Sketch Level Assessment

of Traffic Issues

for the Fluor Daniel I-495 HOT Lane Proposal

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Introduction

Fluor Daniel has proposed to the Virginia Department of Transportation (VDOT) under Virginia's Public-Private Transportation Act (PPTA) the construction of High-Occupancy Toll (HOT) lanes along 13.3 miles of the Capital Beltway (I-495) between the Springfield Interchange and Georgetown Pike. The project is intended to have a "4-2-2-4" configuration, with four general purpose lanes and two HOT lanes per direction, and variable tolling based on the time of day, with higher tolls during peak traffic periods. Vehicles with three or more people will be permitted to use the HOT lanes free of charge.

Key to the financial analysis for this proposal is the estimation of traffic volumes on the HOT lane facility. Since high-occupancy vehicles with three or more passengers (HOV3+) will be free of charge, these vehicles will be using some of the HOT-lane capacity without contributing to revenues for the facility, thereby reducing the capacity available for paying customers and limiting the total revenue available to support the project. The other key factors influencing revenue availability are the time savings and other service attributes available to paying customers relative to travel on the eight conventional Beltway lanes. Paying customers will have to be convinced that the value of traveling on the HOT lanes relative to the conventional lanes is worth the toll. If potential paying customers are using the Beltway for only a short portion of their trips, of if they encounter significant delays entering or exiting the HOT lanes, they may choose to stay in the conventional lanes rather than paying the toll and contributing to revenues.

In a technical memorandum to Fluor Daniel dated April 22, 2004, in response to a letter from VDOT dated April 13, 2004, Gerald Nielsten of Vollmer Associates provides estimates of total and toll-paying traffic volumes on the proposed HOT lanes for 2005 and 2015, along with annual revenue estimates for 2005 through 2025. Vollmer's estimates were developed using MINUTP traffic models obtained from the National Capital Region Transportation Planning Board (TPB) of the Metropolitan Washington Council of Governments (MWCOG) in 1997 (now known as the TPB's Version 1 model) and MWCOG's Round 5.3 land use forecasts.

The TPB's Version 1 model used by Vollmer produces traffic forecasts for a 24-hour period on an average weekday. However, TPB's current model, Version 2.1C, produces traffic volumes by three periods of the day (am-peak, pm-peak, and off-peak). The most recent application of this model which has received federal approval was for the 2003 update to the Constrained Long Range Plan (CLRP) and the FY2004-2009 Transportation Improvement Program (TIP), using MWCOG's Round 6.3 land use forecasts. This analysis was conducted for the milestone years 2005, 2015, 2025 and 2030, and provides a more recent source of travel forecasts than that used by Vollmer.

In response to a request by VDOT, TPB staff has conducted a sketch level assessment of traffic issues for the Fluor Daniel I-495 HOT lane proposal using the Version 2.1C model with MWCOG's Round 6.3 land use forecasts. The assessment focuses on the 2015 milestone year, and analyzes selected links along the 13.3 mile segment of the Beltway from the Springfield Interchange to the American Legion Bridge.

The highway and transit networks included in this TPB staff analysis reflect the adopted Constrained Long Range Plan (CLRP) for 2015, which includes some significant new facilities for both HOV and transit relative to the current network. In particular, the CLRP includes a single HOV "diamond lane" in each direction along this section of the Beltway, with direct ramp connections at the Springfield Interchange and at the Dulles corridor. Entry and exit for this HOV lane is permitted all along the corridor, as is the case, for example, along I-66 outside the Beltway and along I-270 in Maryland. Rail transit along the Dulles corridor is also included to Dulles Airport and beyond into Loudoun County.

The TPB analysis differs from the Vollmer analysis with respect to the modeling, the land use forecasts, and the network improvements assumed by 2015. It provides another perspective on the likely traffic issues related to the HOT lane proposal, which hopefully will be of value to both Fluor Daniel and VDOT as consideration of the Fluor Daniel proposal proceeds.

Overview of Sketch Assessment

As shown in Figure 1, there are eleven segments of freeway on I-495 between the Springfield Interchange and the American Legion Bridge. TPB staff conducted an analysis of these eleven selected links on the inner loop of the Beltway (proceeding in a clockwise direction) for the three time periods forecast by the TPB's Version 2.1C model. The model produces forecasts of HOV3+ traffic in the HOV lane as well as the traffic in the conventional lanes, described here as low-occupancy (LOV) traffic. (For the year 2015, all HOV facilities in the Washington region are assumed to be operating with an HOV3+ designation.)

With regard to LOV traffic, Tables 1, 2, 3, and 4 provide estimates of traffic on each of the eleven segments on the inner loop of the Beltway for the am- and pm-peak periods, the off-peak period, and for the entire 24-hour day. (The totals on these tables include multiple counting of vehicles that use two or more segments of the Beltway).

Figure 2, 3, 4, and 5 provide bar charts showing the percentages of LOV trips which use the Beltway for the various numbers of contiguous segments traveled (one through eleven). The percentage of LOV traffic estimated to pass through all eleven segments in 2015 ranges from 2.5 percent to 4 percent, depending on the time period. Nearly 25 percent of the traffic in each of the three time periods would use only one freeway segment; that is, this traffic is using the Beltway to shift from one radial corridor to another. An additional 15 percent to 25 percent of the traffic (depending upon time of day) would use only two contiguous freeway segments.

The Vollmer analysis projects HOT lane traffic in which "the average trip travels slightly more than two segments," which suggests HOT lane trip patterns similar to those currently projected by TPB staff for the conventional lanes. This raises the question of how many potential paying customers will be willing to pay a toll, assumed by Vollmer to be 20 cents per mile in 2015, to use the HOT lanes for a relatively short distance of perhaps two to three miles. To make this choice travelers would not be prepared to accept much in the way of additional access and egress times to the HOT lanes, and would need some significant time savings to justify the switch to the HOT lanes. The difference in time consumed traveling at 60 mph rather than 30 mph, for example, is one minute per mile, or 2.5 minutes for a 2.5 mile segment. At 20

cents per mile, a 2.5 mile segment would cost a traveler 50 cents for a 2.5 minute savings. By comparison, trips utilizing the entire 13.3 miles of the Beltway would gain 13.3 minutes of time savings at one minute per mile for a cost of $2.66.

Figures 6 through 10 illustrate the patterns of origins and destinations for LOV trips for various segments of the inner loop of the Beltway. What is striking about these figures is that these origins and destinations are concentrated in areas relatively close to the Beltway, further emphasizing that a high proportion of the LOV trips on the Beltway are relatively short trips that will experience at best only a few minutes of time savings from use of the HOT lanes. Just how many of these travelers will be paying customers depends on access and egress times, as well as congestion levels in the conventional lanes.

The HOV3+ volumes forecast for 2015 in the single diamond lanes gives some indication of the likely space requirements for these non-paying customers. HOV3+ usage varies by direction as well as by time of day. In the am-peak, usage on the inner loop builds up from Springfield toward Tysons Corner, while the outer loop builds up towards Tysons Corner from the American Legion Bridge. The heaviest HOV3+ volumes in the am-peak approach 1000 vehicles per hour for the single diamond lane, without any direct access ramps into Tysons Corner. In the pm-peak the HOV3+ flow pattern is the reverse of the am-peak and generally heavier, approaching 1600 vehicles per hour in the single lane in some sections, again without any direct connections into Tysons Corner.

While HOV3+ speeds in 2015 average 65 mph or above throughout the HOV facility, LOV speeds on the conventional lanes vary substantially by period and direction. In the am-peak LOV speeds in both directions drop to the 20-30 mph range in the vicinity of Tysons Corner and are even lower near the American Legion Bridge. However, LOV speeds are in the 30 to 60 mph range on the other segments, depending on direction. There is more congestion during the pm-peak than the am-peak, with speeds at 25 mph or below in both directions and in various locations throughout the corridor. During the off-peak period, speeds generally range from 30 mph to 50 mph in both directions throughout the corridor, with the exception of the vicinity of the American Legion Bridge where they drop below 20 mph at some times of the day.

Conclusion

The TPB forecasts for 2015 using the Version 2.1C model, Round 6.3 land use forecasts, and the 2003 CLRP show a high proportion of LOV trips being relatively short and using relatively few of the eleven Beltway segments. Congestion on the conventional lanes varies significantly by direction and time of day, being severe at certain times and locations and quite moderate at other times and locations.

HOV3+ usage of the single diamond lanes in each direction included in the 2003 CLRP is fairly heavy at certain times and locations, and less heavy but still significant at other times and locations. This usage reflects direct ramp connections at the Springfield Interchange and the Dulles Corridor, but no direct connections into Tysons Corner. HOV3+ usage is heaviest in locations close to Tysons Corner, and could be expected to increase significantly with direct

connections into Tysons Corner and other activity centers along the corridor. HOV3+ volumes of 1600 vehicles per hour or more could be expected in the heaviest directions and locations, requiring about half of the optimal capacity of 3400 vehicles per hour established by Vollmer for the two-lane HOT facility.

This TPB sketch level assessment suggests that the 13.3 miles of the Capital Beltway between the Springfield Interchange and the American Legion Bridge is a complex corridor, with travel demand very largely driven by regional development patterns relatively close to or along the corridor. For HOV3+ vehicles, demand will be greatly affected by the degree of connectivity provided between proposed HOV lanes on the corridor and other existing HOV facilities on I-95, I-395, I-66, and the Dulles Corridor, as well as to development centers along the corridor like Tysons Corner. Potential new priced lanes under consideration for the Beltway in Maryland add another dimension to the complexity and uncertainty.

Demand studies have been conducted for this Beltway corridor by Vollmer and by other agencies as part of the Beltway EIS using an earlier version of the TPB model (Version 1) and earlier rounds of the MWCOG land use forecasts. The general patterns reported in these studies are similar to those found in the TPB analysis, and paint a similar picture of the evolving traffic conditions in the corridor.

None of the studies conducted to date of the HOT lane proposal, including the TPB analysis, has undertaken any detailed sensitivity analyses to test the effects of different connections between HOV facilities; of direct connections into activity centers like Tysons Corner; of different locations and types of access and egress to the HOT lane facility along the corridor; or of different levels of bus services on the HOT lanes. The complexity of the demand patterns for both LOV and HOV3+ reported in this TPB analysis suggests that these kinds of sensitivity analyses could reveal significantly different levels of demand for the HOT lanes by both LOV and HOV3+ vehicles depending on the configuration chosen. This greatly complicates the financial analysis compared, for example, to a corridor like SR91 in California which is a relatively simple configuration with few entry and exit points over a ten-mile stretch.

The likely sensitivity of levels of HOT lane demand, and in turn paying customers, to different design and policy parameters along this corridor argues for an approach which clearly delineates the policy and design framework within which Fluor Daniel is expected to shape its final proposal. Consideration should be given to establishing a process for amending this framework, which would allow for renegotiation with Fluor Daniel over time. The option of adding connectivity to the I-95/I-395 HOV lanes through phase 8 of the Springfield Interchange, for example, may greatly affect HOV3+ demand, and should be explicitly addressed as part of the initial framework or as a potential amendment. Potential direct connectivity of the HOT lanes to additional HOV facilities such as I-66, or into activity centers like Tysons Corner, should also be addressed explicitly, as should levels of bus service on the HOT lanes.

One change in the current policy framework which might reduce much of the complexity and simplify the financial analysis would be to allow Fluor Daniel to assume that <u>all</u> vehicles using the HOT lanes would pay the variable tolls by time of day, and that any discounts for HOV3+ or buses would be handled through a separate arrangement which in effect would

"reimburse" those vehicles for part or all of the toll. This could be done, for example, with the use of special identifying transponders at entry and exit points and selective visual inspection and photo-enforcement at these points. This approach could eliminate the need for police enforcement along the facility; relieve Fluor Daniel of the need to forecast different vehicle occupancies separately; remove the current disincentive to Fluor Daniel for serving non-paying users like HOV3+; and allow for selective point to point discounts for certain vehicle types which could be adjusted as appropriate over time. This approach would also lay the groundwork for compatibility with potential new toll lanes on the Beltway and other facilities in Maryland, where current proposals for "Express Toll Lanes" would involve collecting tolls from all vehicles.

Article 3.1 "High Occupancy Toll Lanes" of HB151 provides that:

> "Emergency vehicles, law-enforcement vehicles using HOT lanes in the performance of their duties, and transit and commuter buses shall meet the high-occupancy requirement for HOT lanes, regardless of the number of occupants in the vehicle;" and
>
> "The high-occupancy requirement for a HOT lanes facility constructed as a result of the Public-Private Transportation Act (§56-556 et seq.) shall not be less than three."

These provisions appear to provide a good starting point for a calibrated approach to HOV eligibility on HOT lanes like that suggested above.

Fluor Daniel has presented a creative proposal for the financing, construction and operation of additional lanes on a heavily traveled portion of the Beltway in Northern Virginia. This TPB sketch level assessment of traffic issues related to the Fluor Daniel proposal highlights the complexity of the forecasted demand patterns for 2015 by vehicle occupancy, direction, and time of day, and the likely high sensitivity of LOV and HOV3+ demand and associated toll revenues to different design and policy parameters along the corridor. Careful consideration needs to be given to these demand sensitivities as more detailed review of the Fluor Daniel proposal proceeds.

Figure 1
11 Freeway Segments Analyzed

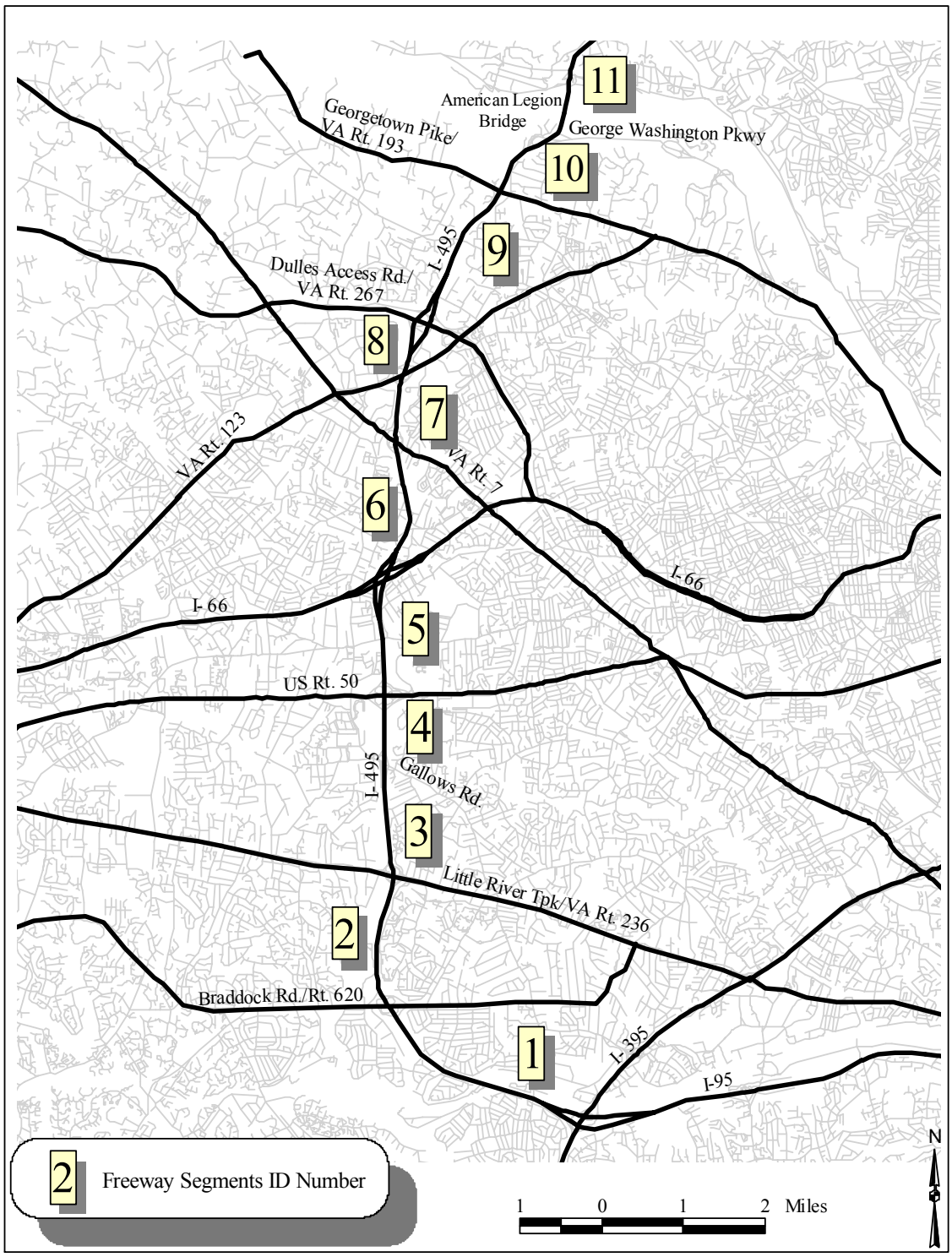
11
American Legion Bridge
George Washington Pkwy
Georgetown Pike/ VA Rt. 193
10
9
I-495
Dulles Access Rd./ VA Rt. 267
8
7
VA Rt. 123
VA Rt. 7
6
I-66
I-66
5
US Rt. 50
4
I-495
Gallows Rd.
3
Little River Tpk/VA Rt. 236
2
Braddock Rd./Rt. 620
1
I-395
I-95
N
2 Freeway Segments ID Number
1 0 1 2 Miles

Table 1
Estimated 2015 A.M. Period
LOV Traffic using the
Inner Loop of the Capital Beltway

Seg. ID No.	Location	AM Peak Period 6:00 AM - 9:00 AM
1	I-395 - Braddock Rd./Rt. 620	15,400
2	Braddock Rd./Rt. 620 - Little River Turnpike/VA 236	16,500
3	Little River Turnpike/VA 236 - Gallows Rd.	16,700
4	Gallows Rd. - US Rt. 50	16,800
5	US Rt. 50 - I-66	13,800
6	I-66 - VA Rt. 7	20,500
7	VA Rt. 7 - VA Rt. 123	14,900
8	VA Rt. 123 - Dulles Access Rd./VA Rt. 267	13,500
9	Dulles Access Rd./VA Rt. 267 - Georgetown Pike/VA Rt. 193	16,800
10	Georgetown Pike/VA Rt. 193 - George Washington Parkway	22,000
11	George Washington Parkway - American Legion Bridge	22,000
	Total	**188,900**

Table 2
Estimated 2015 P.M. Period
LOV Traffic using the
Inner Loop of the Capital Beltway

Seg. ID No.	Location	PM Peak Period 4:00 PM - 7:00 PM
1	I-395 - Braddock Rd./Rt. 620	21,100
2	Braddock Rd./Rt. 620 - Little River Turnpike/VA 236	18,500
3	Little River Turnpike/VA 236 - Gallows Rd.	18,800
4	Gallows Rd. - US Rt. 50	16,000
5	US Rt. 50 - I-66	16,900
6	I-66 - VA Rt. 7	20,000
7	VA Rt. 7 - VA Rt. 123	17,000
8	VA Rt. 123 - Dulles Access Rd./VA Rt. 267	18,300
9	Dulles Access Rd./VA Rt. 267 - Georgetown Pike/VA Rt. 193	19,900
10	Georgetown Pike/VA Rt. 193 - George Washington Parkway	22,800
11	George Washington Parkway - American Legion Bridge	24,300
	Total	**213,600**

Table 3

Estimated 2015 Off-Peak Period

LOV Traffic using the

Inner Loop of the Capital Beltway

Seg. ID No.	Location	Off-Peak Hours
1	I-395 - Braddock Rd./Rt. 620	55,500
2	Braddock Rd./Rt. 620 - Little River Turnpike/VA 236	54,800
3	Little River Turnpike/VA 236 - Gallows Rd.	55,300
4	Gallows Rd. - US Rt. 50	51,900
5	US Rt. 50 - I-66	53,100
6	I-66 - VA Rt. 7	55,500
7	VA Rt. 7 - VA Rt. 123	46,000
8	VA Rt. 123 - Dulles Access Rd./VA Rt. 267	45,400
9	Dulles Access Rd./VA Rt. 267 - Georgetown Pike/VA Rt. 193	48,300
10	Georgetown Pike/VA Rt. 193 - George Washington Parkway	53,700
11	George Washington Parkway - American Legion Bridge	56,100
	Total	**575,600**

Table 4

Estimated 2015 Daily

LOV Traffic using the

Inner Loop of the Capital Beltway

Seg. ID No.	Location	Daily 24 hours
1	I-395 - Braddock Rd./Rt. 620	92,000
2	Braddock Rd./Rt. 620 - Little River Turnpike/VA 236	89,800
3	Little River Turnpike/VA 236 - Gallows Rd.	90,800
4	Gallows Rd. - US Rt. 50	84,800
5	US Rt. 50 - I-66	83,800
6	I-66 - VA Rt. 7	96,000
7	VA Rt. 7 - VA Rt. 123	77,900
8	VA Rt. 123 - Dulles Access Rd./VA Rt. 267	77,200
9	Dulles Access Rd./VA Rt. 267 - Georgetown Pike/VA Rt. 193	84,900
10	Georgetown Pike/VA Rt. 193 - George Washington Parkway	98,600
11	George Washington Parkway - American Legion Bridge	102,300
	Total	**978,100**

Figure 2
Frequency of LOV Trips
by the Number of Contiguous Segments
Traveled on the Capital Beltway

Period: A.M. (6:00 A.M. -9:00 A.M.)

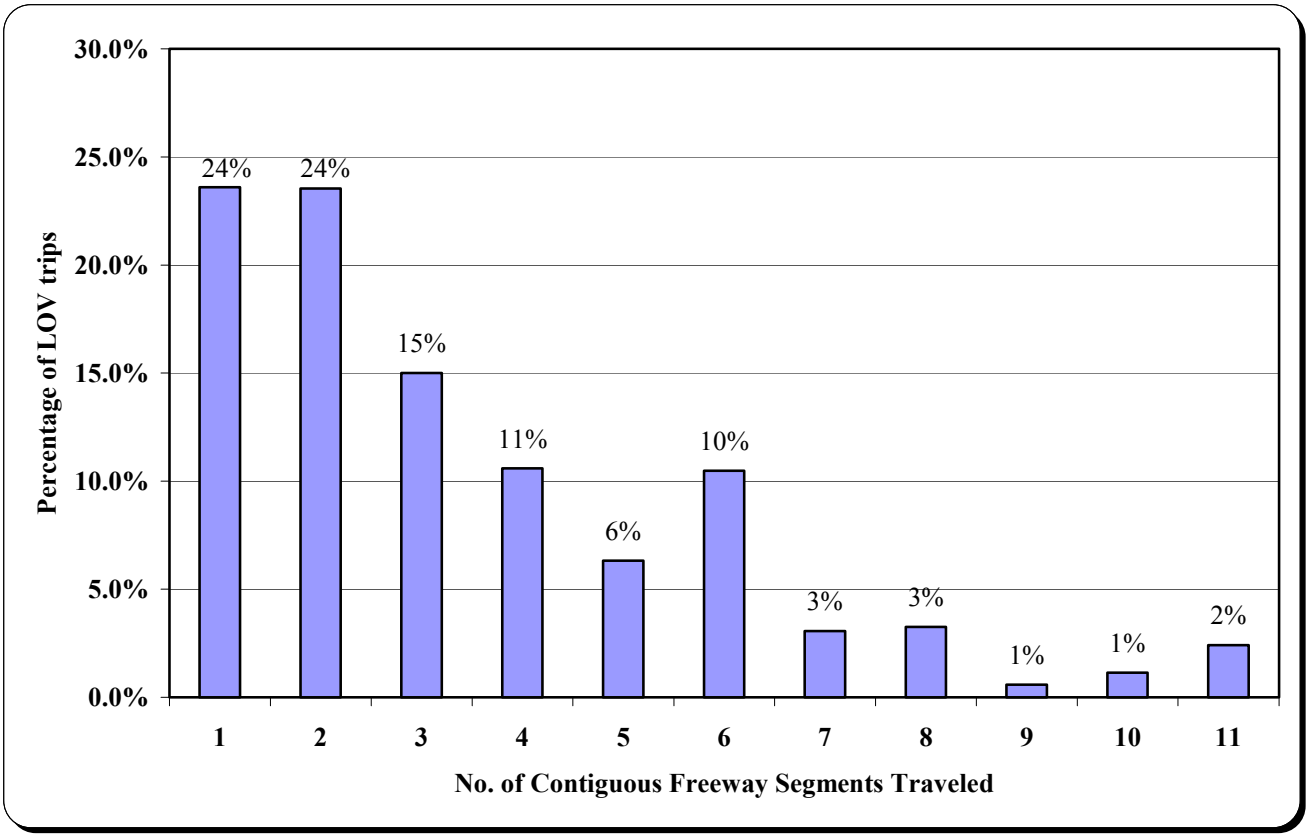

Figure 3
Frequency of LOV Trips
by the Number of Contiguous Segments
Traveled on the Capital Beltway

Period: P.M. (4:00 P.M. -7:00 P.M.)

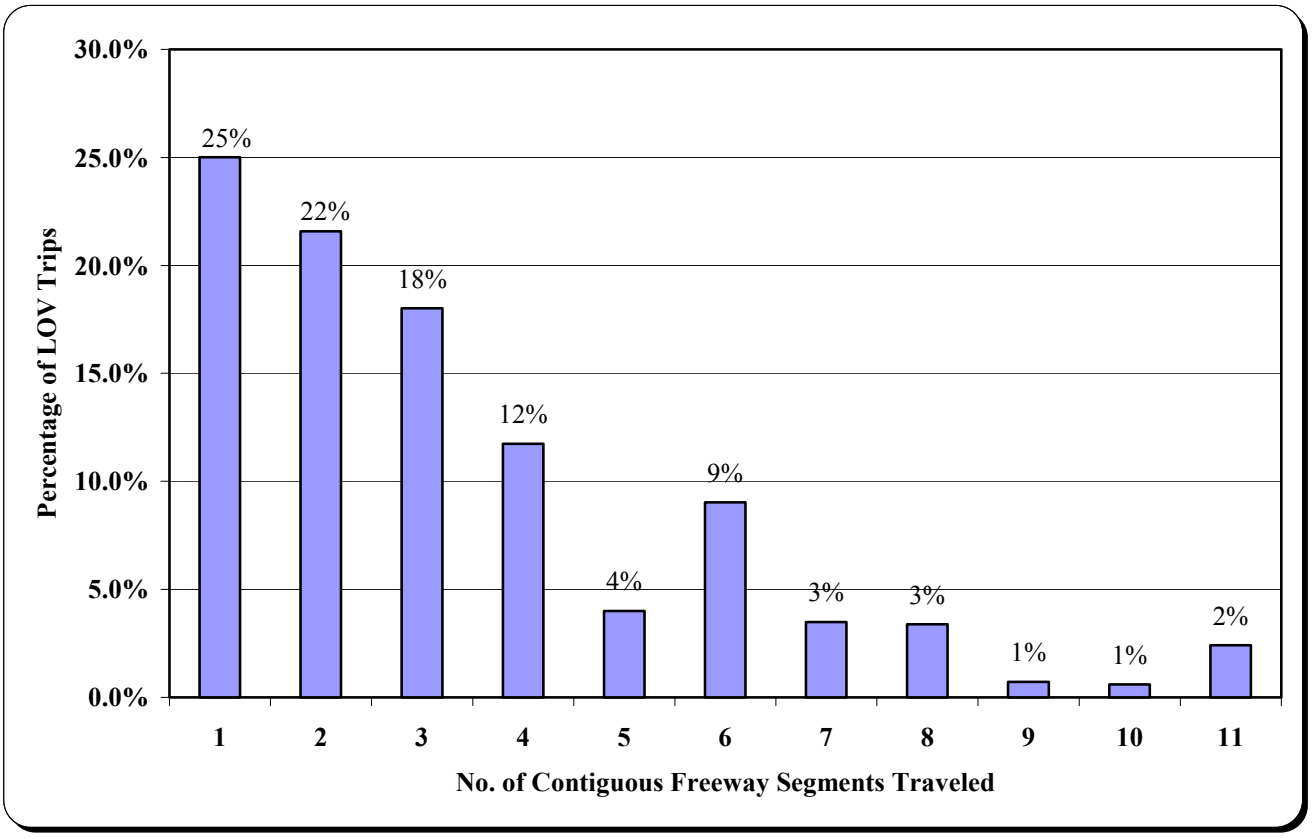

Figure 4
Frequency of LOV Trips
by the Number of Contiguous Segments
Traveled on the Capital Beltway

Period: Off-Peak Hours

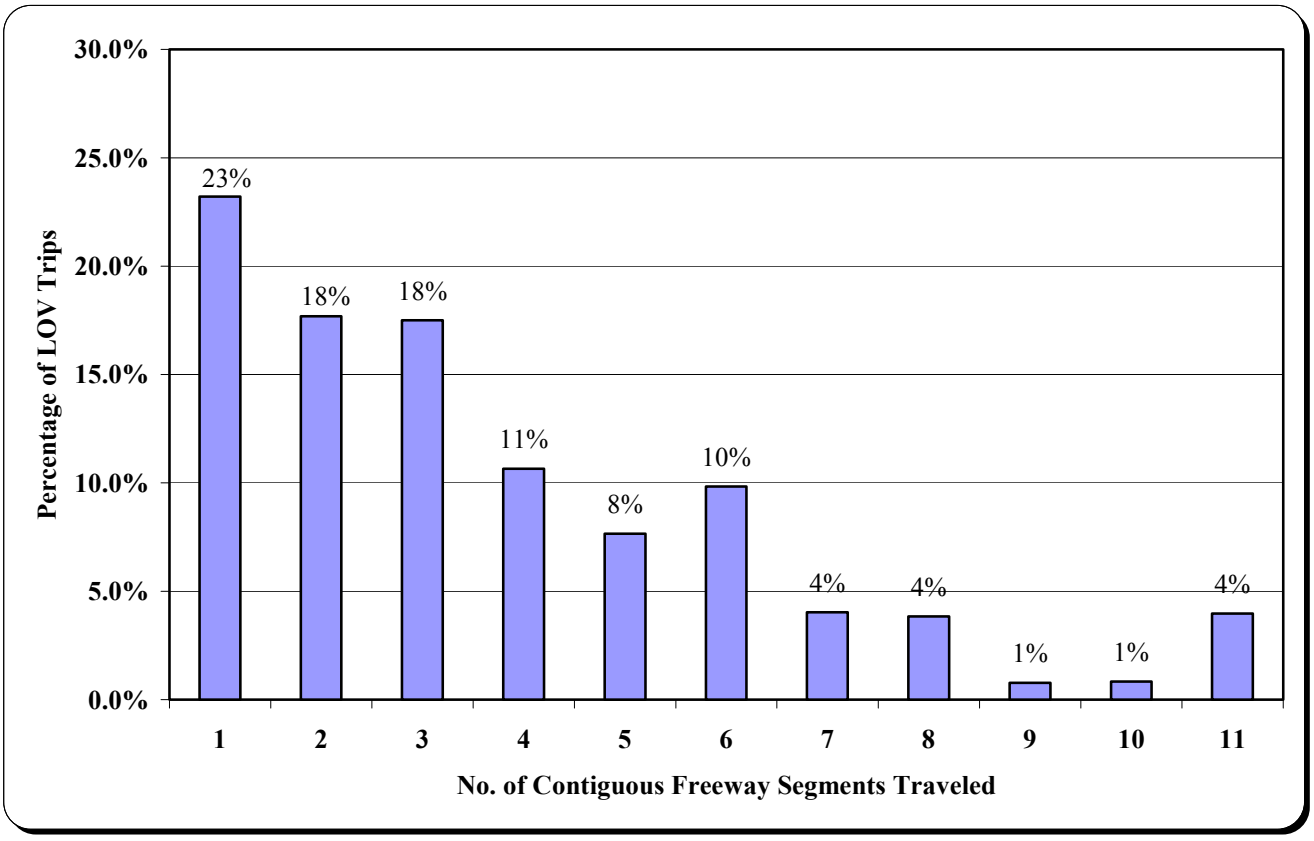

Figure 5
Frequency of LOV Trips
by the Number of Contiguous Segments
Traveled on the Capital Beltway

Period: Daily - 24 Hours

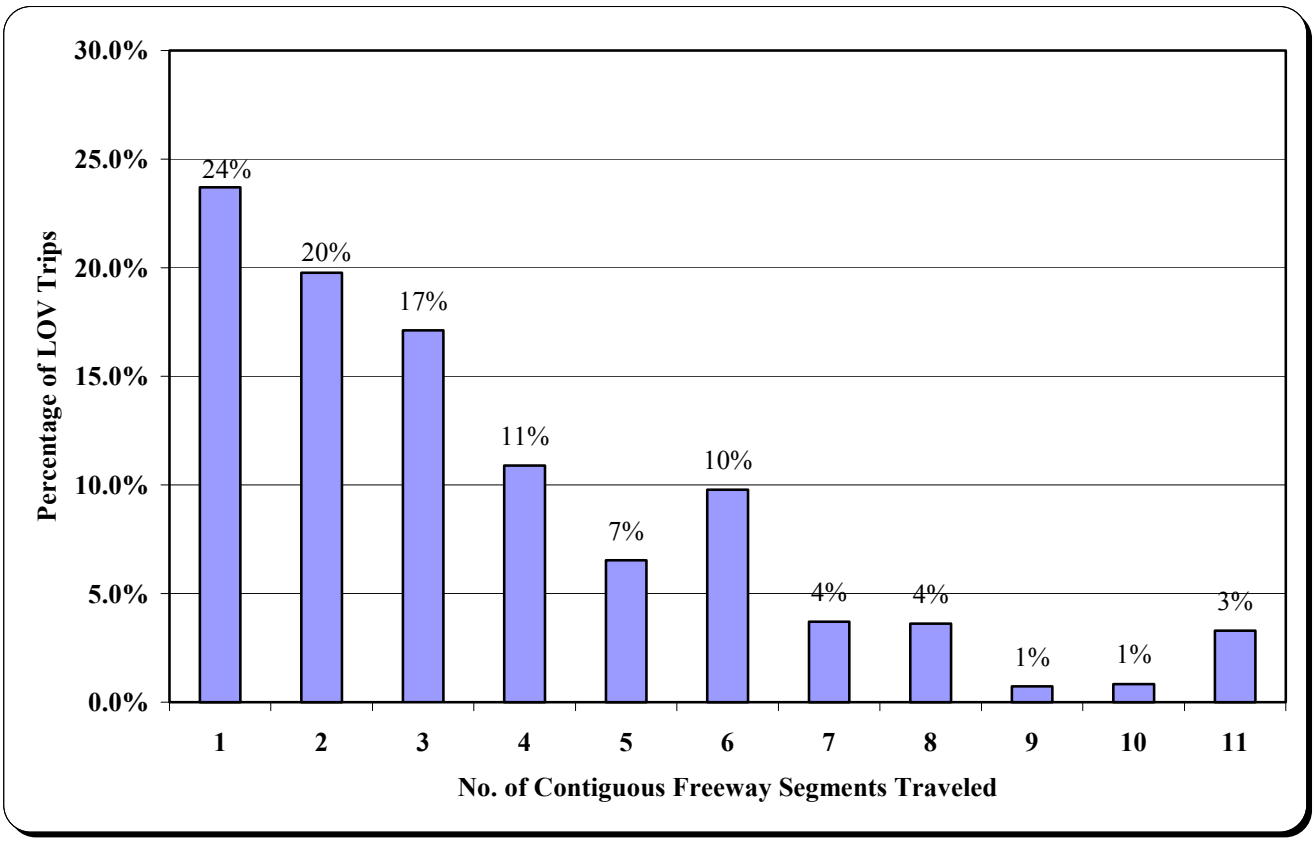

Figure 6
2015 LOV AM Trip Origins
Using the Capital Beltway Inner Loop
between I-395 (Springfield Interchange) and Rt. 620 (Braddock Road)

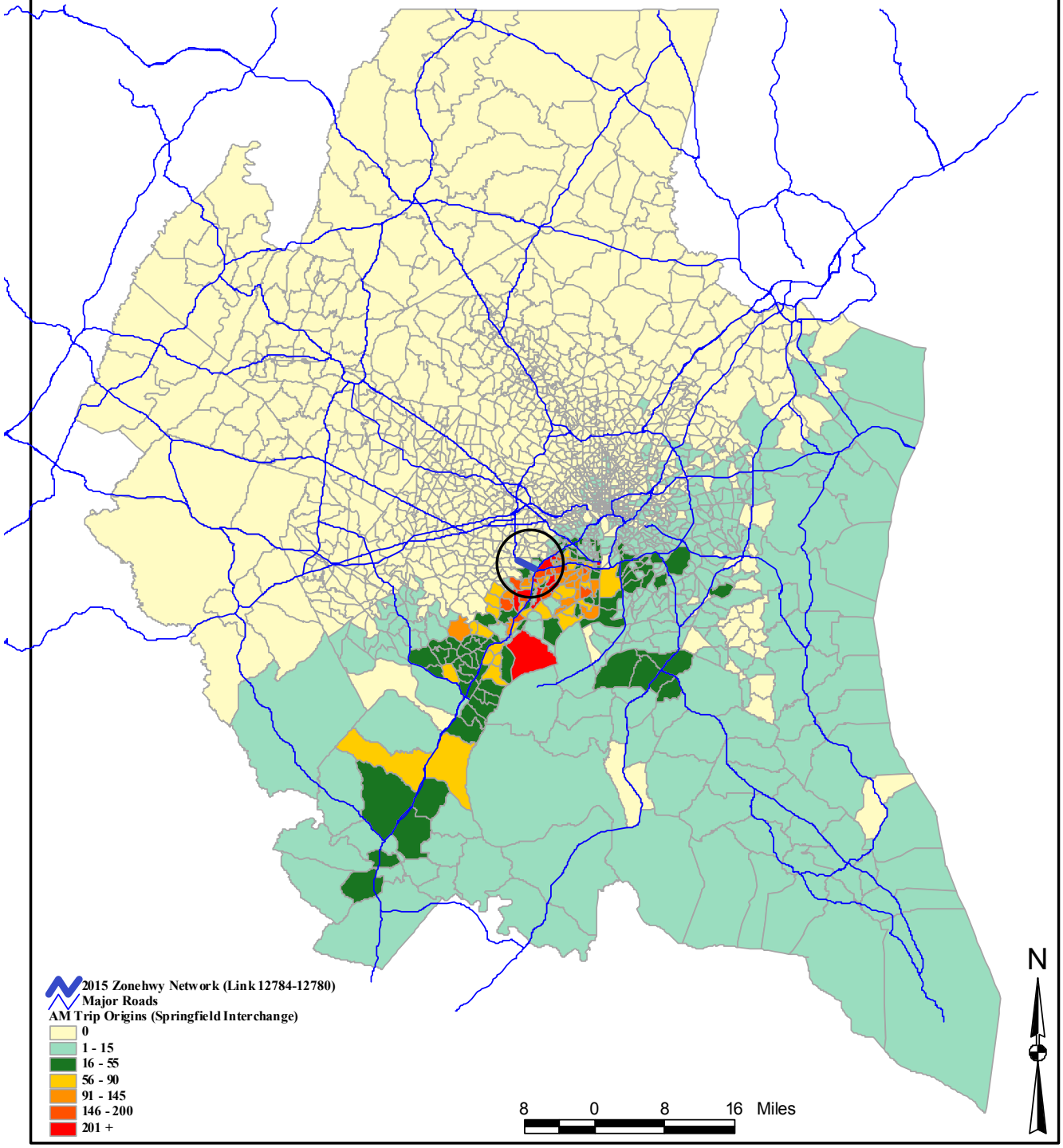

Figure 7
2015 LOV AM Trip Destinations
Using the Capital Beltway Inner Loop
between I-395 (Springfield Interchange) and Rt. 620 (Braddock Road)

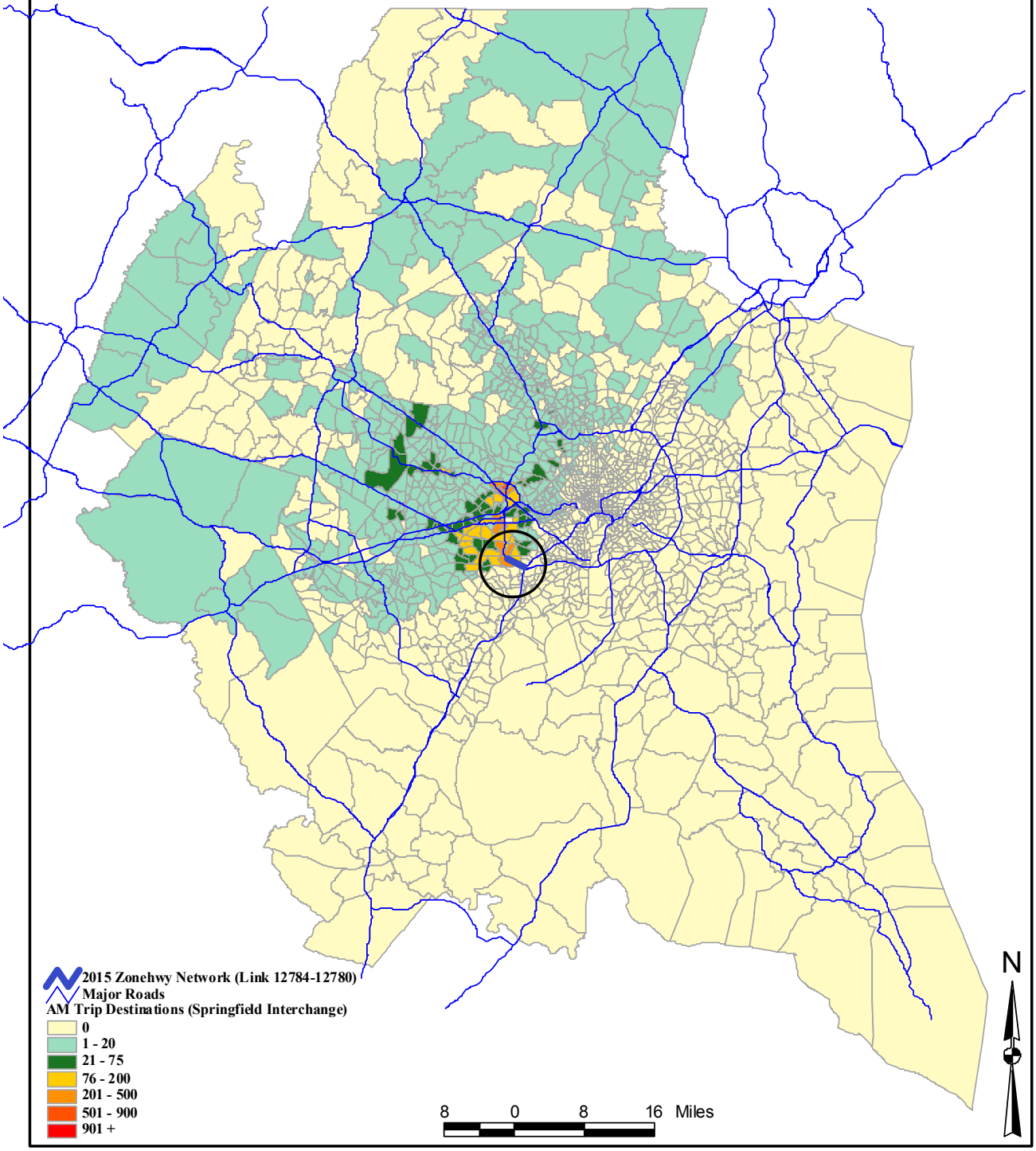

Figure 8
2015 LOV AM Trip Origins
Using the Capital Beltway Inner Loop
between I-66 and VA Rt. 7 (Tysons Corner)

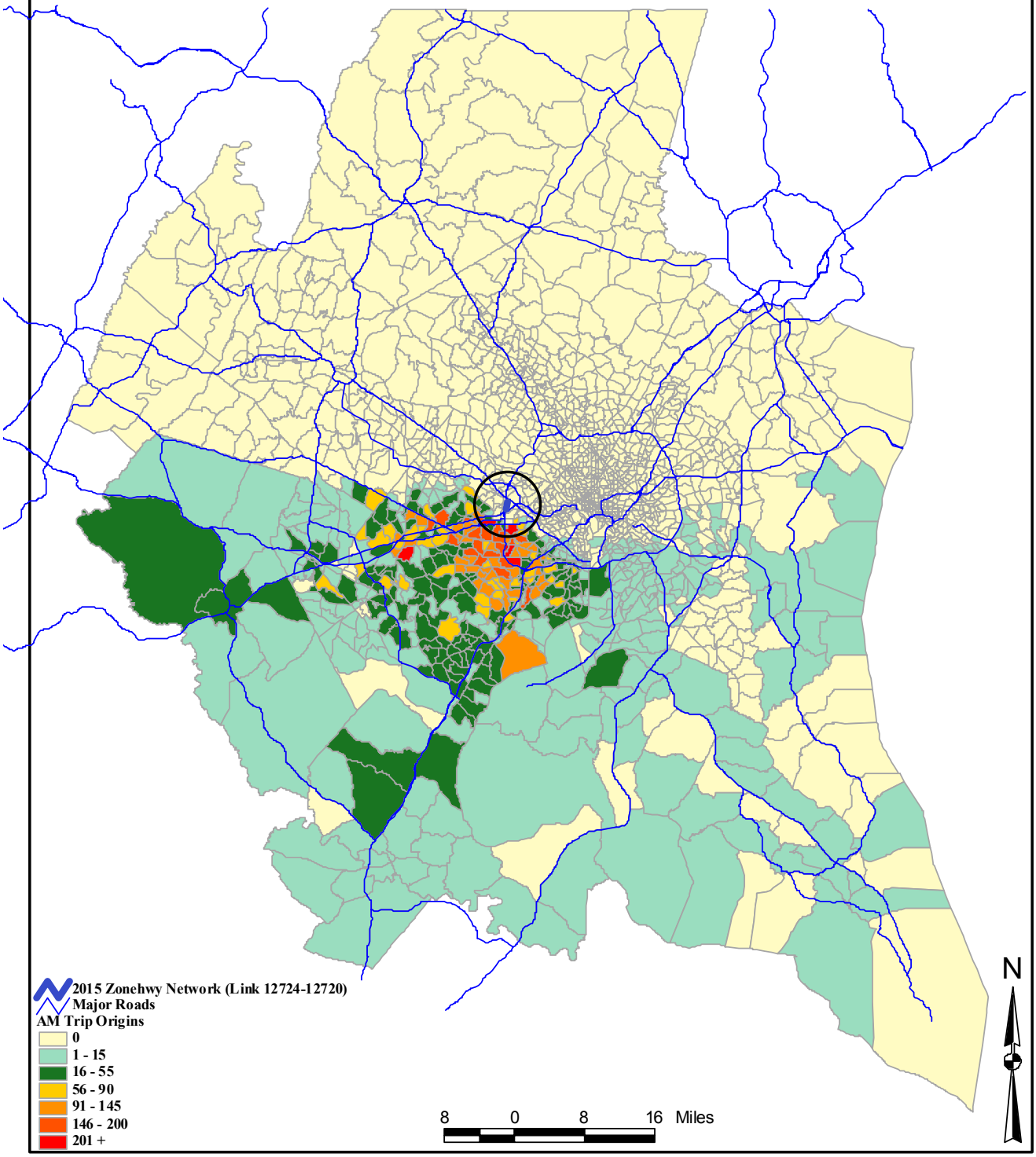

Figure 9
2015 LOV AM Trip Destinations
Using the Capital Beltway Inner Loop
between I-66 and VA Rt. 7 (Tysons Corner)

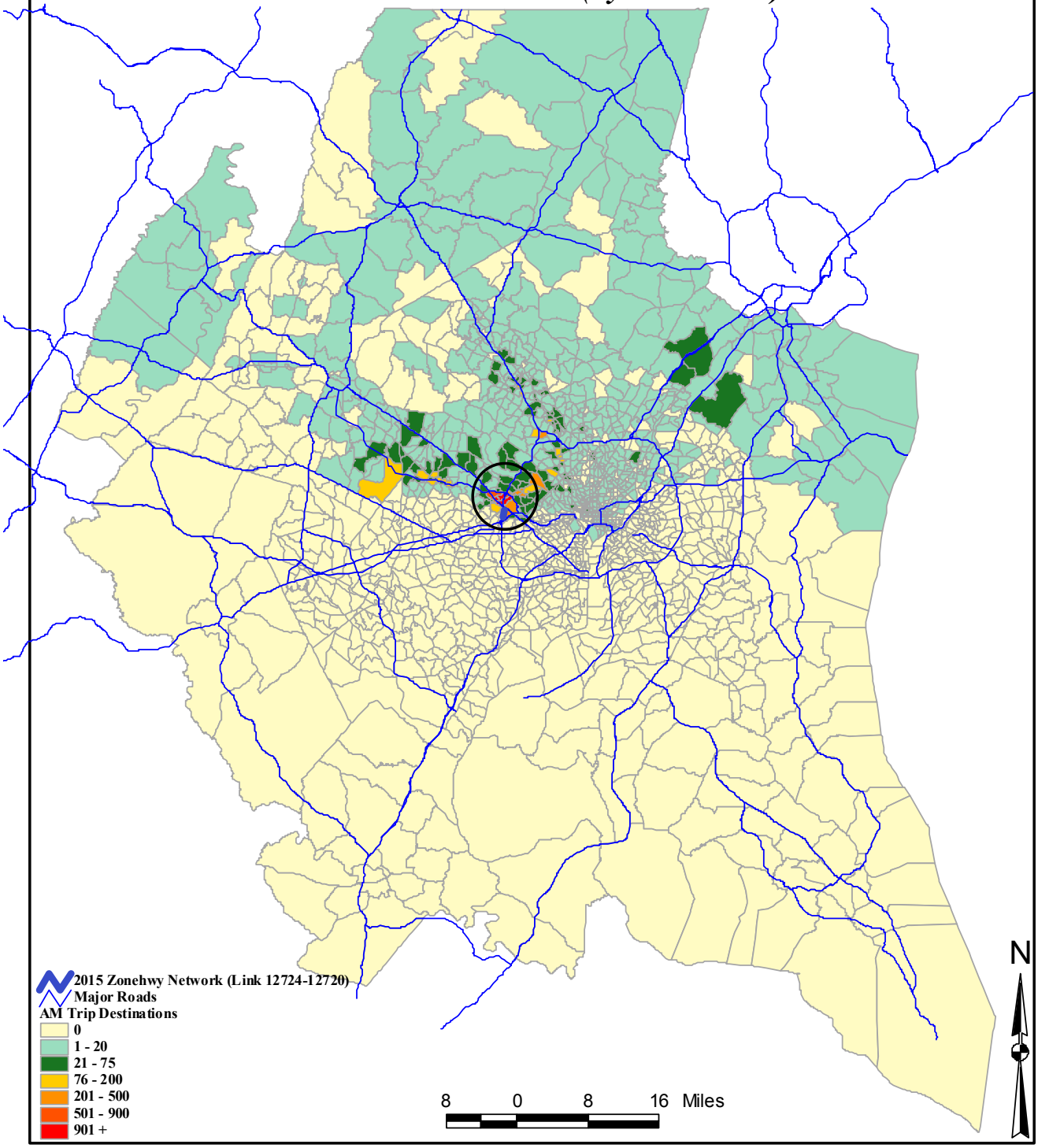

Figure 10
2015 LOV AM Trip Origins
Using the Capital Beltway Inner Loop
between George Washington Pkwy and American Legion Bridge

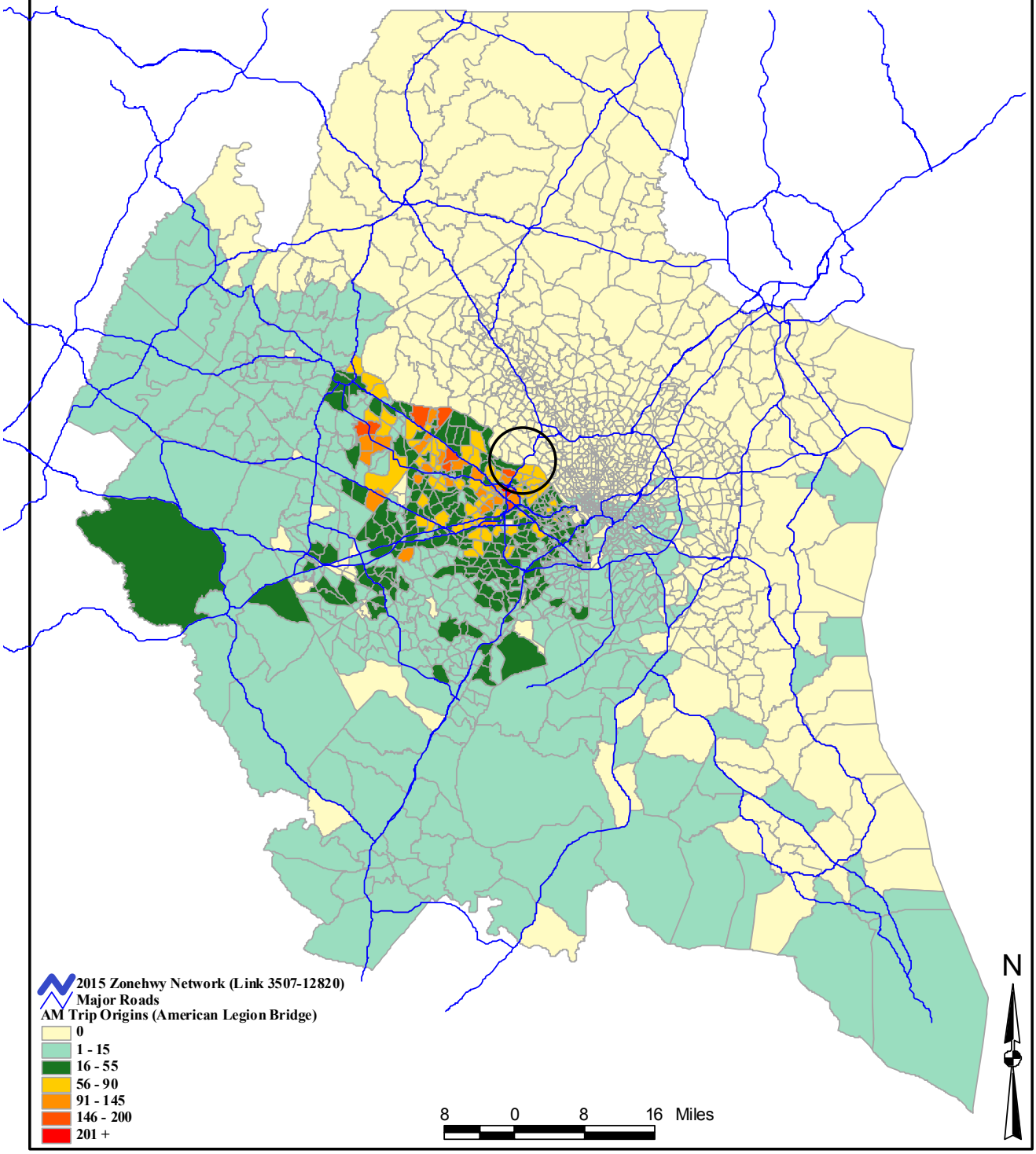

Figure 11
2015 LOV AM Trip Destinations
Using the Capital Beltway Inner Loop
between George Washington Pkwy and American Legion Bridge