	A	A
6th Street & H Street	**Overall**	**A**	**B**	**B**	**B**
	Eastbound	A	B	A	B
	Westbound	B	B	B	B
	Northbound	B	A	B	A
	Southbound	A	C	B	C
6th Street & G Street	**Overall**	**A**	**A**	**A**	**B**
	Eastbound	D	D	D	D
	Westbound	B	B	B	B
	Northbound	A	A	A	B
	Southbound	A	A	A	A
6th Street & F Street	**Overall**	**A**	**A**	**A**	**A**
	Eastbound	C	C	C	C
	Westbound	C	C	C	C
	Northbound	A	A	A	A
	Southbound	B	A	A	A
6th Street & Rescue Squad (Half Signal)	**Overall**	-	-	**A**	**A**
	Northbound	-	-	A	B
	Southbound	-	-	A	A
6th Street & E Street	**Overall**	**C**	**C**	**C**	**C**
	Eastbound	C	B	C	B
	Westbound	C	B	C	C
	Northbound	C	D	C	C
	Southbound	A	B	A	B
6th Street & D Street	**Overall**	**B**	**C**	**B**	**C**
	Eastbound	D	F	D	F
	Westbound	D	D	D	D
	Northbound	A	A	A	A
	Southbound	C	C	D	C
6th Street & Indiana Avenue	**Overall**	**B**	**A**	**B**	**B**
	Eastbound	D	C	D	C
	Northbound	B	B	B	B
	Southbound	A	A	A	A
6th Street & C Street	**Overall**	**C**	**B**	**A**	**B**
	Westbound	D	C	C	C
	Northbound	A	B	A	B
	Southbound	A	A	A	A
6th Street & Pennsylvania Avenue	**Overall**	**B**	**C**	**B**	**C**
	Eastbound	B	E	B	D
	Westbound	B	B	C	A
	Northbound	B	A	A	A
	Southbound	D	D	A	B
6th Street & Constitution Avenue	**Overall**	**A**	**C**	**A**	**C**
	Eastbound	B	A	B	A
	Westbound	A	E	B	D
	Southbound	A	A	A	B

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Table 17: Comparison of Existing LOS with Alternative 3 LOS

6th Street Existing Conditions (Alt 0)				Alt 3	
6th Street Intersections	Approach	Level of Service		Level of Service	
		AM	PM	AM	PM
6th Street & Florida Avenue	**Overall**	**B**	**C**	**B**	**C**
	Eastbound	B	C	B	C
	Westbound	B	B	B	B
	Northbound	A	D	A	D
6th Street & S Street	**Overall**	**B**	**B**	**B**	**B**
	Eastbound	B	C	B	C
	Westbound	C	C	C	C
	Northbound	A	B	A	A
	Southbound	B	B	A	C
6th Street & Rhode Island Avenue	**Overall**	**C**	**B**	**C**	**C**
	Eastbound	D	A	B	B
	Westbound	C	C	D	D
	Northbound	A	A	B	C
	Southbound	D	D	D	C
6th Street & R Street	**Overall**	**B**	**C**	**B**	**B**
	Westbound	B	B	B	C
	Northbound	C	D	A	C
	Southbound	A	A	A	A
6th Street & Q Street	**Overall**	**B**	**A**	**C**	**A**
	Eastbound	F	A	E	B
	Northbound	B	B	A	A
	Southbound	A	A	B	A
6th Street & P Street	**Overall**	**A**	**B**	**C**	**C**
	Eastbound	B	C	D	D
	Westbound	C	C	D	D
	Northbound	A	A	B	B
	Southbound	A	A	C	A
6th Street & O Street	**Overall**	**A**	**B**	**B**	**B**
	Eastbound	C	E	D	F
	Westbound	C	C	D	D
	Northbound	A	A	B	B
	Southbound	A	A	A	A
6th Street & N Street	**Overall**	**B**	**A**	**B**	**C**
	Eastbound	C	C	D	E
	Westbound	C	D	D	D
	Northbound	C	A	A	B
	Southbound	A	A	A	B
6th Street & M Street	**Overall**	**A**	**A**	**C**	**C**
	Eastbound	B	C	C	C
	Westbound	C	C	C	C
	Northbound	A	A	B	B
	Southbound	A	A	B	C
6th Street & L Street	**Overall**	**B**	**B**	**C**	**B**
	Eastbound	A	F	C	C
	Westbound	B	B	D	D
	Northbound	A	A	A	A
	Southbound	B	C	C	B
6th Street & New York Avenue	**Overall**	**B**	**B**	**D**	**C**
	Eastbound	A	A	B	B
	Westbound	B	B	E	E
	Northbound	B	B	C	C
	Southbound	B	B	C	C
6th Street & K Street	**Overall**	**A**	**A**	**B**	**B**
	Eastbound	C	D	C	C
	Westbound	C	C	D	D
	Northbound	A	A	B	B
	Southbound	A	A	A	A
6th Street & Massachusetts Avenue	**Overall**	**B**	**C**	**C**	**C**
	Eastbound	B	C	B	B
	Westbound	A	B	C	D
	Northbound	B	C	B	B
	Southbound	C	D	C	C
6th Street & I Street	**Overall**	**A**	**B**	**B**	**C**
	Eastbound	B	D	C	D
	Westbound	C	C	D	C
	Northbound	A	B	C	C
	Southbound	A	A	B	B
6th Street & H Street	**Overall**	**A**	**B**	**C**	**B**
	Eastbound	A	B	D	C
	Westbound	B	B	D	C
	Northbound	B	A	B	A
	Southbound	A	C	B	C
6th Street & G Street	**Overall**	**A**	**A**	**B**	**C**
	Eastbound	D	D	D	D
	Westbound	B	B	C	F
	Northbound	A	A	B	C
	Southbound	A	A	B	A
6th Street & F Street	**Overall**	**A**	**A**	**A**	**C**
	Eastbound	C	C	C	D
	Westbound	C	C	C	C
	Northbound	A	A	A	C
	Southbound	B	A	A	C
6th Street & Rescue Squad (Half Signal)	**Overall**	**-**	**-**	**A**	**A**
	Northbound	-	-	B	A
	Southbound	-	-	A	A
6th Street & E Street	**Overall**	**C**	**C**	**C**	**D**
	Eastbound	C	B	C	C
	Westbound	C	B	C	D
	Northbound	C	D	C	C
	Southbound	A	B	B	D
6th Street & D Street	**Overall**	**B**	**C**	**B**	**C**
	Eastbound	D	F	D	F
	Westbound	D	D	D	D
	Northbound	A	A	A	A
	Southbound	C	C	D	C
6th Street & Indiana Avenue	**Overall**	**B**	**A**	**B**	**A**
	Eastbound	D	C	D	C
	Northbound	B	B	B	B
	Southbound	A	A	A	A
6th Street & C Street	**Overall**	**C**	**B**	**B**	**B**
	Westbound	D	C	C	D
	Northbound	A	B	A	A
	Southbound	A	A	A	A
6th Street & Pennsylvania Avenue	**Overall**	**B**	**C**	**C**	**C**
	Eastbound	B	E	A	D
	Westbound	B	B	D	A
	Northbound	B	A	B	A
	Southbound	D	D	B	C
6th Street & Constitution Avenue	**Overall**	**A**	**C**	**B**	**C**
	Eastbound	B	A	A	B
	Westbound	A	E	B	E
	Southbound	A	A	B	B

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Table 18: Comparison of Existing LOS with Alternative 4 LOS

9th Street Intersections	Approach	9th Street Existing Conditions (Alt 0) Level of Service		Revised Alt 4 Level of Service	
		AM	PM	AM	PM
9th Street & Florida Avenue	**Overall**	**B**	**B**	**B**	**C**
	Eastbound	B	B	B	B
	Westbound	A	B	A	B
	Northbound	C	C	B	C
	Southbound	B	B	C	C
9th Street & T Street	**Overall**	**A**	**B**	**B**	**B**
	Eastbound	D	D	D	D
	Northbound	A	B	C	C
	Southbound	A	A	A	A
9th Street & S Street	**Overall**	**B**	**B**	**B**	**B**
	Eastbound	C	D	C	D
	Westbound	D	D	D	D
	Northbound	A	B	A	A
	Southbound	A	A	A	A
9th Street & R Street	**Overall**	**A**	**B**	**A**	**B**
	Westbound	B	C	C	D
	Northbound	A	A	A	A
	Southbound	A	B	A	A
9th Street & Rhode Island Avenue	**Overall**	**B**	**C**	**C**	**C**
	Eastbound	E	C	E	C
	Westbound	A	C	B	C
	Northbound	B	B	B	C
	Southbound	B	B	B	D
9th Street & Q Street	**Overall**	**A**	**B**	**B**	**B**
	Eastbound	C	C	E	C
	Northbound	A	B	B	B
	Southbound	A	A	A	A
9th Street & P Street	**Overall**	**A**	**A**	**C**	**B**
	Eastbound	B	A	C	C
	Westbound	B	C	E	C
	Northbound	A	A	A	B
	Southbound	A	A	B	B
9th Street & O Street	**Overall**	**A**	**A**	**C**	**C**
	Eastbound	C	C	C	C
	Westbound	A	C	D	D
	Northbound	A	A	C	C
	Southbound	A	A	B	B
9th Street & N Street	**Overall**	**A**	**B**	**C**	**C**
	Eastbound	C	C	D	C
	Westbound	C	C	D	D
	Northbound	A	B	B	C
	Southbound	A	A	B	B
9th Street & M Street	**Overall**	**B**	**B**	**B**	**B**
	Eastbound	C	C	C	C
	Westbound	C	C	C	D
	Northbound	B	B	C	C
	Southbound	A	A	A	A
9th Street & L Street	**Overall**	**B**	**B**	**B**	**B**
	Westbound	B	C	B	D
	Northbound	C	A	D	A
	Southbound	A	A	B	A
9th Street & Massachusetts Avenue & Mount Vernon Place	**Overall**	**C**	**C**	**C**	**C**
	Eastbound	D	D	D	D
	Westbound	A	A	A	A
	Southbound	D	D	C	D
9th Street & New York Avenue / K Street	**Overall**	**D**	**D**	C	**C**
	Eastbound	D	D	D	C
	Westbound	B	F	B	C
	Southbound	F	D	B	B
9th Street & I Street	**Overall**	**B**	**B**	**B**	**B**
	Eastbound	C	A	C	D
	Westbound	C	D	C	A
	Southbound	B	A	B	D
9th Street & H Street	**Overall**	**C**	**D**	**C**	**D**
	Eastbound	C	D	C	A
	Westbound	D	C	D	D
	Southbound	B	D	C	A
9th Street & G Street	**Overall**	**B**	**C**	**B**	**C**
	Eastbound	C	C	C	C
	Westbound	E	E	E	E
	Southbound	A	B	A	B
9th Street & F Street	**Overall**	**A**	**B**	**B**	**B**
	Eastbound	B	C	B	B
	Westbound	C	C	C	C
	Southbound	A	A	A	A
9th Street & E Street	**Overall**	**A**	**B**	**A**	**B**
	Eastbound	B	B	B	B
	Westbound	B	D	B	D
	Southbound	A	B	A	A
9th Street & D Street	**Overall**	**A**	**A**	**A**	**B**
	Westbound	C	C	C	C
	Southbound	A	A	A	A
9th Street & Pennsylvania Avenue	**Overall**	**B**	**D**	**B**	**D**
	Eastbound	B	D	B	D
	Westbound	A	A	A	A
	Northbound	C	B	C	B
	Southbound	B	D	B	D
9th Street & Constitution Avenue	**Overall**	**B**	**C**	**B**	**C**
	Eastbound	C	C	C	C
	Westbound	B	B	B	A
	Southbound	B	C	B	C

In addition to LOS, changes in travel times[13] were evaluated under the proposed alternatives. Figure 40, Figure 41, and Figure 42 show how northbound and southbound peak hour travel times would change on each street based on the proposed alternatives[14].

Changes to lane configurations, signal timing, and parking for each alternative resulted in new corridor-wide travel times, as highlighted below:

- 5th Street (Alternative 1)
  - AM and PM peak hour travel times were generally the same and actually decreased a little because of proposed adjustments to the north-south green signal length.
  - Because of the high volume of northbound PM traffic, adjustments to signal timing had limited effect (without drastically altering the traffic on larger east-west routes, such as New York Ave and Massachusetts Ave). However, the slight timing changes to attempt to improve north-south traffic had a much bigger effect on *improving* southbound 5th Street traffic (as shown in Figure 40); this is due to the much lower peak hour traffic volumes in the southbound direction.
- 6th Street (Alternative 1)
  - AM and PM peak hour travel times were similar to existing conditions, due to slight changes in signal timing.
  - Southbound travel time was improved, largely due to the proposed relocation of southbound left turns from 6th and Pennsylvania Ave to 6th and Constitution.
- 6th Street (Alternative 2)
  - AM and PM peak hour travel times in both northbound and southbound directions were similar to existing conditions, due to modest changes in signal timing.
- 6th Street (Alternative 3)
  - AM and PM peak hour travel times in both northbound and southbound directions were similar to existing conditions, due to modest changes in signal timing.
  - Southbound travel time was improved, largely due to the relocation of southbound left turns from 6th and Pennsylvania Ave to 6th and Constitution.
- 9th Street (Alternative 4)
  - The northbound portion of 9th Street (from Massachusetts Ave to Florida Ave) had only modest changes in travel time (approximately 1 min increase in travel time for the mile-long northbound portion of the corridor).
  - Southbound travel time (from Florida Ave to Pennsylvania) had only slight changes in travel time over the 1.6 mile long corridor, with AM peak hour travel time decreases by about a minute, and PM peak hour travel time increasing by less than a minute.

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[13] Existing travel times were developed in a Synchro/SimTraffic model, where existing modeled travel times were validated with Inrix™ vehicle probe data (average of midweek travel runs in April 2016).

[14] The travel times for 6th and 9th are from Florida Ave to Constitution Ave. For 5th Street, the travel time is for vehicles traveling from D Street to New York Ave only because the remainder of 5th Street is not proposed to change.

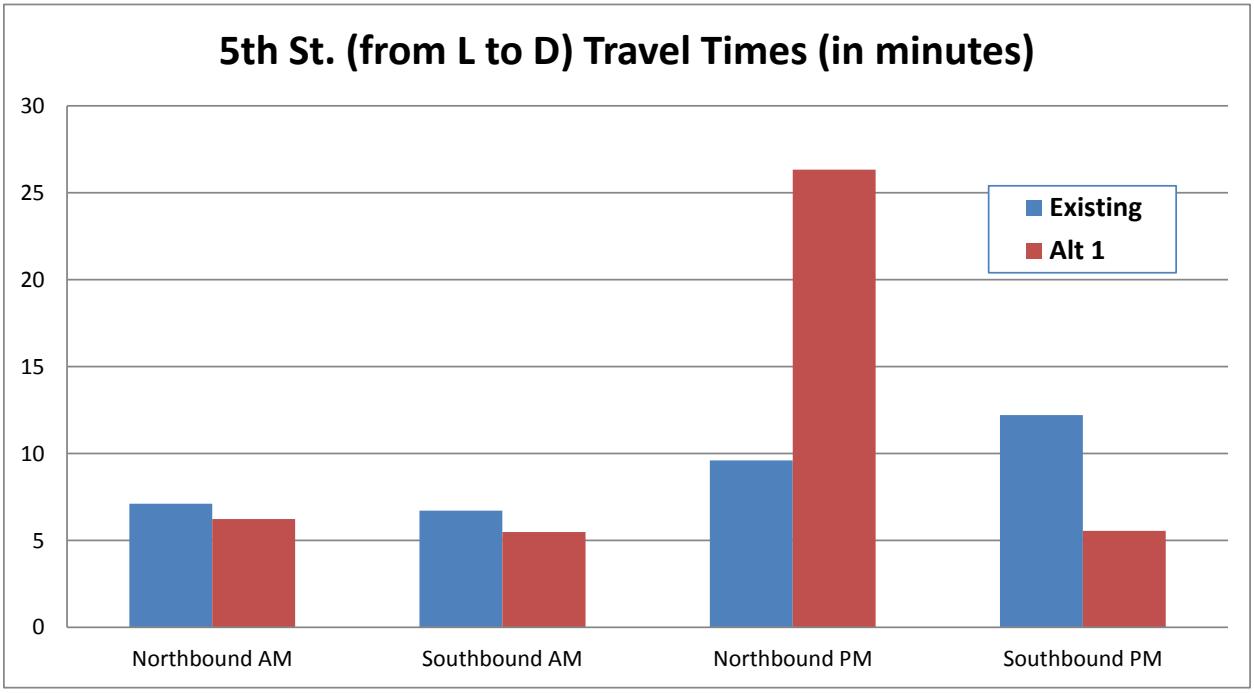

Figure 40: Travel Time Comparison on 5th St. between Existing Conditions and Alternative 1

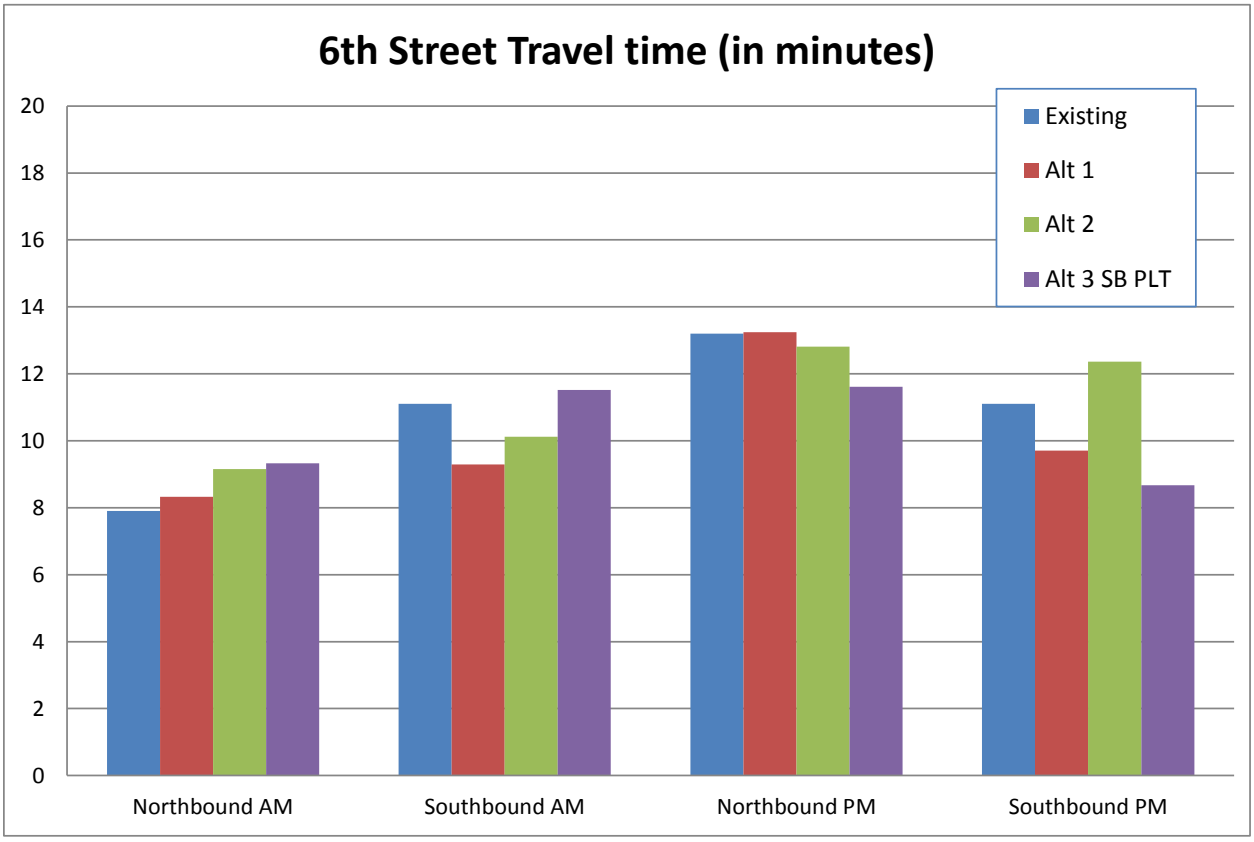

Figure 41: Travel Time Comparison on 6th St. between Existing Conditions and Alternatives 1, 2 and 3

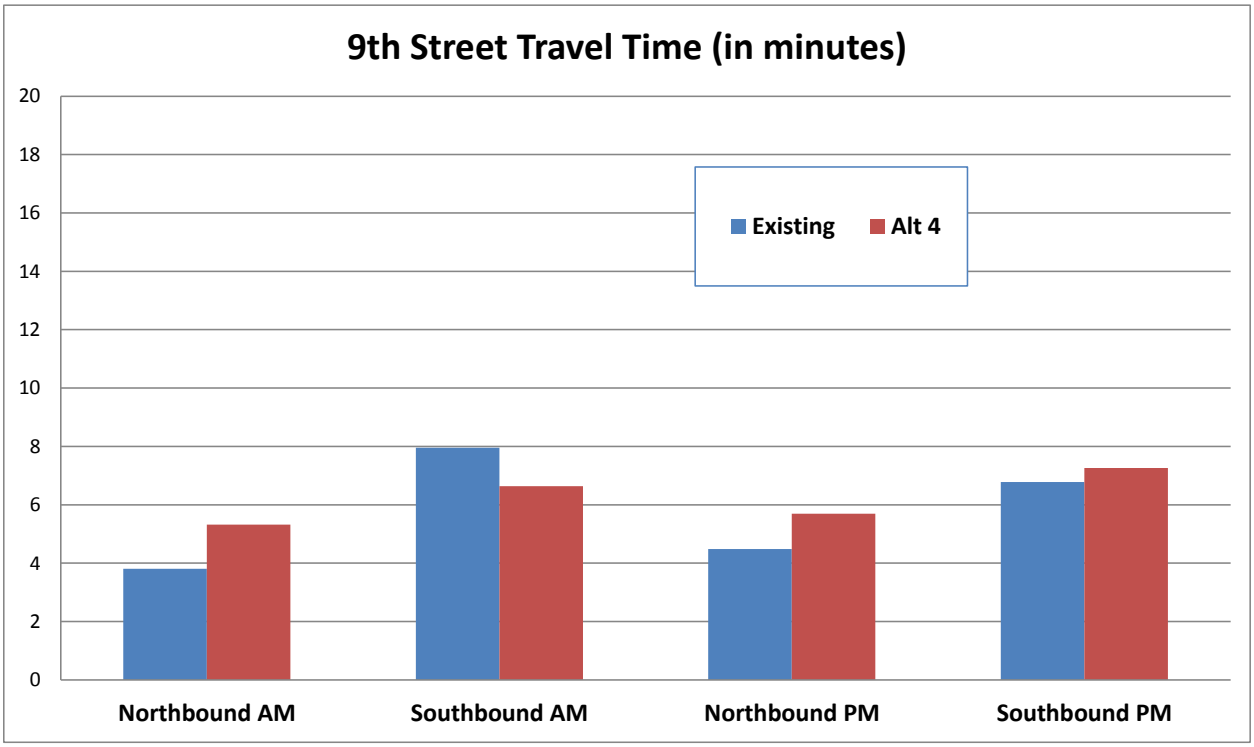

Figure 42: Travel Time Comparison on 9th St between Existing Conditions and Alternative 4

5.5 Bus Loading and Scheduling

Because bus loading occurs curbside, where protected bike lanes are typically located, preliminary alternatives were partially selected based on whether their location would interfere with bus stops. The effects on bus stops from each preliminary alternative are listed below:

- Alternative 1
  - No bus stops on 6th Street, though a few blocks see less than 10 buses per hour.
  - Two northbound and two southbound bus stops on 5th Street.
    - Buses run on a few blocks of 5th Street, though these blocks see less than 10 buses per hour. Buses would be required to turn across the bike lane.
    - Ridership at these four stops is generally low (0-25 riders per peak hour).
- Alternative 2
  - No bus stops on 6th Street, though a few blocks see less than 10 buses per hour. Buses would be required to turn across the bike lane.
- Alternative 3:
  - No bus stops on 6th Street, though a few blocks see less than 10 buses per hour.
- Alternative 4
  - While 9th street has several stops with heavy boarding and alighting, no effect is expected, as all 9th Street buses run southbound - on the west side of the street.

Though few bus stops are affected by the proposed alternatives, the change in travel times can substantially affect scheduling and on-time performance, because the buses travel largely in mixed traffic, with few segments providing dedicated bus facilities. Effects on travel times are highlighted below:

- Alternative 1:
  - Increases to northbound travel times will substantially affects bus scheduling and on-time performance for the northbound bus stops, as northbound travel time increases significantly along 5th Street in the area where the stops are located.
  - Southbound 5th Street bus scheduling and on-time performance could improve, as reduced travel times are predicted for the area where the stops are located.
- Alternative 2
  - No effect to bus scheduling and performance is expected, because travel times are generally the same, and buses run only on a very short segment of 6th Street.
- Alternative 3
  - No effect to bus scheduling and performance is expected, because travel times are generally the same, and buses run only on a very short segment of 6th Street.
- Alternative 4
  - The minor changes in peak hour travel time are not expected to adversely affect scheduling and on-time performance at these stops.

5.6 Pedestrian Safety

None of the alternatives, in their current conceptual stage, reduce curb-to-curb crossing distance; intersection crossing distance and available pedestrian crossing time is expected to remain the same. However, all alternatives substitute a travel lane for a protected bike lane for some roadway segments, resulting in fewer vehicle travel lanes for pedestrians to cross. Additionally, since congestion will increase slightly in some of the preliminary alternatives, slower free flowing speeds are expected[15].

Also, Alternatives 2, 3, and 4 introduce protected-only turning movement phases for vehicles. At New York Ave, the right turn movement from northbound 6th Street to eastbound New York Ave is protected for Alternatives 2 and 3; while in alternative 3 only, the northbound 6th Street right turn onto eastbound Rhode Island Ave is also a protected-only movement. Alternative 4 provides protected-only southbound left turns at most intersections, and prohibits southbound left turns at others. While these phasing changes are proposed to remove vehicle-bike conflicts by separating each movement, they have the ancillary effect of also removing pedestrian and vehicle conflicts, as northbound cyclists and pedestrians would traverse through each intersection at the same time.

[15] Free-flowing speeds, in this case, are travel speeds that are not affected by the presence of approaching red light or by vehicles queued up at an approaching intersection.

5.7 Emergency Vehicle Access

Based on the AM and PM peak hour travel time differentials, only Alternatives 1 has the potential to affect emergency vehicle response time. 5th Street northbound response time will be negatively affected in the PM peak commuting hour.

5.8 Social/Community Effects

The study area crosses many neighborhoods with different characteristics and uses, including residential, commercial, park, mixed-use, and institutional (including government buildings, churches, and schools) areas.

Some churches along on 6th Street and 9th Street have stated their concern that the addition of a protected bicycle lane will negatively affect the ability of people to access services and other church functions. Currently, select segments of 6th Street and 9th Street allow parking diagonally, in order to allow more cars to park in front of churches. Alternatives 1 and 2 would remove about 28 diagonal back-in spaces; Alternative 3 would remove about 16 angled spaces; and Alternative 4 would remove zero spaces but relocate one of the four block faces to the opposite side of 9th Street. In addition to designated parking, some churches also use roadway space for loading and unloading cars and buses during large events, such as funerals or large gatherings. DDOT has worked with church leaders to minimize effects on parking, by allowing angled parking through the bike lane on Sundays in Alternatives 1 and 2. Each of the alternatives offers flexibility for large events, such as funerals, to manage parking and provide improved bike facilities. Alternatives 3 and 4 provide greater flexibility in this regard for churches on the west side of both streets.

From the mostly-residential northern end of the study area to the public/institutional southern end, there are many types of road users who travel to, from, and within the study area. DDOT surveys have shown that the majority of both people on bicycles and people driving prefer the separation between cyclists and motor vehicles provided by the protected facilities that have been installed on 15th Street NW and Pennsylvania Avenue NW. The addition of this protected corridor will have a positive effect on cyclists and drivers, as both may derive a greater sense of safety from the separation of modes. Pedestrians will also benefit, as there will likely be fewer people riding bicycles on the sidewalks.

5.9 Economic Effects

5.9.1 Parking

All of the alternatives affect some of the 1800 parking spaces within the study area. Each alternative removes both commercial and residential parking spaces to varying degrees.

While some residents and visitors may see any removal of parking as a negative economic effect, there are also clear positive economic benefits of re-purposing a small amount of parking spaces to provide protected bicycle facilities. Surveys of bicyclists that use existing protected bicycle facilities in DC have

shown that they visit business more often because of the availability of a protected bike facility. Other projects in cities from Portland to New York have seen similar positive effects.

5.9.2 Driving and Transit Commute Times

The alternatives vary widely in their effects to commute times (i.e., AM and PM peak travel times). While Alternatives 2, 3, and 4 would not have a significant change over existing commute times, Alternative 1 could lead to significant increases in commute times on Northbound 5th Street NW. While it is unlikely that a small change in commute time would have an economic effect, it is possible that a more extreme increase could influence commuting patterns, altering the times that people arrive and depart from their job, which could have negative economic consequences. Similarly, WMATA and commuter buses that run on Northbound 5th Street NW would see substantial changes in the scheduling and on-time performance.

5.10 Historic Preservation

As shown in Table 19 below, the study area includes portions of several historic districts, and contains several historic properties (as identified on the National Register). All three streets contained within the Alternatives (9th St NW, 6th St NW, and 5th St NW) are historic streets designated on the original L'Enfant plan for DC.

It is not anticipated that access to any historic sites or circulation within the historic districts would be impeded, and all design elements of the protected lanes (e.g., flexible posts, curbs, and paint) can be adjusted to meet the applicable District design guidelines, and to ensure that vertical elements do not interrupt views to historic sites. If warranted, the DC State Historic Preservation Office (SHPO) may review the final design for the protected lanes to ensure that there are no adverse effects on historic districts or properties.

Table 19: Historic Properties along the Study Corridors

Alternative	Corridor Passes Through These Historic Districts	Historic Properties and Landmarks Abutting the Corridor (National Register)
Alternative 1 (5th St NW and 6th St NW)	• Florida Avenue • Mt. Vernon Square • Mt. Vernon Triangle • Pennsylvania Avenue • Downtown • Constitution Avenue	• Third Baptist Church (1546 5th St NW) • Saint Mary's Catholic Church (725 5th St NW) • Moran Building (501-509 G St NW) • Pension Building (National Building Museum, 440 G St NW) • DC Court of Appeals (450 E St NW) • Oriental Building Association (600 F St NW) • The Myrene Apartments (703 6th St NW) • Bulletin Building (717 6th St NW)
Alternative 2 (6th St NW)	• Florida Avenue • Mt. Vernon Square • Pennsylvania Avenue • Downtown • Constitution Avenue	• Oriental Building Association (600 F St NW) • The Myrene Apartments (703 6th St NW) • Bulletin Building (717 6th St NW)
Alternative 3 (6th St NW)		
Alternative 4 (9th St NW)	• Greater U Street • Shaw • Blagden Alley/Naylor Court • Downtown • Pennsylvania Avenue • Federal Triangle • Constitution Avenue	• National Archives (700 Pennsylvania Ave NW) • LeDroit Block (800-10, 812, 814-16, & 818 F St. & 9th St, NW) • Washington Loan & Trust Company (900 F St NW) • Old Masonic Temple (909 F St NW) • National Portrait Gallery (600 7th St NW) • Martin Luther King Jr. Memorial Library (901 G St NW) • Victor Building Façade (724-726 9th St NW) • Carnegie Library (801 K St NW) • Mt. Vernon Place Church (900 Massachusetts Ave NW) • American Federation of Labor (901 Massachusetts Ave NW) • Carter G. Woodson House (1538 9th St NW) • Phyllis Wheatley YWCA (901 Rhode Island Ave NW)

5.11 Effects on Streetscape Aesthetics

While the final design for the corridor is yet to be determined, it is likely that it will include new flexible posts or raised curbs, new traffic signals (for Alternatives 3 and 4), new signs, and new lane re-striping and bicycle markings.

All elements will conform to standards contained in the Federal Highways Administration's Manual on Uniform Traffic Control Devices, as well as the DDOT Design and Engineering Manual. For example, the DDOT manual requires that all streets within the federal aid systems (i.e., collectors and arterials, which include 5th, 6th, and 9th Streets NW) will be constructed with granite curbs. The final design will also adhere to aesthetic requirements set forth by historic districts; granite curbs with brick gutters would be required for the historic districts within the study area.

As noted previously, any effects on aesthetics within historic districts can be mitigated through design adjustments. Any necessary adjustments will be determined in cooperation with SHPO during the final design process.

5.12 Construction Costs and Staging

5.12.1 Construction Costs

The planning-level estimate for construction costs vary for the alternatives (Table 20). While the final details and chosen materials have not been finalized, the cost estimates generally assumes the inclusion of the following items:

- New thermoplastic lines
- New bicycle markings
- New flexible posts[16] (every 20 feet)
- Eradication of existing pavement markings (resurfacing of entire project was not assumed)
- Signal retiming at all affected signals
- Design fee (i.e. final construction drawings) for final striping plan
- Design fee (i.e. final construction drawings) for modified/new signals
- New signal heads, poles, and hardware
- Parking meter removal, as needed

[16] For cost estimate only; protection could incorporate curbs instead, which would increase the nominal cost for each Alternative equivalently.

Table 20: Planning-level Costs for each Alternative

Alternative	Cost in $
Alternative 0 (no-build)	$0
Alternative 1	$360,000
Alternative 2	$350,000
Alternative 3	$760,000
Alternative 4	$940,000

The primary cost differential between Alternatives 1 & 2 and Alternatives 3 & 4 are due to the need for modified signal heads at each intersection, resulting in increased design and installation costs. Alternative 3 would need new signal heads at selection locations, while Alternative 4 would need new signal heads and poles at select locations.

5.12.2 Staging

Installation for each alternative generally consists of grinding down existing pavement markings, applying new thermoplastic lines, installing flexible posts and/or curbs or other barriers, applying new bicycle markings, retiming all affected signals, and installing new signal heads and hardware where needed (mainly in Alternatives 3 and 4). The estimated time for completion of each alternative is eight to sixteen weeks.

Construction for this type of project would occur on a lane-by-lane basis; entire blocks would not be shut down. For each lane being reconstructed, travel and/or parking would have to be diverted or removed. Construction would typically occur during off-peak hours, so as to minimize effects to traffic. Construction that affects residential parking areas would occur mid-day so as to minimize inconvenience during commuting hours. During construction, DDOT will post notifications to indicate which parking spaces will be removed (temporarily and permanently), and where people can find alternate parking locations.

If an alternative with an existing bike lane or designated route is chosen – i.e., Alternatives 1 and 4 – an alternative bicycle route will be designated during construction, as necessary. There will be little to no effect on pedestrian/sidewalk access.

Table 21 on the following page summarizes the transportation-related effects from each Build Alternative; critical effects that cannot be mitigated through design are shown bolded.

Table 21: Summary of Critical Effects for All Build Alternatives

Performance metric	Critical Effect on Traffic, Parking and Loading			
	Alt 1	Alt 2	Alt 3	Alt 4
Mainline Protection for cyclists	**Southbound bike lane is unprotected from Florida Ave to S Street and along the Verizon Center layby. Northbound bike lane is unprotected from L Street to Rhode Island Ave.**	**Southbound and Northbound bike lanes are unprotected from Florida Ave to S Street. Southbound bike lane is unprotected along the Verizon Center layby. Northbound bike Lane is unprotected along 6th Street Fire Department driveways and Hampton Inn layby.**	Southbound and Northbound bike lanes are unprotected from Florida Ave to S Street and along the 6th Street Fire Department driveways and Hampton Inn layby.	Cyclist protection provided with the exception of several small driveways.
Intersection turn movement protection for cyclists	**Several intersections have heavy left turn and right turn vehicle movements. Cannot be mitigated through protected turn movements without substantial impacts to traffic.**	**Several intersections have heavy left turn and right turn vehicle movements. Cannot be mitigated through protected turn movements without substantial impacts to traffic.**	Several intersections have heavy left turn and right turn vehicle movements. All lefts and one right-turn can be mitigated with protected-only turn phases with minimal effect on traffic.	Several intersections have heavy left turning traffic, all of which can be mitigated with protected turn movements without affecting traffic.
Angled Back-in Sunday Parking	**Church angled parking is in direct conflict for 4 contiguous blocks and would block bike lane**	**Church angled parking is in direct conflict for 4 contiguous blocks and would block bike lane**	Church angled parking is not in direct conflict. Traffic mitigation would require removing 16 diagonal back-in spaces	Church angled parking is in direct conflict for 1 non-continuous block and would block bike lane
Loss of Residential and RPP spaces	**114 full-time parking spaces (including 44 RPP spaces) become peak hour restricted. An additional 30 spaces removed.**	58 full-time parking spaces (including 13 RPP spaces) become peak hour restricted.	5 full-time parking spaces removed	Approximately 35-45 full-time parking spaces removed (including 7 RPP spaces) .
Church Loading	Direct conflict with loading for 5 churches.	Direct conflict with loading for 5 churches.	Direct conflict with loading for 1 church.	Direct conflict with loading for 1 church.
Commercial Loading and Events	Verizon Center utilizes west outside travel lane for Metropolitan Police Department staging during national events.	Verizon Center utilizes west outside travel lane for Metropolitan Police Department staging during national events.	n/a	Convention Center curbside loading operations; can be mitigated through management and relocation of services.
Bus Service	**Affects on-time performance and scheduling of northbound 5th Street peak hour bus service.**	n/a	n/a	Bus Service not affected
Traffic	**Unmitigatable traffic congestion at the intersection of 5th and New York Ave.**	Traffic impacts are mitigatable.	Traffic impacts are mitigatable. Requires 9' travel lanes.	Traffic impacts are mitigatable.
Loss of metered/ commercial spaces	**70 northbound metered spaces removed permanently**	none	4 commercial curbside spaces, that are restricted in the PM only are removed. 15 additional AM/PM peak hour restricted spaces will be removed. 72 spaces that currently allow parking between 9:30 AM and 4:00 PM, will be parking prohibited during this time; parking will be allowed after 6:30 PM. 40 peak-hour restricted spaces become full-time.	20 metered spaces converted from full-time to peak-hour restricted. 17 metered spaces are lost permanently. 8 taxi standing spaces are lost.
Emergency vehicle	Predicted traffic congestion could affect emergency vehicle travel time along 5th Street.	Emergency vehicle travel time not affected	Emergency vehicle travel time not affected	Emergency vehicle travel time not affected

6 Summary of Public Outreach and Engagement

Outreach and engagement for this project occurred via:

- Stakeholder meetings
- Project website
- Public meetings
- Information sent out to the public via an email list
- Comments and materials sent via email to DDOT

A summary of all meetings and comments is provided below.

6.1 Stakeholder Meetings

At the start of the project, DDOT identified key stakeholders to engage before the first public meeting in October 2015. Between June and September, DDOT met with churches, bicycling advocates, and large destinations within the study area, such as the convention center (Table 22). The purpose of these meetings was to introduce the project, obtain feedback on the preliminary alternatives, and (where applicable) get an understanding of operational issues, including parking and passenger and delivery loading and unloading.

Table 22: Summary of Stakeholder Meetings

Organization	Meeting Summary
DC Bicycle Advisory Council	At the BAC meeting, DDOT provided an overview of the project including the process, engagement, and information about the October public meeting.
EventsDC	DDOT met with EventsDC to get an understanding of the operations at the convention center. EventsDC staff stated that the bike lanes on 9th Street NW are problematic because of taxi, bus, and shuttle queuing; pedestrian traffic; and event staging. During events, there can be as many as 200 shuttles and buses queued on 9th Street NW.
First Rising Mt. Zion Baptist Church	Church leaders are concerned about availability of parking with the implementation of bike lanes. Currently, parking is a challenge with the restricted residential permit parking areas, and the church does not have off-street parking. However, there is a lot across the street that could potentially accommodate the church if there was an agreement. They are concerned about the alternatives that show bike lanes on the west side of 6th Street NW. They prefer to see bike lanes on 7th or 9th Streets.
Howard University	Howard University representatives were supportive of the concept of protected bike lanes, in general. They stated that protected bike lanes on 7th Street NW could connect the campus via the bus/bike lane project under construction. The university has new development projects targeted on the west side of campus along 9th Street NW and on the east side along 4th Street NW. An alternative on 6th or 9th Streets NW could connect the students to Downtown.
New Bethel Baptist Church	The church representatives stated that angled parking is not enough for their current operations. The lack of parking limits their church operations and programming. Passenger loading and unloading is in the driveway in front of 9th and S Streets NW. Deliveries are in the lot or the driveway. They are concerned about the bike lanes and their potential effect to funeral processions and other event parking.

Calvary Baptist Church	In a phone call with the church facilities manager, the church was generally supportive of bike lanes and stated that they will support whatever is best for the neighborhood.
Springfield Baptist Church	The church representatives expressed concerns about parking and access to the church. Currently, the church uses 6th Street NW for funerals and passenger loading and unloading. They would like to see angled parking extended on Sundays. They requested that future renderings show cars and parking, so they can have a better idea how the bike lanes fit within street.
Washington Area Bicyclist Association	WABA is supportive of protected bike lanes to increase safety for people biking and encourage more people to bike. Several people have been hit and seriously injured while biking along 6th Street NW. They believe this project is important to the Mayor's Vision Zero initiative, and that any of the build alternatives are necessary to advance these multimodal safety goals.
United House of Prayer	The church leadership provided an overview of church operations including special events that bring over 8,000 people, funerals, providing food at the café, and daily meetings and services at the church. A major concern is parking. The church needs parking for charter buses during special events and funerals, and angled parking on Sundays for church services. They would like to see angled parking extended to 9pm on Sundays. They use the west side of 6th Street NW for loading/unloading of deliveries and passengers, and bus staging, in addition to handicap accessibility. They expressed concern over the congestion that occurs when 7th Street NW is closed for special events at the convention center and after events at the Verizon Center. They do not wish to see bike lanes on 6th Street NW.

6.2 Project Website

DDOT launched the project website, www.DCcycletrack.com, in October 2015. The website provided background information about the study purpose and need, maps and data related to the analyses, information about the alternatives, meeting announcements and materials, and a comment form to send input. A summary of comments from the website form is in the "Summary of Comments" section below.

6.3 Public Meetings

DDOT held two public meetings to gain feedback from the public on the project purpose and need, as well as the alternatives.

6.3.1 Public Meeting #1: Thursday, October 22, 2015 (Watha T. Daniel/Shaw Neighborhood Library)

Approximately 270 people attended the first public meeting. The meeting attendees were parishioners from the large churches in the study area, residents, and bicycle advocates. DDOT intended to host an open-house style meeting; however, due to attendee actions, the meeting shifted to a larger question, answer, and comment session. DDOT provided written forms for people to submit comments. DDOT displayed informational boards that covered the general context of the study area, to explain why there is a need to study the possibility of protected bike lanes in eastern downtown DC. Other subject material included percentage of population that regularly commuted by bicycle, vehicle turn movements, bus

boardings and alightings, level of service for AM and PM peak periods, Capital Bikeshare usage, curbside parking inventory, and pedestrian crossing volumes.

6.3.2 Public Meeting #2: Saturday, February 6. 2016 (KIPP DC – Will Academy)

At the second meeting, DDOT provided more detailed data and in-depth analysis on the alternatives and the "No-Build" option. Approximately 350 people attended this meeting, along with members of the media. The meeting had informational boards lining the school's hallway leading to the auditorium space, which was used for the main meeting. The informational boards were explored during an open-house hour at the start of the meeting and expanded on material provided at the first meeting, with a particular focus on the results of traffic analysis. The format included a detailed presentation followed by time for moderated public comments. A panel of DDOT officials were present to take note of concerns and comments. DDOT gave neighborhood officials, organization leaders, and ANC representatives five minutes each to comment on behalf of their organizations. DDOT gave members of the general public two minutes each to provide their comments. In addition, DDOT provided written forms for people to submit comments. A summary of comments from each public meeting can be found in the "Summary of Comments" section below.

6.4 Summary of Comments

6.4.1 Email Comments Received Prior to Public Meeting 1 (10/1/2015-10/21/2015)

Prior to the first public meeting, DDOT received 143 comments via the website comment form. Of these, 119 comments expressed support for protected lanes, 18 comments expressed that they were not in support of the project (largely due to potential effects to church operations, including parking), and six comments did not express a preference. Of the comments in favor of the bike lanes, many said they would be fine with several of the alternatives that were presented on the website. For people that had a preference for one or more of the alternatives, there were 34 comments in support of Alternative 2, 24 supporting Alternative 3, 12 supporting Alternative 4, and four supporting Alternative 1.

6.4.2 Public Meeting #1 (10/22/2015)

The written comments from the meeting showed that 25 people supported bike lanes within the study area and 43 did not support bike lanes within the study area. Of the eight respondents that selected a preference, four respondents preferred Alternative 4, three respondents preferred Alternative 2, and one respondent preferred Alternative 3.

Major themes from the meeting comments include:

- Reconsider 7th Street NW as an Alternative
    - Better connections to the north (to Georgia Avenue NW) and south (to Southwest Waterfront).
    - Remove parking through Chinatown and prioritize buses and bikes
- Connect the bike network

    - 9th Street NW provides better connections to other bike networks to the north (11th Street and Sherman Avenue NW) and the south (going into SW)
- Incorporate traffic calming and pedestrian safety
    - Motor vehicles are driving too fast and are aggressive
    - Protect vulnerable users, including children and elderly
    - Widen sidewalks on 6th and 9th Street NW to improve safety for pedestrians
- Find a compromise for parking for religious institutions
    - Compromise and allow parking in the bike lanes during worship, 7 AM-2 PM on Sundays
    - Add diagonal parking on 7th Street NW between L and N Streets NW
    - Consider making 6th Street NW one-way on Sunday to accommodate angled parking
    - Look into opportunities for valet parking at church and off-site parking
- Use protected bike lanes as placemaking (design considerations)
    - Minimum of 10 feet to accommodate pedicabs
    - Consider the "12 year old test" - could a 12-year-old bike safely?
    - Consider intersections in the design
    - Protected Lanes in the same direction as traffic flow
        - Safer interaction with cyclist and motor vehicles
        - Less likely to have illegal parking in the bike lanes
    - Protected Lanes on same side (counter flow)
        - Safer because it reduces people biking in the wrong direction
- Balance the needs of a changing community
    - Gentrification threatens the existence of the churches
    - Churches and other religious institutions are important anchors in the community
    - Needs of tax payers and residents should be prioritized
    - The District is changing and our roadway needs to evolve

6.4.3 Email Comments Received Between Public Meetings (10/22/2015-2/5/2016)

Between the first and second public meetings, DDOT received 123 comments via the website comment form. Of these, 110 expressed support for protected lanes, four expressed that they were not in support of the project (due to potential effects on traffic and church parking), and nine comments did not express a preference for or against the project. Of the comments in favor of the bike lanes, a slight majority (15 comments) expressed support for Alternative 2, with 13 supporting Alternative 3, 12 supporting Alternative 1, and seven supporting Alternative 4.

6.4.4 Public Meeting #2 (2/6/2016)

The second public meeting provided the community with an option to comment verbally or via written comments.

On the written comment forms, 105 people stated that they supported bike lanes within the study area and 11 did not support lanes within the study area. Of the 58 respondents that selected a preference in

alternatives, 26 respondents preferred Alternative 3, 16 respondents preferred Alternative 2, 11 respondents preferred a No-Build Alternative, and seven respondents preferred Alternative 4.

Fifty people, including representatives of local ANCs and institutions, provided verbal comments during the meeting, with 40 speaking in support of bike lanes, 9 against bike lanes, and one speaking neutrally. Of those who spoke in favor of the bike lanes, 15 spoke in favor of Alternative 3, six spoke in favor of Alternative 2, and two spoke in favor of Alternative 4. (Some speakers supported more than one alternative.) Many speakers called for compromise, but also focused on the need for safety for all road users.

Major themes from both the spoken and written meeting comments are shown in Table 23.

Table 23: Major Themes from Public Commentary at Public Meeting #2

Alternative	Likes	Dislikes
No Build	No effect on parking or churches	Shaw area and DC in general need more biking options No protection for cyclists
Alternative 1	Further east/ further away from existing bike lanes	Option has the least protection for bikers Wrong way cycling is likely to happen Preference for both directions to be on same street
Alternative 2	Reduces speed of travel One way bike lanes Provides angled parking Separated travel lanes Fewer car lanes	Will limit parking for church services Not continuously protected; Does not provide adequate infrastructure Allowing Sunday parking defeats the purpose of protected bike lanes
Alternative 3	Least effect on travel lanes/flow Keeps parking lane Reduces likelihood of people riding in the wrong direction Provides angled parking	No protection from passengers leaving parked cars Will limit parking for church services Two-way bike lane not as safe
Alternative 4	Best protects bikers Fully protected	No protection from passengers leaving parked cars Too far west Two-way bike lane not as safe Does not address existing issues on 6th Effects parking spaces

In addition to comments received at the meeting, DDOT received approximately 750 scanned comment forms (sent as a package) from the public meeting, all of which expressed a preference for the no-build alternative, though few other comments were given on the comment forms.

6.4.5 Email Comments Received After the Second Meeting

After the second meeting, DDOT received 225 comments (between 2/6/2016 and 3/15/2016) via the website comment form. Of these, 201 expressed support for protected lanes, 23 expressed that they were not in support of the project (due largely to church parking issues, but also potential effects on traffic), and one comment did not express a preference. Of the comments in favor of the bike lanes, a majority (48 comments) expressed support for Alternative 3, with 33 supporting Alternative 2, 33 supporting Alternative 4, and six supporting Alternative 1.

6.5 Other Input Received

In addition to the input above, DDOT also received and considered the following:

- A petition against the bike lanes from parishioners of several churches (1146 signatures).
- A petition against the bike lanes from Springfield Baptist Church (approximately 150 signatures)
- Emails in support of the bike lane project from WABA members (1746 emails)

6.6 Long-time resident and Institutional Concerns

The neighborhoods of the Eastern Downtown Protected Bicycle Lanes Study, have experienced rapid growth and demographic change. According to the US Census the largest zip code in the area: 20001, which encompasses the neighborhoods of Shaw, Cardozo, LeDroit Park, Chinatown, Mt. Vernon Square, and Truxton Circle, has seen approximately 15% growth in population between 2000 and 2010. The number of housing units increased by just over 33%. Compared to the District's growth of approximately 5% in population and 8% in housing units.[17] [18]

However, the racial and ethnic demographics have changed more dramatically. The historically Black/African American neighborhoods saw and approximate 28% drop in the Black/African American Community and an over 380% increase in the White population during the same time period.[19] [20] The median household income increased from $25,095 in 2000 to $83,035 in 2014.[21] [22] Compared, District-wide, to an approximate 11% drop in the Black/African American community and a 31% increase in the

[17] U.S. Census Bureau, 2010 Census.

[18] U.S. Census Bureau, Census 2000.

[19] U.S. Census Bureau, Census 2000.

[20] U.S. Census Bureau, 2010 Census.

[21] U.S. Census Bureau, Census 2000.

[22] U.S. Census Bureau, 2010-2014 American Community Survey 5-Year Estimates

White population. The median household income for the District went from $40,127 to $65,235.[23] [24] This growth and change is also evident in visits to the study area and observation of many new residential and mixed use construction projects within the neighborhoods.

With these rapid community changes, comes community challenges of neighborhood housing affordability, social networks and sense of community, development pressures, and neighborhood institutions. Bicycle lanes have occurred alongside this change with large increases in bicycle facilities over the last 15 years in the District. Long-time residents and institutions, especially those that typically rely on cars and parking for transportation and access to amenities and services, associate the demographic changes occurring in their neighborhoods with changes in infrastructure. They see the increase in bicycle facilities as occurring because of the neighborhood change rather than a response to increasing bicycle mode split and resulting crashes and serious injuries. Therefore, bicycle lanes that provide protected facilities and that challenge existing curbside uses, become a symbol of catering to new demographics.

6.7 Conclusion and Overall Preferences

Nearly 5,000 comments were submitted from members of the community, parishioners of the churches, and users of the streets in the eastern downtown area of the District. The majority of comments showed support for bike lanes in a 52% to 48% split with the latter in favor of the no-build option. The most favored option is Alternative 3, the bi-directional protected lanes on the east side of 6th Street NW, which gained 40% of the overall preferences expressed. This was favored largely because of the minimal effects on church parking, traffic congestion, travel time, and the ability to function as a full-time protected bicycle facility. The second most favored is Alternative 2, the separated curb-side protected lanes on 6th Street NW, for which 34% of people expressed a preference. However, the suggestion for Sunday parking to occur within the protected facility in Alternative 2 was viewed unfavorably by most commenters.

7 Recommendations

7.1 Evaluation of each Alternative's Critical Flaws

All alternatives would affect traffic, parking, or loading to varying degrees. While certain effects on each transportation element could be mitigated via design or engineering, the cumulative sum of those elements that *cannot* be mitigated add up to eliminate two preliminary alternatives: Alternatives 1 and 2. For Alternatives 3 and 4, additional engineering design and stakeholder engagement are necessary to determine whether the effects of the project can be successfully addressed. For each alternative, effects on transportation or parking/loading are noted below, with critical unmanageable effects bolded.

[23] U.S. Census Bureau, Census 2000.

[24] U.S. Census Bureau, 2010 Census.

7.1.1 Alternative 1:

- Northbound traffic along 5th causes congestion at New York Ave. Replacing two northbound lanes with one in the PM peak hour causes heavy delays from New York Ave, south to D Street; these delays affect the limited bus service on 5th Street, as well as emergency vehicle operations. Conceivably, these delays could cause some traffic to divert to northbound 6th Street, where there is space capacity.
- Lack of protection along 5th Street from L St to Rhode Island Ave. Roadway width of 30' prevents incorporating protection without removing all of the northbound curbside residential parking.
- The median along Rhode Island Ave prevents the 5th Street bike lane from reaching Florida Ave. This could potentially be mitigated with a median break that would also need a signal to protect cyclists through the intersection.
- **Unprotected northbound right turns at New York Ave. Heavy right turns could not be protected without further increasing already-substantial delays in northbound 5th Street traffic due to the elimination of a travel lane.**
- **Permanent loss of 77 commercial parking spaces in the CBD, on 5th Street – 16 full-time back-in spaces and 61 spaces that are restricted in the afternoon peak period only.**
- Full-time parking was converted to peak hour-restricted along Southbound 6th Street from R Street to L Street.
- Several downtown locations on 6th Street require unprotected block segments due to lengthy laybys/driveways.
- The inclusion of right-turn mixing zones would result in about 28 less back-in diagonal spaces on Sundays.
- Four continuous blocks of 6th Street southbound allow back-in diagonal parking on Sundays, utilizing two of the existing three southbound lanes. **Options for cycling southbound under these conditions include utilizing the remaining travel lane in mixed traffic while diagonal parking occupies the protected bike lanes, or removing the allowance of diagonal Sunday parking.**

7.1.2 Alternative 2:

- Fourteen heavy turning movements that were identified along 6th Street could be the source for bike-vehicle conflicts. Of these, only one was mitigated in this alternative.
- No curbside parking is removed in this alternative.
- The inclusion of right-turn mixing zones would result in about 28 less back-in diagonal spaces on Sundays.
- Traffic flow issues along northbound and southbound 6th can generally be mitigated. **However, traffic flow comes at the expense of not being able to protect cyclists from heavy right-turning and left-turning movements. Protecting many of these movements from cyclist conflict would affect traffic operations significantly.**

- **Both the east and west sides of 6th Street have multiple lengthy laybys/driveways where vertical protection from the main line would have to be removed.**
- Four continuous blocks of 6th Street southbound allow back-in diagonal parking on Sundays, utilizing two of the existing three southbound lanes. **Options for cycling southbound under these conditions include utilizing the remaining travel lane in mixed traffic while diagonal parking occupies the protected bike lanes, or removing the allowance of diagonal Sunday parking.**

7.1.3 Alternative 3:

- Fourteen heavy turning movements that were identified along 6th Street are the source for bike-vehicle conflicts. Of these, all but three intersections in this alternative were mitigated through separating and protecting bikes and turning vehicles.
- From Pennsylvania Ave to L Street, 9 foot travel lanes would be required in the northbound direction.
- The east side of 6th Street has multiple lengthy laybys/driveways where vertical protection from the main line would have to be removed.
- Four continuous blocks of 6th Street southbound allow back-in diagonal parking on Sundays, utilizing two of the existing three southbound lanes. However, this alternative requires two southbound travel lanes – one thru-right lane and one left only lane. A design option for mitigating this would be to limit parking at intersection *approaches* to parallel only parking, such that two approach lanes remain at each intersection. This would result in under 20 back-in diagonal spaces removed on Sundays.
- Most 6th Street metered parking spaces that are currently restricted during the AM and PM peak periods only, are proposed to be restricted from 7:00 AM through 6:30 PM. Parking spaces on the west side of 6th Street will generally be converted to allow curbside parking full-time.

7.1.4 Alternative 4:

- Several full-time metered curbside parking spots on both the east and west sides of 9th street would be removed and other spots would become peak-hour restricted.
- Cyclist protection at intersections with heavy vehicle turn movements was integrated into the design through protected-only left turn movements (there are no heavy right turn movements across the proposed bike lanes).
- Because travel time foes not materially change, traffic congestion is not expected to affect emergency vehicles and bus scheduling/operations, of which the latter runs every 3 to 5 minutes in the peak commuting hours.
- Preserving Sunday back-in parking along 9th Street requires switching two blocks of angled parking designation from the east side to the west side, such that only parallel parking is allowed along all east side blocks faces at all times. All four blocks of designated Sunday back-in parking would be on the west side of 9th Street.

- During major events held at the Convention Center, such as the recent Nuclear Summit, 9th Street is closed to traffic. This could result in the closing of the protected bike lanes during similar events. Similarly, during broadcast events at the Convention Center, transmission cables could lay across the bike lanes.

7.2 Alternatives for Additional Design

Based on the analysis above, DDOT eliminated Alternatives 1 and 2. In addition to the No Build alternative, **DDOT will advance Build Alternatives 3 and 4 for further design and analysis,** both of which would provide a two-way protected lane on the east side of the street.

Both alternatives result in beneficial bicycle infrastructure and each would expand the bicycling infrastructure on the eastern side of downtown. Both build alternatives successfully satisfy this element of the study goals and objectives. The Alternative 4, on 9th Street, provides longer continuous protection for cyclists and has fewer turning conflicts with motor vehicles than Alternative 3 on 6th Street. Neither alternative would have substantial constructability challenges at this stage of analysis. Alternative 4, on 9th Street, could provide benefit through some rationalization of traffic patterns, especially south of Massachusetts, and the condition of the roadway is poorer due to adjacent construction. This could be addressed during the installation of the bike lane.

Both build alternatives result in minor traffic impacts. Alternative 4 would result in slight increases in travel time on 9th Street, particularly in the northbound direction. 9th Street carries some WMATA buses in the southbound direction and more vehicles overall than 6th Street. Travel times and traffic conditions on 6th Street would remain basically the same in Alternative 3, with slight increases in both directions during AM Peaks and slight decreases in both directions in PM peaks.

Both build alternatives require some changes to parking. Alternative 3, on 6th Street, affects more metered parking downtown and 16 Sunday angled spaced. Alternative 4, on 9th Street, removes 35-45 residential spaces in Shaw and zero Sunday angled spaces. The Sunday parking effects on 6th Street in Alternative 3 could be mitigated by expanding the angled parking provision to an additional block on 6th Street or by modifying parking configurations on other side streets.

Table 24 below provides a comparison of the three remaining alternatives.

Table 24: Comparison of Remaining Alternatives

Factor	No Build	6th St Alternative (Alt 3)	9th St Alternative (Alt 4)
Description	No change from existing conditions	Continuous two-way north-south bike lane on east side of 6th Street from S Street to Pennsylvania	Continuous two-way north-south bike lane on east side of 9th Street from Florida to Pennsylvania
Changes since draft public review	- none	- Extended protected bike lane north to S Street across Rhode Island Avenue - Refined design and parking between New York and Mass Ave to improve traffic performance	- Improved traffic performance by modifying cross section north of New York Avenue - Improved traffic performance by modifying cross section south of Mass Ave
Safety and continuity of bike facility	- No continuous north-south bike lane in study area.	- 1.5 miles protected bike lane (of 1.6 miles total corridor length) - 6 of 8 heavy turn movements protected	- 1.7 miles protected bike lane. - 6 of 6 heavy turn movements protected or prohibited
Vehicular traffic	- *6th Street*: 0 intersections at LOS E/F; 1 AM and 5 PM approaches at LOS E/F; - *9th Street:* 0 intersections at LOS E/F; and 3 AM and 2 PM approaches at LOS E/F	- 0 intersections at LOS E/F; - 4 AM and 10 PM approaches at LOS E/F; - No significant change in travel times	- 0 intersections at LOS E/F; - 3 AM and 1 PM approaches at LOS E/F; - No significant change in travel times
Curbside parking	- Approx. 1,800 total spaces in study area	- 5 residential parking spaces removed. - 15 metered spaces removed - 40 metered spaces converted from rush hour restricted to full time parking - 72 metered spaces converted to no parking until after 7pm	- 35-45 residential spaces removed. - 20 metered spaces converted from full time to peak-hour restricted. - 17 metered spaces removed completely.
Sunday Angled Parking	- Approx 152 spaces on 6th Street - Approx 140 spaces on 9th Street	- 4 congregations on 6th Street - 16 spaces removed on 6th Street - 1 congregation directly adjacent to bike lane	- 2 congregations on 9th Street - No reduction, with the exception of N Street to O Street, where the church has closed. Also need to switch from east side to west side at New Bethel to be in line with Shiloh
Events	- No change to existing.	- No change to existing Verizon Center loading operations.	- Modify Convention Center bus, truck, and media staging areas on 9th Street

7.3 Next Steps

This study defined the goals and objectives for continuous protected bike lanes on the eastern side of downtown Washington, DC and defined the full range of potential alternatives. This study documented existing conditions, engaged a wide range of stakeholders on preliminary and refined alternatives, and analyzed the potential effects of new bike facilities on traffic, parking, and safety for people biking. This study has found two alternatives that appear to be viable, but require additional design and stakeholder engagement in order to determine whether the potential effects can be mitigated. Both build alternatives 3 and 4 should be advanced to a 30% design level in order to more fully define effects and provide stakeholders with a more clear view of these effects. The build alternatives should continue to be compared to the "No Build" alternative to provide a baseline for potential effects.

Key areas for further detailed design and evaluation:

Alternative 3

- Alternative locations for increased diagonal Sunday parking.
- Lane widths and street design south of New York Avenue.
- Design of Rhode Island Avenue/6th Street/R Street intersection and northern terminus of bike lane.
- Design of protection for bike lane.
- Detailed constructability review.

Alternative 4

- Finalize new turn restrictions / parking modifications in northern section.
- Design of bike facility adjacent to Convention Center.
- Design of bike facility adjacent to Mount Vernon Square.
- Design of protection for bike lane.
- Detailed constructability review.

Advancing two "Build" alternatives to a 30% design level does not require the protected bike lanes to be installed. Advancing both alternatives to this level is a prudent approach to more fully defining the potential impacts for all stakeholders and finalizing potential mitigations. During this preliminary design stage, DDOT should engage with the Advisory Neighborhood Commissions, adjacent institutions, property owners, and residents, and other community and business groups. After the preliminary design stage, if a build alternative is selected, DDOT can proceed with final design and then installation. Developing 30% design is typically a 6 to 9 month process for a project of this type, and final design and installation can take an additional 12 to 18 months, depending on the complexity of construction. During the 30% design process, DDOT will be able to better determine the timeline and timing of installation, if a build alternative is selected.