# 3: IMPACTS REVIEW

This section of the report focuses on the influence and impact site generated traffic will have on the local transportation network, with the following purpose:

- To provide information to the District Department of Transportation (DDOT) and other agencies on how the development of the site will influence the local transportation network. This report accomplishes this by identifying the potential trips generated by the site on all major modes of travel and where these trips are expected to travel to and from.
- To determine if development of the site will lead to adverse impacts on the local transportation network. This report accomplishes this by projecting future conditions with and without development of the site and performing analysis of intersection delays. These delays are compared to the acceptable levels of delay set by DDOT standards to determine if the site will negatively impact the study area. The report describes what improvements to the transportation network are needed to mitigate adverse impacts.

## *3.1 Site Transportation Demand*

### *3.1.1 Base Trip Generation*

Traditionally, trip generation for a proposed development is calculated based on the methodology outlined in the Institute of Transportation Engineers' (ITE) *Trip Generation*, 9th Edition. For this report, the methodology was supplemented to account for the urban nature of the site (*Trip Generation* provides data for non-urban, low transit use sites) and to generate trips for multiple modes. The following summarizes the methodology that was used in this study.

First, ITE *Trip Generation* was used to develop base vehicular-trip rates, not accounting for reductions due to mode split. The *Trip Generation Handbook*, 2nd Edition was also consulted for guidelines for estimating trip generation. Trip generation was projected for the morning and afternoon weekday peak hours of the adjacent street traffic (typically one hour between 7:00 and 9:00 AM and between 4:00 and 6:00 PM). The following summarizes the trip generation projections:

- Office trips were projected based on LU 710 for General Office. *Trip Generation* defines an office as "a building that houses multiple office tenants". The land use represents a location where affairs of businesses, commercial or industrial organizations, or professional persons or firms are conducted. An office building can contain a mixture of tenants including professional services, insurance companies, investment brokers and tenant services, such as a bank or saving and loan institution, a restaurant or cafeteria, and service retail facilities. The morning and afternoon peak hour trips were generated using the regression equations provided based on average vehicle trip ends per 1,000 square feet of gross floor area. The regression equation was chosen for the weekday office projections due to the high (over 0.75) coefficient of determination ($R^2$). For the office uses, the morning and afternoon weekday peak hours of the Generator correspond to the peak hours of the adjacent street traffic.
- For the trips generated by the on-street retail, LU 820 for Shopping Center was applied in lieu of individual trip rates—such as bank, pharmacy, and supermarket—for the retail uses because applying individual rates would not account for the interaction between the retail uses (shoppers visiting more than one store). The Shopping Center trip rate accounts for these uses and interactions. The morning and afternoon weekday peak hour trips were generated based on the data provided for the peak hours of the adjacent roadway network – one hour between 7:00 and 9:00 AM and between 4:00 and 6:00 PM, respectively. *Trip Generation* provides information on the hourly variation of shopping center traffic for shopping centers with less than 100,000 square feet. For the

weekday trips, the morning and afternoon peak hours of the shopping center typically do not coincide with the peak hours of the adjacent roadway network, so the peak hours of the adjacent roadway network were used to correspond with the time periods analyzed in the study. All of the trip projections were generated based on the average rates provided based on average vehicle trip ends per 1,000 square feet of gross leasable area. According to the *Trip Generation Handbook*, the weighted average rate should be used to estimate trip rates for land uses with low value independent variables. This is due to the y-intercept of the regression equation, which can yield an illogical trip projection. Although the coefficient of determination ($R^2$) for the regression equations provided is high (above 0.75), the average rates were used due to the low square footage of retail provided (under 50,000 SF).

Table 4 shows the base number of trips generated by the proposed development.

**Table 4: Base Vehicular-Trip Generation**

| Land Use | Size | | Base Vehicular Trip Generation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | AM Peak Hour | | | PM Peak Hour | | | Weekday Total |
| | | | *In* | *Out* | *Total* | *In* | *Out* | *Total* | |
| Office | 153,992 | Square Feet | 238 | 32 | 270 | 43 | 208 | 251 | 1,824 |
| Retail | 4,000 | Square Feet | 2 | 2 | 4 | 7 | 8 | 15 | 172 |
| **Total Base Vehicle-Trips** | | | **240** | **34** | **274** | **50** | **216** | **266** | **1,996** |

## *3.1.2 Average Vehicle Occupancy and Person-Trips*

The average vehicular occupancy (AVO) rates are based on the rates published in the *2009 NHTS* by the FHWA. Based on the information contained in the report, Table 5 shows the AVO assumed for each land use[2] contained in the proposed development. The AVO for the office uses is based on the "To or From Work" trip purpose, and the AVO for the ground-floor retail use is based on the "Shopping" trip purpose.

**Table 5: Average Vehicle Occupancy**

| Land Use | Average Vehicle Occupancy |
|---|---|
| Office | 1.13 persons/vehicle |
| Retail | 1.78 persons/vehicle |

The total weekday peak hour person-trips were generated for the proposed PUD based on (1) the base vehicular trips shown previously in Table 4; and (2) the average vehicular occupancy rates shown previously in Table 5. In order to calculate the person-trips, the vehicular trips are multiplied by the average vehicular occupancy. Table 6 shows the base person-trips generated by the proposed 2100 K Street PUD.

**Table 6: Base Person-Trip Generation**

| Land Use | AVO | | Base Person-Trip Generation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | AM Peak Hour | | | PM Peak Hour | | | Weekday Total |
| | | | *In* | *Out* | *Total* | *In* | *Out* | *Total* | |
| Office | 1.13 | Persons/Vehicle | 269 | 36 | 305 | 49 | 235 | 284 | 2,061 |
| Retail | 1.78 | Persons/Vehicle | 4 | 3 | 7 | 12 | 15 | 27 | 306 |
| **Total Base Person-Trips** | | | **273** | **39** | **312** | **61** | **250** | **311** | **2,367** |

[2] *2009 National Household Transportation Survey*. "Table 16: Average Vehicle Occupancy for Selected Trip Purpose 1977, 1983, 1990, and 1995 NPTS, and 2001 and 2009 NHTS (Person Miles per Vehicle Mile" for 2009 data, Page 33. Federal Highway Administration (FHWA), 2010.

### *3.1.3 Mode Split*

Following the base trip generation, the trips were split into each mode: transit (consisting of both Metrorail and Metrobus/DC Circulator), walking, biking, and vehicle. Each land use was analyzed by mode separately in order to account for varying mode splits. The mode split estimates for the PUD were developed using survey information contained in several sources: WMATA's *2005 Development-Related Ridership Survey*, results from the 2000 U.S. Census, and files from Gorove/Slade's library. The following describes in detail how the mode split assumptions were assembled based on information from these sources.

**Office Uses**

WMATA's *2005 Development-Related Ridership Survey* has generally been used as the standard source for developing mode split estimates for office uses located in the DC area. The survey included data collected from 17 office sites located at distances from Metrorail stations varying from 0 (buildings located above or directly adjacent to a Metrorail portal) to 3,000 feet. Similar to the residential, several summary tables are available. Table 7 shows the residential mode share for all trips based on the location typology: Central Business District (CBD), Suburban – Inside the Beltway, and Suburban – Outside the Beltway, as well as the average for all sites surveyed.

**Table 7: WMATA *Ridership Survey* Mode Split for Office Sites**

| Typology[3] | Mode | | | |
|---|---|---|---|---|
| | *Metrorail* | *Metrobus & Other Transit* | *Auto* | *Walk & Other* |
| CBD | 63% | 12% | 21% | 5% |
| Suburban – Inside the Beltway | 21% | 9% | 66% | 6% |
| Suburban – Outside the Beltway | 8% | 3% | 89% | 0% |
| All sites surveyed[4] | 25% | 9% | 62% | 6% |

The mode splits shown in Table 7 are an average of several sites surveyed. Applying an average of these mode splits to the PUD may not be appropriate because the sites surveyed do not have similar characteristics, such as the amount of parking per square foot of space, walking distance to Metrorail, and employee benefits for non-auto commuters. Using data from other office sites surveyed in WMATA's report would also not be appropriate, because they also differ greatly. Additionally, the *Ridership Survey* notes that 72% of the office commuters that responded to the survey were offered subsidized or free parking by their employers[5].

The Transportation Demand Management (TDM) plan for the 2100 K Street site will contain measures that will ensure that the parking garage will be priced at market rate. Information contained within the *2010 State of the Commute* report shows why only offering market rate pricing will have a large influence on the office mode split. Table 8 shows the mode split difference between all commuters surveyed in the State of the Commute surveys split between whether or not the commuter was offered free parking.

**Table 8: Mode Split Difference Based on Free Parking (Entire DC Area)**

[3] *2005 Development-Related Ridership Survey, Final Report.* "Table 4: Commute Mode Share at Office Sites by Concentric Location Typology", Page 23. Washington Metropolitan Area Transit Authority (WMATA), 2006.
[4] *2005 Development-Related Ridership Survey, Final Report.* "Table 3: Commute Mode Share at Office Sites", Page 22. Washington Metropolitan Area Transit Authority (WMATA), 2006.
[5] *2005 Development-Related Ridership Survey, Final Report.* Page 23. Washington Metropolitan Area Transit Authority (WMATA), 2006.

| Parking Benefit[6] | Mode | | | | |
|---|---|---|---|---|---|
| | *Drive Alone* | *Carpool* | *Bus* | *Train* | *Walk/Bike* |
| Free Parking Offered | 82% | 6% | 3% | 5% | 4% |
| No Free Parking | 41% | 10% | 11% | 32% | 6% |

The State of the Commute report also contains responses of mode splits for all commuters employed in the District, as shown in Table 9.

**Table 9: Primary Mode of Travel by State of Residence and State of Employment**

| State[7] | Primary Mode of Travel | | | | |
|---|---|---|---|---|---|
| | *Drive Alone* | *Carpool/ Vanpool* | *Bus* | *Train* | *Bike/Walk* |
| **State of Residence** | | | | | |
| District of Columbia | 41% | 7% | 14% | 27% | 11% |
| Maryland | 72% | 7% | 5% | 15% | 1% |
| Virginia | 72% | 8% | 5% | 13% | 2% |
| **State of Employment** | | | | | |
| District of Columbia | 42% | 11% | 10% | 33% | 4% |
| Maryland | 84% | 5% | 5% | 4% | 2% |
| Virginia | 82% | 6% | 3% | 7% | 2% |

Based on this information, the following steps were taken to project the mode split for the office use, starting with the *WMATA* data for office sites located within the CBD.

- The amount of transit use was assumed to be 55%. While it is expected that the PUD will have a Metrorail and Metrobus use similar to the office sites located within the CBD, as shown in Table 7, a conservative transit mode share of 55% was assumed.
- The amount of cycling was set to 3%, to reflect the site's location near the several bike lanes, off-street trails, and signed bicycle routes and the amount of residents located within a 10-15 minute bicycle ride from the site.
- Similarly, the walk mode split was set to 7% to reflect the amount of existing and future residents in walking distance of the site, compared to the District average as a whole.

Thus, the mode split possible for the Office uses is as follows:

- Vehicle: 35%
- Transit: 55%
- Walk: 7%
- Bike: 3%

**Retail Uses**

[6] *2010 State of the Commute Survey Report*. "Figure 41: Primary Commute Mode by Free Parking Available at Work", Page 46. Commute Connections, 2011.

[7] *2010 State of the Commute Survey Report*. "Table 34: Primary Mode by State of Residence and State of Employment", Page 61. Commute Connections, 2011.

Similar to the Office uses, the main source of mode split information for retail sites is the WMATA Ridership Survey. Contained within the report are summaries of mode splits for five retail sites within the Metropolitan area, and one within the District. However, no one site models the conditions of the proposed PUD. However, data provided for the U Street station area site were investigated as this site is located a comparable distance from the Metro. Table 10 summarizes the mode split information for the U Street site and an average for all of the retail sites surveyed.

**Table 10: WMATA *Ridership Survey* Mode Split for Retail Sites**

| Retail Location[8] | Mode | | | |
|---|---|---|---|---|
| | *Metrorail* | *Metrobus &* | *Auto* | *Walk & Other* |
| U Street Main Street | 44% | 13% | 19% | 25% |
| All retail sites surveyed | 29% | 8% | 36% | 27% |

Based on the above information, the projected mode split for the Retail trips is broken down as follows, based on the data provided for the U Street site:

- Drive: 20%
- Total transit: 55%
- Walk: 23%
- Bike: 2%

**Summary**

Table 11 summarizes the mode split assumptions.

**Table 11: Mode Split Assumptions**

| Land Use | Mode Split | | | |
|---|---|---|---|---|
| | *Vehicle* | *Transit* | *Walk* | *Bike* |
| Office | 35% | 55% | 7% | 3% |
| Retail | 20% | 55% | 23% | 2% |

### *3.1.4 Multi-Modal Trip Generation*

Based on the trip generation calculations and the mode split assumptions shown previously (and summarized in Table 11), Table 12 shows the resulting calculations by mode. The proposed development will generate approximately 96 vehicular trips, 172 transit trips, 23 walking trips, and 9 bicycle trips during the morning peak hour; 91 vehicular trips, 171 transit trips, 26 walking trips, and 10 bicycle trips during the afternoon peak hour; and 673 vehicular trips, 1,302 transit trips, 214 walking trips, and 68 bicycle trips during a typical weekday.

[8] *2005 Development-Related Ridership Survey, Final Report*. "Table 15: Mode Shares at Retail, Hotel and Entertainment Sites", Page 34. Washington Metropolitan Area Transit Authority (WMATA), 2006.

**Table 12: Trip Generation for Proposed Development by Mode**

| Land-Use/Mode | Trip Generation by Mode | | | | | | |
|---|---|---|---|---|---|---|---|
| | AM Peak Hour | | | PM Peak Hour | | | Daily Total |
| | *In* | *Out* | *Total* | *In* | *Out* | *Total* | |
| **Vehicle Trips** | | | | | | | |
| Office | 83 | 12 | 95 | 16 | 72 | 88 | 638 |
| Retail | 1 | 0 | 1 | 1 | 2 | 3 | 35 |
| *Total New Vehicle Trips* | *84* | *12* | *96* | *17* | *74* | *91* | *673* |
| **Transit Person-Trips** | | | | | | | |
| Office | 148 | 20 | 168 | 27 | 129 | 156 | 1,134 |
| Retail | 2 | 2 | 4 | 7 | 8 | 15 | 168 |
| *Total New Transit Person-* | *150* | *22* | *172* | *34* | *137* | *171* | *1,302* |
| **Walking Person-Trips** | | | | | | | |
| Office | 19 | 2 | 21 | 3 | 17 | 20 | 144 |
| Retail | 1 | 1 | 2 | 3 | 3 | 6 | 70 |
| *Total New Walking Person-* | *20* | *3* | *23* | *6* | *20* | *26* | *214* |
| **Bicycling Person-Trips** | | | | | | | |
| Office | 8 | 1 | 9 | 1 | 8 | 9 | 62 |
| Retail | 0 | 0 | 0 | 0 | 1 | 1 | 6 |
| *Total New Bicycling Person-* | *8* | *1* | *9* | *1* | *9* | *10* | *68* |
| **Total Trips*** | **262** | **38** | **300** | **58** | **240** | **296** | **2,257** |

** - Combination of person-trips and vehicle-trips*

### *3.1.5 Net New Trip Generation*

As stated previously, the 2100 K Street site contains an existing office building with an underground parking garage. As shown previously in Figure 10, the existing garage is accessed via a curb cut located along 21st Street NW. In order to determine the existing trip generation of the site, a traffic count was performed at the driveway on Tuesday, March 11, 2014 between the hours of 6:30 and 9:30 AM and between 4:00 and 7:00 PM.

Based on the peak hour of the adjacent roadway network, as explained later in this report, the existing driveway generated a total of 9 inbound trips during the morning peak hour and a total of 38 outbound trips during the afternoon peak hour. Based on the peak hour of the site, the existing driveway generated a total of 11 inbound trips during the morning peak hour and a total of 38 outbound trips during the afternoon peak hour.

Using the peak hour of the adjacent roadway network, the proposed 2100 K Street PUD is projected to generate 87 net new morning peak hour vehicular trips and 53 net new afternoon peak hour vehicular trips, as shown in Table 13.

**Table 13: Net New Vehicular Trip Generation**

| Land-Use | Vehicular Trip Generation | | | | | |
|---|---|---|---|---|---|---|
| | AM Peak Hour | | | PM Peak Hour | | |
| | *In* | *Out* | *Total* | *In* | *Out* | *Total* |
| Office | 83 | 12 | 95 | 16 | 72 | 88 |
| Retail | 1 | 0 | 1 | 1 | 2 | 3 |
| *Total New Vehicle Trips* | *84* | *12* | *96* | *17* | *74* | *91* |
| Existing Trip Generation | (9) | (0) | (9) | (0) | (38) | (38) |
| **Net New Vehicular Trips*** | **75** | **12** | **87** | **17** | **36** | **53** |

## 3.2 Roadway Capacity and Operations

This section defines the analysis assumptions, analyses the vehicular impacts of the proposed development, and makes recommendations for improvements where needed.

### 3.2.1 Scope of Analysis

The purpose of the vehicular capacity analysis is to determine the existing conditions of the intersections located in the immediate vicinity of the proposed development. The following intersections were selected, as shown in Figure 12:

1. 23rd Street NW & I (Eye) Street NW
2. 22nd Street NW, L Street NW, & New Hampshire Avenue NW
3. 22nd Street NW & K Street Westbound Ramp
4. 22nd Street NW & K Street Eastbound Ramp
5. 22nd Street NW & Pennsylvania Avenue NW
6. 22nd Street NW & I (Eye) Street NW
7. 21st Street NW & L Street NW
8. 21st Street NW & K Street NW
9. 21st Street NW, I (Eye) Street NW, & Pennsylvania Avenue NW
10. 19th Street NW, H Street NW, & Pennsylvania Avenue NW
11. 20th Street NW & K Street NW
12. K Street Eastbound Ramp & Private Alley
13. 21st Street NW & Private Alley
14. K Street Eastbound Ramp & IFC Driveway
15. 21st Street NW & IFC Driveway
16. 21st Street NW & 2100 K Driveway

Intersection capacity analyses were performed for the existing conditions at each intersection within the study area during the morning and afternoon peak hours, as well as for future conditions with and without the proposed development. The study scenarios are as follows:

- 2014 Existing Conditions
- 2019 Future Conditions <u>without</u> Development (2019 Background)
- 2019 Future Conditions <u>with</u> Development (2019 Future)

The *Synchro, Version 7.0* software package was used to analyze the study intersections based on the <u>Highway Capacity Manual</u> (HCM) methodology. The *Synchro* model was compiled using signal timings provided by DDOT and with lane configurations and traffic volumes collected by Gorove/Slade. The following sections review the assumptions made for the technical analyses, as summarized in Table 15.

### *3.2.2 Traffic Volume Assumptions*

The following section reviews the traffic volume assumptions made and methodologies used in the roadway capacity analyses, summarized in Table 15.

**2014 Existing Conditions**

The overall purpose of this study is to show what effect the proposed development will have on the transportation system in the study area. The existing conditions in and around the site are characterized in order to provide a foundation for assessing the transportation implications of the proposed development. This is determined by examining the peak traffic hours, which are directly associated with the peaking characteristics of the site and the adjacent transportation system. These peaking characteristics are found through analysis of existing count data.

DDOT and National standards require that traffic counts be conducted on a weekday, not including Monday or Friday, when traffic conditions can be described as "typical". This includes the consideration for adjacent uses, such as retail, special events, and recreation facilities and for major traffic generators, such as the area public school system or any large public or private institutions. Weekend and other off-peak periods are also often reviewed if the study area includes other uses that may be relatively inactive during the "typical" weekday.

The traffic counts conducted on "typical" day are used to determine the morning and afternoon "peak hour" of traffic within the study area. According to the Highway Capacity Manual (HCM) methodologies, a one-hour analysis period is preferred. Analysis periods that exceed one hour are not usually used because traffic conditions are typically not steady for long time periods and because the adverse impact of short peaks in traffic demand may not be detected in a long time period. The "peak hour" represents the worst-case scenario, when the system traffic volumes are the highest. The use of a "typical" weekday morning and afternoon peak hours are used to ensure that conclusions regarding adverse impacts and their respective mitigation measures would apply to the vast majority of time roadways are used in the study area. Although there may be times when volume flows exceed these conditions, such as during special events, holiday weekends, or other times depending on the study area and site location, it is the industry standard to design transportation infrastructure for the peak times during "typical" weekdays.

In order to ensure that the data collected contains the peak hour, traffic counts are taken for a period of several hours during the morning and afternoon peak periods. From these peak periods, a peak hour is derived for both the morning and the afternoon time periods. According to the Transportation Impact Analyses for Site Development Manual published by the Institute of Transportation Engineers (ITE), data is generally collected during the weekday morning (7:00 to 9:00 AM) and afternoon (4:00 to 6:00 PM) peak hours. Although this is the standard, Gorove/Slade usually collects data for a three-hour (or longer) period to ensure that the peak hour is contained within the data collection timeframe.

The peak period counts are analyzed to determine the one hour during the morning and afternoon periods that contains the highest cumulative directional traffic demands. From each peak period count, the morning and afternoon "peak hours" are determined by summing up the four fifteen-minute consecutive time periods in the study area that experience the highest cumulative traffic volumes. These morning and afternoon "peak hours" are analyzed for the system of intersections investigated, choosing the "peak hour" of the entire system instead of each individual intersection.

Following the above guidelines, traffic counts, including vehicular and pedestrian volumes, were conducted by Gorove/Slade at the key study intersections between the hours of 6:30 and 9:30 AM and between 4:00 and 7:00 PM on Tuesday, March 11, 2014; Wednesday, March 26, 2014; Thursday, March 27, 2014; Thursday, April 10, 2014; and Wednesday, April 23, 2014. These count dates represent "typical" weekdays when the DC public school systems were in session, as well as the surrounding counties in Maryland and Virginia. These "typical" weekdays also represent time periods that include normal operation for other major traffic generators in the study area. The results of the traffic counts are included in the Technical Appendix. The morning and afternoon peak hours for the system of intersections being studied occurred between 8:30 – 9:30 AM and 5:00 – 6:00 PM, respectively. The existing peak hour traffic volumes are shown on Figure 13.

**2019 Future Conditions without Development (2017 Background)**

The 2100 K Street PUD is anticipated to be complete in 2018. Therefore, the future analysis year is 2017 (anticipated completion year plus one year). The traffic projections for the 2019 future condition without the development consist of the traffic generated by background developments with planned completion by 2019, as well as inherent growth on the study area roadways.

In the study area, the only known, approved background development is the 2100 Pennsylvania Avenue development, which is located south of the proposed development. The 2100 Pennsylvania Avenue development, also known as Site 75A of the George Washington University, is bounded by I Street on the south, Pennsylvania Avenue on the north, 22nd Street on the west, and 21st Street on the east. The parcel was identified in the GWU Campus Plan as a potential redevelopment site and was approved as a Stage 2 PUD on February 25, 2013. A "Revised Transportation Impact Study" was submitted by Wells + Associates, Inc. in September 2012 in support of the development.

Redevelopment of Site 75A will consist of demolishing the existing office building at 2100W Pennsylvania Avenue and the adjacent townhouses along Pennsylvania Avenue and constructing a new commercial building in their place. The proposed 11-story building will include 250,000 square feet of commercial space. The ground floor is approximately 22,428 square feet and will be flexible space to be used as office space or community/building serving retail space. The remaining 227,572 square feet will be office space. Construction is anticipated to begin no earlier than 2014. For purposes of the TIS, occupancy of the new building was assumed to occur in 2016.

Table 14 shows the trip generation for the 2100 Pennsylvania Avenue development, based on information contained within the TIS. The background trips were distributed though the study area roadways based on the distribution and assignment shown in the TIS. Detailed background information is included in the Technical Attachments.

**Table 14: Background Development-Trip Generation**

| Land Use | Size | | Trip Generation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | AM Peak Hour | | | PM Peak Hour | | | Weekday |
| | | | *In* | *Out* | *Total* | *In* | *Out* | *Total* | Total |
| Proposed Office Development | 255,550 | Square Feet | 349 | 48 | 397 | 62 | 303 | 368 | 2,747 |
| *Non-Auto Trips* | | | *(175)* | *(24)* | *(198)* | *(31)* | *(151)* | *(182)* | *(1,374)* |
| **Vehicular Trips** | | | **174** | **24** | **198** | **31** | **151** | **182** | **1,373** |
| Existing Office Development | 87,554 | Square Feet | 149 | 20 | 169 | 30 | 147 | 177 | 1,204 |
| *Non-Auto Trips* | | | *(74)* | *(10)* | *(84)* | *(15)* | *(73)* | *(88)* | *(602)* |
| **Vehicular Trips** | | | **75** | **10** | **85** | **15** | **74** | **89** | **602** |
| **Total Net New Vehicular Background Trips** | | | **99** | **14** | **113** | **16** | **77** | **93** | **771** |

In addition to the 2100 Pennsylvania Avenue background development, other traffic increased due to inherent growth on the study area roadways were accounted for with a 0.5% per year growth rate compounded annually over the study period (2014-2019). This rate was estimated based on a comparison between existing and past average annual weekday traffic volumes obtained from DDOT for 2006-2011. This growth rate was applied to all movements, with the exception of those entering the existing site and adjacent IFC driveways.

The traffic volumes generated by the background development and the inherent growth were added to the existing (2014) traffic volumes in order to establish the future (2019) traffic volumes without the proposed development. The traffic volumes for the future conditions without the development are shown on Figure 14.

**2019 Future Conditions with Development (2019 Future)**

Existing traffic volumes and travel patterns in the study area were analyzed in order to determine the trip distribution for the trips added by the proposed PUD, as shown in Figure 15. Based on this review of the existing traffic volumes and the proposed site access location shown previously on Figure 10, the net new site-generated vehicular trips shown in Table 13 were distributed through the study area intersections, as shown on Figure 16.

The traffic volumes for the future (2019) conditions with the proposed development were calculated by adding the development-generated traffic volumes to the future (2019) without the proposed development traffic volumes. Thus, the future condition with the proposed development scenario includes traffic generated by existing volumes, the growth percentage, background development, and the proposed 2100 K Street PUD. The future (2019) traffic volumes with the proposed development are shown on Figure 17.

### *3.2.3 Geometry and Operations Assumptions*

The following section reviews the roadway geometry and operations assumptions made and the methodologies used in the roadway capacity analyses, summarized in Table 15.

**2014 Existing Conditions**

Gorove/Slade conducted field reconnaissance to confirm the existing lane configurations and traffic controls at the intersections within the study area, shown on Figure 18. Existing signal timings and offsets were obtained from DDOT and confirmed during field reconnaissance.

**2019 Future Conditions without Development (2019 Background)**

The lane configurations for the 2019 future conditions without the proposed development are based on the existing lane configurations. No roadway infrastructure changes were assumed for the future conditions without development for 2019. The lane configurations and traffic controls for the 2019 background conditions are shown on Figure 18.

**2019 Future Conditions with Development (2019 Future)**

The lane configurations for the 2019 future conditions with the proposed PUD are based on the lane configurations for the 2019 conditions without the proposed development. No roadway infrastructure changes were assumed for the future conditions with development for 2019. The lane configurations and traffic controls for the 2019 future conditions are shown on Figure 18.


Figure 12: Study Area Intersections

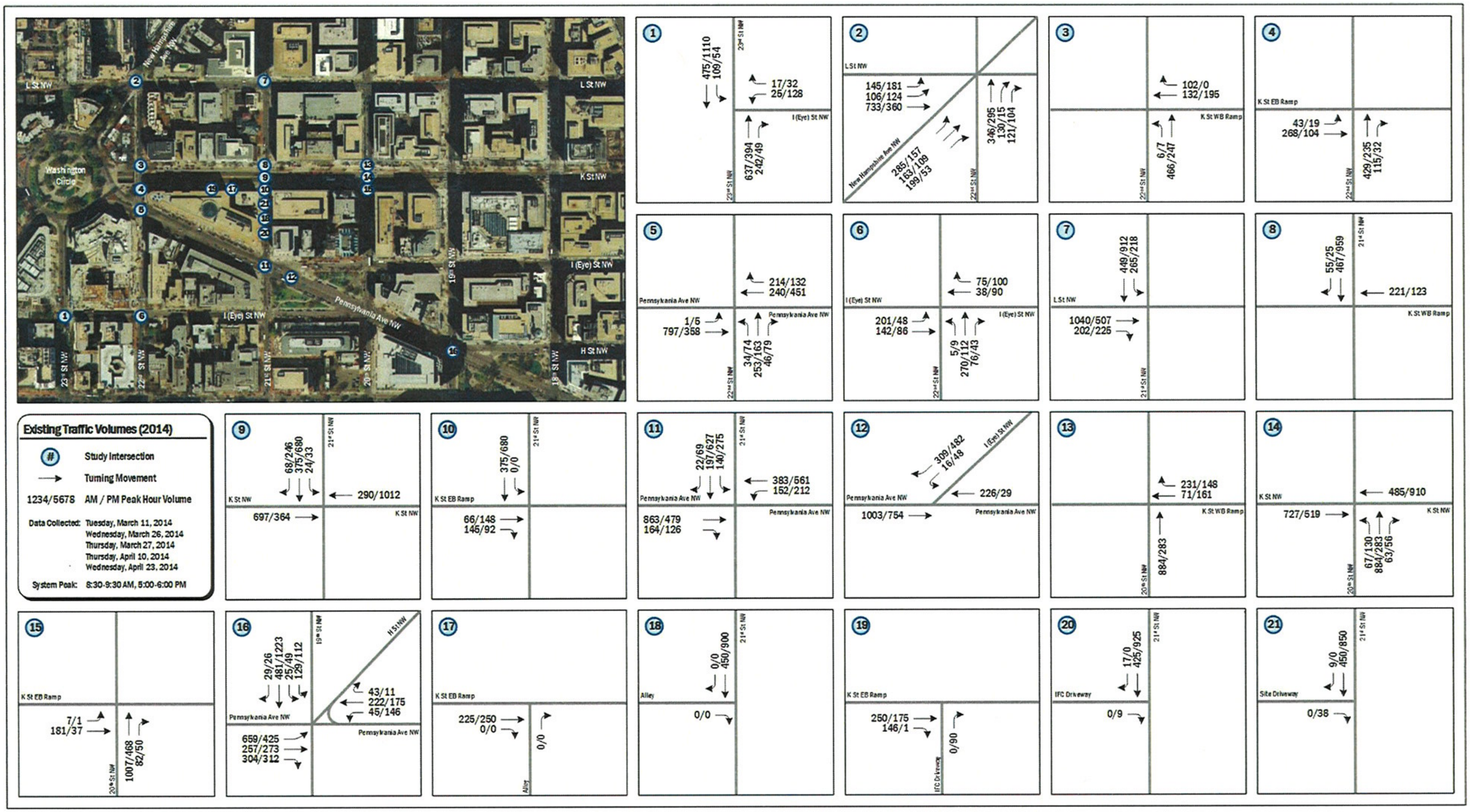


Figure 13: 2014 Existing Peak Hour Traffic Volumes

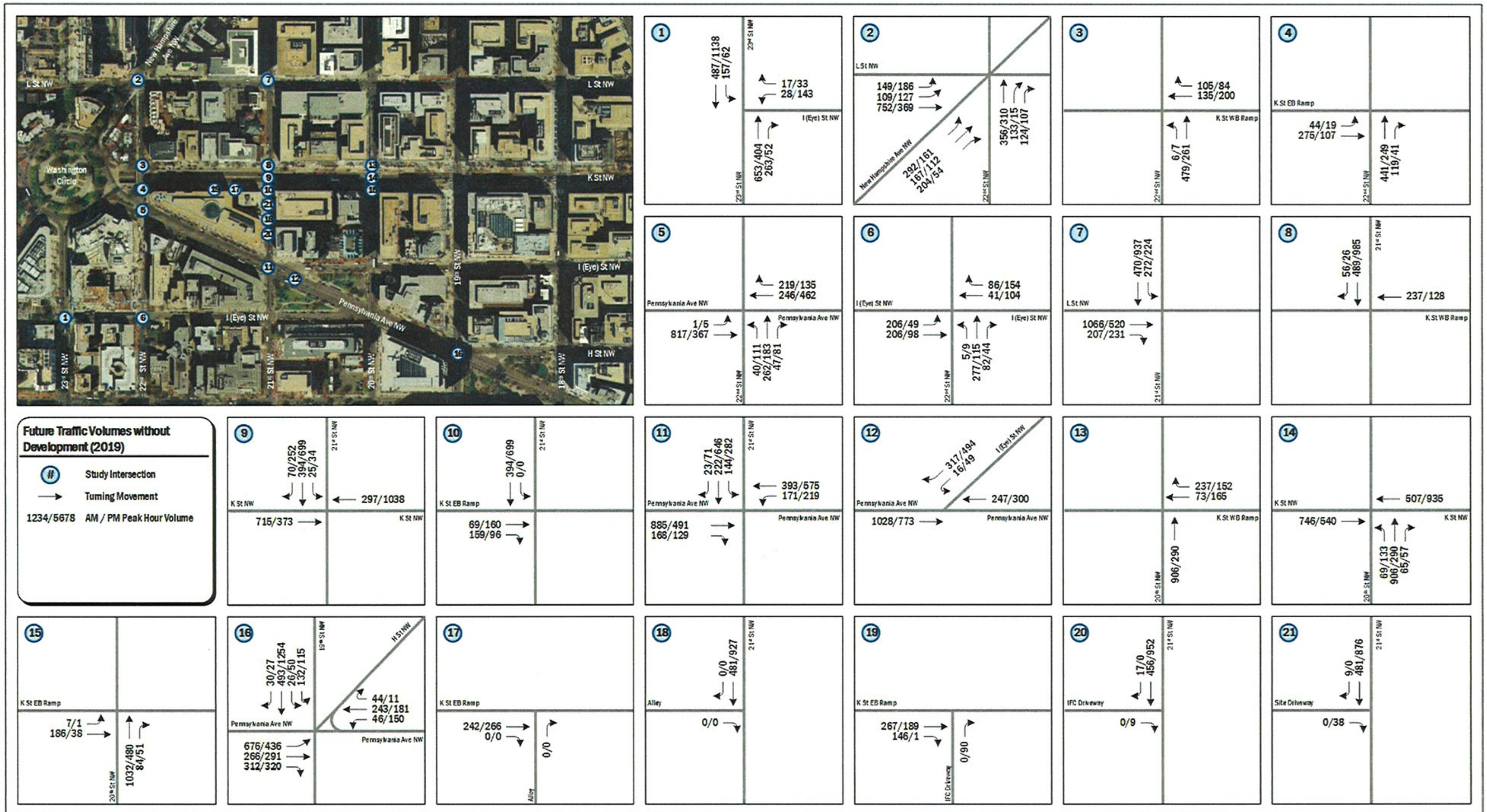


Figure 14: 2019 Background Peak Hour Traffic Volumes

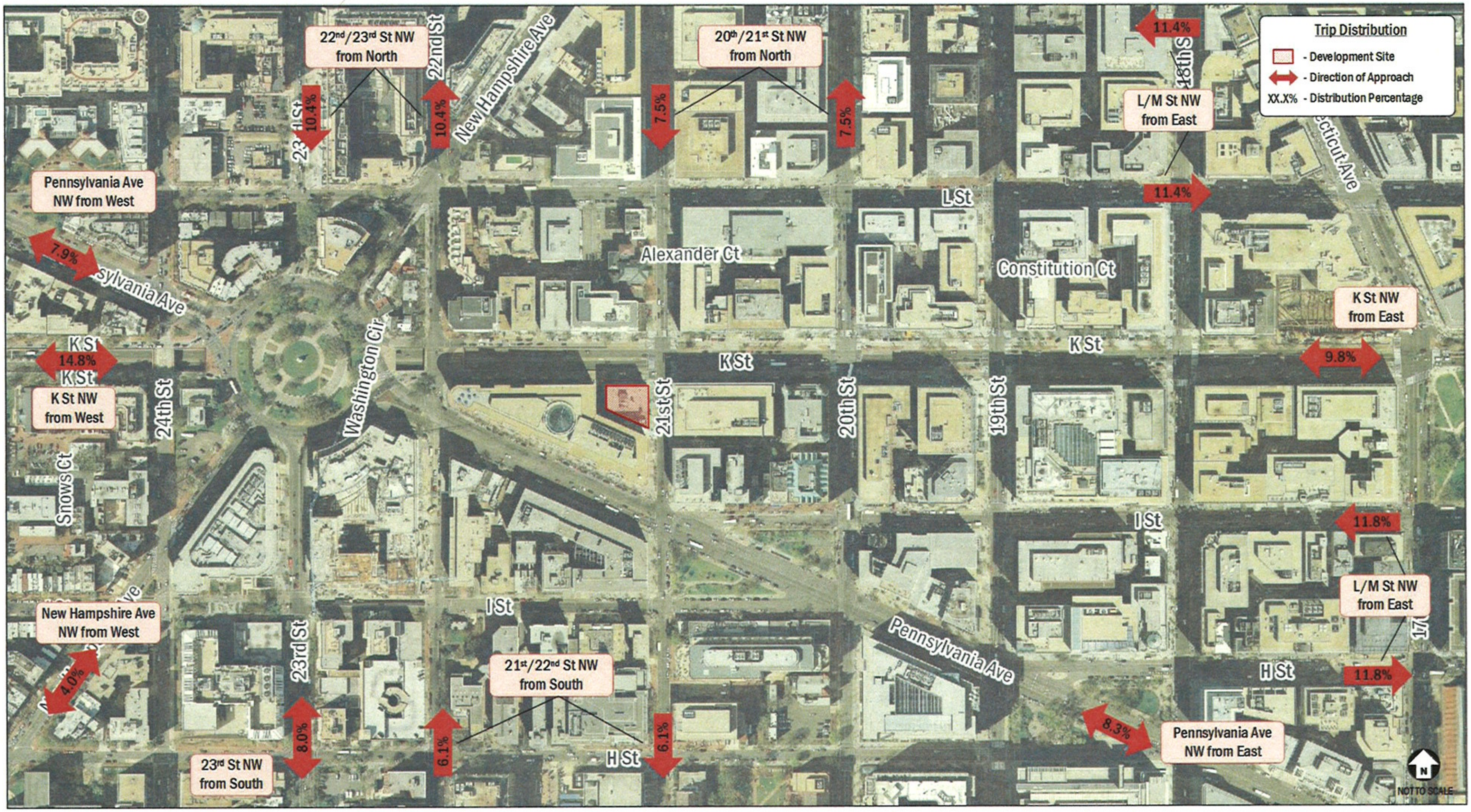


Figure 15: Trip Distribution for Site-Generated Trips

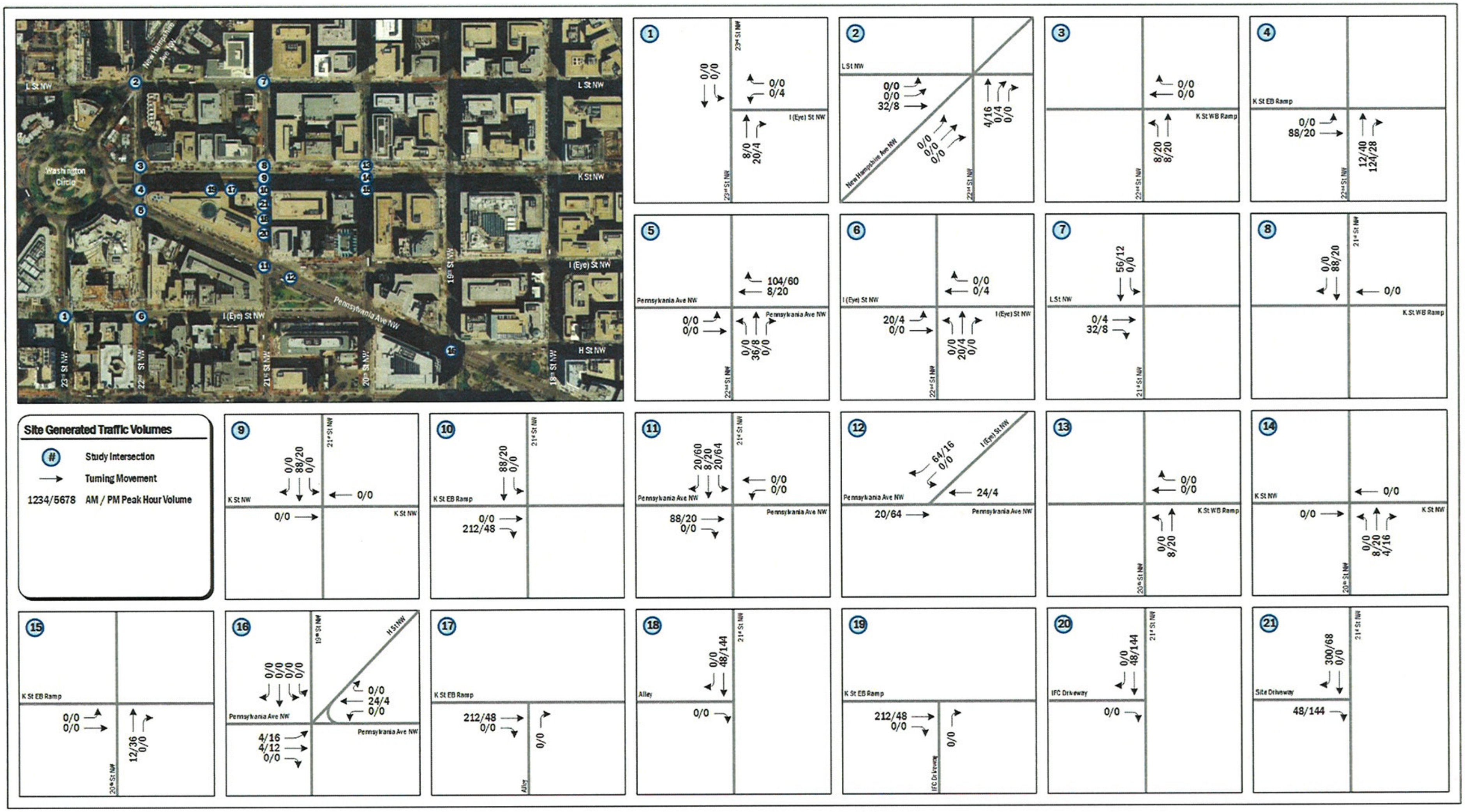


Figure 16: Site-Generated Traffic Volumes

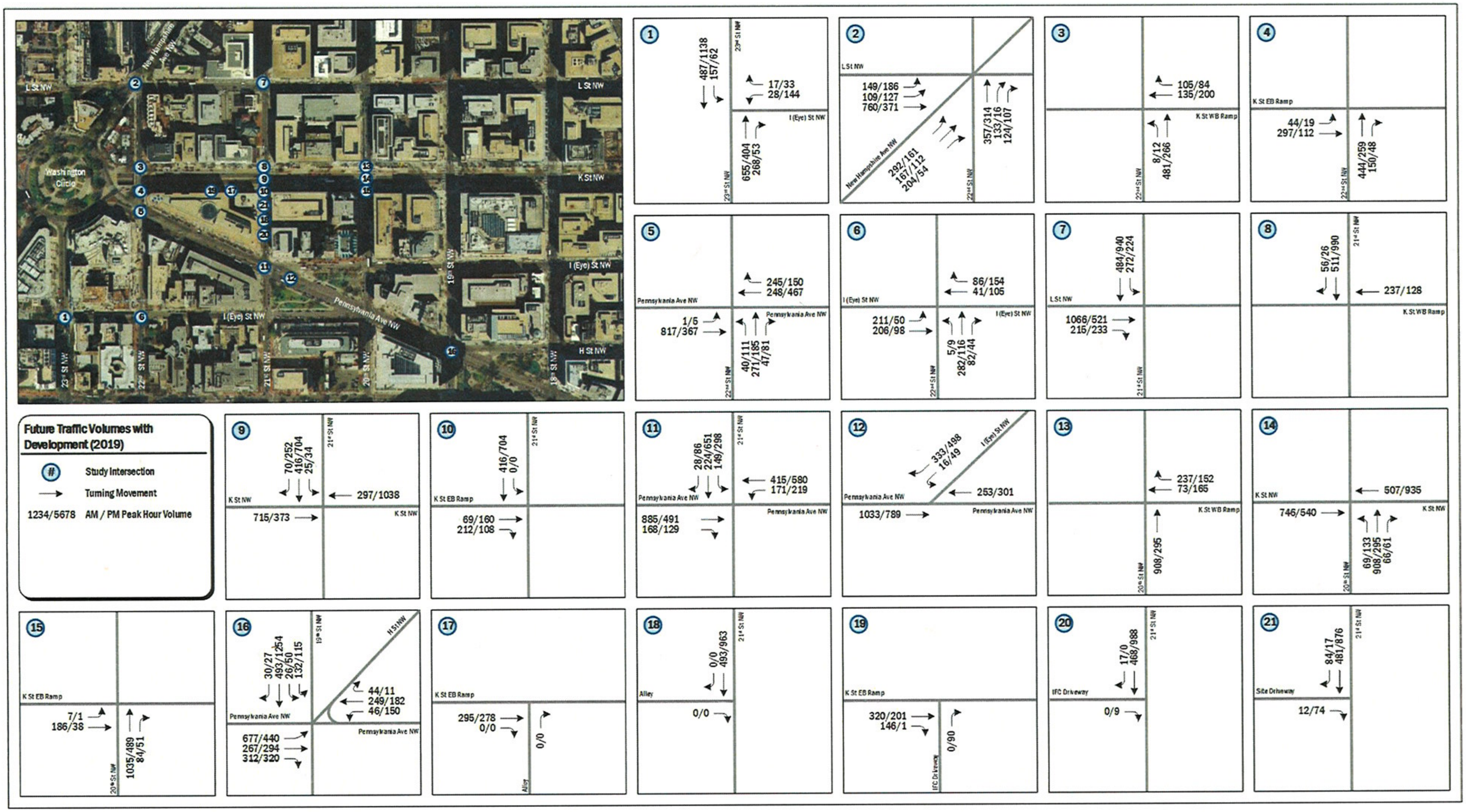


Figure 17: 2017 Future Peak Hour Traffic Volumes

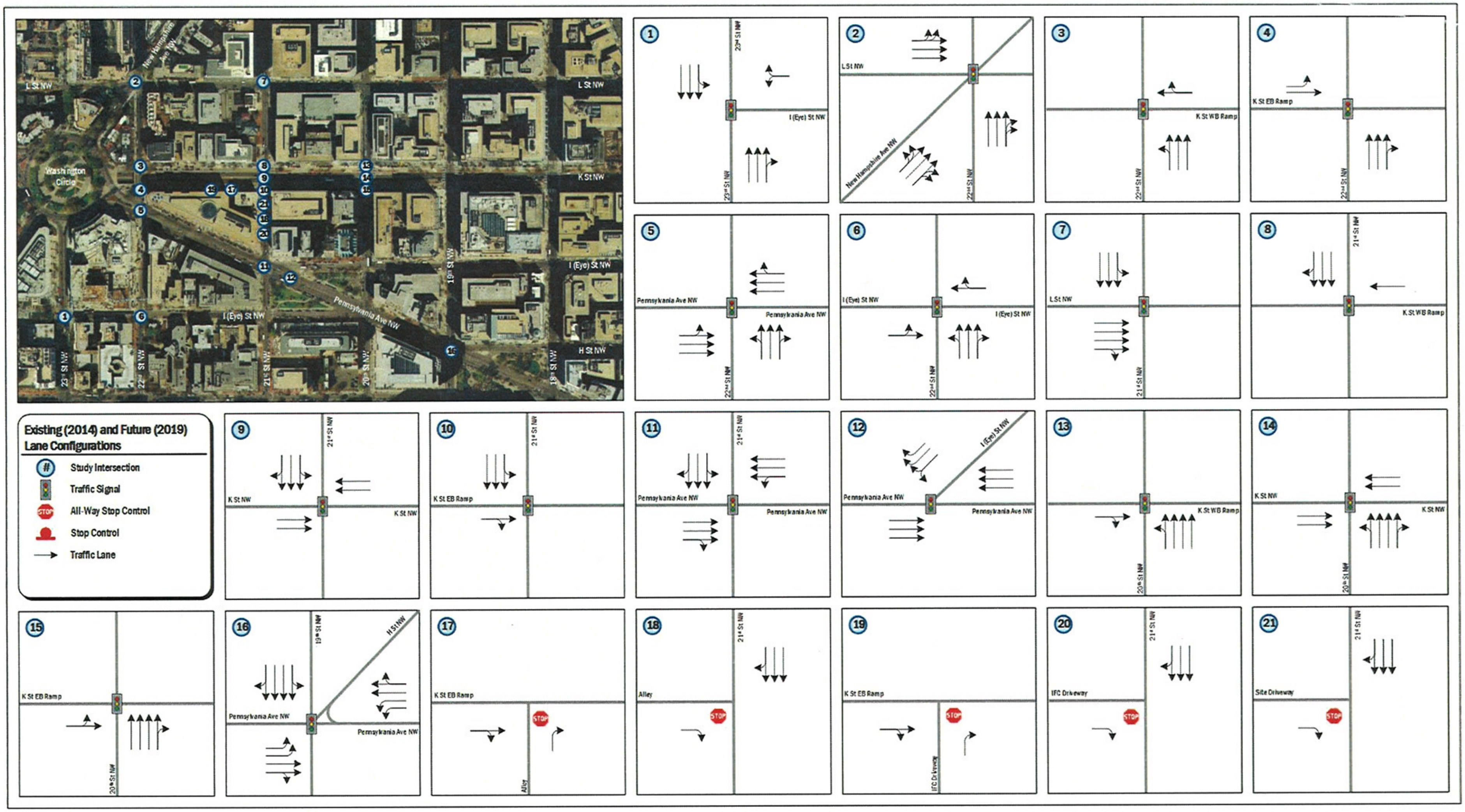


Figure 18: 2014 Existing and 2017 Background/Future Lane Configurations and Traffic Controls

**Table 15: Summary of Vehicular Capacity Analysis Assumptions**

| |
|---|
| **2014 Existing Conditions** |
| • Dates of data collection:<br>  ○ Tuesday, March 11, 2014<br>  ○ Wednesday, March 26, 2014<br>  ○ Thursday, March 27, 2014<br>  ○ Thursday, April 10, 2014<br>  ○ Wednesday, April 23, 2014<br>  ○ Counts taken from 6:30 – 9:30 AM and 4:00 – 7:00 PM<br>  ○ Count sheets in Technical Appendix<br>• System Peak: 8:30 – 9:30 AM, 5:00 – 6:00 PM<br>• Geometries and lane configurations based on existing conditions<br>• Signal timings/phasings/offsets provided by DDOT |
| **2019 Future Conditions without Development (2019 Background)** |
| • Background development included 2100 Pennsylvania Avenue, located south of PUD. Trip generation, mode split, and trip assignment information obtained from TIS performed by Wells + Associates, Inc. in September 2012<br>• Assumed background growth percentage of 0.5%/year, compounded annually, added to all volumes except those entering/existing driveways<br>• No roadway infrastructure or signal timing improvements assumed |
| **2019 Future Conditions with Development (2019 Future)** |
| • Site trip generation and mode split assumptions are detailed in Section 3.1<br>• Trip distribution for vehicles based on existing traffic volumes and travel patterns in the study area<br>• No external roadway infrastructure or signal timing changes assumed |

### *3.2.4 Vehicular Analysis Results*

Intersection capacity analyses were performed for the three scenarios outlined in Section 3.2.1 at the intersections contained within the study area during the morning and afternoon peak hours. *Synchro, Version 7.0* was used to analyze the study intersections based on the Highway Capacity Manual (HCM) methodology. The results of the capacity analyses are expressed in level of service (LOS) and delay (seconds per vehicle) for each approach. A LOS grade is a letter grade based on the average delay (in seconds) experienced by motorists traveling through an intersection. LOS results range from "A" being the best to "F" being the worst. LOS E is typically used as the acceptable LOS threshold in the District; although LOS F is sometimes accepted in urbanized areas. For the purpose of this analysis, LOS E was defined as unacceptable.

The LOS capacity analyses were based on: (1) the peak hour traffic volumes outlined in Section 3.2.2; (2) the lane use and traffic controls outlined in Section 3.2.3; and (3) the Highway Capacity Manual (HCM) methodologies (using *Synchro 7* software). The average delay of each approach and LOS is shown for the signalized intersections in addition to the overall average delay and intersection LOS grade. The HCM does not give guidelines for calculating the average delay for a two-way stop-controlled intersection, as the approaches without stop signs would technically have no delay. Detailed LOS descriptions and the analysis worksheets are contained in the Technical Appendix.

In addition to the capacity analyses presented above, a queuing analysis was performed at the study intersections. The queuing analysis was performed using the *Synchro 7.0* software. The 50$^{th}$ percentile and 95$^{th}$ percentile maximum queue lengths are shown for each lane group at the study area signalized intersections. The 50$^{th}$ percentile maximum queue is the maximum back of queue on a typical cycle. The 95$^{th}$ percentile queue is the maximum back of queue with 95$^{th}$ percentile traffic volumes. For unsignalized intersection, the 95th percentile queue is reported for each lane group (including free-flowing left turns and stop-controlled movements) based on the HCM calculations. Table 16 shows the results of the capacity analyses, including LOS and average delay per vehicle (in seconds) for the 2014 Existing and 2019 Background and Future scenarios. The capacity analysis results for the morning peak hour are shown on Figure 19 and for the afternoon peak hour are shown on Figure 20. Queuing results for the study intersection are shown in Table 17.

Generally speaking, the proposed development is considered to have an impact at an intersection within the study area if the capacity analyses show an LOS E or F at an intersection or along an approach in the future conditions with the proposed development where one does not exist in the future conditions without the proposed development. As shown in Table 16, the majority of the study are intersections operate under acceptable conditions during the morning and afternoon peak hours. However, the northeastbound approach of New Hampshire Avenue NW at the intersection with 22nd Street NW and L Street NW operates under unacceptable conditions during the morning peak hour for all scenarios. This failing approach also causes the overall intersection to operate under unacceptable conditions during the morning peak hour for all scenarios. In the afternoon peak hour, the westbound K Street ramp at 22nd Street NW operates under unacceptable conditions for all scenarios.

It is recommended that signal timing improvements be investigated at these intersections, including the 3-intersection cluster of 22nd Street with the K Street ramps and with Pennsylvania Avenue NW, outside the scope of this study. Table 18 shows the capacity analysis results following the optimization of the signal timings and offsets. Table 19 shows the queuing results following the recommendations outlined above.

As noted above, the proposed development is considered to have a detrimental impact at an intersection if the capacity analyses show an LOS E or F at an intersection in the future conditions with the proposed development where one does not exist in the future conditions without the proposed development. As shown in Table 16, the proposed 2100 K Street PUD will not have a detrimental impact at any of the study area intersections.

**Table 16: Peak Hour Capacity Analysis Results**

| Intersection | Approach | Existing Conditions (2014) | | | | Future Background Conditions (2019) | | | | Total Future Conditions (2019) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | AM Peak Hour | | PM Peak Hour | | AM Peak Hour | | PM Peak Hour | | AM Peak Hour | | PM Peak Hour | |
| | | Delay | LOS | Delay | LOS | Delay | LOS | Delay | LOS | Delay | LOS | Delay | LOS |
| **23rd St NW & I (Eye) St NW** | **Overall** | **10.2** | **B** | **13.8** | **B** | **10.5** | **B** | **14.1** | **B** | **10.5** | **B** | **14.2** | **B** |
| | Westbound | 32.0 | C | 52.3 | D | 31.8 | C | 52.1 | D | 31.8 | C | 52.3 | D |
| | Northbound | 9.5 | A | 8.1 | A | 9.7 | A | 8.2 | A | 9.8 | A | 8.2 | A |
| | Southbound | 9.0 | A | 10.6 | B | 9.4 | A | 10.9 | B | 9.4 | A | 10.9 | B |
| **22nd St NW, L St NW, & New Hampshire Ave NW** | **Overall** | 76.2 | E | **30.8** | **C** | 80.8 | F | **30.9** | **C** | 80.6 | F | **31.0** | **C** |
| | Eastbound | 26.5 | C | 30.7 | C | 26.9 | C | 31.1 | C | 27.0 | C | 31.1 | C |
| | Northbound | 18.0 | B | 19.5 | B | 18.6 | B | 19.1 | B | 18.6 | B | 19.4 | B |
| | Northeastbound | 204.6 | F | 43.2 | D | 218.9 | F | 43.6 | D | 218.9 | F | 43.6 | D |
| **22nd St NW & K St WB Ramp** | **Overall** | **13.9** | **B** | **41.1** | **D** | **14.4** | **B** | **43.5** | **D** | **14.3** | **B** | **42.8** | **D** |
| | Westbound | 35.0 | D | 76.4 | E | 36.4 | D | 82.0 | F | 36.4 | D | 82.0 | F |
| | Northbound | 1.2 | A | 0.5 | A | 1.2 | A | 0.6 | A | 1.2 | A | 0.5 | A |
| **22nd St NW & K St EB Ramp** | **Overall** | **12.2** | **B** | **10.6** | **B** | **12.1** | **B** | **10.2** | **B** | **12.8** | **B** | **10.4** | **B** |
| | Eastbound | 16.3 | B | 20.2 | C | 16.4 | B | 20.3 | C | 16.9 | B | 20.4 | C |
| | Northbound | 9.1 | A | 5.7 | A | 9.0 | A | 5.4 | A | 9.8 | A | 5.8 | A |
| **22nd St NW & Pennsylvania Ave NW** | **Overall** | **15.8** | **B** | **24.0** | **C** | **15.8** | **B** | **23.7** | **C** | **16.1** | **B** | **23.8** | **C** |
| | Eastbound | 8.5 | A | 12.4 | B | 8.6 | A | 12.4 | B | 8.6 | A | 12.4 | B |
| | Westbound | 12.1 | B | 35.4 | D | 12.0 | B | 35.6 | D | 12.6 | B | 35.5 | D |
| | Northbound | 41.1 | D | 19.3 | B | 40.5 | D | 18.8 | B | 40.6 | D | 18.8 | B |
| **22nd St NW & I (Eye) St NW** | **Overall** | **21.6** | **C** | **18.1** | **B** | **21.9** | **C** | **20.3** | **C** | **22.2** | **C** | **20.3** | **C** |
| | Eastbound | 12.6 | B | 13.1 | B | 14.5 | B | 13.3 | B | 15.0 | B | 13.4 | B |
| | Westbound | 8.8 | A | 17.5 | B | 9.0 | A | 22.5 | C | 9.0 | A | 22.6 | C |
| | Northbound | 34.4 | C | 23.7 | C | 34.6 | C | 23.8 | C | 34.7 | C | 23.8 | C |
| **21st St NW & L St NW** | **Overall** | **23.6** | **C** | **20.8** | **C** | **23.8** | **C** | **21.1** | **C** | **23.8** | **C** | **21.2** | **C** |
| | Eastbound | 24.5 | C | 13.4 | B | 24.6 | C | 13.6 | B | 24.6 | C | 13.6 | B |
| | Southbound | 22.1 | C | 25.8 | C | 22.4 | C | 26.2 | C | 22.5 | C | 26.2 | C |
| **21st St NW & K St WB** | **Overall** | **27.3** | **C** | **29.0** | **C** | **27.7** | **C** | **29.5** | **C** | **28.2** | **C** | **29.5** | **C** |
| | Westbound | 10.5 | B | 27.0 | C | 10.8 | B | 27.1 | C | 10.8 | B | 27.1 | C |
| | Southbound | 35.3 | D | 29.3 | C | 36.1 | D | 29.8 | C | 36.5 | D | 29.9 | C |
| **21st St NW & K St NW** | **Overall** | **8.9** | **A** | **19.9** | **B** | **8.9** | **A** | **20.0** | **C** | **8.8** | **A** | **20.0** | **B** |
| | Eastbound | 12.5 | B | 17.6 | B | 12.6 | B | 17.7 | B | 12.6 | B | 17.7 | B |
| | Westbound | 9.6 | A | 35.9 | D | 9.6 | A | 36.2 | D | 9.6 | A | 36.2 | D |
| | Southbound | 3.3 | A | 3.7 | A | 3.3 | A | 3.7 | A | 3.3 | A | 3.7 | A |
| **21st St NW & K St EB** | **Overall** | **7.2** | **A** | **6.3** | **A** | **7.3** | **A** | **6.6** | **A** | **8.4** | **A** | **6.9** | **A** |
| | Eastbound | 10.2 | B | 15.5 | B | 10.8 | B | 16.2 | B | 13.1 | B | 17.0 | B |
| | Southbound | 5.3 | A | 2.8 | A | 5.2 | A | 2.7 | A | 5.0 | A | 2.7 | A |