

## **APPENDICES**

## **APPENDIX A – 2017 PEAK HOUR TRAVEL TIME INDEX**

Note:

1. Calculations and visualizations were provided by the “Trend Map” tool of the Vehicle Probe Project Suite developed by the CATT Lab of the University of Maryland, <https://vpp.ritis.org/>.
2. Peak Hour: 8:00-9:00 am is the regional morning peak hour, and 5:00-6:00 pm is the regional afternoon peak hour, Monday through Friday.
3. Congestion levels are categorized by the value of Travel Time Index:
  - TTI = 1.0: Free flow
  - 1.0<TTI<=1.3: Minimal
  - 1.3<TTI<=1.5: Minor
  - 1.5<TTI<=2.0: Moderate
  - 2.0<TTI<=2.5: Heavy
  - 2.5<TTI: Severe

Figure A1: Travel Time Index on the Interstates and Freeways during Weekday 8:00-9:00 am, 2017

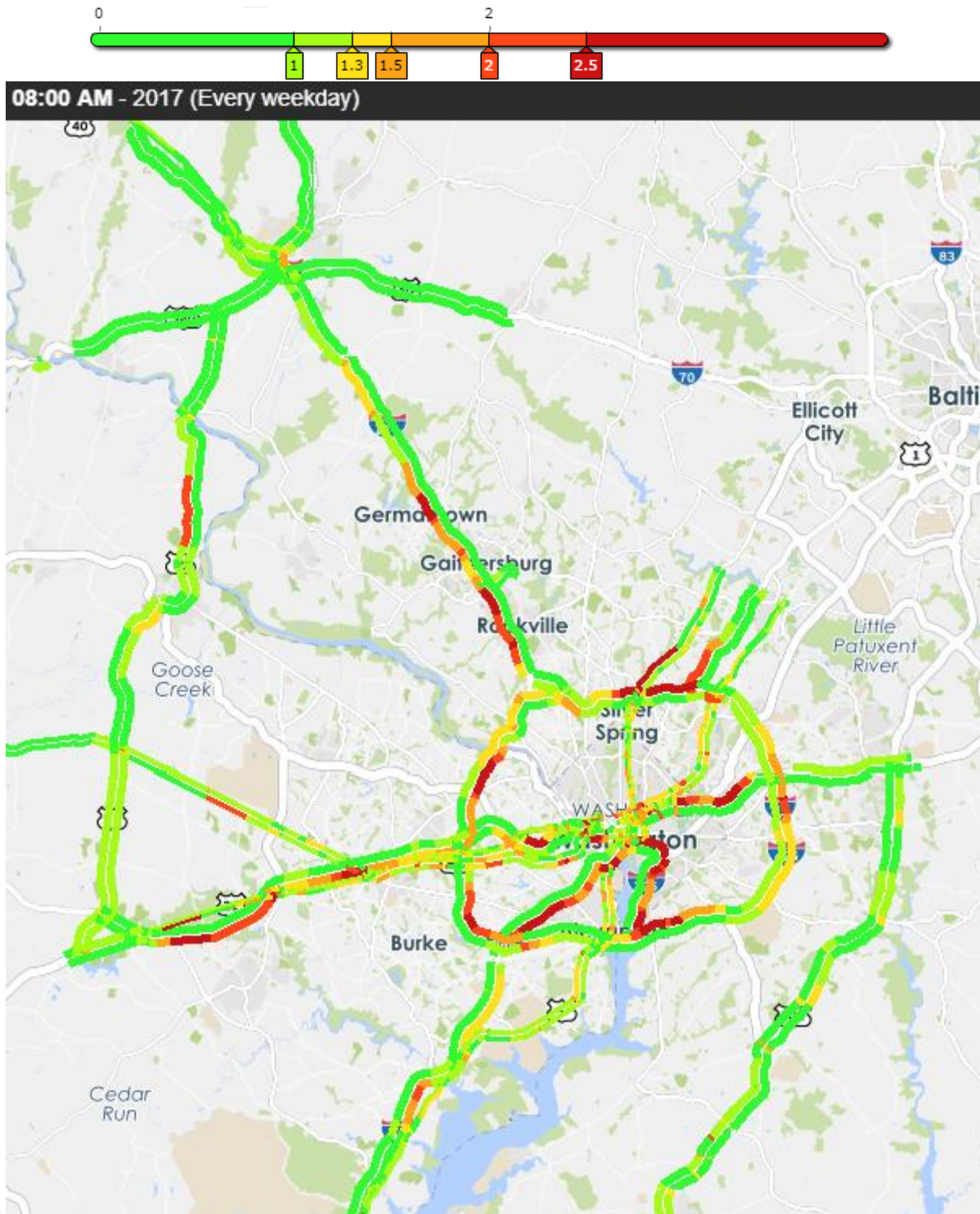


Figure A2: Travel Time Index on the Interstates and Freeways during Weekday 5:00-6:00 pm, 2017

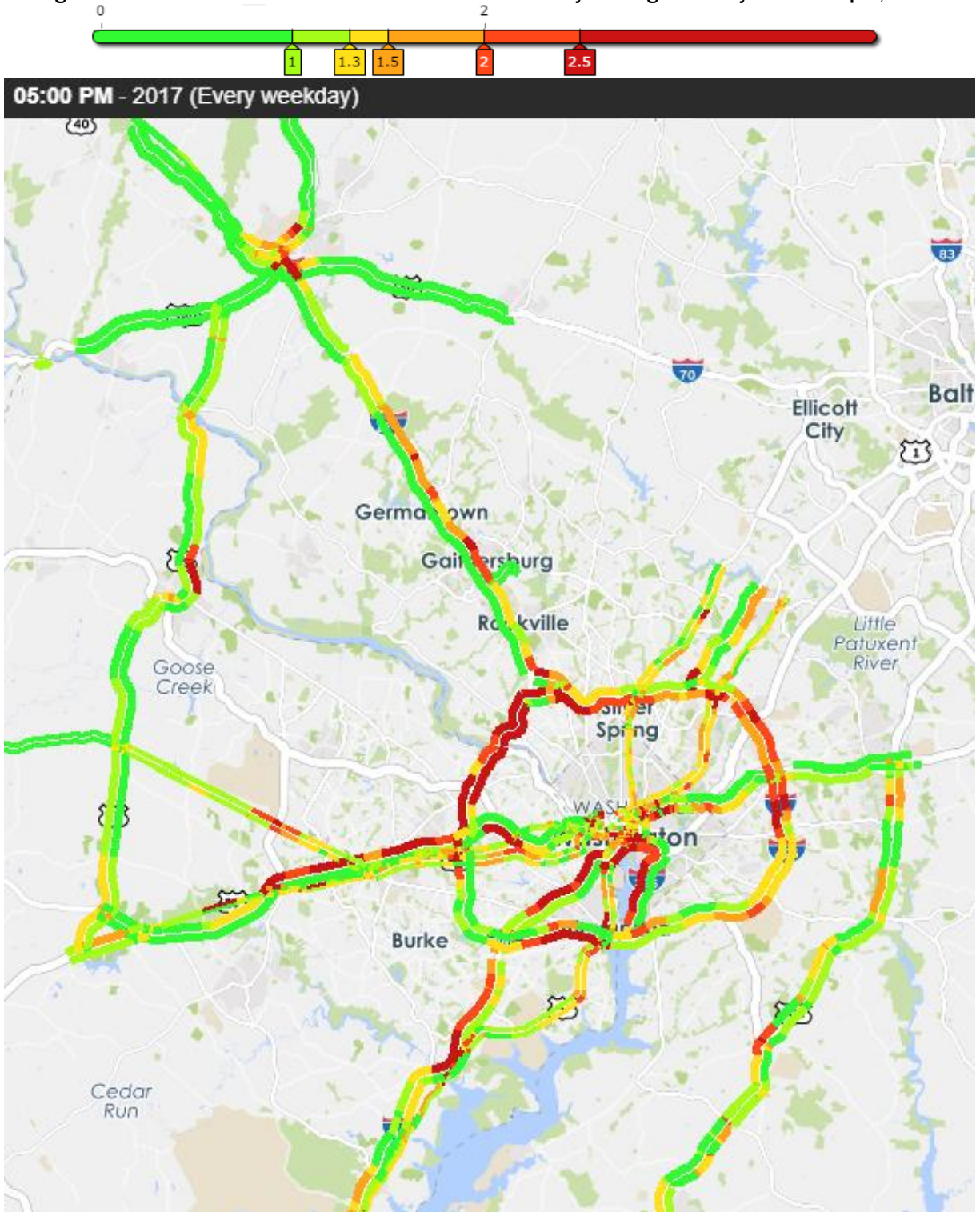




Figure A3: Travel Time Index in DC during Weekday 8:00-9:00 am, 2017

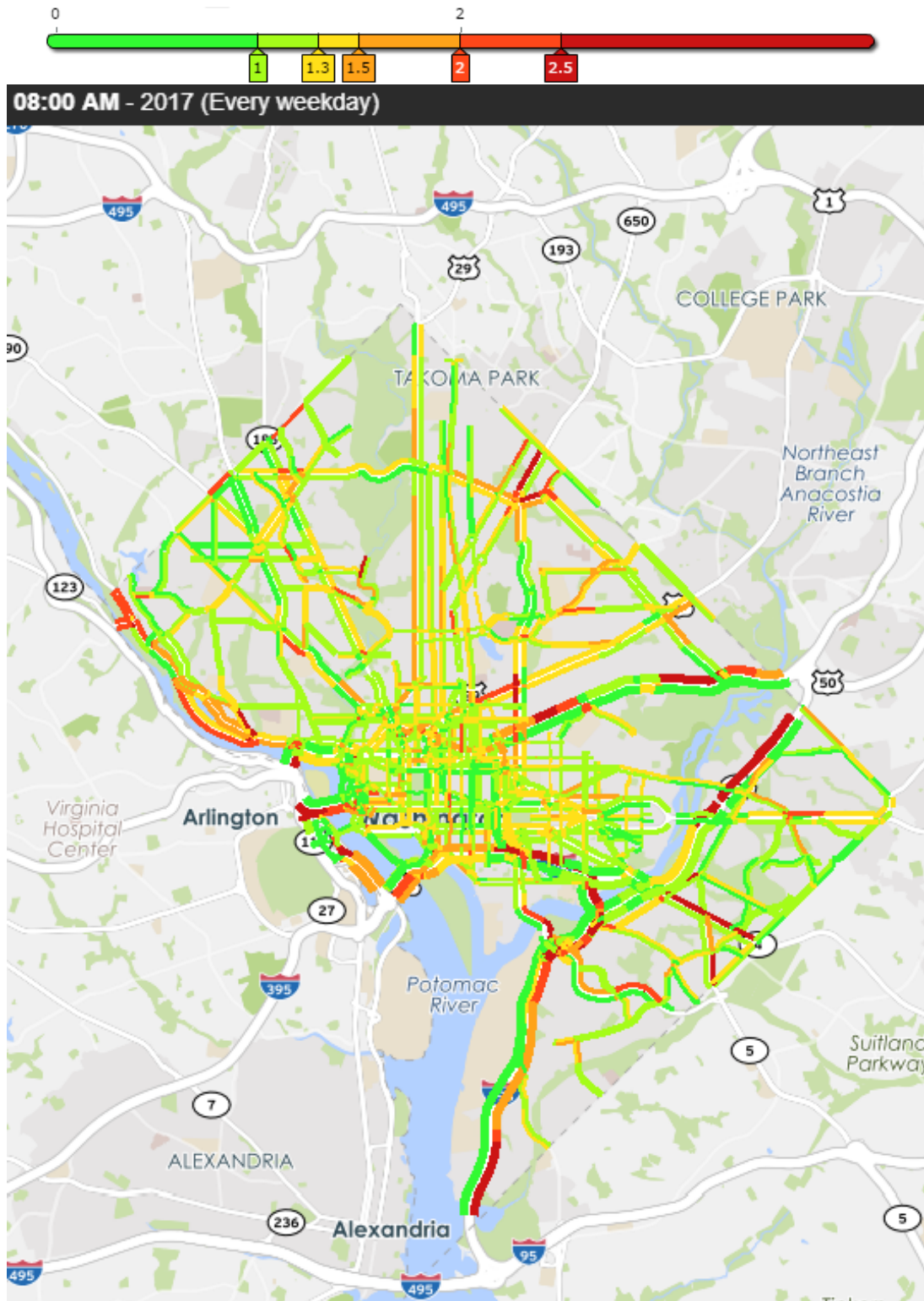


Figure A4: Travel Time Index in DC during Weekday 5:00-6:00 pm, 2017

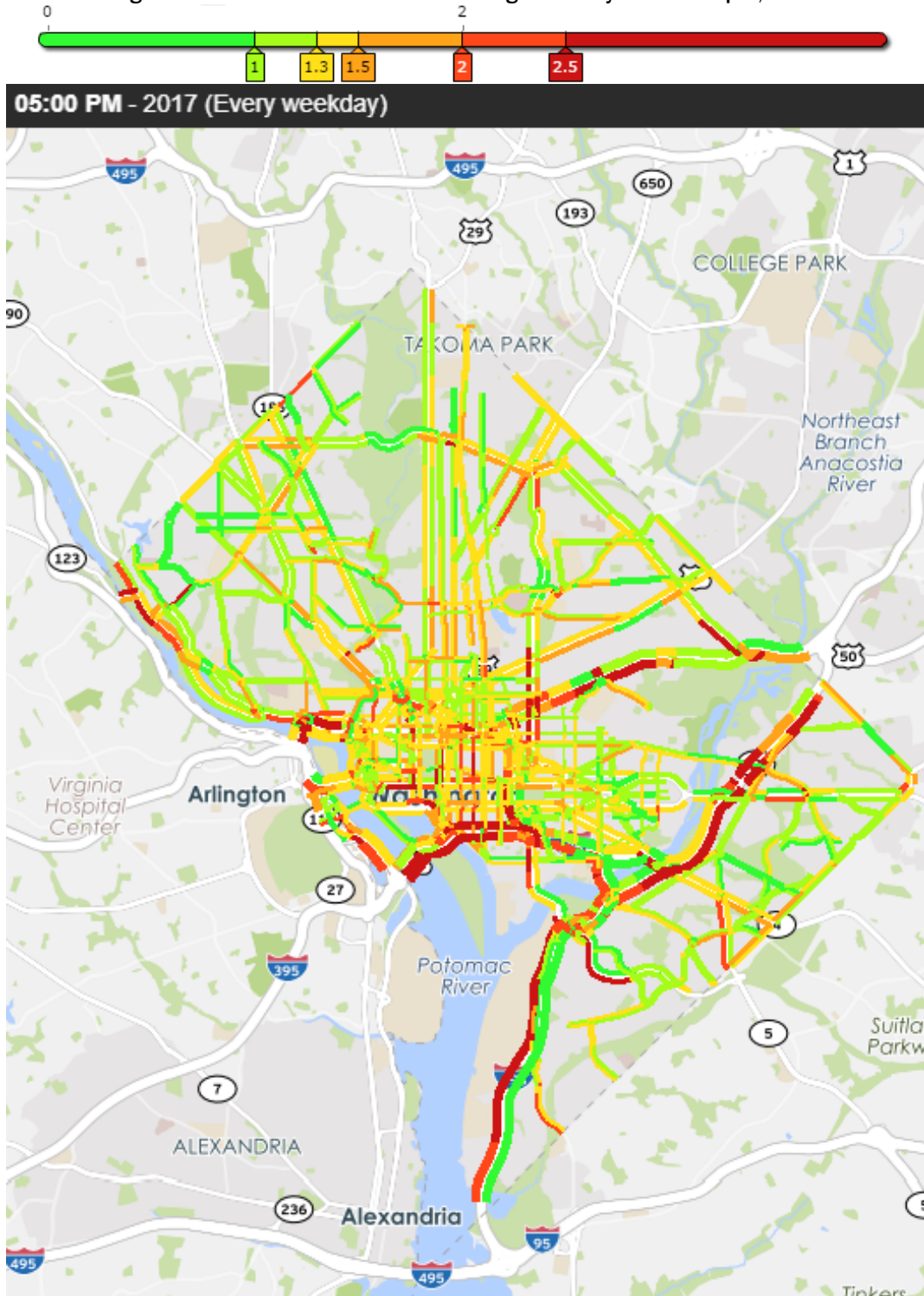


Figure A5: Travel Time Index in Frederick County, MD during Weekday 8:00-9:00 am, 2017

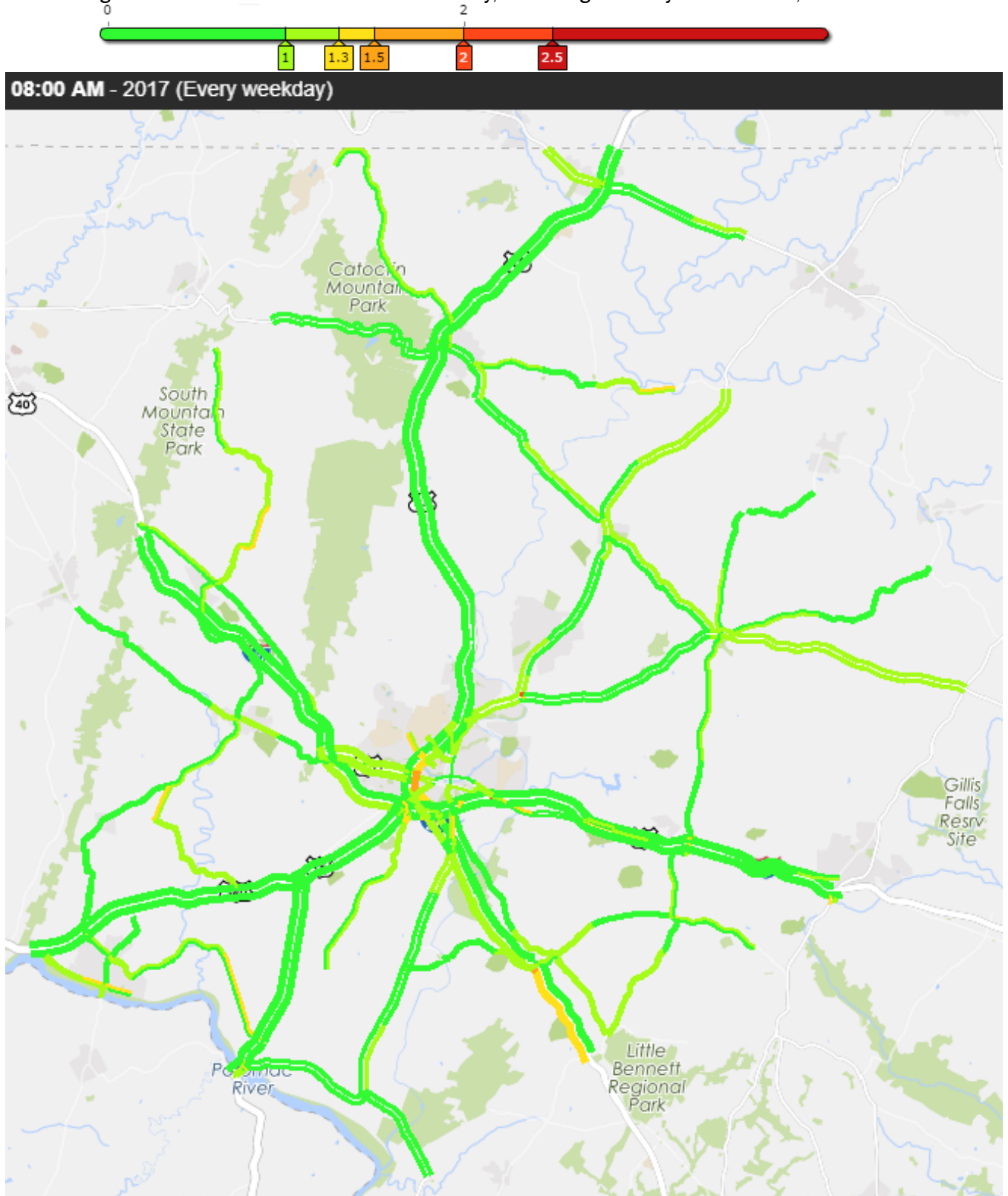


Figure A6: Travel Time Index in Frederick County, MD during Weekday 5:00-6:00 pm, 2017

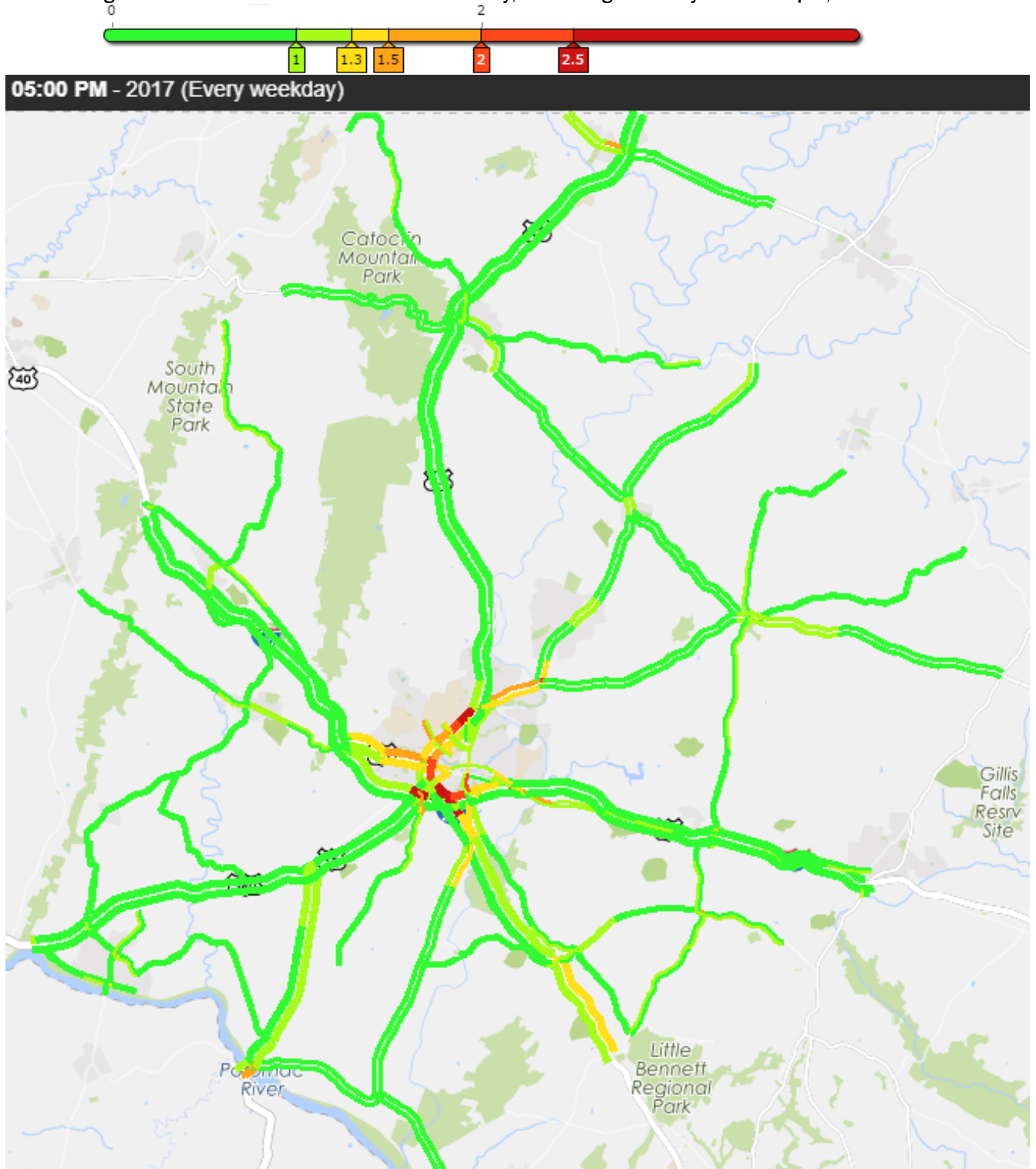




Figure A7: Travel Time Index in Montgomery County, MD during Weekday 8:00-9:00 am, 2017

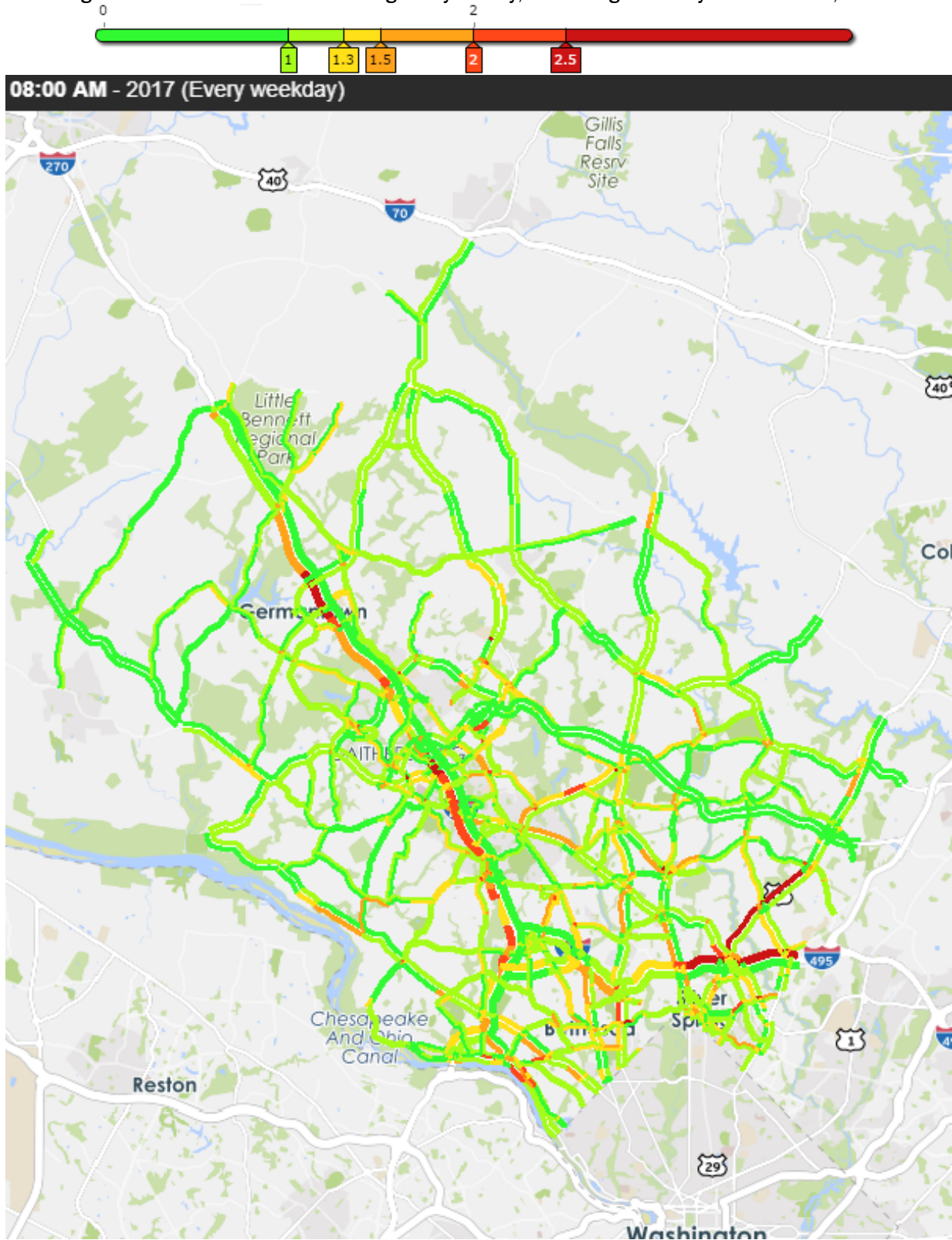


Figure A8: Travel Time Index in Montgomery County, MD during Weekday 5:00-6:00 pm, 2017

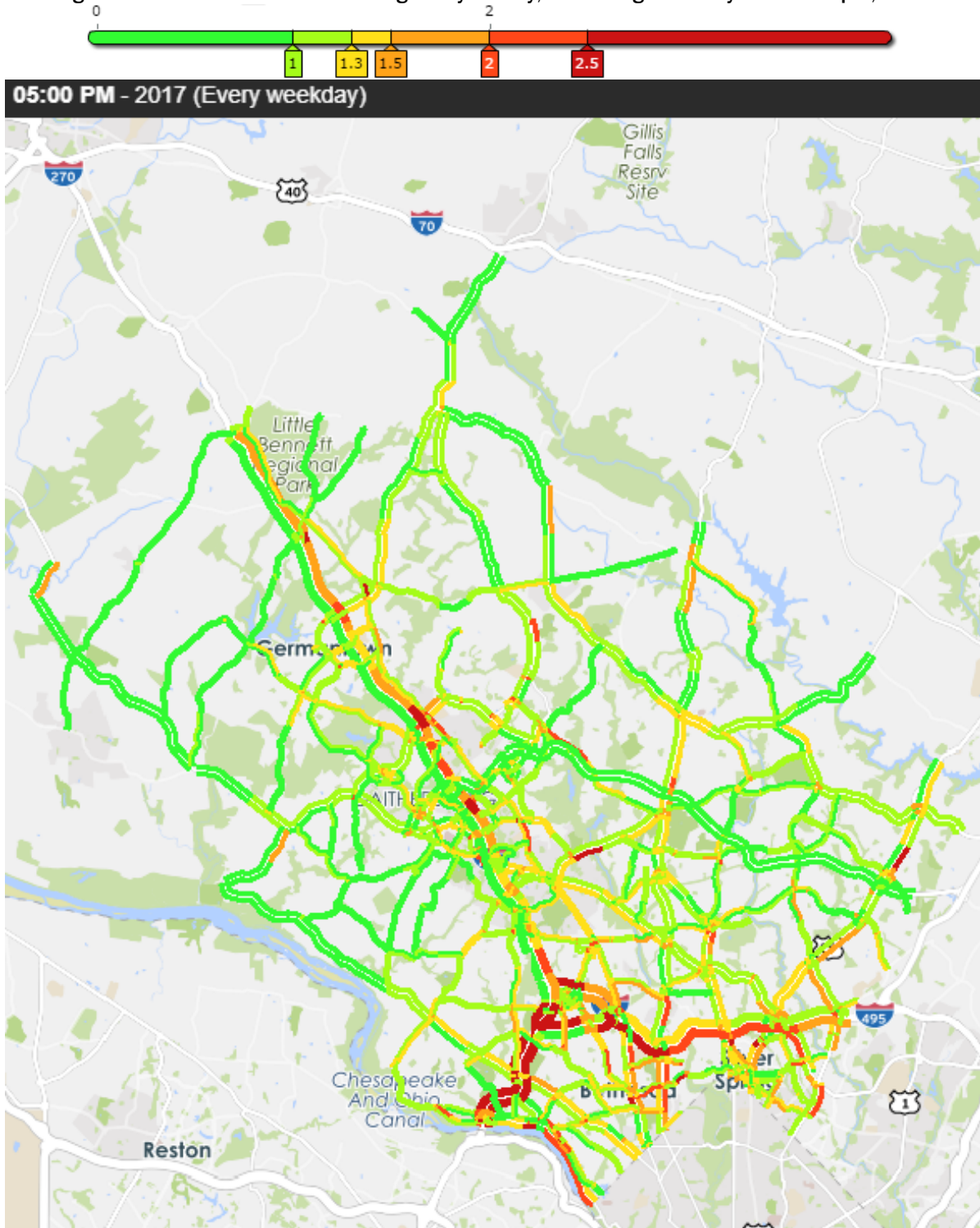


Figure A9: Travel Time Index in Prince George's County, MD during Weekday 8:00-9:00 am, 2017

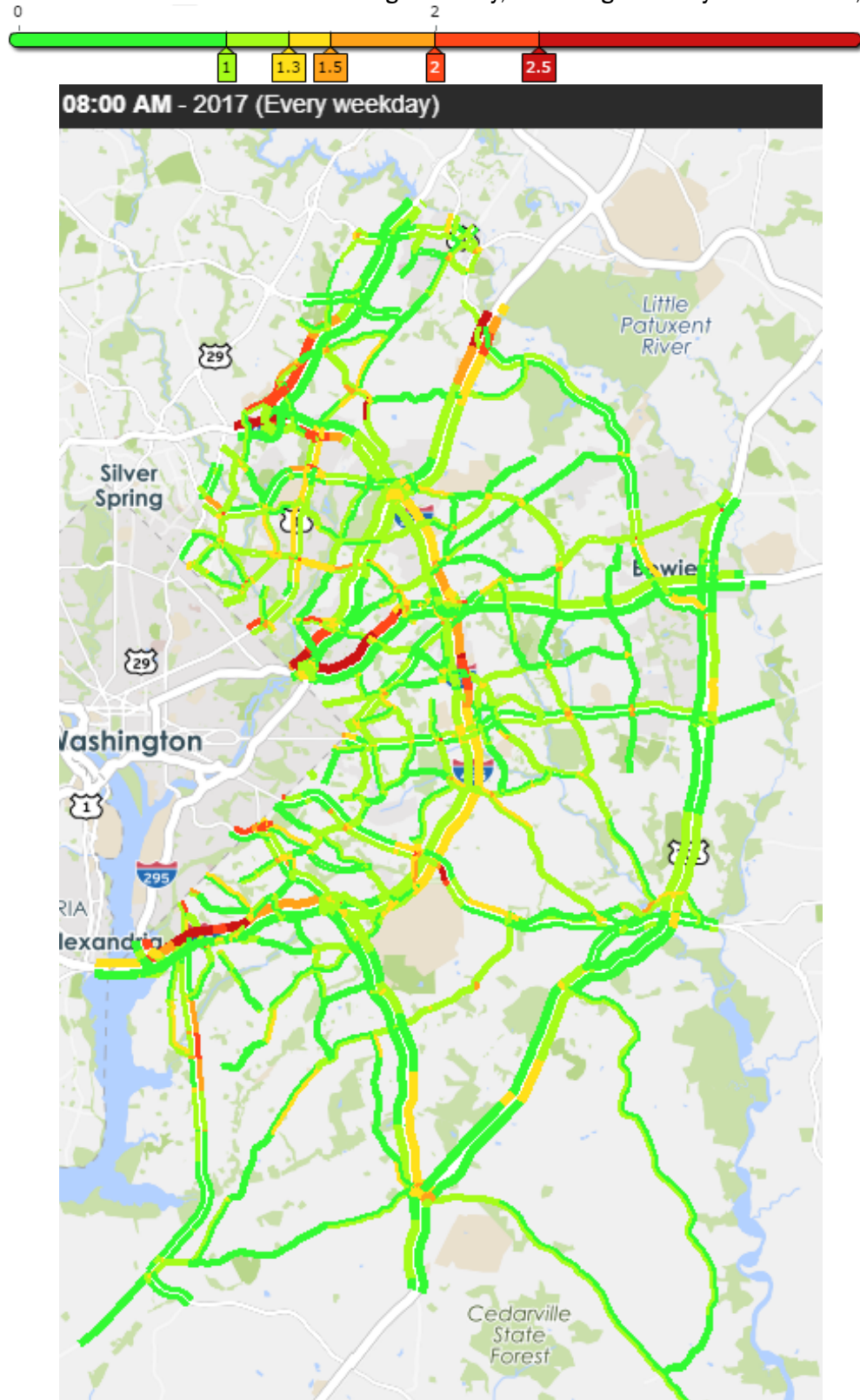




Figure A10: Travel Time Index in Prince George's County, MD during Weekday 5:00-6:00 pm, 2017

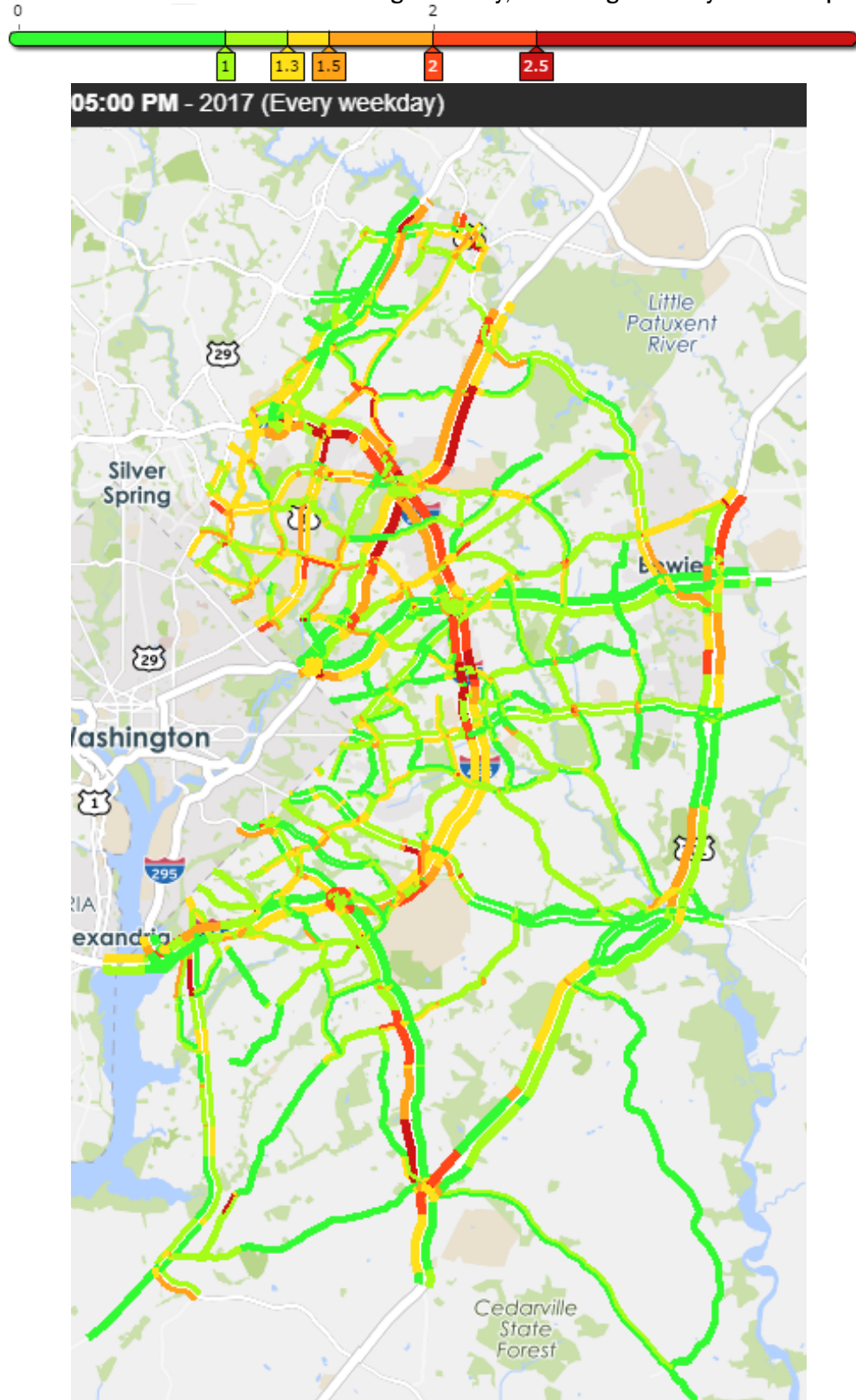




Figure A11: Travel Time Index in Charles County, MD during Weekday 8:00-9:00 am, 2017

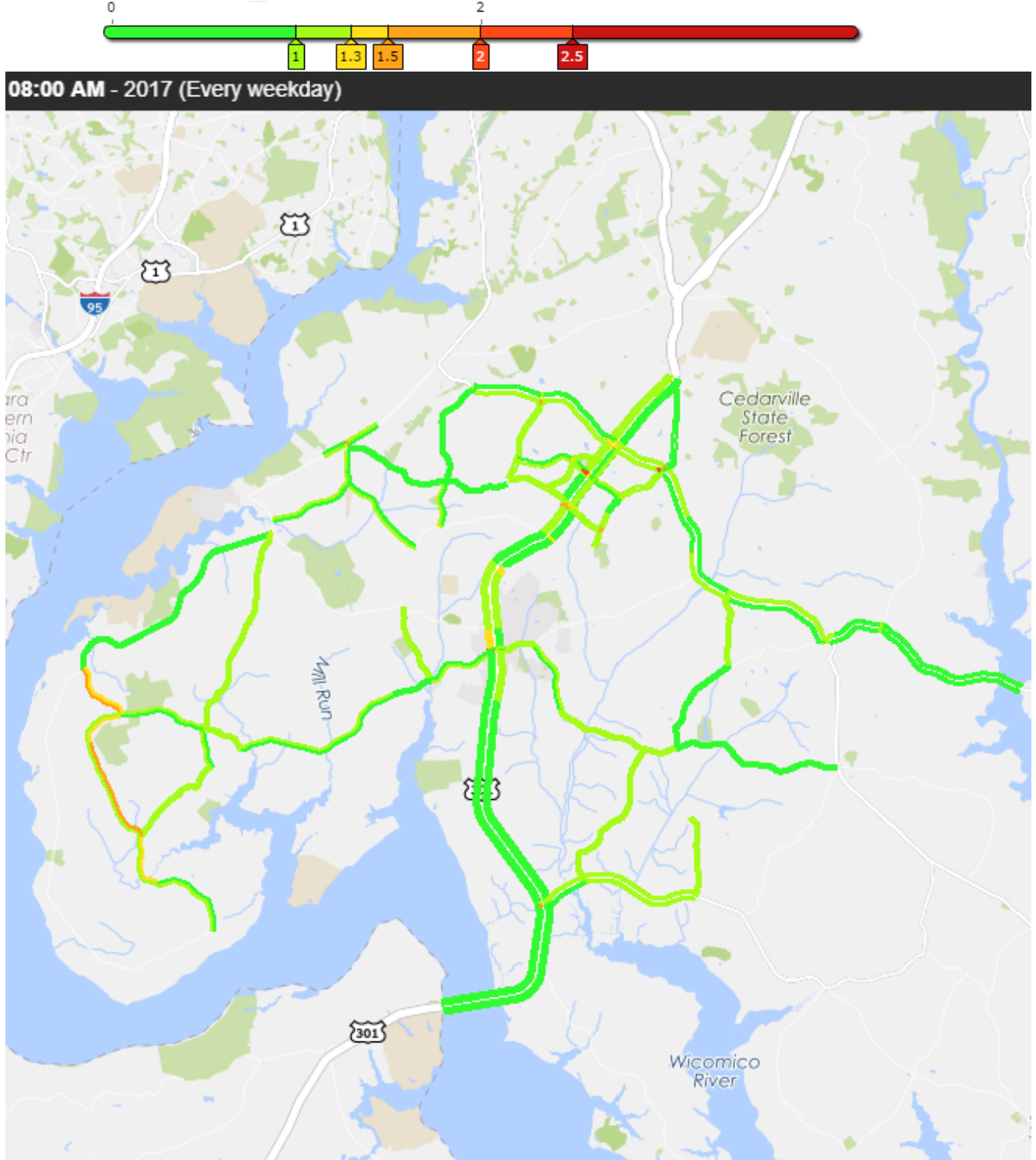


Figure A12: Travel Time Index in Charles County, MD during Weekday 5:00-6:00 pm, 2017

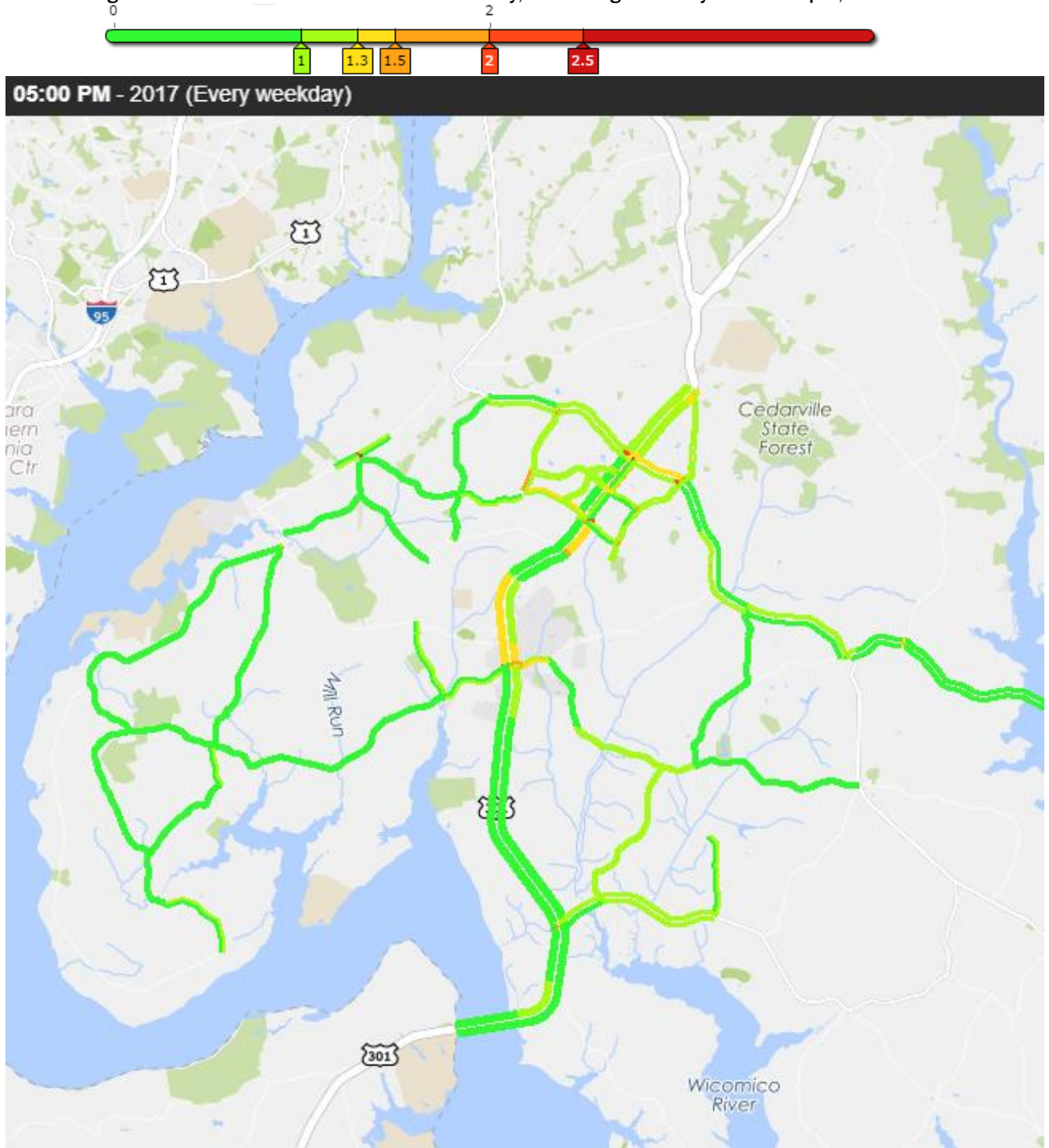


Figure A13: Travel Time Index in Loudoun County, VA during Weekday 8:00-9:00 am, 2017

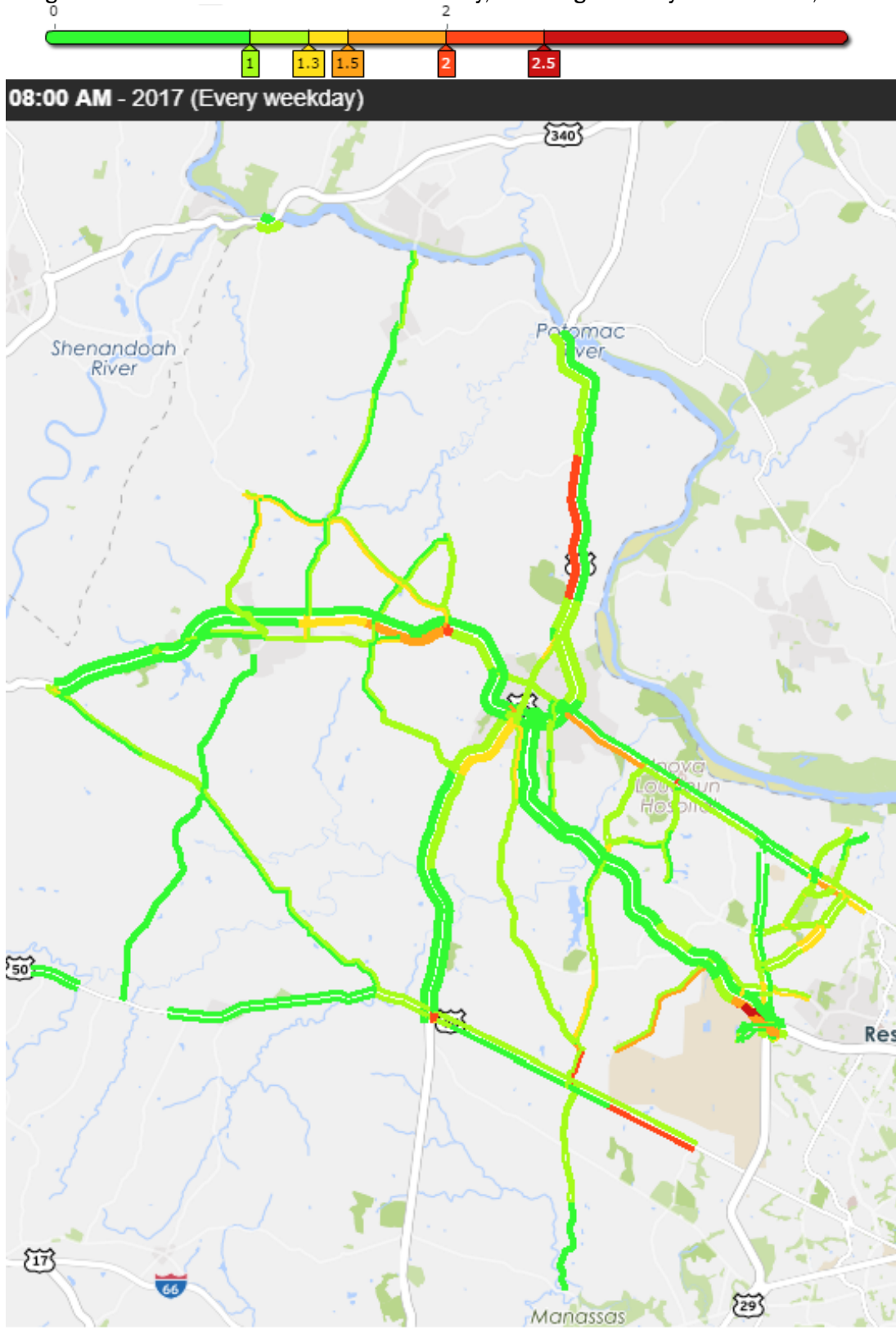


Figure A14: Travel Time Index in Loudoun County, VA during Weekday 5:00-6:00 pm, 2017

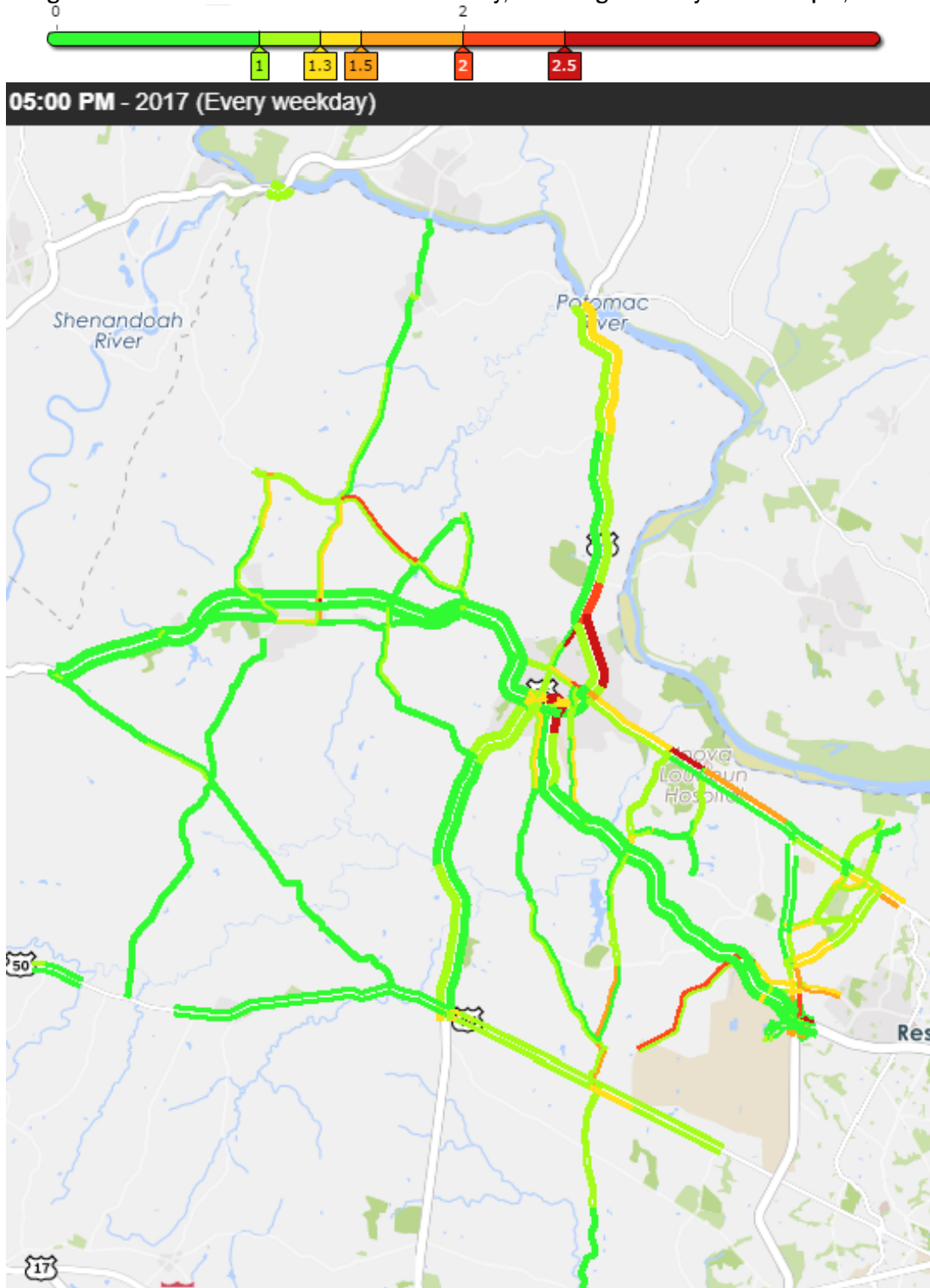




Figure A15: Travel Time Index in Fairfax, Prince William Counties and Cities of Fairfax, Manassas, and Manassas Park, VA during Weekday 8:00-9:00 am, 2017

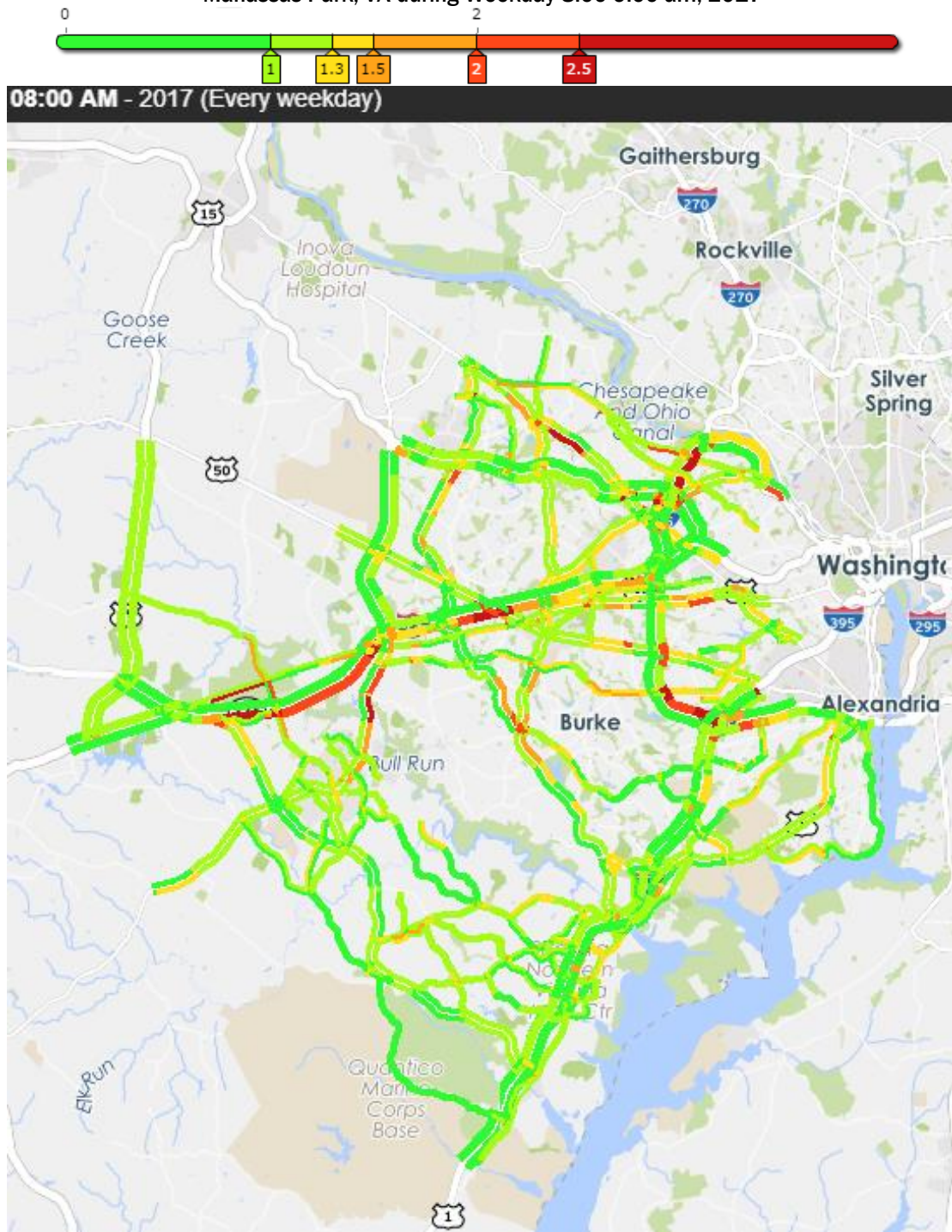


Figure A16: Travel Time Index in Fairfax, Prince William Counties and Cities of Fairfax, Manassas, and Manassas Park, VA during Weekday 5:00-6:00 pm, 2017

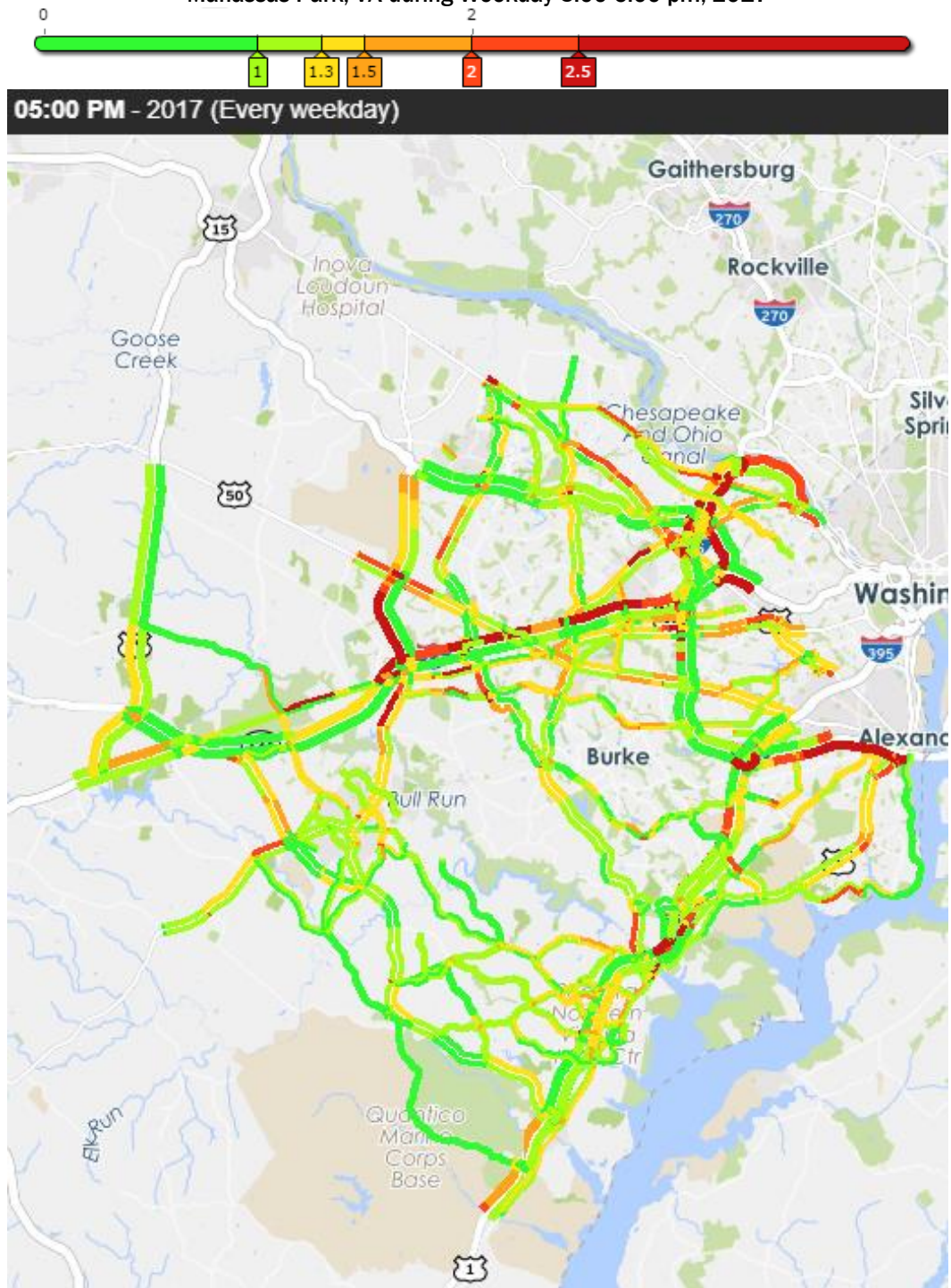


Figure A17: Travel Time Index in Cities of Alexandria, Arlington, and Falls Church, VA during Weekday 8:00-9:00 am, 2017

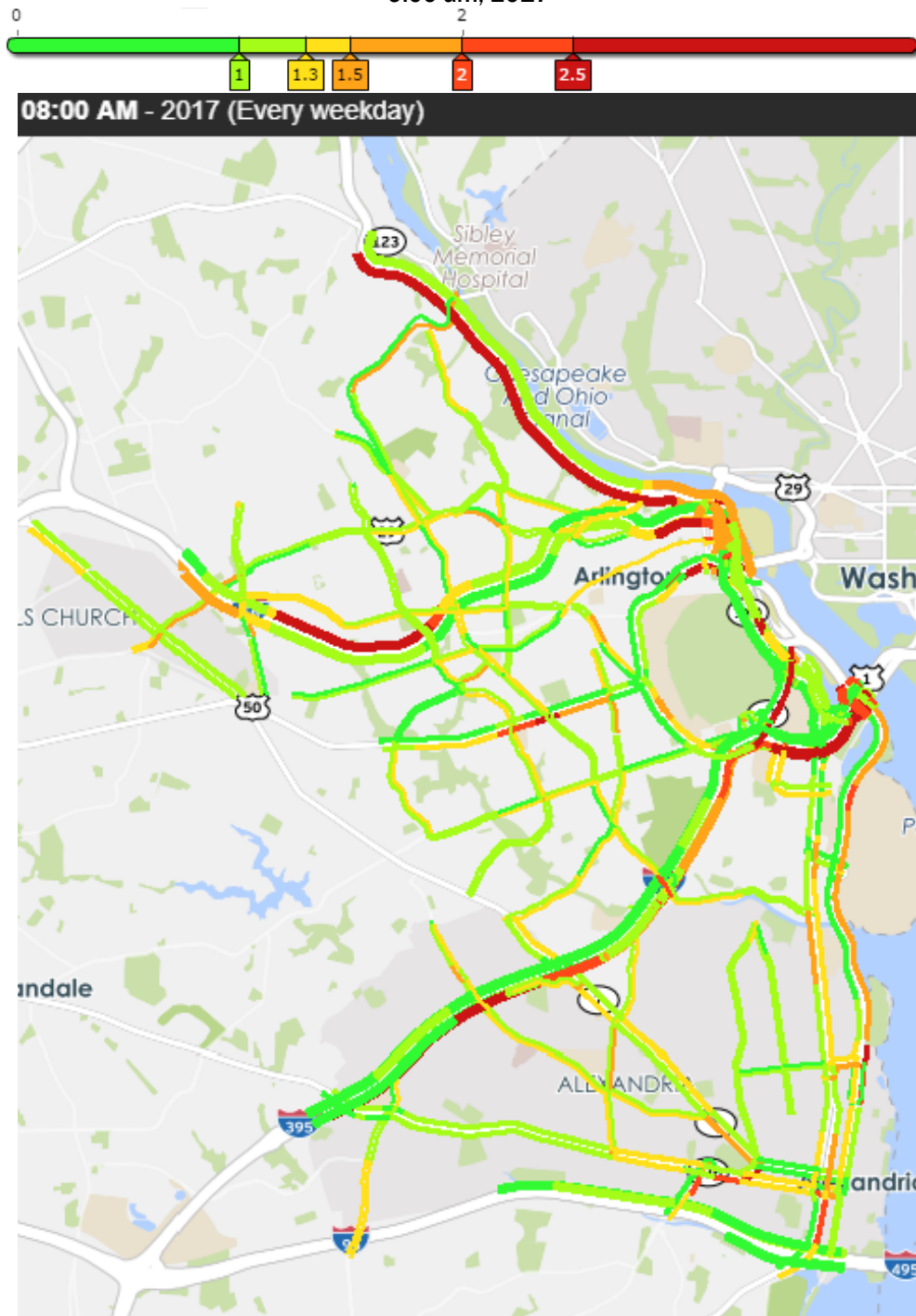
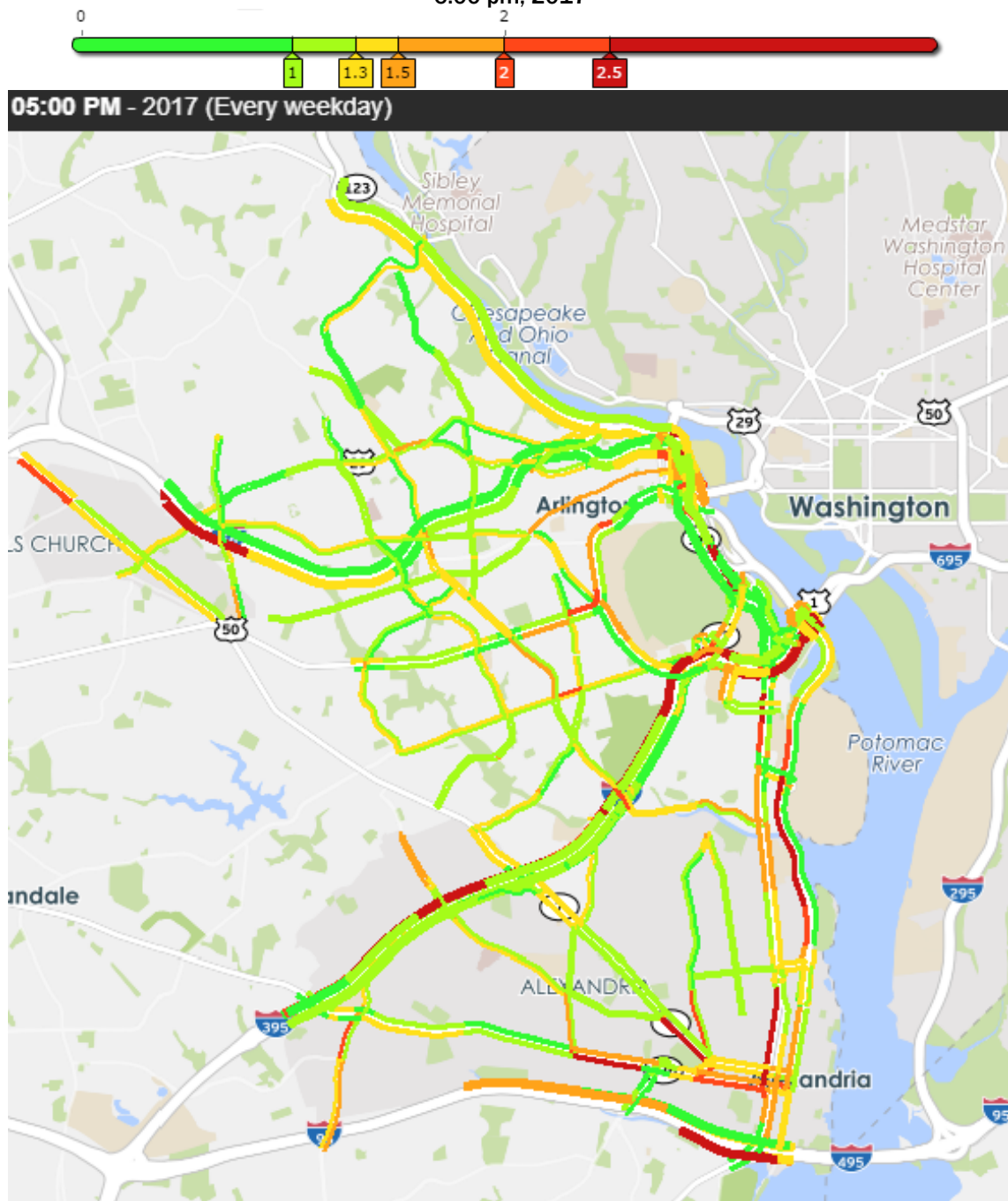




Figure A18: Travel Time Index in Cities of Alexandria, Arlington, and Falls Church, VA during Weekday 5:00-6:00 pm, 2017





## **APPENDIX B – 2017 PEAK HOUR PLANNING TIME INDEX**

Note:

1. Calculations and visualizations were provided by the “Trend Map” tool of the Vehicle Probe Project Suite developed by the CATT Lab of the University of Maryland, <https://vpp.ritis.org/>.
2. Peak Hour: 8:00-9:00 am is the regional morning peak hour, and 5:00-6:00 pm is the regional afternoon peak hour, Monday through Friday.

Figure B1: Planning Time Index on the Interstates and Freeways during Weekday 8:00-9:00 am, 2017

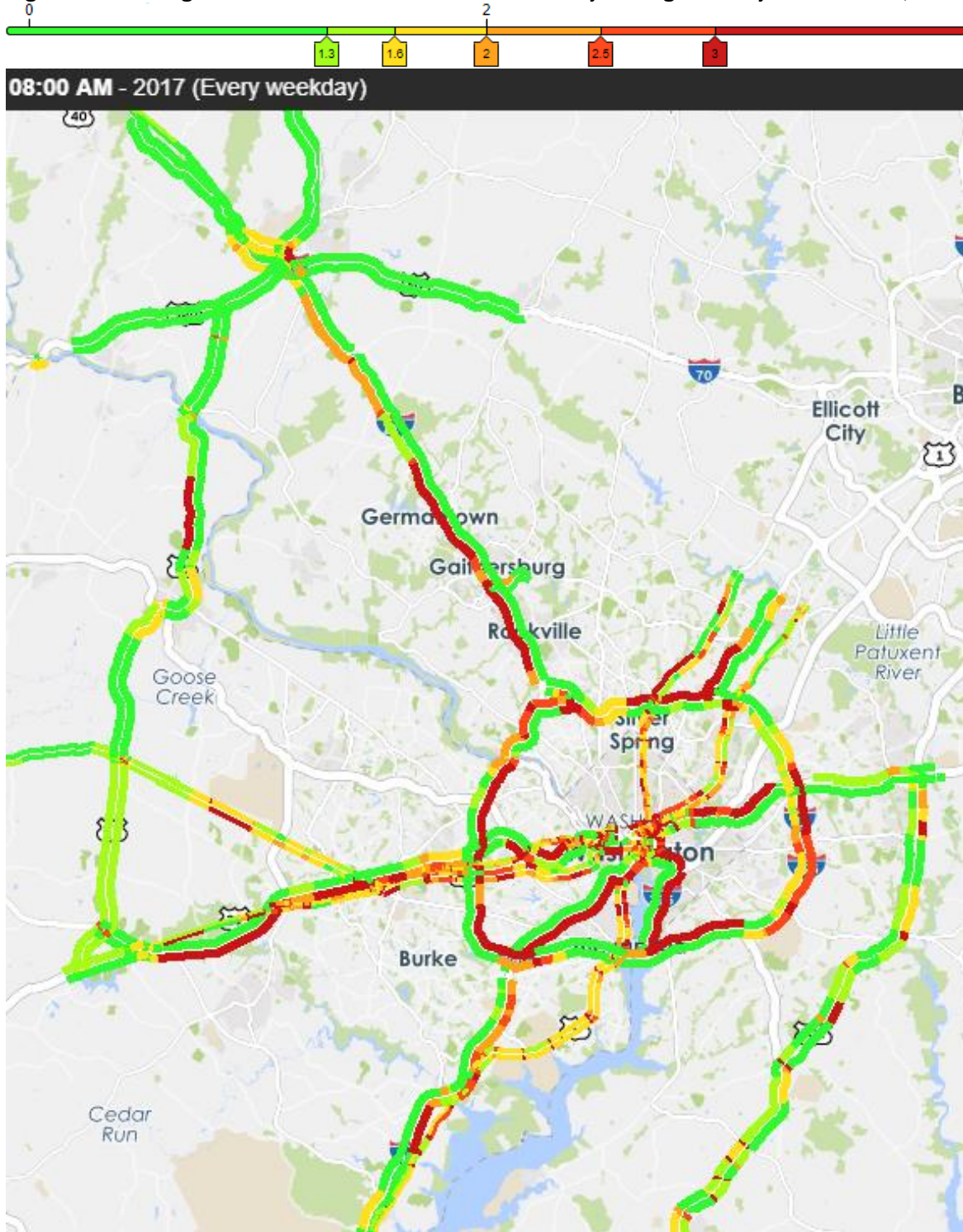


Figure B2: Planning Time Index on the Interstates and Freeways during Weekday 5:00-6:00 pm, 2017

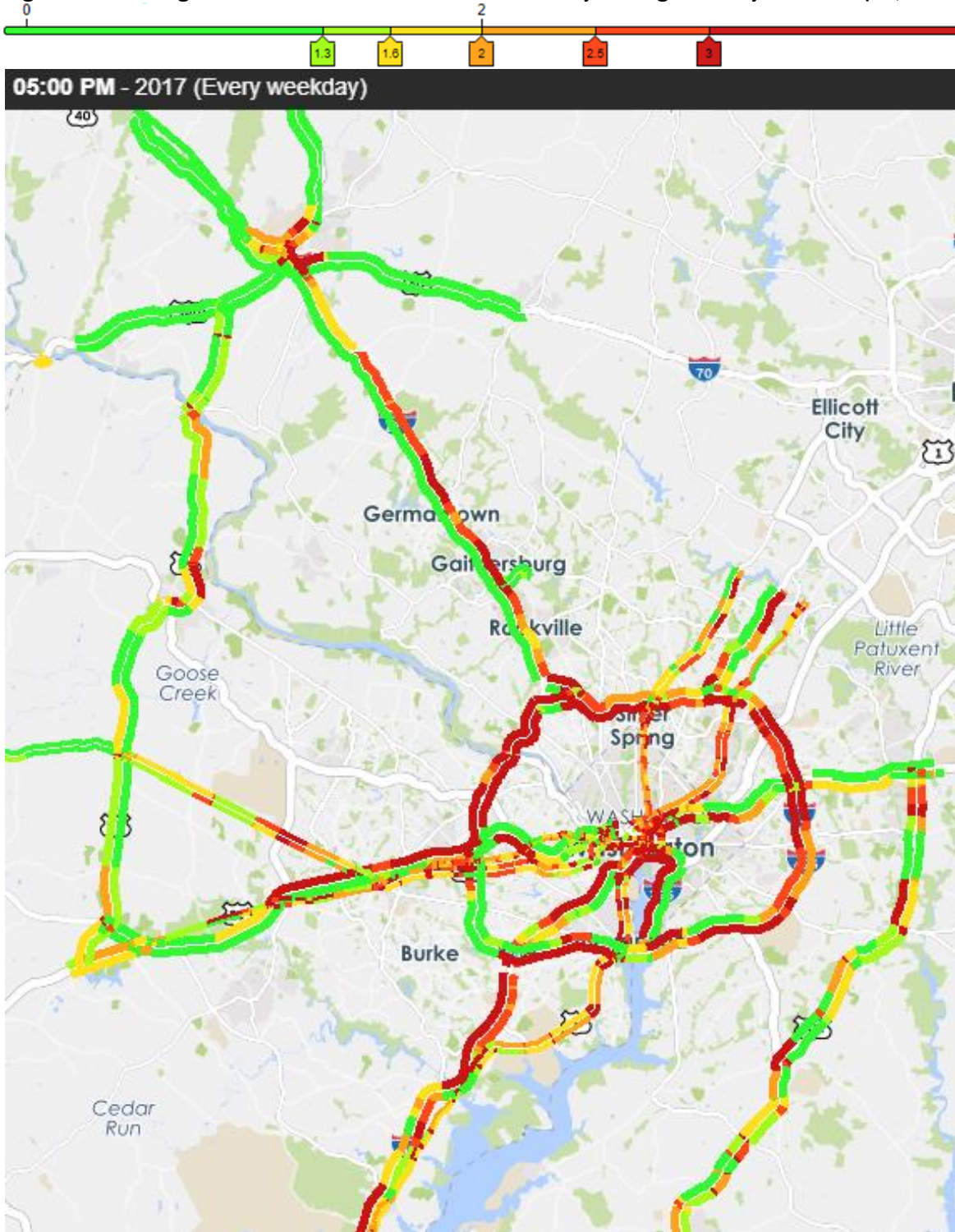




Figure B3: Planning Time Index in DC during Weekday 8:00-9:00 am, 2017

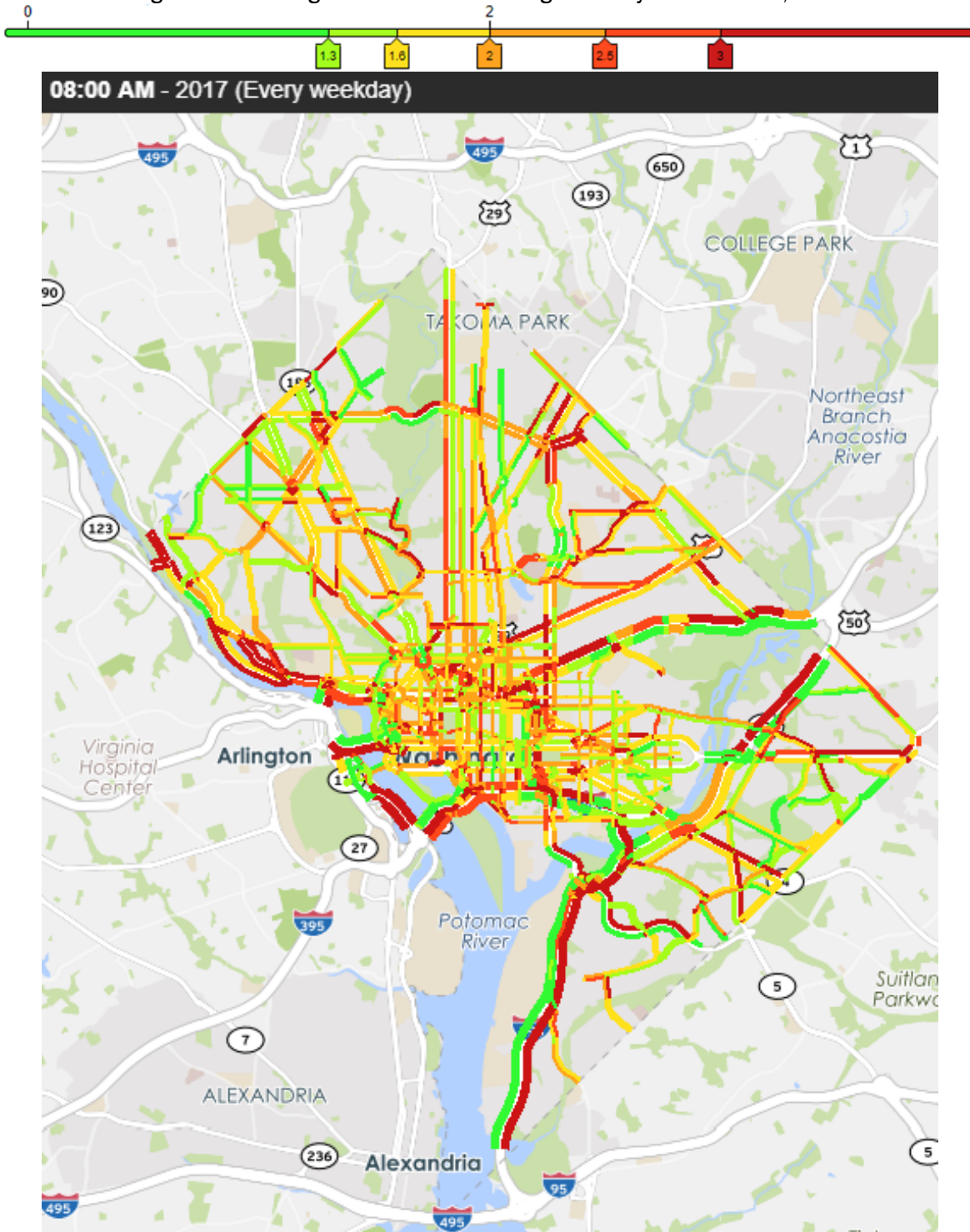






Figure B5: Planning Time in Frederick County, MD during Weekday 8:00-9:00 am, 2017

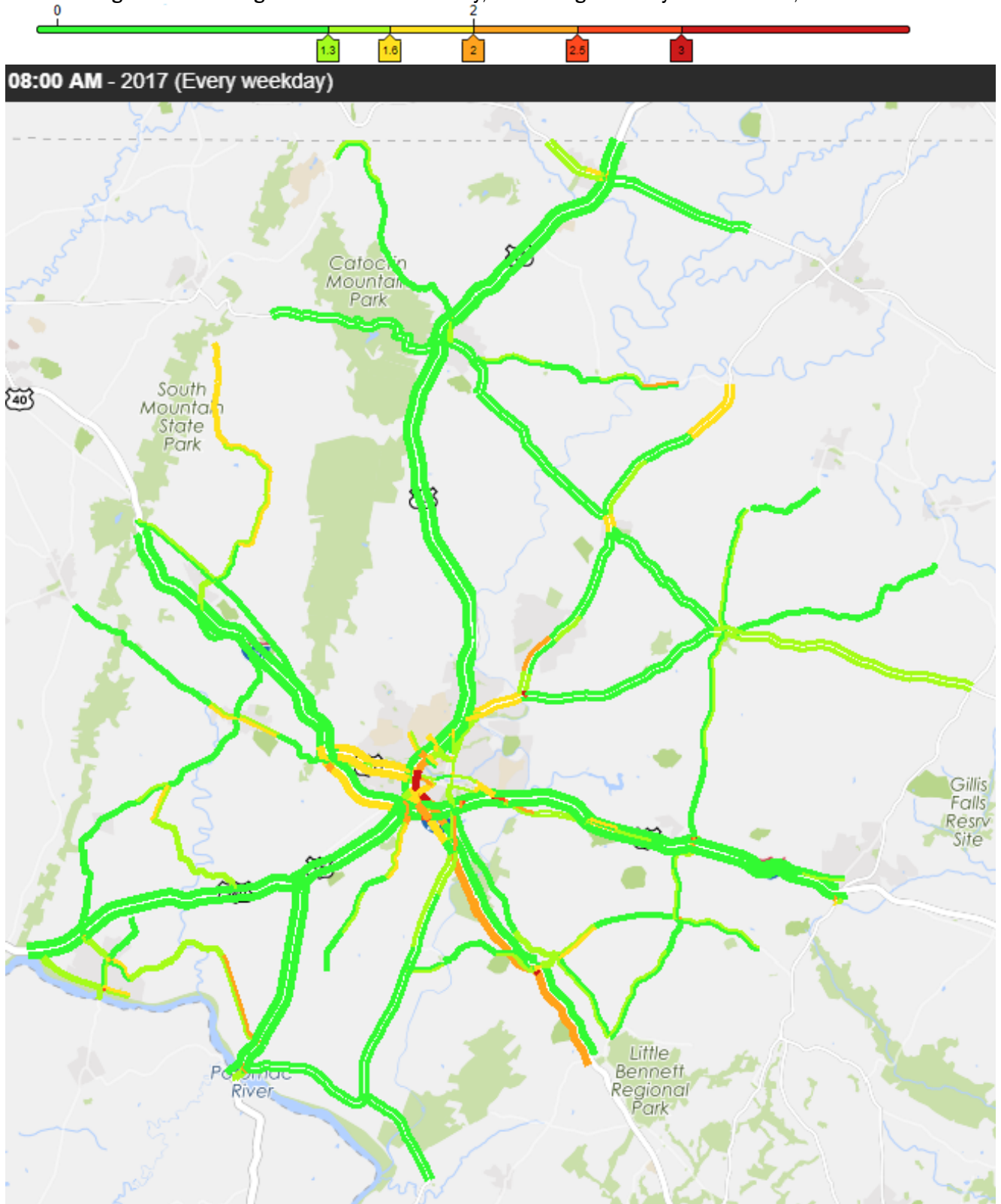


Figure B6: Planning Time Index in Frederick County, MD during Weekday 5:00-6:00 pm, 2017

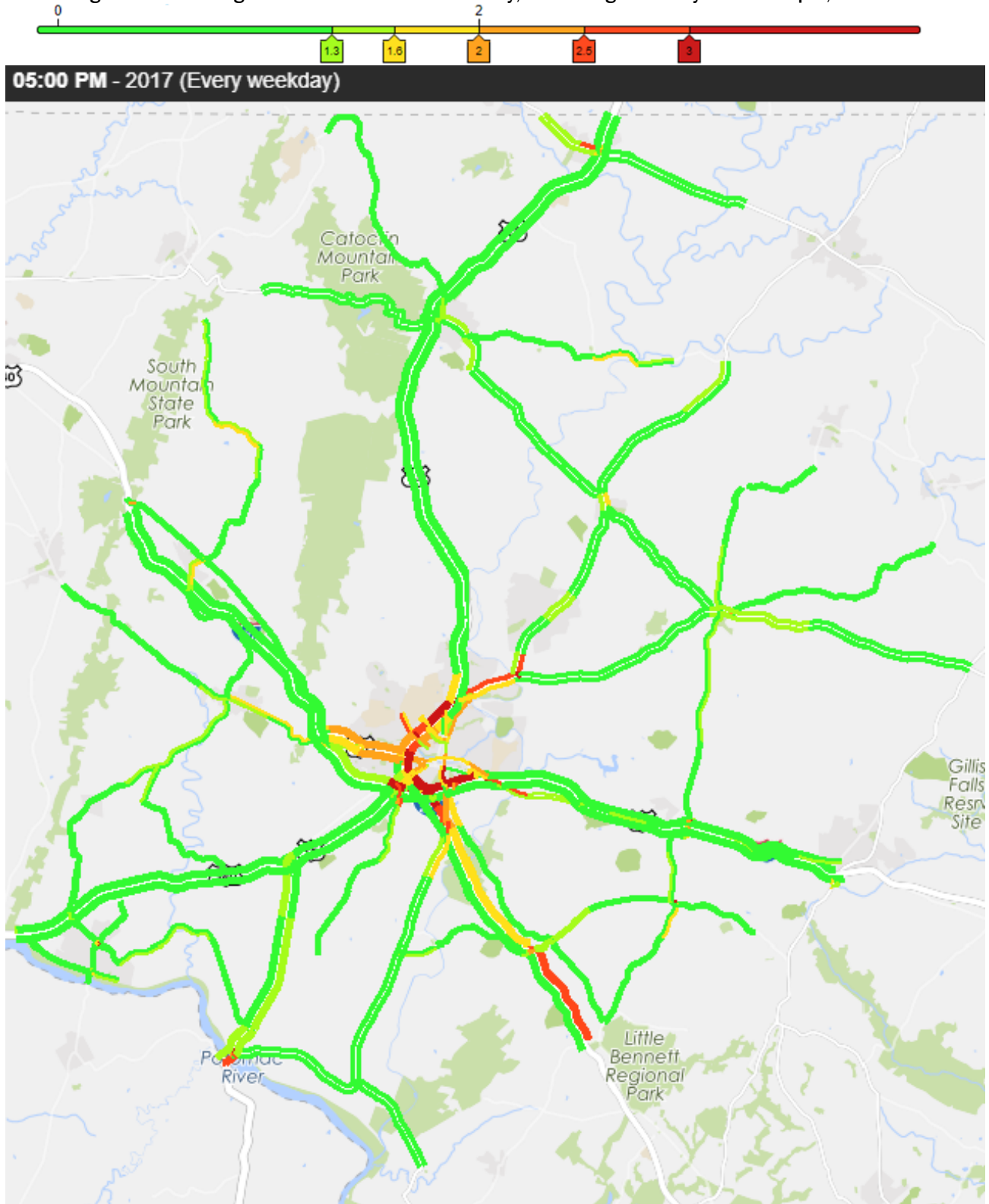


Figure B7: Planning Time Index in Montgomery County, MD during Weekday 8:00-9:00 am, 2017

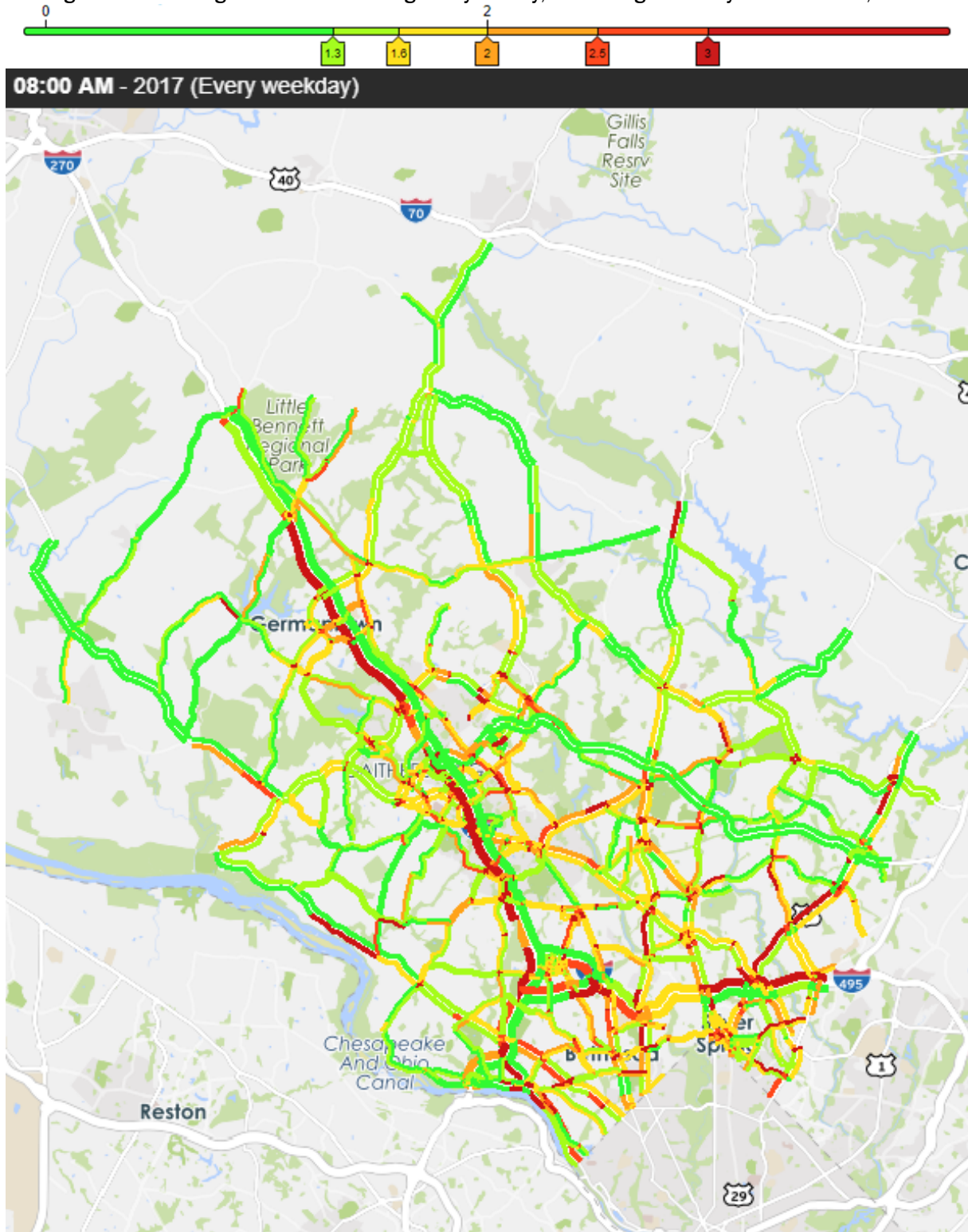




Figure B8: Planning Time Index in Montgomery County, MD during Weekday 5:00-6:00 pm, 2017

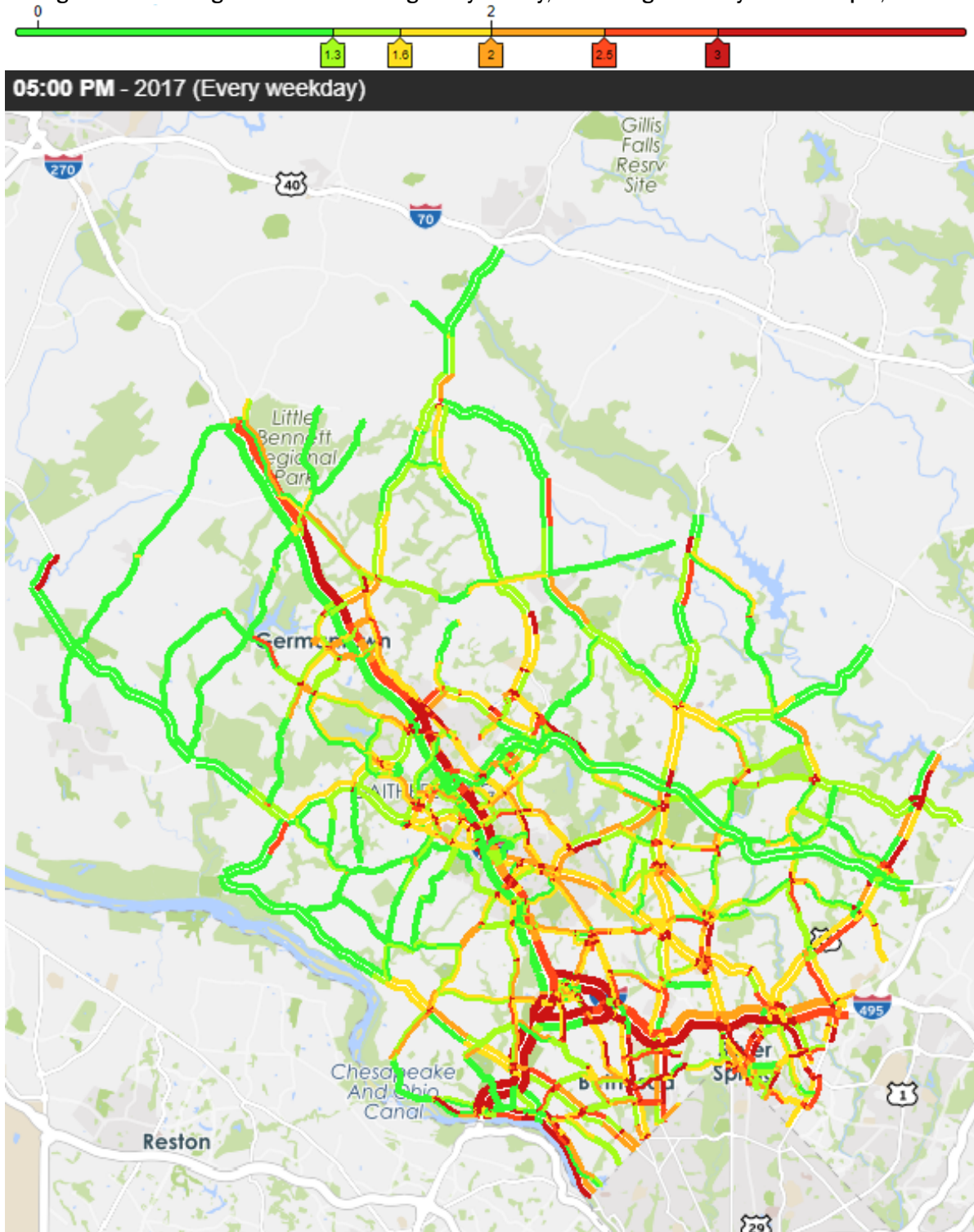


Figure B9: Planning Time Index in Prince George's County, MD during Weekday 8:00-9:00 am, 2017

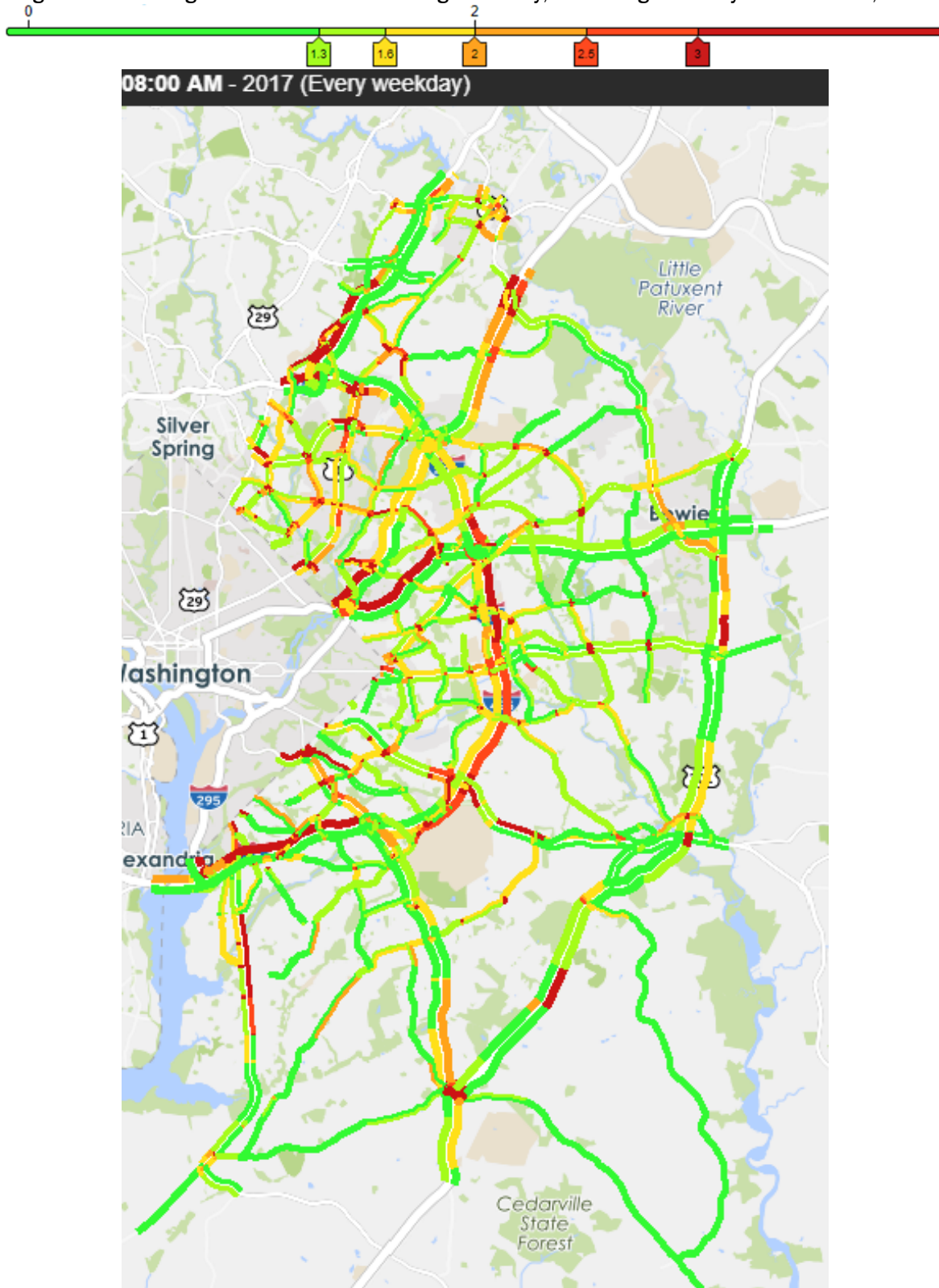


Figure B10: Planning Time Index in Prince George's County, MD during Weekday 5:00-6:00 pm, 2017

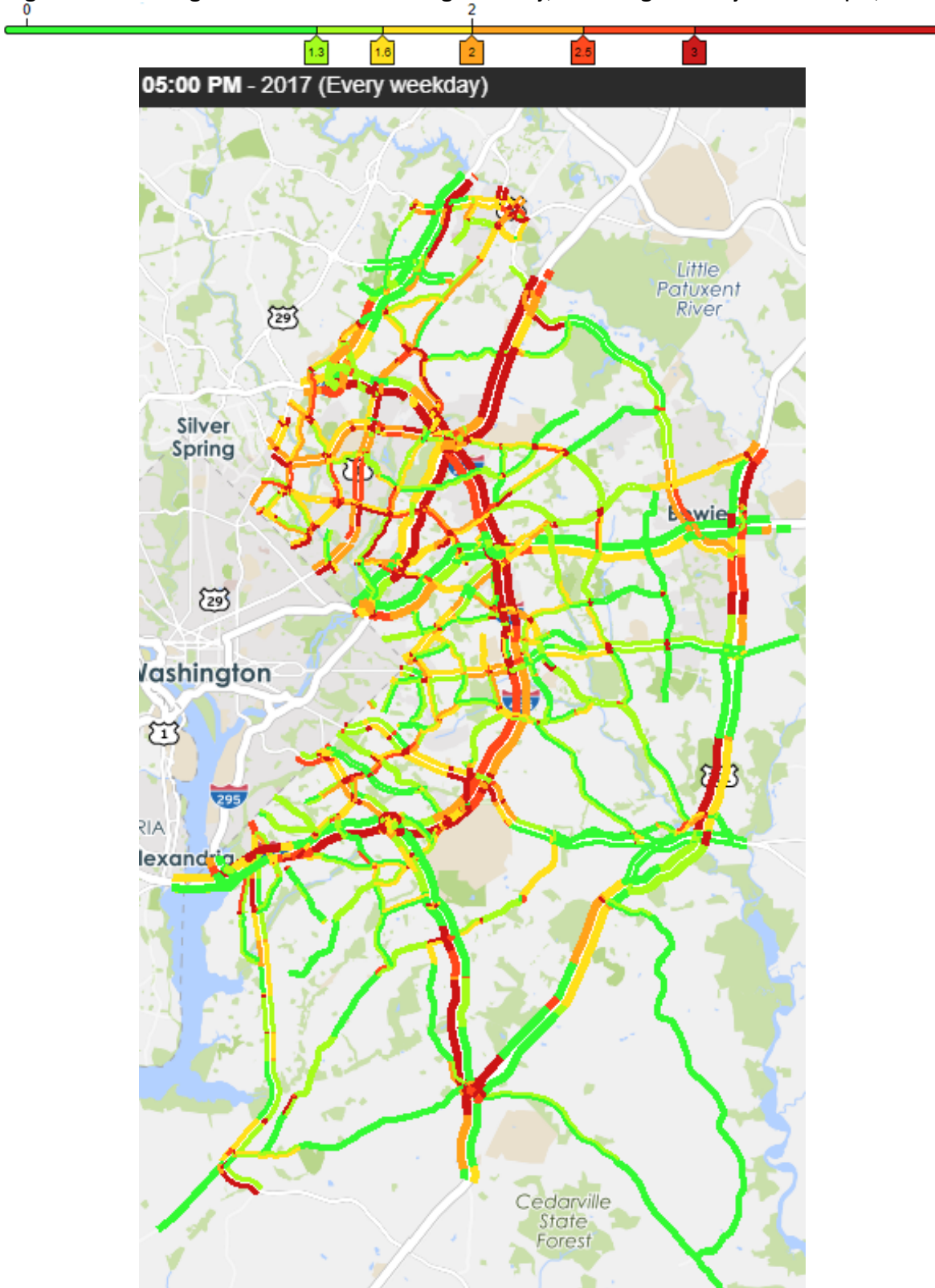


Figure B11: Planning Time Index in Charles County, MD during Weekday 8:00-9:00 am, 2017

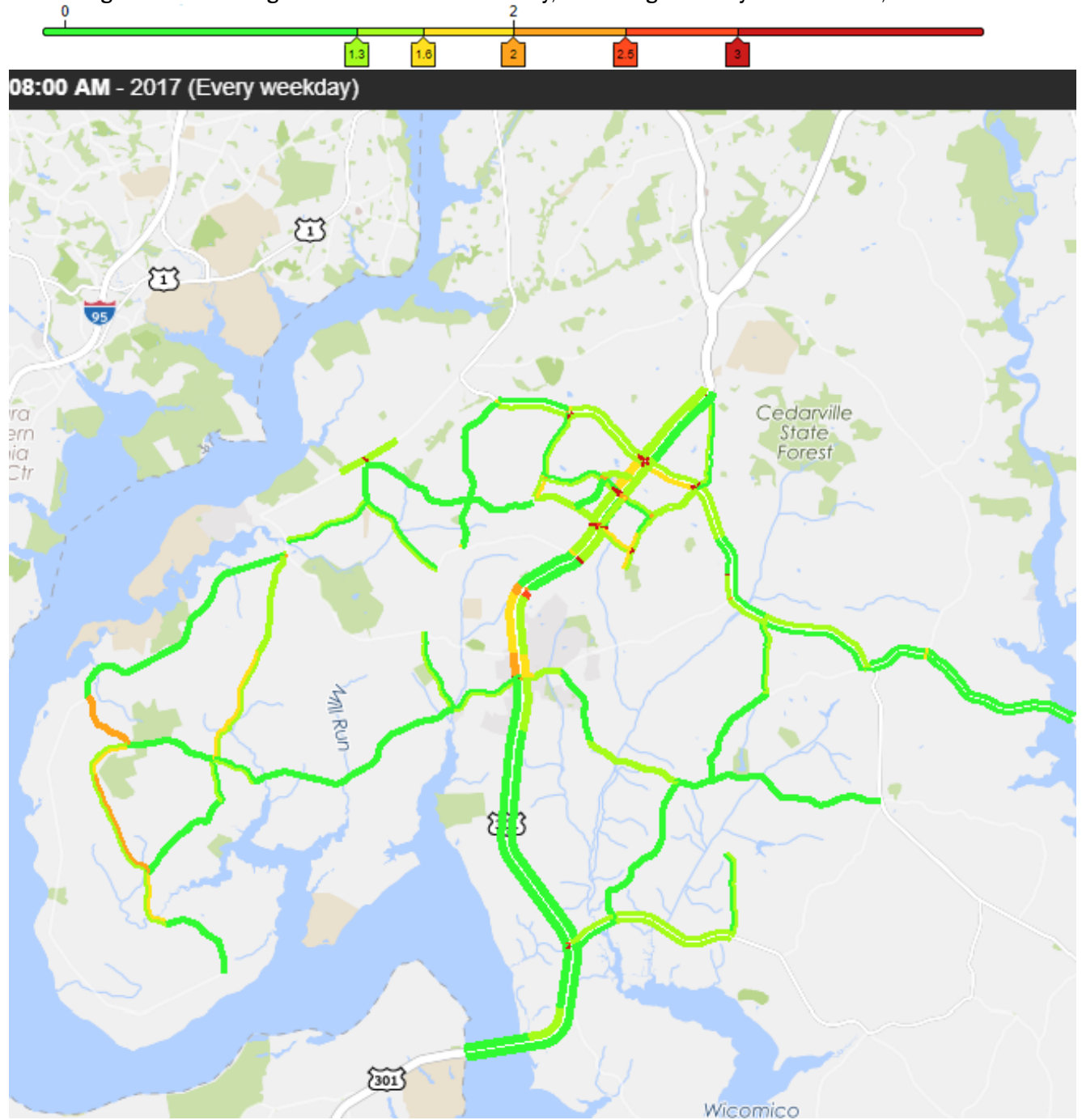




Figure B12: Planning Time Index in Prince Charles County, MD during Weekday 5:00-6:00 pm, 2017

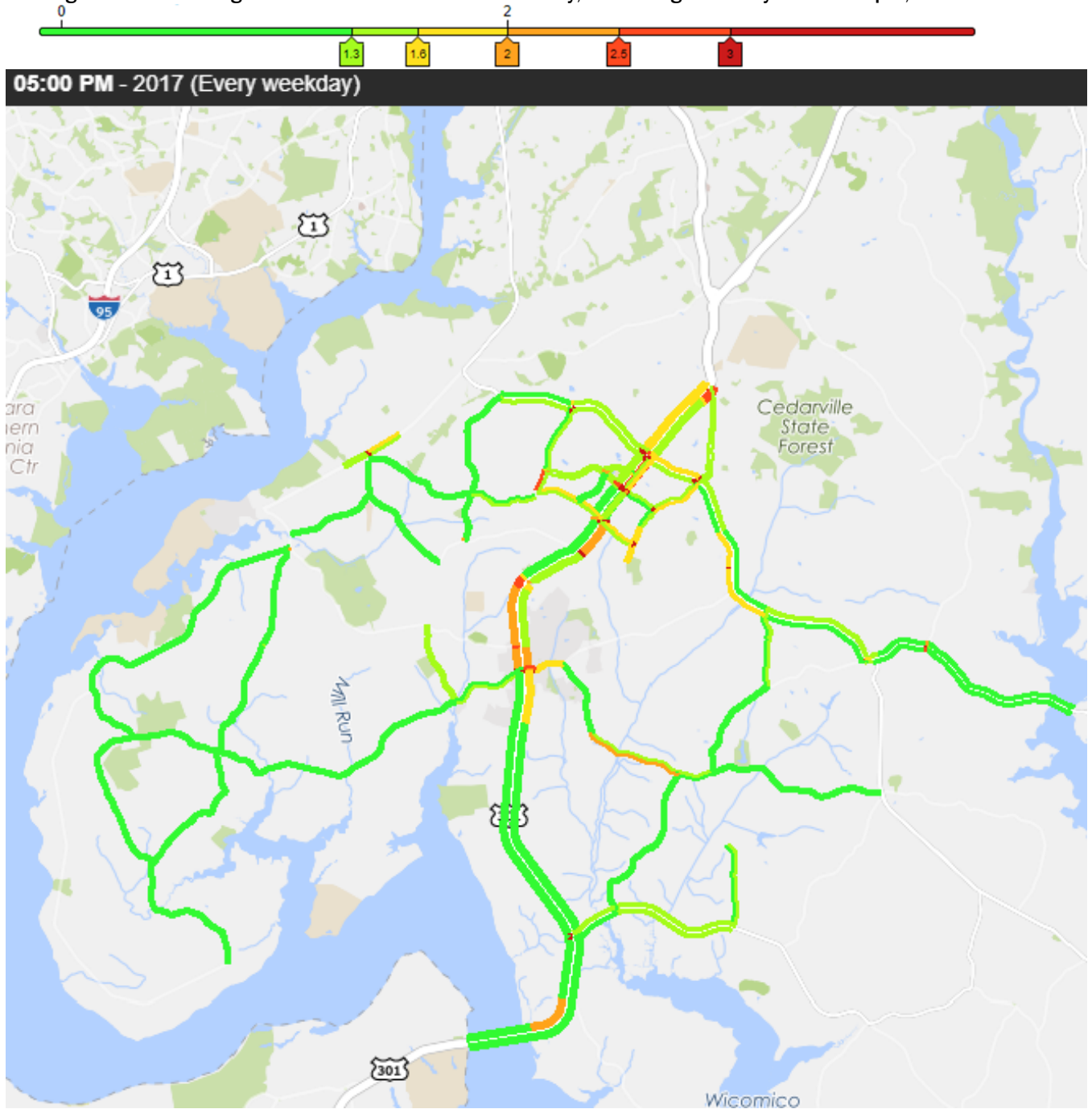


Figure B13: Planning Time Index in Loudoun County, VA during Weekday 8:00-9:00 am, 2017

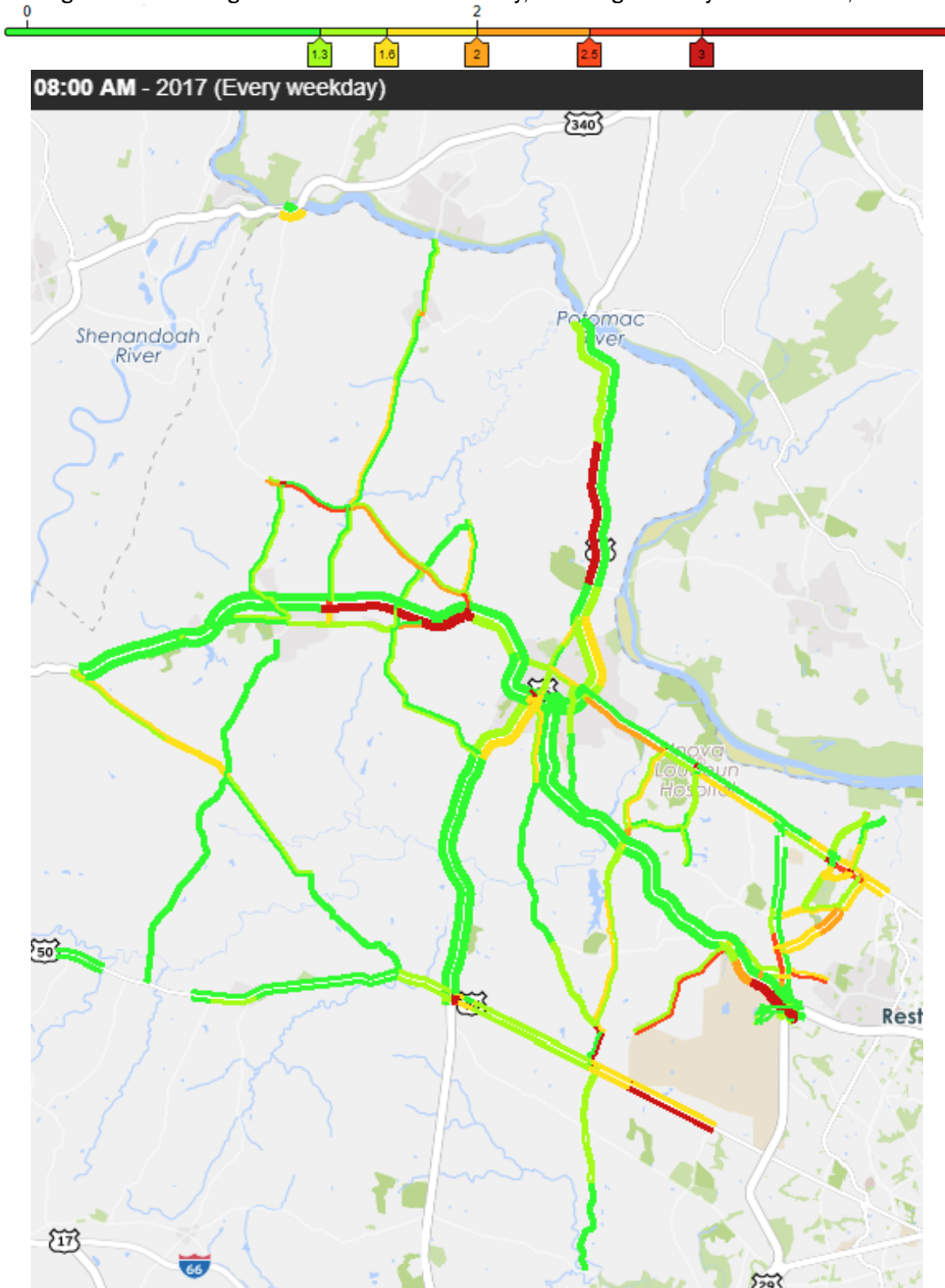


Figure B14: Planning Time Index in Loudoun County, VA during Weekday 5:00-6:00 pm, 2017

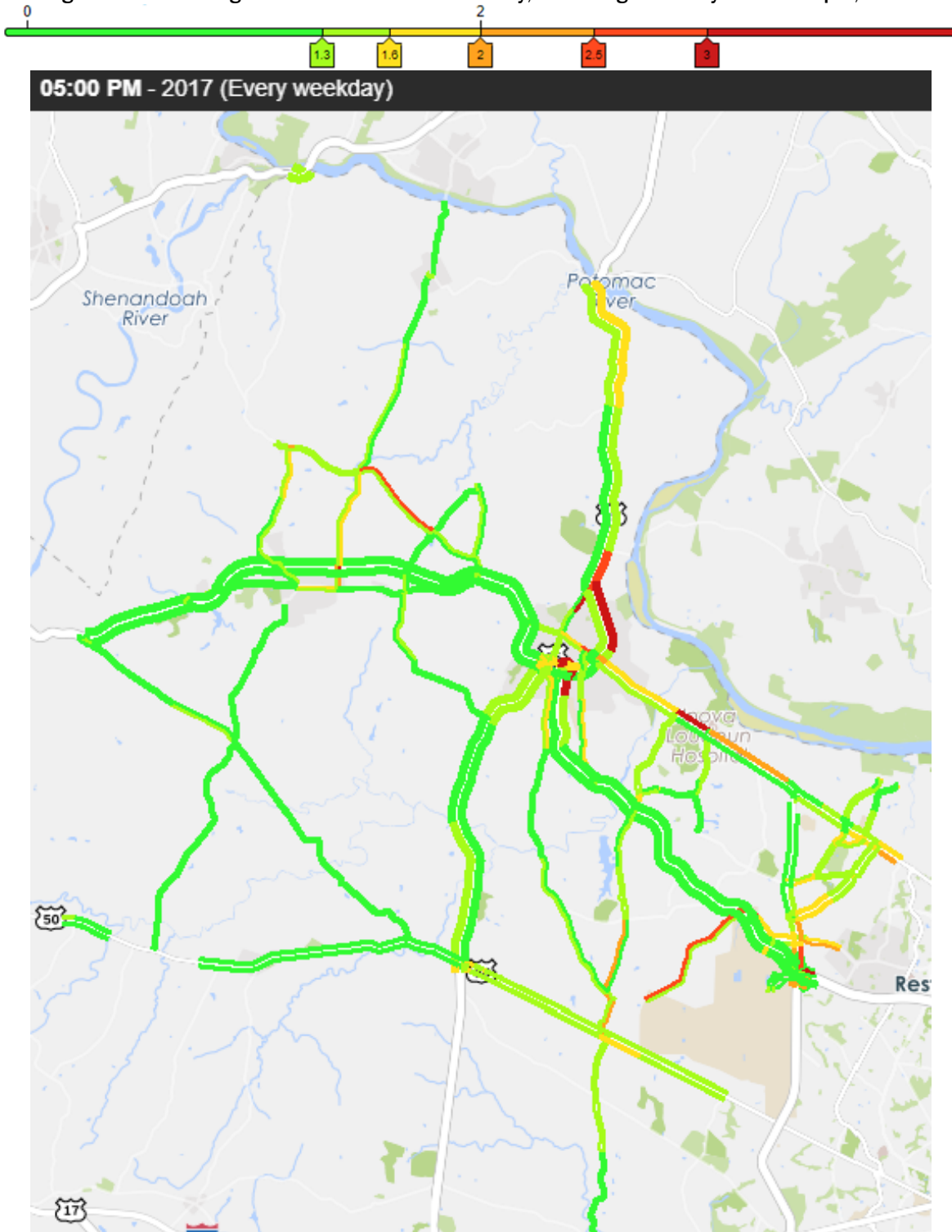


Figure B15: Planning Time Index in Fairfax, Prince William Counties and Cities of Fairfax, Manassas, and Manassas Park, VA during Weekday 8:00-9:00 am, 2017

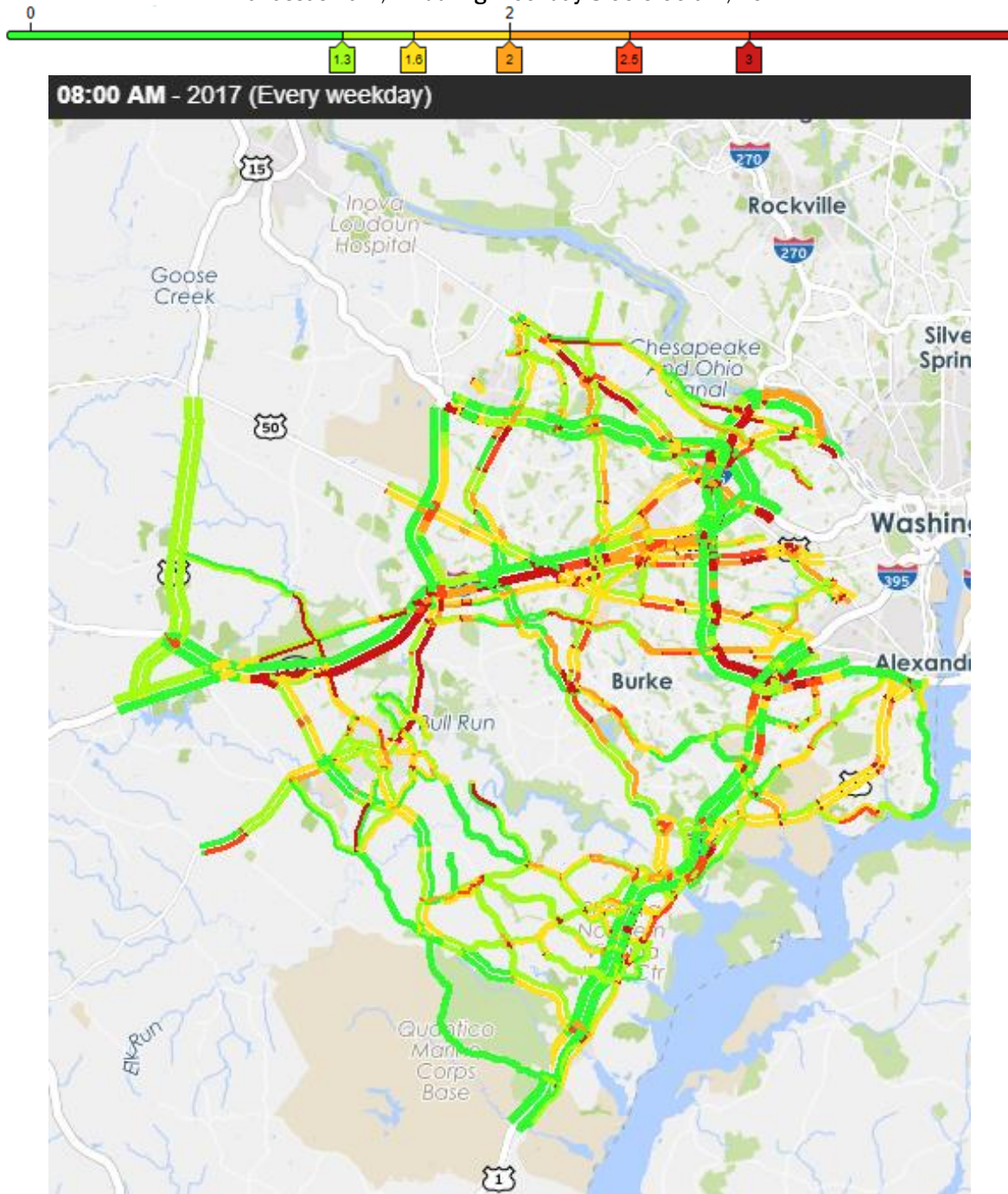




Figure B16: Planning Time Index in Fairfax, Prince William Counties and Cities of Fairfax, Manassas, and Manassas Park, VA during Weekday 5:00-6:00 pm, 2017

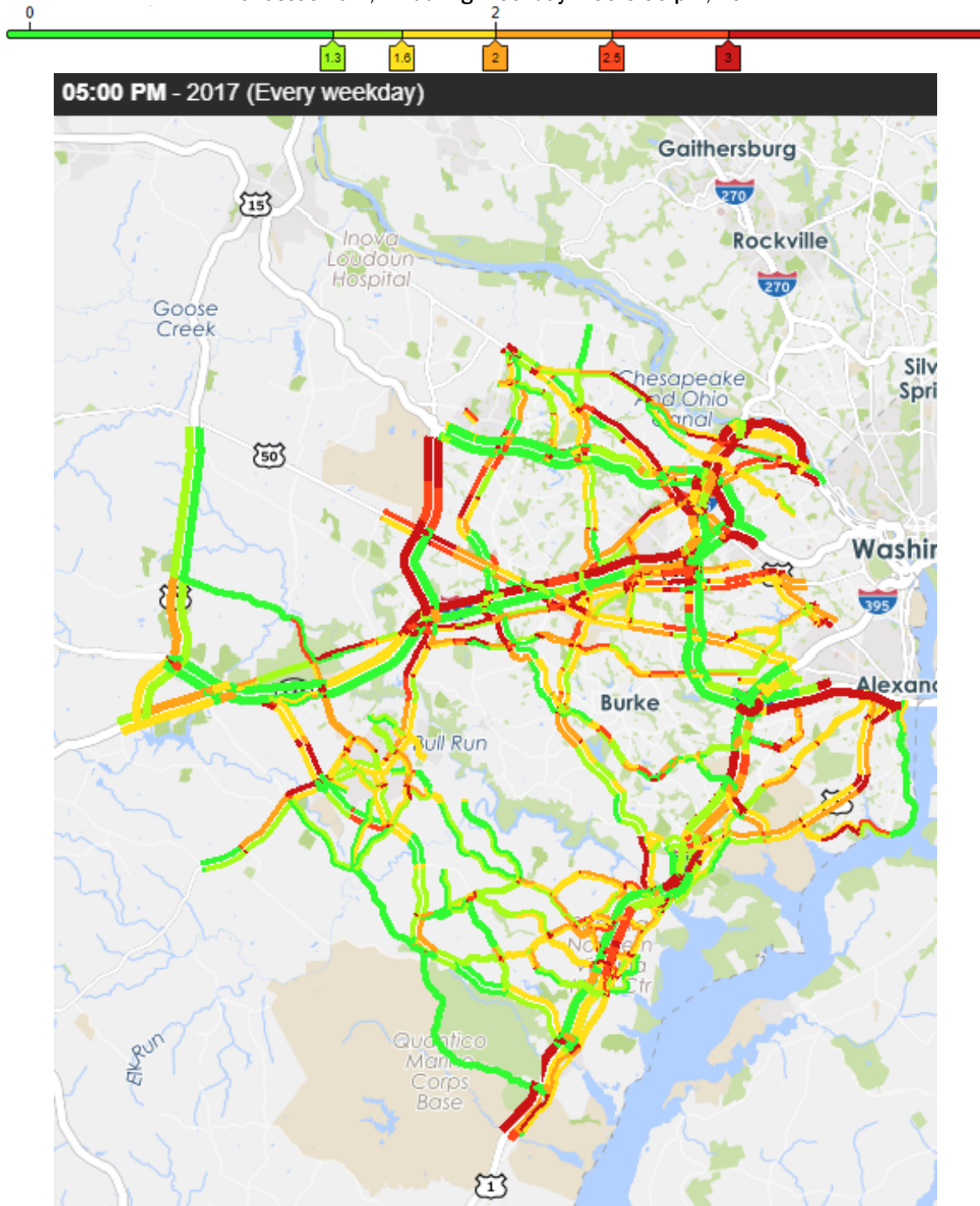


Figure B17: Planning Time Index in Cities of Alexandria, Arlington, and Falls Church, VA during Weekday 8:00-9:00 am, 2017

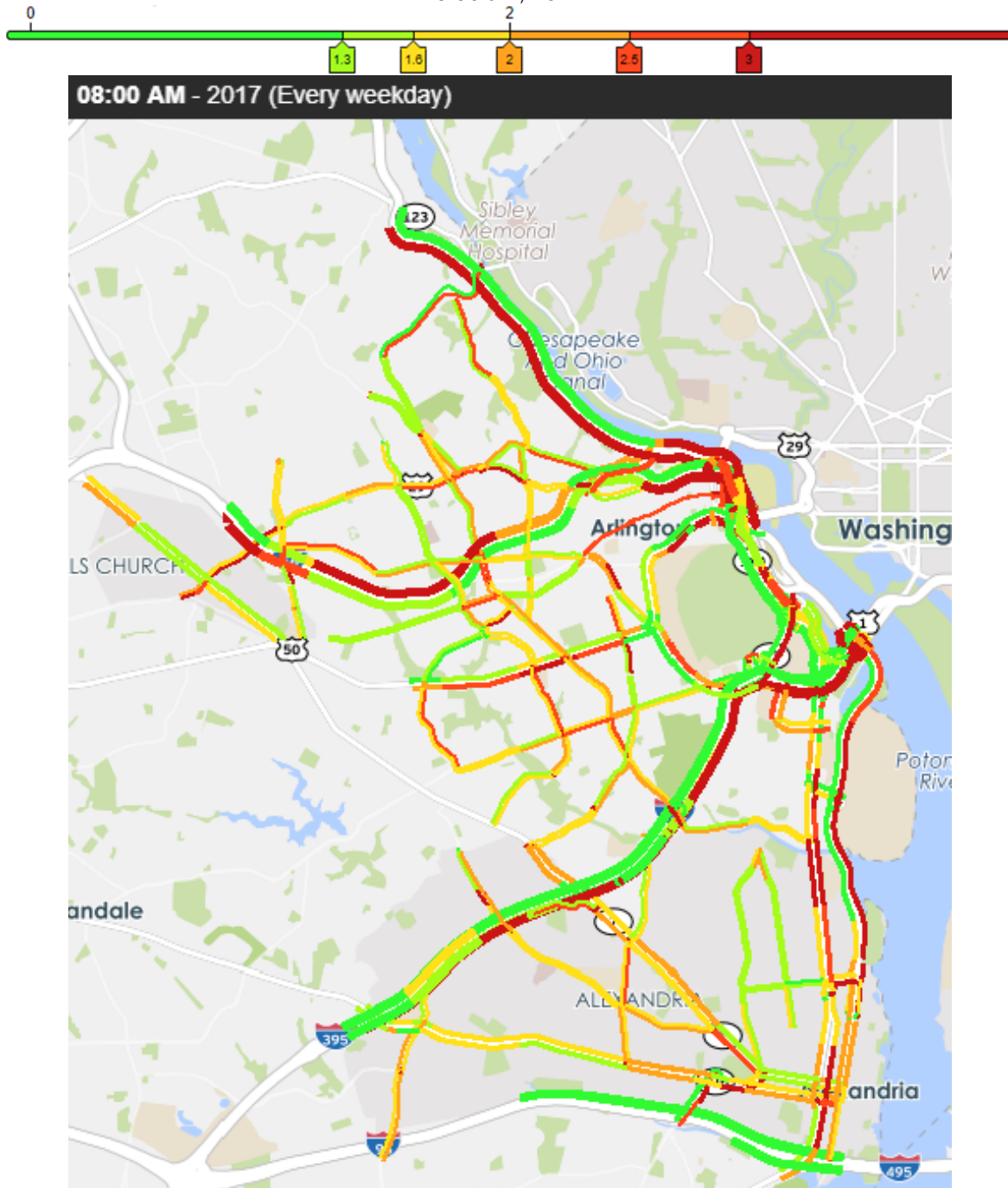
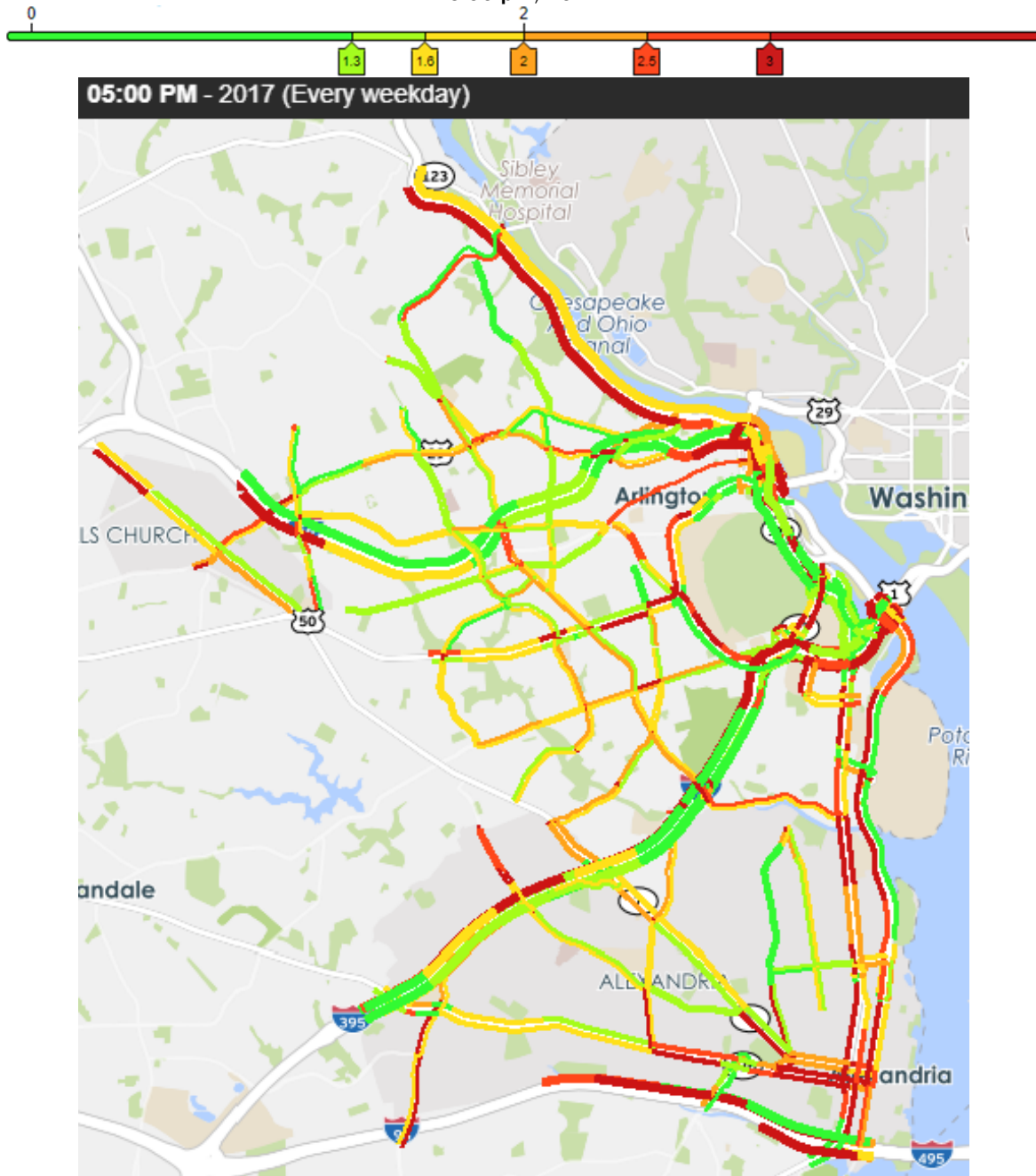


Figure B18: Planning Time Index in Cities of Alexandria, Arlington, and Falls Church, VA during Weekday 5:00-6:00 pm, 2017



## **APPENDIX C – 2010 AND 2015-2017 TRAVEL TIMES ALONG MAJOR FREEWAY COMMUTE CORRIDORS**

Note:

1. Calculation and visualization were provided by the “Performance Charts” tool of the Vehicle Probe Project Suite developed by the CATT Lab of the University of Maryland, <https://vpp.ritis.org/>.
2. There are 18 major commuter corridors defined in this report:
  - C1 I-270 between I-370/Sam Eig Hwy/Exit 9 and I-70/US-40
  - C2 I-270 between I-370/Sam Eig Hwy/Exit 9 and I-495/MD-355
  - C3 VA-267 between VA-28/Exit 9a and VA-123/Exit 19
  - C4 I-66 between VA-28/Exit 53 and I-495/Exit 64
  - C5 I-66 between I-495/Exit 64 and Theodore Roosevelt Memorial Bridge
  - C6 I-95 between VA-234/Exit 152 and Franconia Rd/Exit 169
  - C7 I-95 HOV between VA-234/Exit 152 and Franconia Rd/Exit 169
  - C8 I-395 between I-95 and H St
  - C9 I-395 HOV between I-95 and US-1
  - C10 US-50 between MD-295/Kenilworth Ave and US-301/Exit 13
  - C11 MD-295 between US-50/MD-201/Kenilworth Ave and MD-198
  - C12 I-95 between I-495/Exit 27-25 and MD-198/Exit 33
  - C13 I-495 between I-270/Exit 35 and I-95/Exit 27
  - C14 I-495 between I-95/Exit 27 and US-50/Exit 19
  - C15 I-495 between US-50/Exit 19 and I-95/I-395/Exit 57
  - C16 I-495 between I-95/I-395/Exit 57 and I-66/Exit 9
  - C17 I-495 between I-66/Exit 9 and I-270/Exit 35
  - C18 I-295 between I-495 and 11<sup>th</sup> St. Bridge
3. Travel times were drawn for only normal weekdays – Tuesdays, Wednesdays and Thursdays.



**Figure C1**

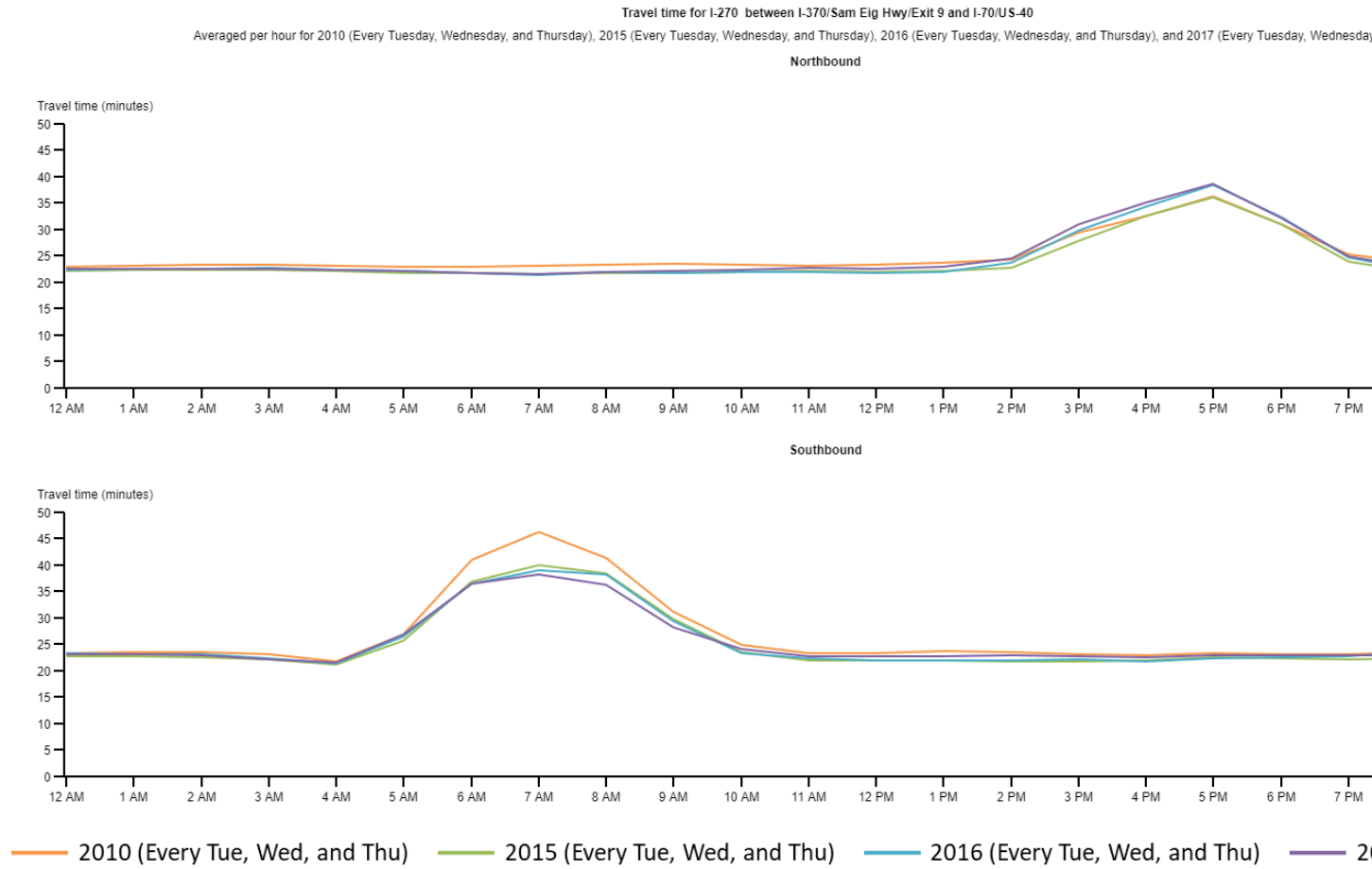


Figure C2

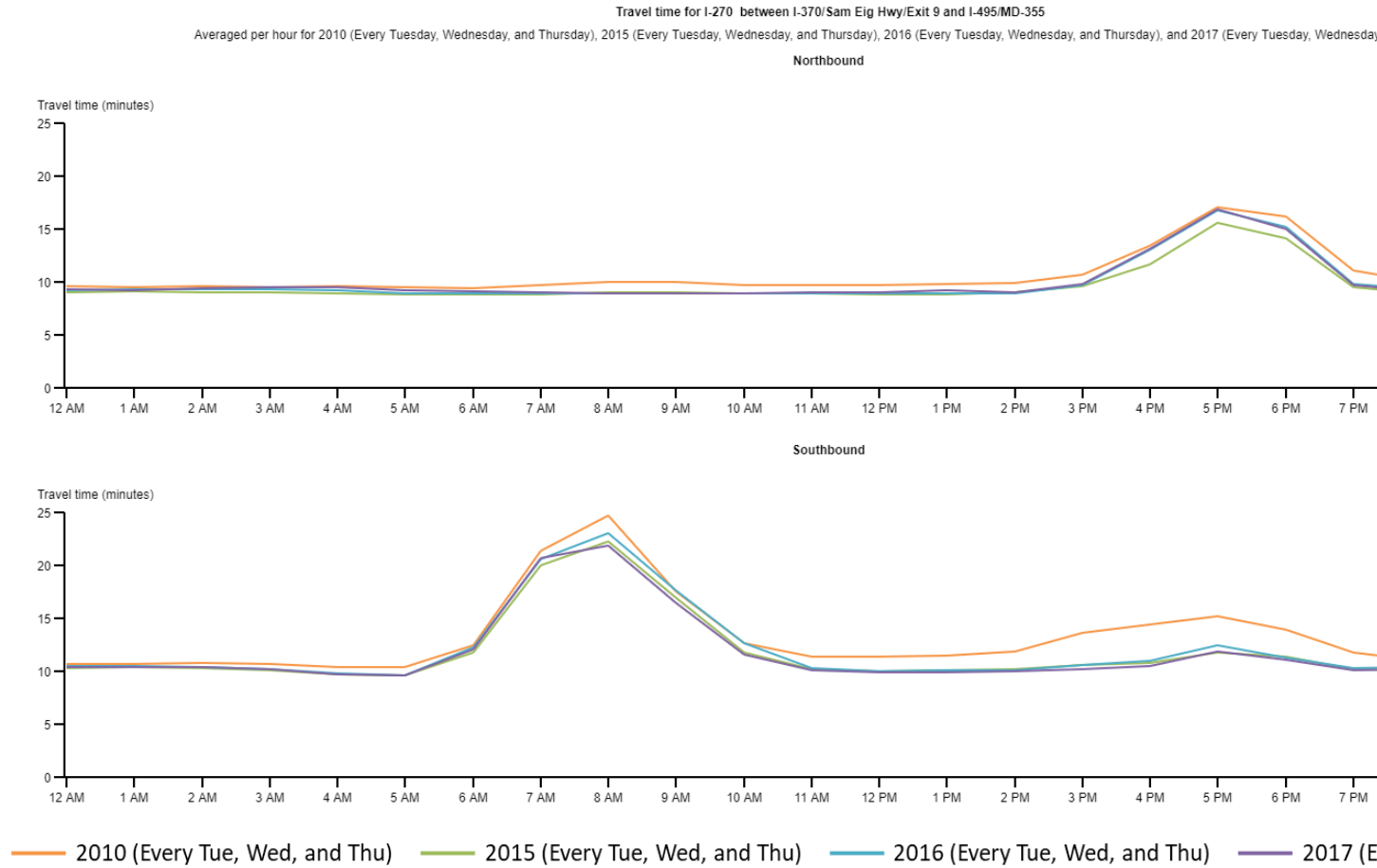


Figure C3

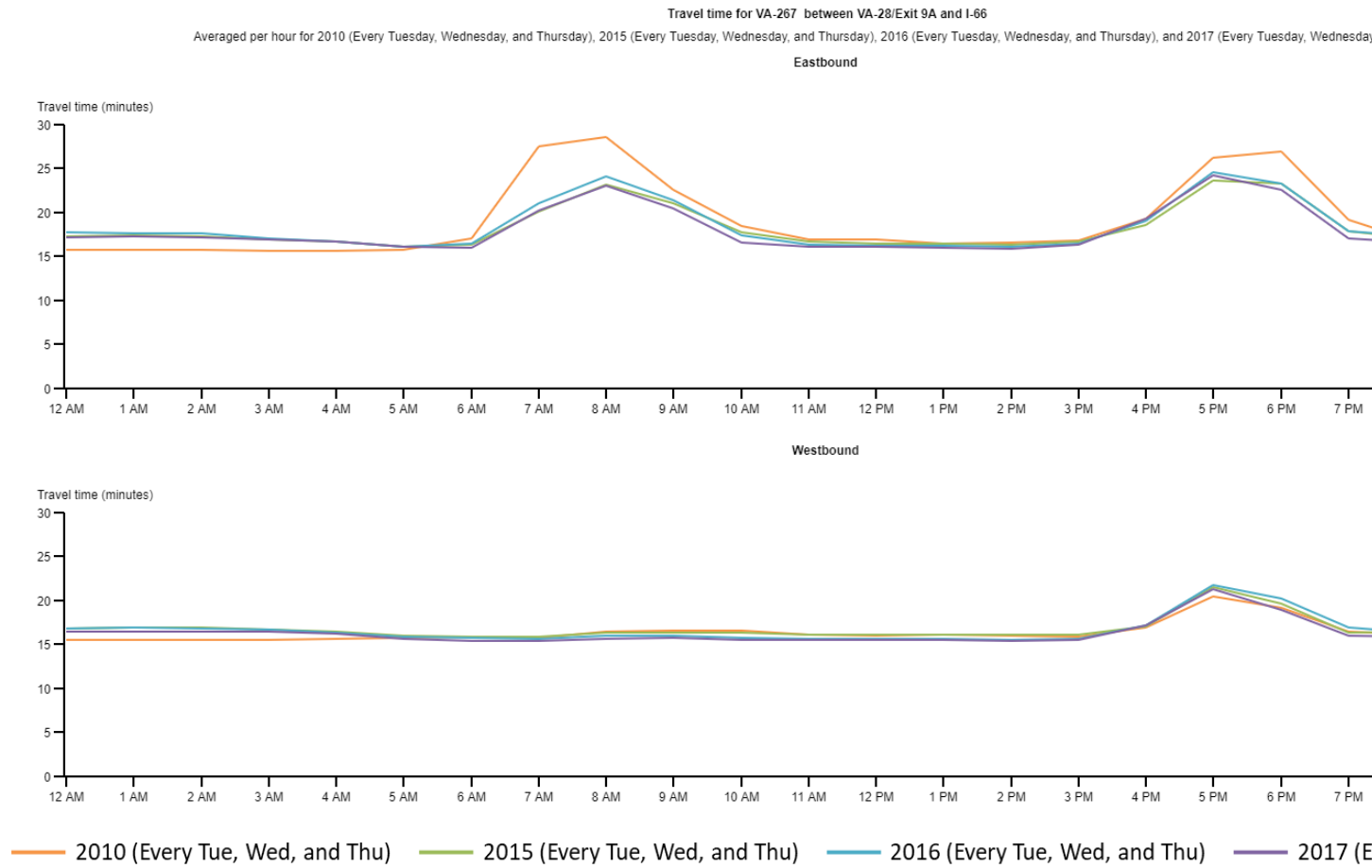


Figure C4

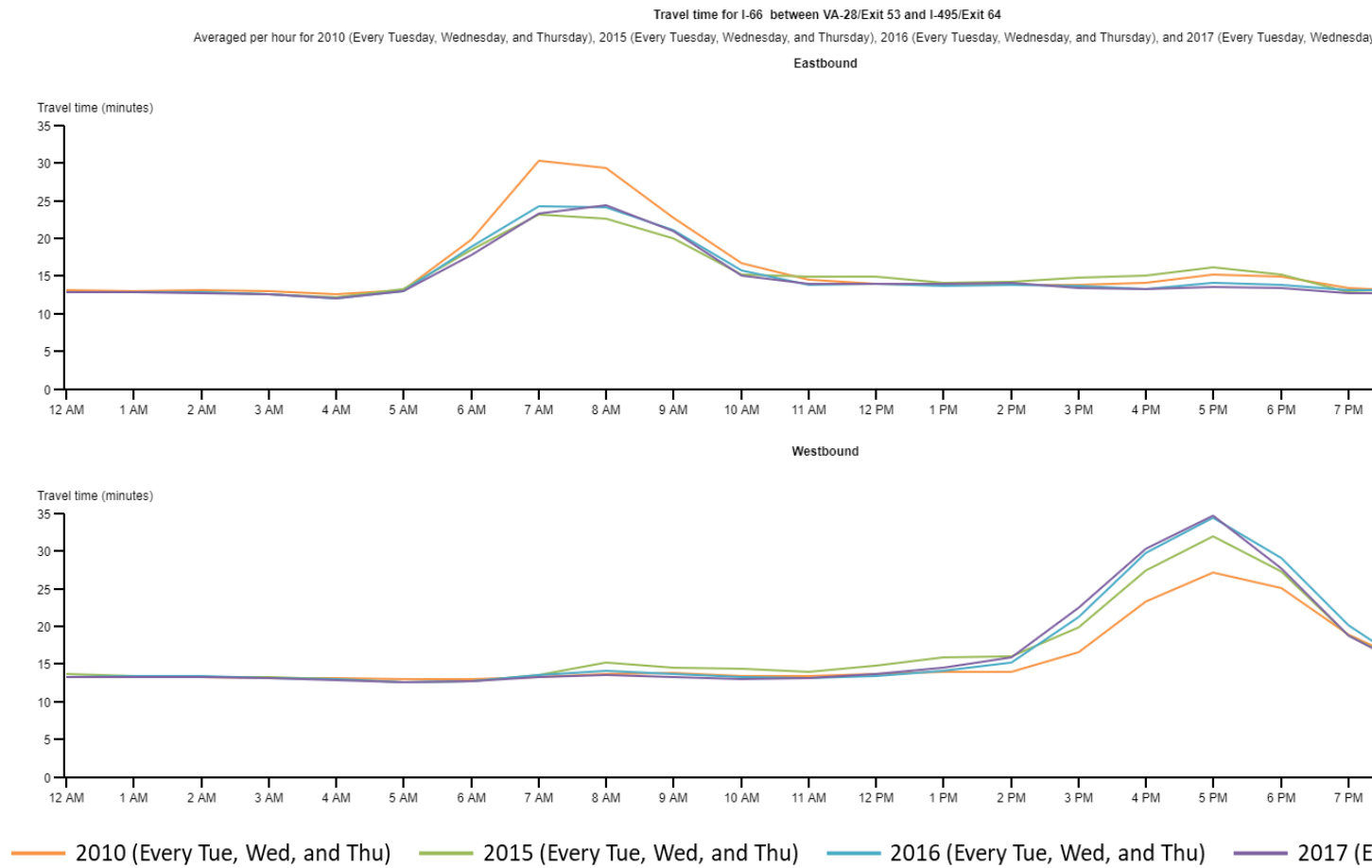




Figure C5

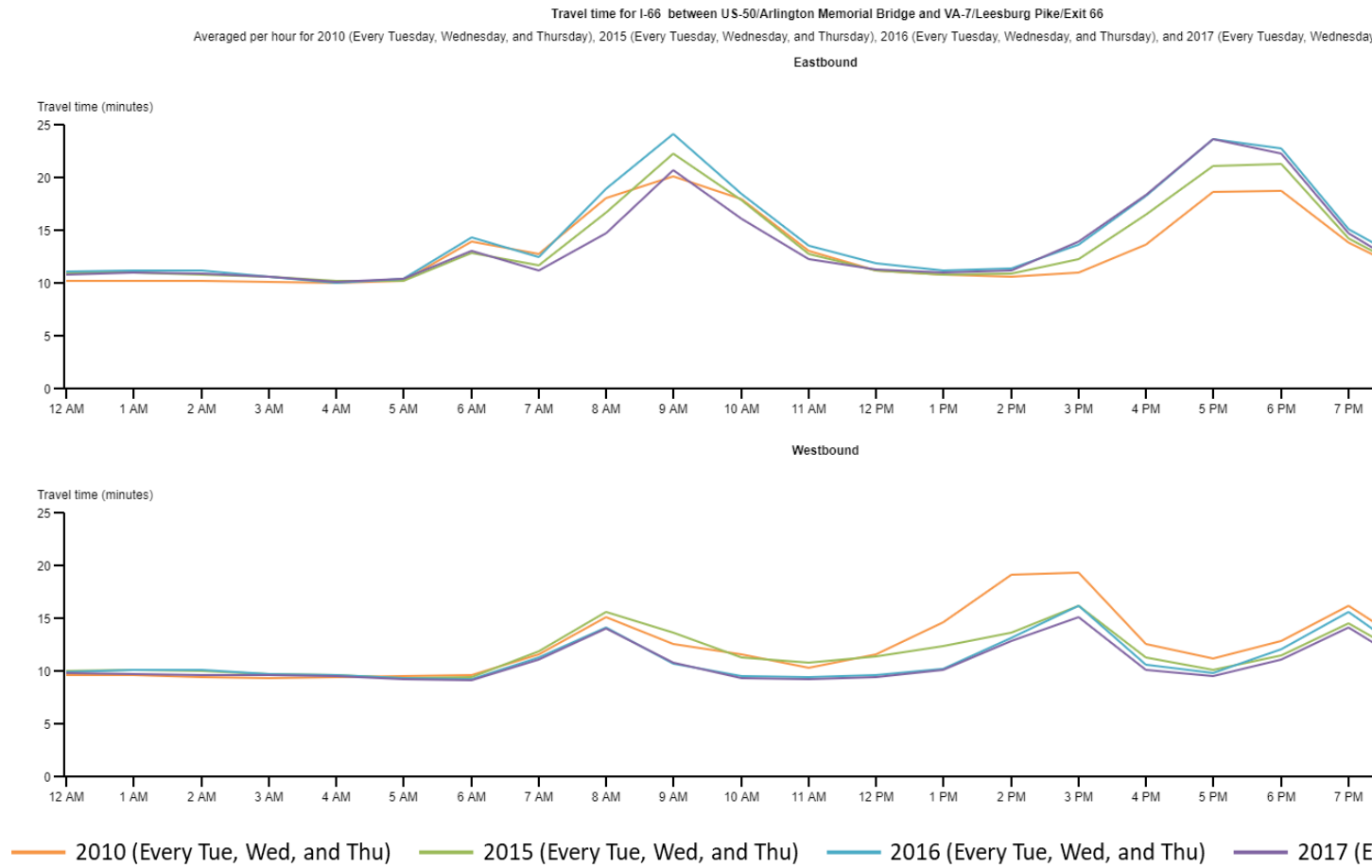


Figure C6

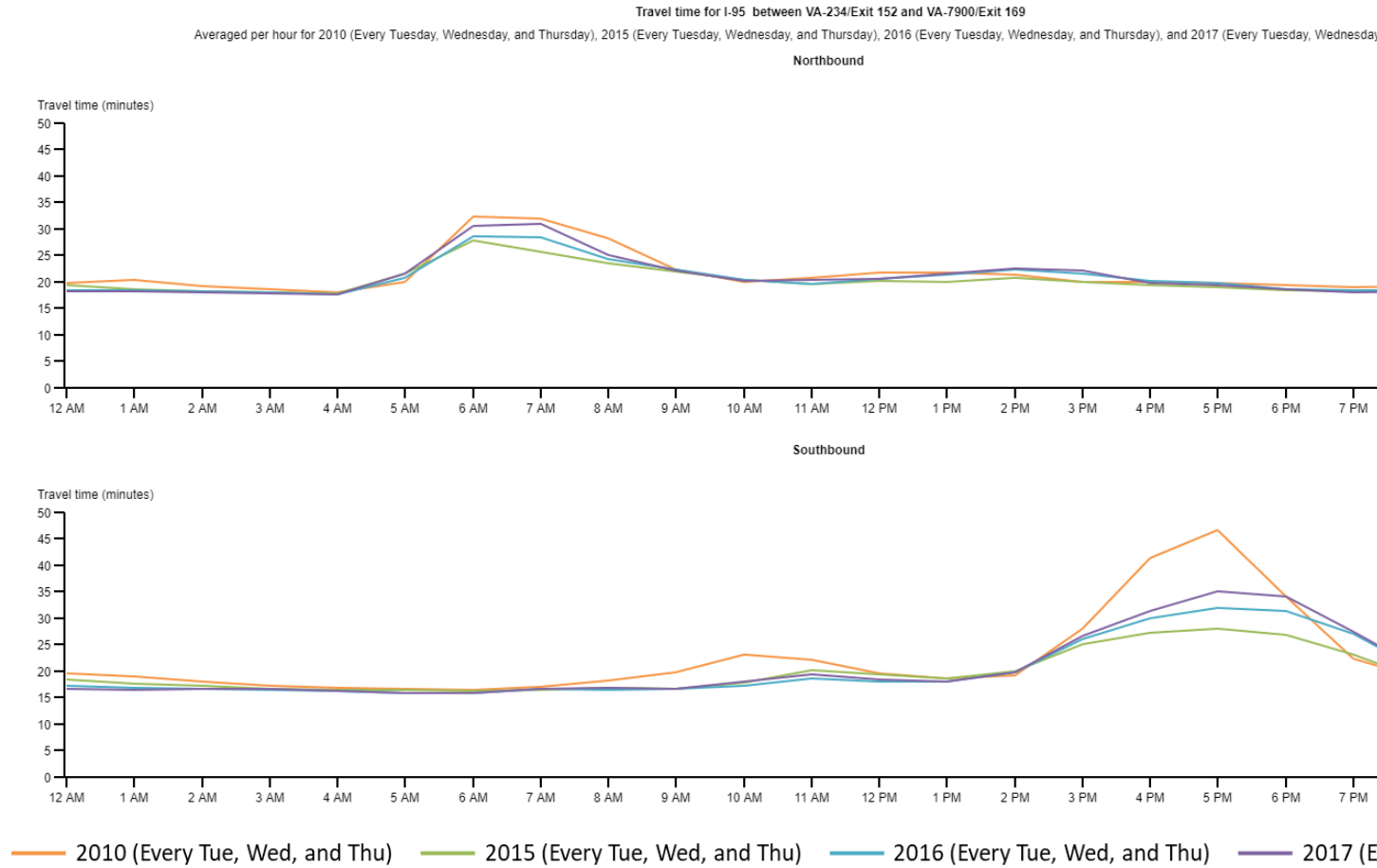
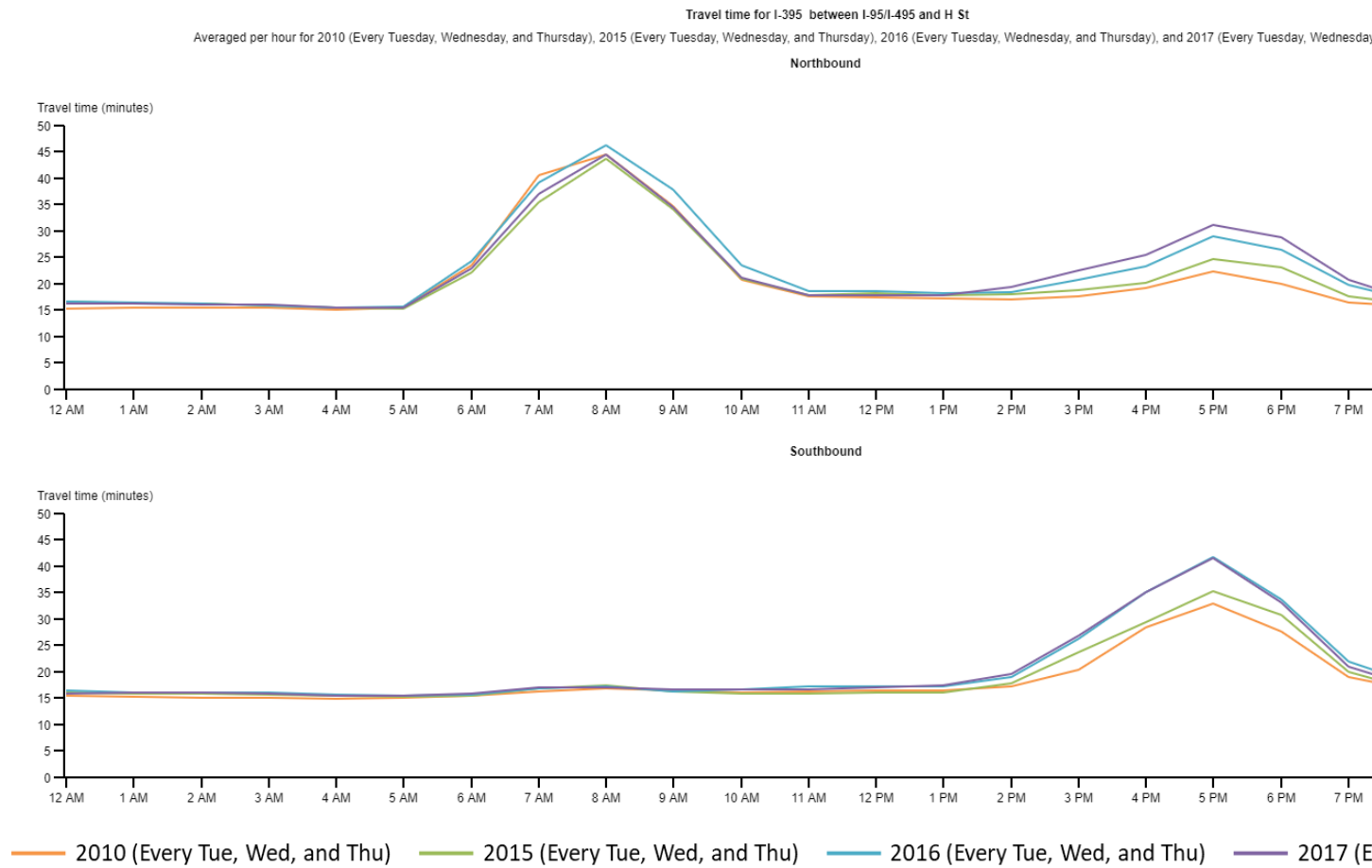




Figure C8





**Figure C9**

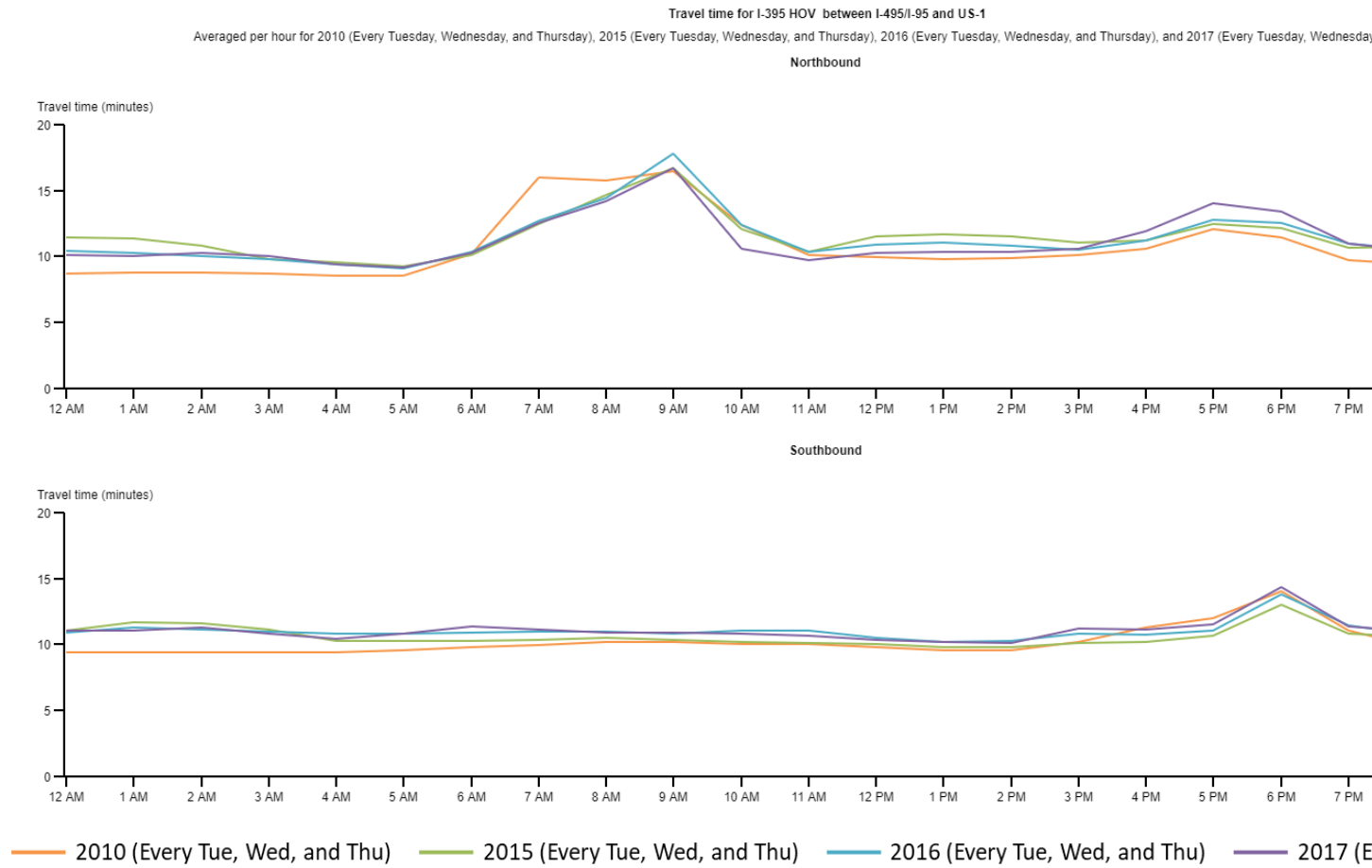


Figure C10

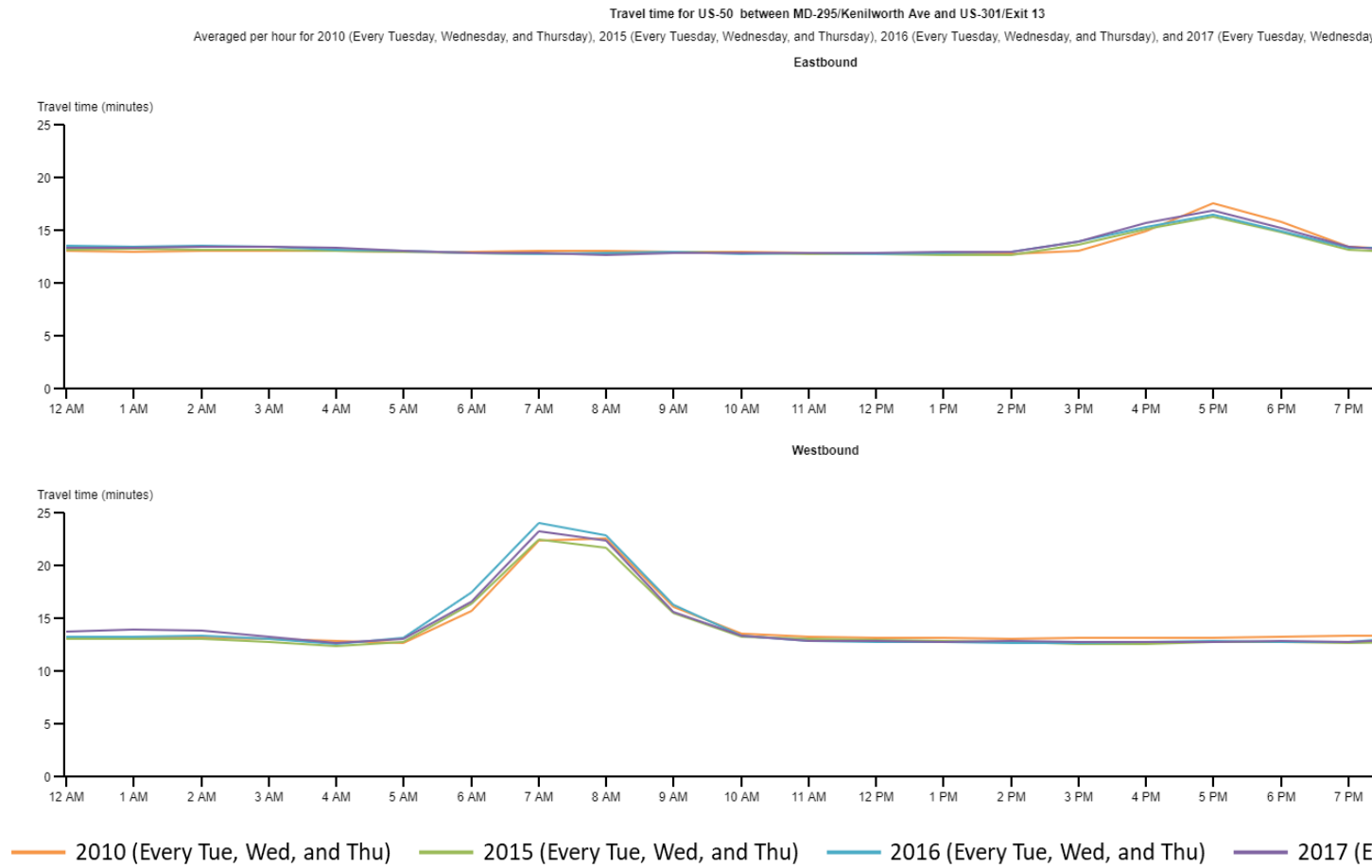
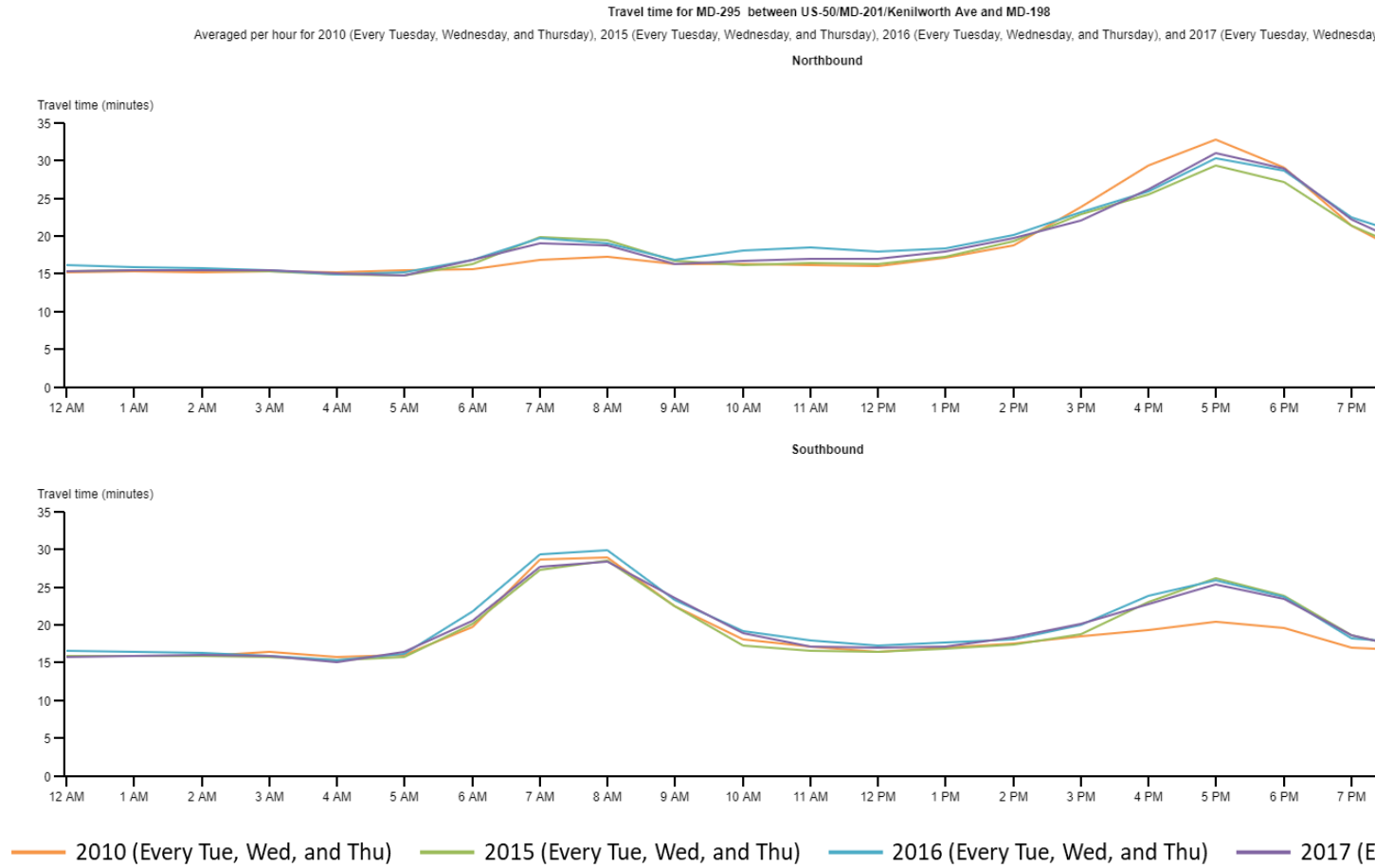
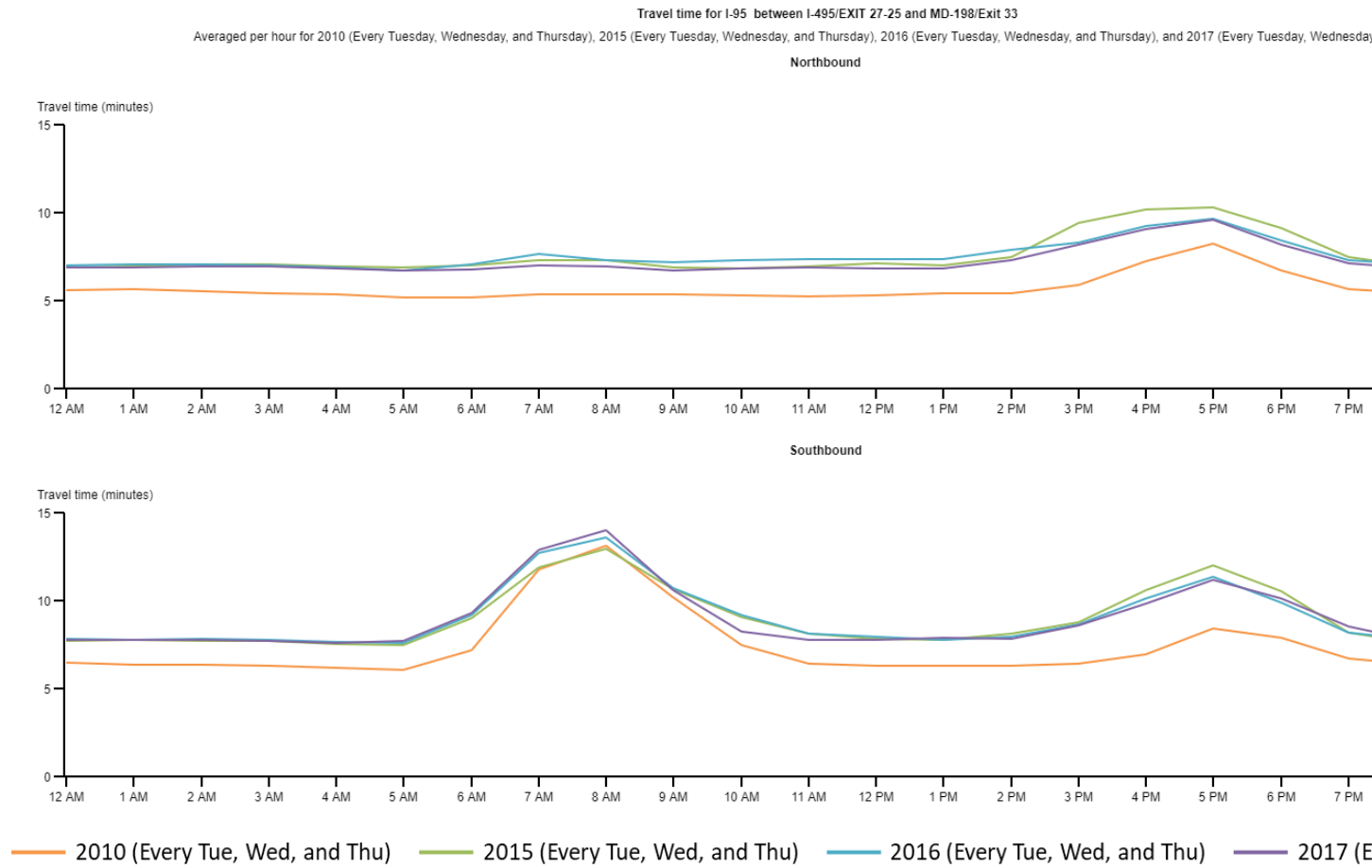


Figure C11



**Figure C12**





**Figure C13**

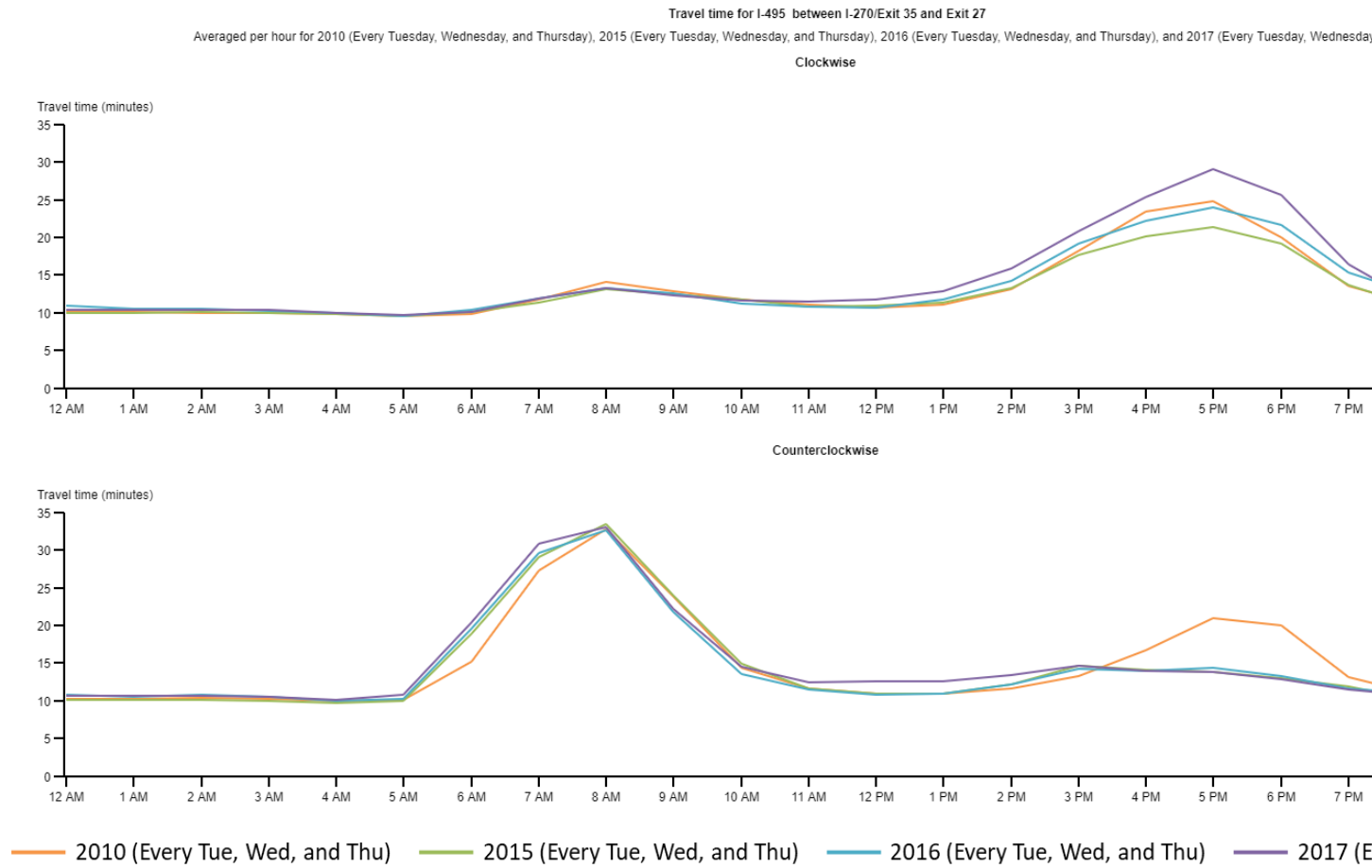
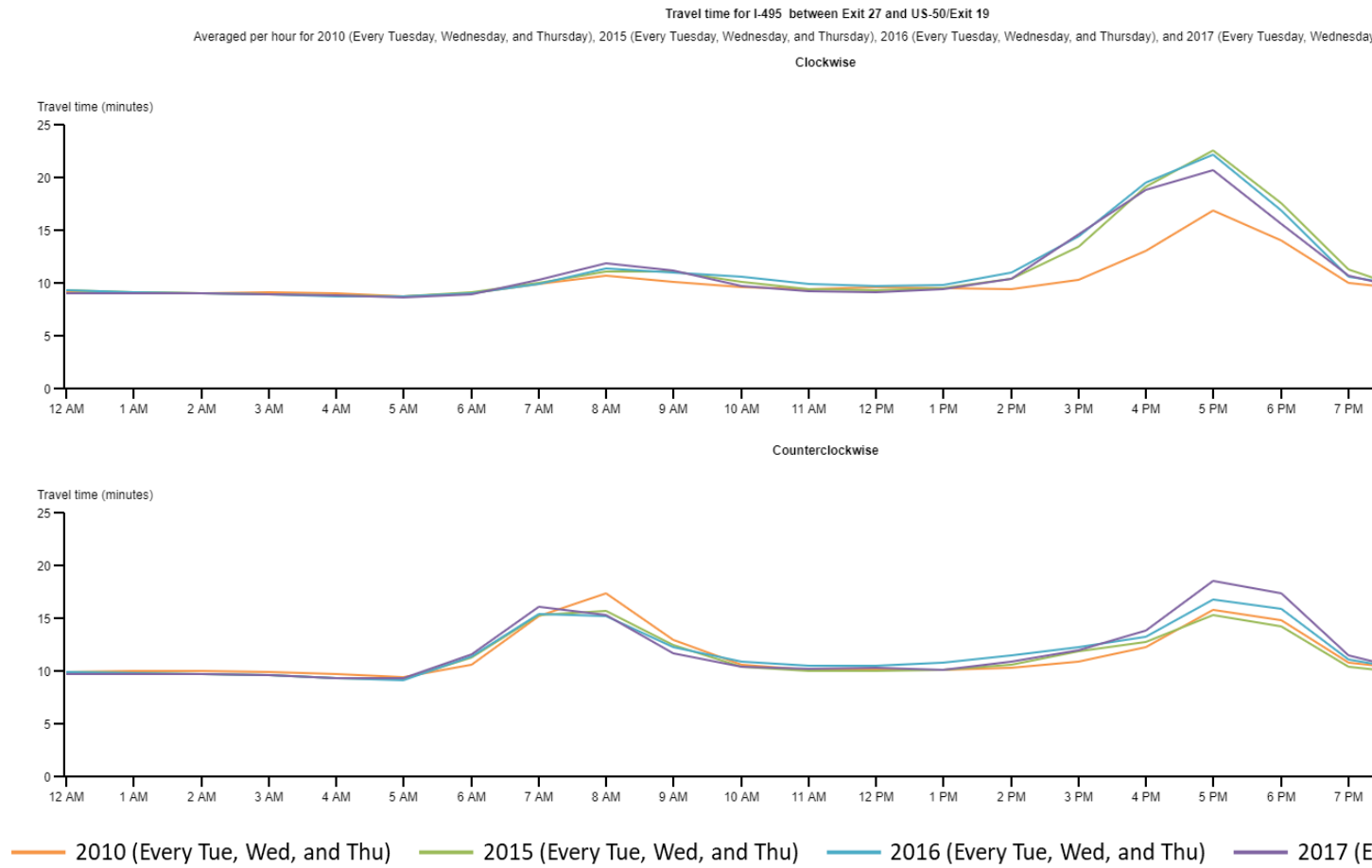
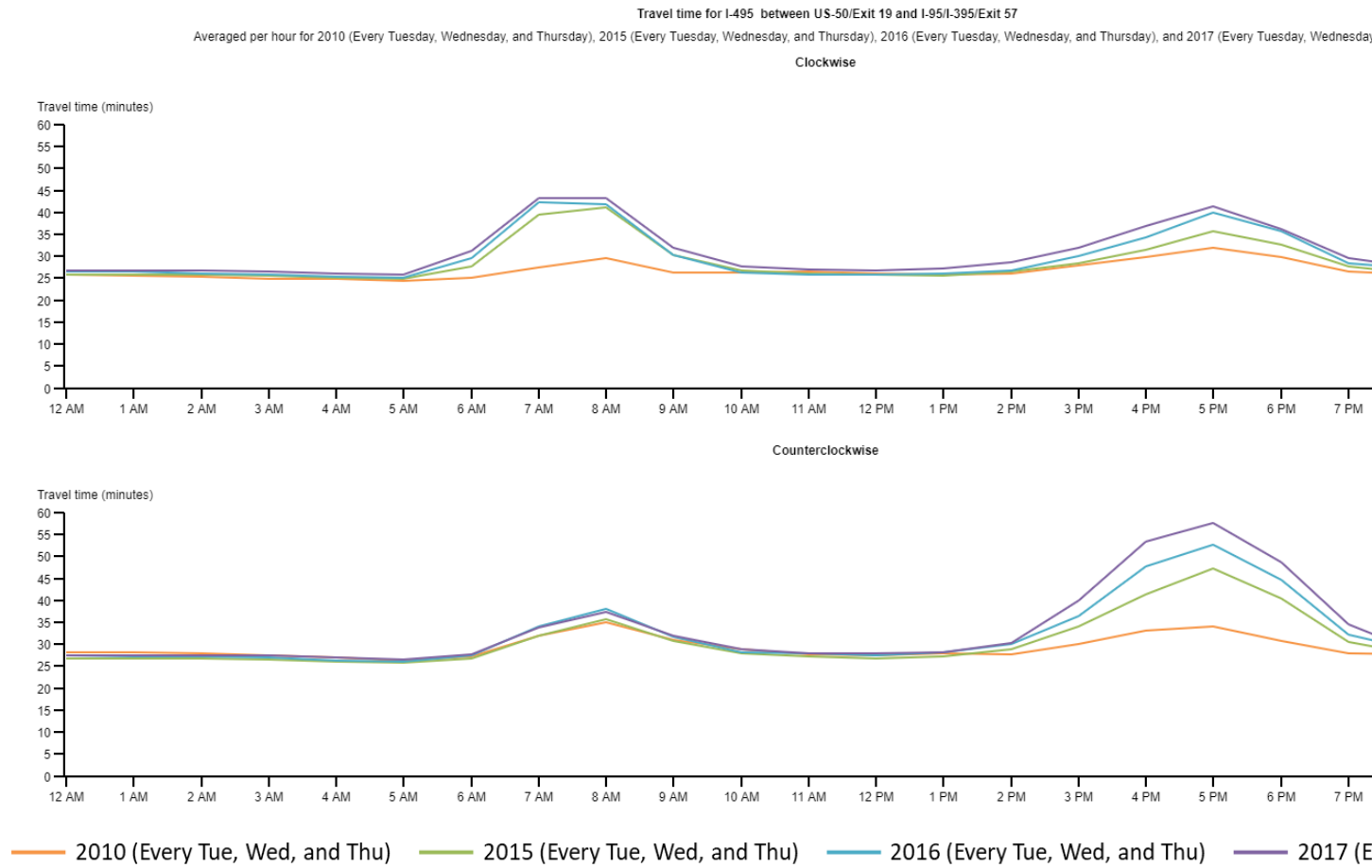


Figure C14



**Figure C15**



**Figure C16**

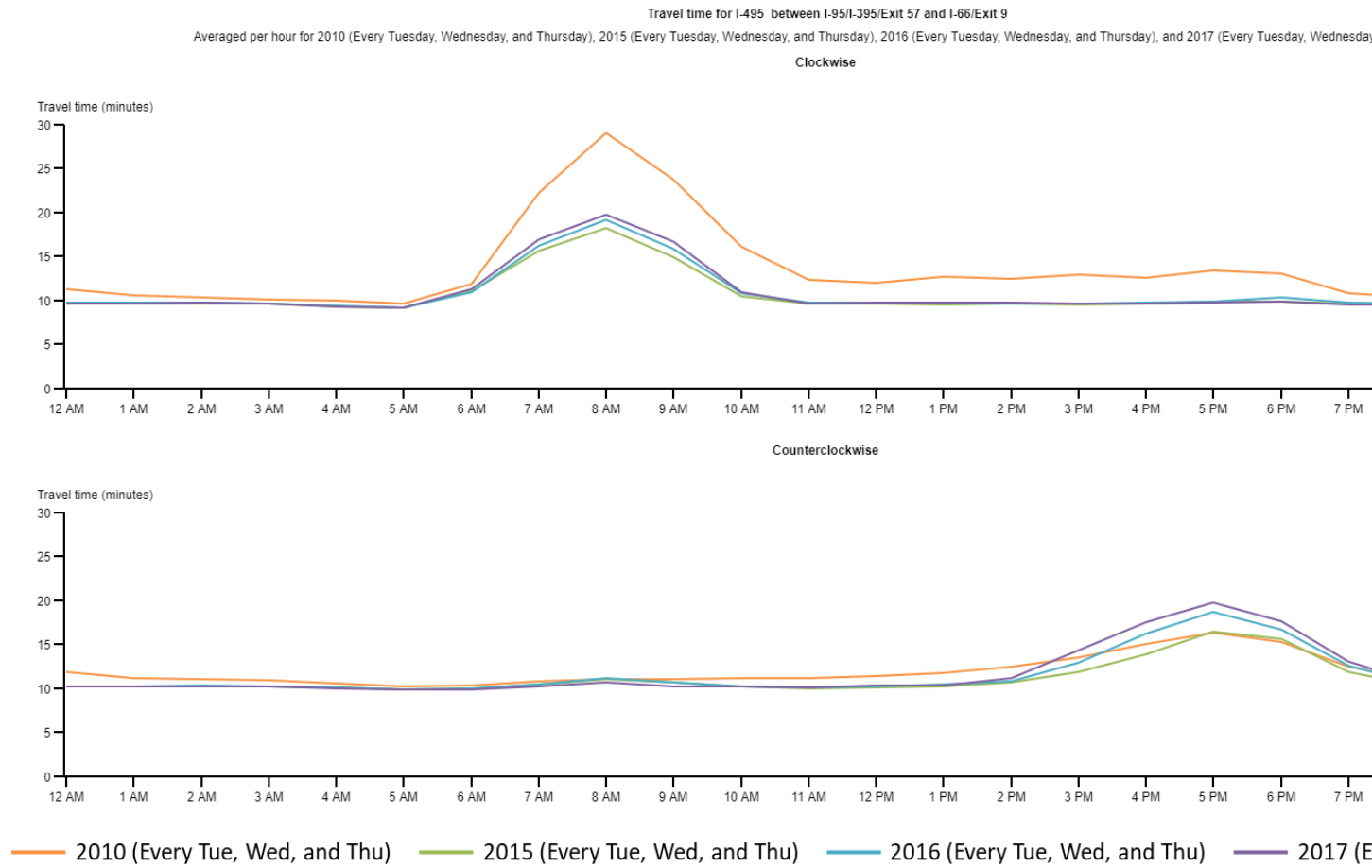
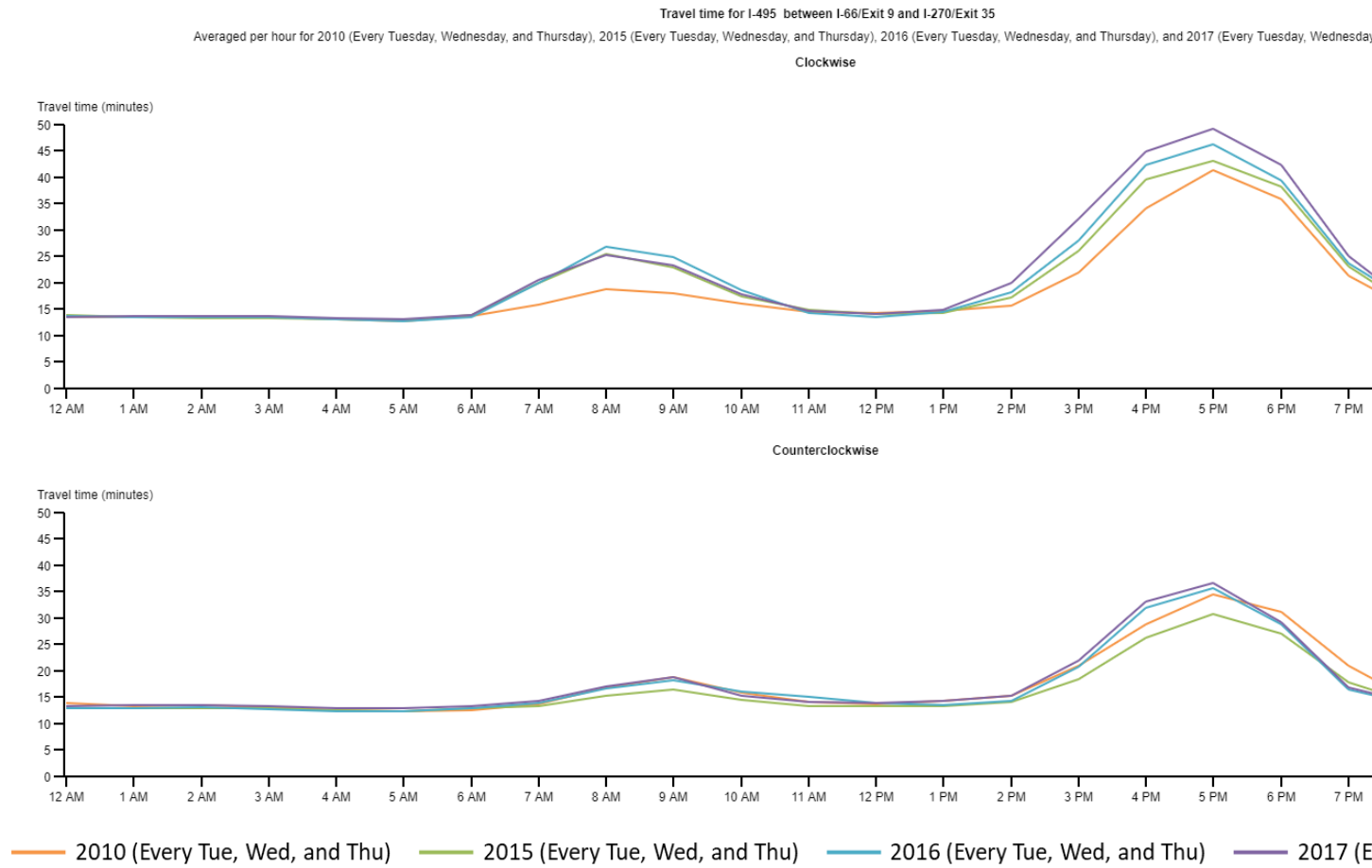
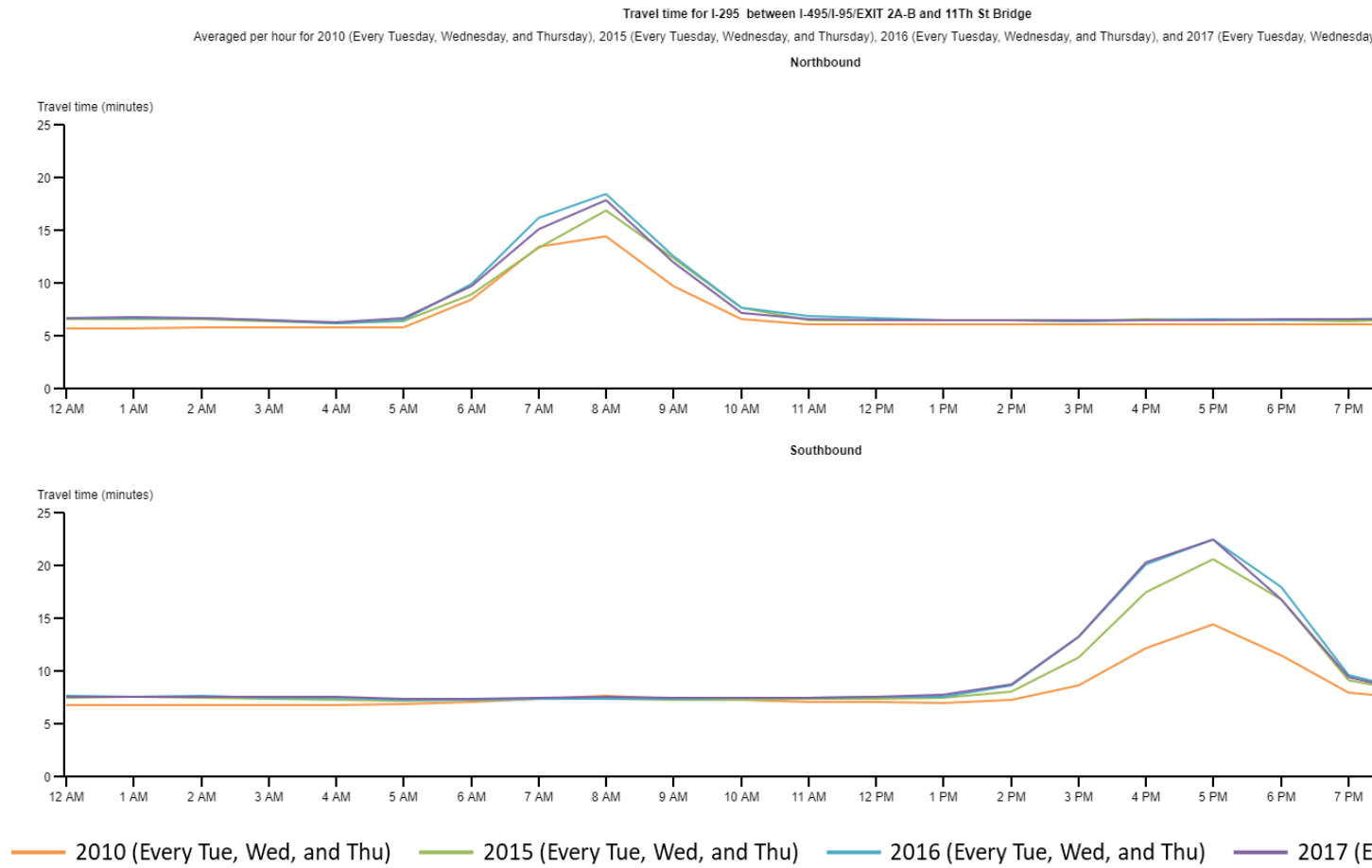




Figure C17



**Figure C18**





**APPENDIX D – 2014 PERFORMANCE OF HIGH-OCCUPANCY VEHICLE FACILITIES ON  
 FREEWAYS IN THE WASHINGTON REGION**

Table D1: Observed Average Auto Occupancies in the AM Peak Direction during HOV-Restricted Periods (Spring 2014)

<b>Observed average auto occupancies in the A.M. peak direction during HOV-restricted periods (Spring, 2014)</b>				
Facility	HOV lane average auto occupancies	Number of autos needed to move 1000 persons at HOV occupancy rate	Non-HOV lane average auto occupancies	Number of autos needed to move 1000 persons at non-HOV occupancy - rate
I-395 Shirley Highway between Va. 120 (S. Glebe Road) and Arlington Ridge Road	2.8	360	1.1	910
I-95 Shirley Highway between Va. 286 (Fairfax County Parkway) and Va. 289 (Franconia Springfield Parkway)	2.6	380	1.1	910
I-66 between Sycamore Street and Va. 120 (North Glebe Road)	1.7	590	N/A	N/A
I-66 between Va. 243 (Nutley Street) and I-495	1.9	530	1.1	910
I-270 between the "split" and Rockledge Drive	1.9	530	1.0	1000
I-270Y (I-270 Spur) between the "split" and Democracy Boulevard	1.8	560	1.0	1000
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesburg Pike)	1.9	530	1.1	910
U.S 50 between Md. 197 (Collington Road) and Md. 704 (MLK, Jr. Highway)	1.6	630	1.0	1000

1.9

Note:  
 - Average auto occupancy rounded to nearest 1/10.



Table D2: Observed AM Peak Direction Average HOV Auto Occupancies Over Time

<b>2014 Observed average HOV auto occupancies in the A.M. Peak Direction Over Time</b>							
<b>Facility</b>	<b>Year</b>						
	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2004</b>	<b>2007</b>	<b>2010</b>	<b>2014</b>
I-395 Shirley Highway between Va. 120 (S. Glebe Road) and Arlington Ridge Road	2.7	2.6	2.9	2.5	2.5	2.8	2.8
I-95 Shirley Highway between Va. 286 (Fairfax County Parkway) and Va. 289 (Franconia Springfield Parkway)	2.6	2.8	2.8	2.6	2.6	2.5	2.6
I-66 between Sycamore Street and Fairfax Drive	1.8	1.8	1.8	1.7	1.8	1.5	1.7
I-66 between Va. 243 (Nutley Street) and I-495	2.0	1.7	1.9	2.0	1.9	1.8	1.9
I-270 between the "split" and Rockledge Drive	1.9	1.7	1.7	1.9	1.5	2.0	1.9
I-270Y (I-270 Spur) between the "split" and Democracy Boulevard	1.9	1.8	1.8	1.5	1.8	1.9	1.8
I-270 between Montrose Road and the "split"	N/A	N/A	N/A	1.7	1.6	1.9	1.9
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesburg Pike)	N/A	N/A	1.8	1.8	1.8	1.7	1.6
U.S 50 between Md. 197 (Collington Road) and Md. 704 (MLK, Jr. Highway)	N/A	N/A	N/A	1.6	1.9	1.8	1.9

Notes:  
 - Data in table are rounded.

**Table D3: Observed Person Movements in the AM Peak Direction during HOV-Restricted Periods (Spring 2014)**

<b>Observed person movements in the A.M. peak direction during HOV-restricted periods (Spring, 2014)</b>						
<b>Facility And Hours of HOV-restricted operation</b>	<b>Number of HOV lanes</b>	<b>HOV lane person movements (autos, vanpools, motorcycles and buses) during HOV-restricted period</b>	<b>HOV lane persons per lane per hour</b>	<b>Number of non-HOV lanes</b>	<b>Non-HOV lane person movements during HOV-restricted period</b>	<b>Non-HOV lane persons per lane per hour</b>
I-395 Shirley Hwy. between Va. 120 (S. Glebe Rd.) and Arlington Ridge Rd. 6:00 A.M. to 9:00 A.M.	2	27,200	4,500	4	21,600	1,800
I-95 Shirley Hwy. between Va. 286 (Fairfax County Pkwy.) and Va. 289 (Franconia Springfield Pkwy.) 6:00 A.M. to 9:00 A.M.	2 <i>Includes Newington Flyover Ramp</i>	15,700	2,600	4	15,700	1,300
I-66 between Sycamore Street and Fairfax Drive 6:30 A.M. to 9:00 A.M.	2	16,300	3,300	0 <i>No non-HOV lanes</i>	N/A	N/A
I-66 between Va. 243 (Nutley Street) and I-495 5:30 A.M. to 9:30 A.M.	1	11,700	2,900	3	19,900	1,700
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesburg Pike) 6:30 A.M. to 9:00 A.M.	1	6,900	2,800	3	11,000	1,500
I-270 between Montrose Road and the "split" 6:00 A.M. to 9:00 A.M.	1	10,700	3,600	5	24,600	1,600
I-270 between the "split" and Rockledge Drive 6:00 A.M. to 9:00 A.M.	1	4,700	1,600	3	12,100	1,300
I-270Y (I-270 Spur) between the "split" and Democracy Boulevard 6:00 A.M. to 9:00 A.M.	1 <i>Includes Westlake Drive Ramp</i>	5,900	2,000	3	12,600	1,400
U.S. 50 between Md. 797 (Collington Road) and Md. 704 (MLK, Jr. Highway) 24 Hours, 7 Days/Week (5:00 A.M. to 10:00 A.M. assumed in calculations)	1	4,400	900	3	19,500	1,300

Note:

- All person movements rounded to nearest 100

**Table D4: AM Peak Hour Person Movements during HOV-Restricted Periods (Spring 2014)**

<b>A.M. peak hour person movements during HOV-restricted periods (Spring 2014)</b>						
<b>Facility</b>						
<b>And peak hour within HOV-restricted period</b>	Number of HOV lanes	HOV lane person movements (autos, van-pools, motorcycles and buses) during peak hour in HOV-restricted period	HOV lane persons per lane per hour	Number of non-HOV lanes	Non-HOV lane person movements during HOV-restricted period	Non-HOV lane persons per lane per hour
I-395 Shirley Hwy. between Va. 120 (S. Glebe Rd.) and Arlington Ridge Rd. 7:00 A.M. to 8:00 A.M.	2	10,600	5,300	4	8,300	2,100
I-95 Shirley Hwy. between Va. 286 (Fairfax County Pkwy.) and Va. 289 (Franconia Springfield Pkwy.) 6:30 A.M. to 7:30 A.M.	2 <i>Includes Newington Flyover Ramp</i>	11,500	5,800	4	6,200	1,600
I-66 between Sycamore Street and Fairfax Drive 7:45 A.M. to 8:45 A.M.	2	6,900	3,500	0 <i>No non-HOV lanes</i>	N/A	N/A
I-66 between Va. 243 (Nuttley Street) and I-495 7:00 A.M. to 8:00 A.M.	1	3,200	3,200	3	5,200	1,700
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesboro Pike) 7:00 A.M. to 8:00 A.M.	1	3,200	3,200	3	4,800	1,600
I-270 between the "split" and Rockledge Drive 7:45 A.M. to 8:45 A.M.	1	1,700	1,700	3	4,600	1,500
I-270Y (I-270 Spur) between the "split" and Democracy Boulevard 8:00 A.M. to 9:00 A.M.	1 <i>Includes Westlake Drive Ramp</i>	2,100	2,100	3	4,300	1,400
I-270 between Montrose Road and the "split" 7:45 A.M. to 8:45 A.M.	1	3,800	3,800	5	8,900	1,800
U.S. 50 between Md. 197 (Collington Road) and Md. 704 (MLK, Jr. Highway) 7:15 A.M. to 8:15 A.M.	1	1,000	1,000	3	5,100	1,700

Note:  
 - All person movements rounded to nearest 100

Table D5: Mean AM Peak Period / Peak Direction Travel Times Over Time by Facility

Mean A.M. Peak Period / Peak Direction Travel Times Over Time by Facility																		
Facility	HOV route travel time (minutes)						Non-HOV route travel time (minutes)						Time Savings (HOV Time - Non-HOV Time)					
	1997	1999	2004	2007	2010	2014 (Methodology Change)	1997	1999	2004	2007	2010	2014 (Methodology Change)	1997	1999	2004	2007	2010	2014 (Methodology Change)
	(95% Margin of Error in Parenthesis)						(95% Margin of Error in Parenthesis)											
I-95/I-395 (northbound) From Va.234 (Dumfries) to the Pentagon <i>HOV route is 28.1 miles</i>	26 (+/-1)	27 (+/-1)	29 (+/-4)	31 (+/-6)	35 (+/-8)	29	65 (+/-6)	58 (+/-3)	66 (+/-15)	82 (+/-22)	76 (+/-26)	184	39	31	37*	51*	47*	155*
I-66 (eastbound) From Va.234 Business (Manassas) to Va. end of T. Roosevelt Bridge <i>HOV route is 27.8 miles</i>	43 (+/-3)	41 (+/-8)	53 (+/-8)	48 (+/-9)	66 (+/-17)	141	71 (+/-11)	69 (+/-5)	70 (+/-14)	76 (+/-13)	102 (+/-29)	193	28	28	17*	28*	10*	52*
Va.267/I-66 (eastbound) From Va.28 to Va. end of T. Roosevelt Bridge <i>HOV route is 23.4 miles</i>	N A	31 (+/-1)	28 (+/-1)	26 (+/-2)	47 (+/-9)	54	N A	51 (+/-5)	48 (+/-2)	33 (+/-5)	77 (+/-17)	94	N A	20	20*	7	-14	40
I-270 & East Spur (southbound) From I-370 to Old G'town Road <i>HOV route is 8.8 miles</i>	11 (+/-1)	18 (+/-1)	13 (+/-2)	12 (+/-4)	23 (+/-3)	23	16 (+/-3)	22 (+/-4)	19 (+/-3)	20 (+/-8)	18 (+/-3)	23	5	4	6	8	-3	0
I-270 and West Spur (southbound) From I-370 to S end of I-270 Spur <i>HOV route is 8.6 miles</i>	11 (+/-2)	16 (+/-3)	14 (+/-7)	13 (+/-3)	12 (+/-3)	20	17 (+/-4)	23 (+/-3)	22 (+/-3)	18 (+/-5)	16 (+/-5)	44	6	7	8	5	6	24
U.S.50 (westbound) From U.S.301/Md.3 to I-95/I-495 <i>HOV route is 9.0 miles</i>	N A	N A	9 (+/-0)	7 (+/-1)	7 (+/-1)	13	N A	13 (+/-2)	12 (+/-2)	8 (+/-2)	8 (+/-1)	20	N A	N A	3	1	1	7

Notes:

- Data in table are rounded to whole minutes.
- I-66 (eastbound) non-HOV route uses I-66 to I-495 (southbound) to U.S.50 (eastbound) to I-66 on T. Roosevelt Bridge
- Va.267 (eastbound) HOV route uses Va. 267 to Dulles Connector Road to I-66 (eastbound)
- Va.267 (eastbound) non-HOV route uses Va.267 to I-495 (northbound) to G.Washington Mem. Parkway (southbound) to I-66 on T. Roosevelt Bridge
- All travel time runs on Va.267 (HOV and non-HOV) performed with an EZ-Pass transponder.
- Travel time savings shown with an asterisk (\*) are statistically significant at the 95% confidence level using a Tukey Test for 2004-2010. Time savings without an asterisk are not statistically significant.
- Margins of Error computed at 95% confidence level using two-tailed test.



Table D6: AM Peak Direction Travel Time Summary for HOV and non-HOV Lanes (2014)

<b>2014 Regional HOV Monitoring</b>									
<b>A.M. Peak Direction Travel Time Summary for HOV and non-HOV Lanes</b>									
<b>Facility</b>	<b>Facility Section</b>	<b>Length (miles)</b>	<b>HOV Time (mins.)</b>	<b>Non-HOV Time (mins.)</b>	<b>Time Savings</b>		<b>Mean Speeds</b>		
					<i>In Minutes</i>	<i>in Min./Mi.</i>	<b>HOV (MPH)</b>	<b>Non-HOV (MPH)</b>	
<b>I-95/I-395</b>	<b>From Va. 234 to the Pentagon</b>	27.6	29	184	155	5.6	57	9	
	<i>Outside Beltway</i>	17.5	18	117	99	5.7	57	9	
	<i>Inside Beltway</i>	10.7	11	36	25	2.3	60	18	
<b>I-66</b>	<b>From U.S. 15 to the T. Roosevelt Bridge</b>	35.3	141	193	52	1.5	15	11	
	<i>Outside Beltway</i>	17.8	71	97	26	1.5	15	11	
	<i>Inside Beltway</i>	10.5	11	63	52	5.0	58	10	
<b>Va. 267</b>	<b>From Va.28 to the T. Roosevelt Bridge (via Dulles Connector and I-66)</b>	23.4	45	94	49	2.1	31	15	
	<i>Va. 267 only</i>	14.9	28	60	32	2.1	32	15	
<b>I-270</b>	<b>From I-370 to I-495 (passing Md. 187)</b>	9.9	23	23	0	0.0	26	26	
	<b>I-270Y (I-270 Spur) From I-370 to I-495 (passing Democracy Blvd.)</b>	11.0	32	44	12	1.1	11	15	
<b>U.S. 50</b>	<b>From U.S. 301/Md. 3 to Capital Beltway</b>	6.5	13	20	7	1.1	31	20	

Notes:

- Facility Length rounded to nearest 1/10 of a mile
- HOV Times, Non-HOV Times and Time Savings in Minutes rounded to nearest whole minute
- Time Savings rounded to nearest 1/10 of a minute

## **APPENDIX E – SUMMARY OF TRANSPORTATION EMISSION REDUCTION MEASURE (TERM) ANALYSIS REPORT FY 2015-2017<sup>1</sup>**

In addition to air quality benefits, the evaluation results of these TERMS show significant vehicle trips (VT) and vehicle miles traveled (VMT) reductions, contributing directly to congestion management in the region.

### **Background**

This report presents the results of an evaluation of four Transportation Emission Reduction Measures (TERMs), voluntary Transportation Demand Management (TDM) measures implemented by the National Capital Region Transportation Planning Board's (TPB) Commuter Connections program at the Metropolitan Washington Council of Governments (COG) to support the Washington, DC metropolitan region's air quality conformity determination and congestion management process. This evaluation documents transportation and air quality impacts for the three-year evaluation period between July 1, 2014 and June 30, 2017, for the following TERMS:

- Maryland and Virginia Telework – The Maryland portion of this TERM provides information and assistance to Maryland commuters and employers to further in-home and telecenter-based telework programs. The Virginia portion provides assistance to employers and employees participating in the Telework! VA (TWVA) program.
- Guaranteed Ride Home – Eliminates a barrier to use of alternative modes by providing free rides home in the event of an unexpected personal emergency or unscheduled overtime to commuters who use alternative modes.
- Employer Outreach – Provides regional outreach services to encourage large, private-sector and non-profit employers voluntarily to implement commuter assistance strategies that will contribute to reducing vehicle trips to worksites, including the efforts of jurisdiction sales representatives to foster new and expanded trip reduction programs. The Employer Outreach for Bicycling TERM also is part of this analysis.
- Mass Marketing – Involves a large-scale, comprehensive media campaign to inform the region's commuters of services available from Commuter Connections as one way to address commuters' frustration about the commute. Various special promotional events also are part of this TERM.

COG's National Capital Transportation Planning Board (TPB), the designated Metropolitan Planning Organization (MPO) for the Washington, DC metropolitan region, adopted and continues to support these TERMS, among others, as part of the regional Transportation Improvement Program (TIP). The purpose of the TERMS is to help the region reduce emissions in support of air quality goals for the region and to meet federal requirements for the congestion management process. The Commuter Connections program is considered integral in regional travel demand management and is included in

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<sup>1</sup> Nicholas Ramfos, Lori Diggins, Eric Schreffler and Phillip Winters, National Capital Region Transportation Planning Board (TPB) Commuter Connections Program 2015-2017 Transportation Emission Reduction Measure Analysis Report, November 21, 2017.

<https://www.mwcog.org/file.aspx?D=8%2fy1rpdJLtKw6otYYA9fxpS26Ap9ZDIETZI6Mar8mnA%3d&A=PosGAfvOg%2bM76Edp9AdoidpaNpR2HAbX%2bxyKkc4rT8%3d>

the region's TERMS technical documentation which was updated in October 2015. Travel parameters prior to the year 2010 were captured by the regional travel demand model. Only the effects of the incremental growth of the Commuter Connections program post 2010 will be accounted for in future analysis years in the event the impacts are needed as part of the region's air quality conformity determination.

COG/TPB's Commuter Connections program, which also operates an ongoing regional rideshare program, is the central administrator of the TERMS noted above. Commuter Connections elected to include a vigorous evaluation element in the implementation plan for each of the adopted TERMS to develop information to guide sound decision-making about the TERMS. This report summarizes the results of the TERM evaluation activities and presents the transportation and air quality impacts of the TERMS and the Commuter Operations Center (COC).

This evaluation represents a comprehensive evaluation for these programs. It should be noted, however, that the evaluation is conservative in the sense that it includes credit only for impacts that can be reasonably documented with accepted measurement methods and tools. Note that many of the calculations use data from surveys that are subject to some statistical error, at rates common to such surveys.

A primary purpose of this evaluation was to develop meaningful information for regional transportation and air quality decision-makers, COG/TPB staff, COG/TPB program funding agencies, and state and local commute assistance program managers to guide sound decision-making about the TERMS. The results of this evaluation will provide valuable information for regional air quality conformity and the region's congestion management process, to improve the structure and implementation procedures of the TERMS themselves, and to refine future data collection methodologies and tools.

### **Summary of TERM Impact Results**

The objective of the evaluation is to estimate reductions in vehicle trips (VT), vehicle miles traveled (VMT), and tons of vehicle pollutants (Nitrogen Oxides (NO<sub>x</sub>), Volatile Organic Compounds (VOC), Particulate Matter (PM<sub>2.5</sub>), Particulate Matter NO<sub>x</sub> precursors (PM and NO<sub>x</sub>), and Carbon Dioxide (CO<sub>2</sub>)) resulting from implementation of each TERM and compare the impacts against the goals established for the TERMS. The impact results for these measures are shown in Table A for each TERM individually. Results for all TERMS collectively and for the Commuter Operations Center (COC) are presented in Table B.

As shown in Table A, the TERMS combined exceeded the collective goals for vehicle trips reduced by 14% and exceeded the VMT goal by about 18%. The TERMS did not reach the emission goals; the impact for NO<sub>x</sub> was 31% under the goal and VOC impact was 10% under the goal, but these deficits were due largely to changes in the emission factors. The TERM goals were set in 2006, using 2006 emission factors. Goals for some TERMS were re-set since the issuance of the FY2012 - 2014 Commuter Connections TERM Analysis Report. Emission factors used in the 2017 evaluation were considerably lower than the factors from 2014 and lower still than the factors used in 2011, reflecting a cleaner vehicle fleet.

When the COC results are added to the TERM impacts, as presented in Table B, the combined impacts exceeded the vehicle trip and VMT reduction goals by 8% and 9%, respectively. The combined TERM - COC program impacts fell 37% short of the NO<sub>x</sub> goal and were 14% below the VOC goal. Again, the change in the emission factors affected the emission results.

Two TERMS, Telework – Maryland Assistance and Employer Outreach, easily met their individual goals for participation and travel impact. Employer Outreach exceeded vehicle trip and VMT goals by substantial margins. The Employer Outreach for Bicycling TERM component did not meet its goals, but the absolute deficits were small. The Virginia telework component (Telework!VA) also met the goals set for the program.

The impacts for the other two TERMS were below their goals. Vehicle trip reductions and VMT reductions for the Guaranteed Ride Home TERM were about half of the goals set for these impacts, primarily due to declining registrations, compared with 2014 and previous years. The Mass Marketing TERM's vehicle trip and VMT reductions were 6% and 10% short of their respective goals. The Commuter Operations Center and the Software Upgrades TERM also were under their goals for vehicle trips and VMT reduced.

Additional details on the calculations for each TERM and for the Commuter Operations Center are described in individual sections of this report. The reasons for the shortfalls from the goals also are discussed in the individual report sections.

**Table A**  
**Summary of Daily Impact Results for Individual TERMS (July 2014 – June 2017) and Comparison to Goals**

TERM	Participation <sup>1)</sup>	Daily Vehicle Trips Reduced	Daily VMT Reduced	Daily Tons NOx Reduced	Daily Tons VOC Reduced
<b>Maryland Telework Assistance <sup>2)</sup></b>					
2017 Goal	31,854	11,830	241,209	0.122	0.072
Impacts (7/14 – 6/17)	44,350	14,839	361,204	0.096	0.070
Net Credit or (Deficit)	12,496	3,009	119,995	(0.026)	(0.002)
<b>Virginia Telework Assistance – Telework! VA <sup>2)</sup></b>					
2017 Goal	800	155	2,548	0.003	0.001
Impacts (7/14 – 6/17)	1,531	490	9,359	0.003	0.002
Net Credit or (Deficit)	731	335	6,811	0.000	0.001
<b>Guaranteed Ride Home</b>					
2017 Goal	36,992	12,593	355,136	0.177	0.097
Impacts (7/14 – 6/17)	16,742	6,398	181,335	0.040	0.023
Net Credit or (Deficit)	(20,250)	(6,195)	(173,801)	(0.137)	(0.074)
<b>Employer Outreach – all employers participating <sup>3)</sup></b>					
2017 Goal	1,847	82,524	1,393,783	0.561	0.320
Impacts (7/14 – 6/17)	2,046	102,625	1,841,429	0.474	0.350
Net Credit or (Deficit)	199	20,101	447,646	(0.087)	0.030
<b>Employer Outreach – new / expanded employer services since July 2014 <sup>3)</sup></b>					
2017 Goal	91	N/A	N/A	N/A	N/A
Impacts (7/14 – 6/17)	765	25,936	482,153	0.123	0.090
Net Credit or (Deficit)	674	N/A	N/A	N/A	N/A
<b>Employer Outreach for Bicycling <sup>3)</sup></b>					
2017 Goal	590	404	2,421	0.0016	0.0015
Impacts (7/14 – 6/17)	597	373	1,640	0.0008	0.0012
Net Credit or (Deficit)	7	(31)	(781)	(0.0008)	(0.0003)
<b>Mass Marketing</b>					
2017 Goal	23,168	10,809	181,932	0.085	0.025
Impacts (7/14 – 6/17)	23,016	10,133	163,250	0.042	0.019
Net Credit or (Deficit)	(152)	(676)	(18,682)	0.043	(0.006)
<b>TERMS (all TERMS collectively)</b>					
2017 Goal		117,911	2,174,608	0.948	0.515
Impacts (7/14 – 6/17)		134,485	2,556,577	0.655	0.464
Net Credit or (Deficit)		16,574	381,969	(0.293)	(0.051)

- 1) Participation refers to number of commuters participating, except for the Employer Outreach TERM. For this TERM, participation equals the number of employers participating.
- 2) Maryland impacts represent portion of regional telework attributable to TERM-related activities in Maryland. Virginia impacts represent portion of regional telework attributable to the TW!VA program in Virginia. Total telework credited for conformity is higher than reported for the TERM.
- 3) Impacts for Employer Outreach - all employers participating includes impacts for Employer Outreach – new / expanded employer services since July 2014 and for Employer Outreach for Bicycling.



**Table B**  
**Summary of TERM and COC Results (July 2014 – June 2017) and Comparison to Goals**

TERM	Participation	Daily Vehicle Trips Reduced	Daily VMT Reduced	Daily Tons NOx Reduced	Daily Tons VOC Reduced
<b>TERMS (all TERMS collectively)</b>					
2017 Goal		117,911	2,174,608	0.948	0.515
Impacts (7/14 – 6/17)		134,485	2,556,577	0.655	0.464
<b>Net Credit or (Deficit)</b>		<b>16,7574</b>	<b>381,969</b>	<b>(0.293)</b>	<b>(0.051)</b>
<b>Commuter Operations Center – Basic Services</b>					
2017 Goal	91,609	24,425	512,637	0.241	0.115
Impacts (7/14 – 6/17)	77,662	19,949	401,327	0.105	0.079
<b>Net Credit or (Deficit)</b>	<b>(13,947)</b>	<b>(4,476)</b>	<b>(111,310)</b>	<b>(0.136)</b>	<b>(0.036)</b>
<b>Commuter Operations Center – Software Upgrades <sup>1)</sup></b>					
2017 Goal	4,681	2,379	66,442	0.028	0.011
Impacts (7/14 – 6/17)	4,178	1,779	51,340	0.011	0.006
<b>Net Credit or (Deficit)</b>	<b>(503)</b>	<b>(600)</b>	<b>(15,102)</b>	<b>(0.017)</b>	<b>(0.005)</b>
<b>All TERMS plus COC</b>					
2017 Goal		144,715	2,753,687	1.217	0.641
Impacts (7/14 – 6/17)		156,213	3,009,244	0.771	0.549
<b>Net Credit or (Deficit)</b>		<b>11,498</b>	<b>255,557</b>	<b>(0.446)</b>	<b>(0.092)</b>

1) Impacts for Commuter Operations Center – software Upgrades are in addition to the impacts for the Commuter Operations Center – Basic Services. This project was previously part of the Integrated Rideshare TERM.

Table C, on the following page, presents annual emission reduction results for PM 2.5, PM 2.5 precursor NOx, and CO2 emissions (Greenhouse Gas Emissions - GHG) for each TERM and for the COC. COG/TPB did not establish specific targets for these impacts for the Commuter Connections TERMS. But COG has been measuring these impacts for other TERMS, thus these results are provided.

As shown, the TERMS collectively reduce 8.7 annual tons of PM 2.5, 175 annual tons of PM 2.5 precursor NOx, and 264,235 annual tons of CO2 (greenhouse gas emissions). When the Commuter Operations Center is included, these emissions impacts rise to 10.2 annual tons of PM 2.5, 206.2 annual tons of PM 2.5 pre-cursor NOx, and 310,982 annual tons of CO2 (greenhouse gas emissions)..

**Table C**  
**Summary of Annual PM 2.5 and CO2 (Greenhouse Gas) Emission Results for Individual TERMS**

TERM	Annual Tons PM 2.5 Reduced	Annual Tons PM 2.5 Precursor NOx Reduced	Annual Tons CO2 Reduced
Maryland Telework Assistance <sup>1)</sup>	1.275	25.675	38,820.0
Virginia Telework Assistance (TW!VA) <sup>1)</sup>	0.025	0.700	1,012.5
Guaranteed Ride Home	0.552	10.585	17,664.1
Employer Outreach – all employers <sup>2)</sup>	6.275	126.775	190,093.1
Employer Outreach – new/expanded employers <sup>2)</sup>	1.650	32.975	49,801.5
Employer Outreach for Bicycling	0.000	0.250	195.3
Mass Marketing	0.556	11.369	16,644.8
<b>TERMS (all TERMS collectively)</b>	<b>8.683</b>	<b>175.104</b>	<b>264,234.5</b>
Commuter Operations Center – basic services (not including Software Upgrades)	1.377	28.137	41,766.3
Commuter Operations Center – Software Upgrades	0.150	2.975	4,981.1
<b>All TERMS plus Commuter Operations Center</b>	<b>10.210</b>	<b>206.216</b>	<b>310,981.9</b>

- 1) Maryland impacts represent portion of regional telework attributable to TERM-related activities in Maryland. Virginia impacts represent portion of regional telework attributable to the TW!VA program in Virginia. Total telework credited for conformity is higher than reported for the TERM.
- 2) Impacts for new / expanded employer programs and Employer Outreach for Bicycling are included in the Employer Outreach – all employers.

Finally, Table D shows comparisons of daily reductions in vehicle trips, VMT, NOx, and VOC from the 2017 TERM analysis (July 2014 through June 2017) to results of the 2014 analysis (July 2011 through June 2014). As noted before and as described in the footnotes to the table, the emission factors declined between 2014 and 2017, resulting in decreased emission reductions, even though some of the TERMS achieved greater vehicle trip and VMT reductions in 2017 than in 2014.

The impacts for the Telework TERM and Employer Outreach were substantially higher in 2017 than in 2014. Impacts for GRH and for the Mass Marketing TERMS were lower in the 2017 analysis than in 2014. But the vehicle trip impact for Mass Marketing was only 2% below that for 2014 and the VMT impact was only 6% below 2014. The Commuter Operations Center also had lower impacts in 2017 than in 2014, largely due to a lower than expected application count.

**Table D**  
**Summary of Results for Individual TERMS 7/14– 6/17 Compared with 7/11 – 6/14**

TERM	Daily Vehicle Trips Reduced	Daily VMT Reduced	Daily Tons NOx Reduced	Daily Tons VOC Reduced
<b>Maryland Telework Assistance</b>				
July 2014 – June 2017	14,839	361,204	0.096	0.070
July 2011 – June 2014	9,651	205,511	0.101	0.051
Change <sup>1)</sup>	5,188	155,693	(0.005)	0.019
<b>Virginia Telework Assistance – Telework! VA</b>				
July 2014 – June 2017	490	9,359	0.003	0.002
July 2011 – June 2014 <sup>2)</sup>	N/A	N/A	N/A	N/A
Change	490	9,359	0.003	0.002
<b>Guaranteed Ride Home</b>				
July 2014 – June 2017	6,398	181,335	0.040	0.023
July 2011 – June 2014	7,711	212,834	0.087	0.033
Change <sup>1)</sup>	(1,313)	(31,473)	(0.047)	(0.011)
<b>Employer Outreach – All services except Employer Outreach for Bicycling</b>				
July 2014 – June 2017	102,252	1,839,789	0.473	0.349
July 2011 – June 2014	78,210	1,325,107	0.533	0.304
Change <sup>1)</sup>	24,042	514,682	(0.059)	0.045
<b>Employer Outreach for Bicycling</b>				
July 2014 – June 2017	373	1,640	0.001	0.001
July 2011 – June 2014	323	1,937	0.001	0.001
Change <sup>1)</sup>	50	(297)	0.000	0.000
<b>Mass Marketing</b>				
July 2014 – June 2017	10,133	163,250	0.042	0.019
July 2011 – June 2014	10,294	173,269	0.081	0.024
Change <sup>1)</sup>	(161)	(10,019)	(0.038)	(0.005)
<b>All TERMS</b>				
July 2014 – June 2017	134,485	2,556,577	0.655	0.464
July 2011 – June 2014	106,189	1,918,658	0.803	0.412
Change <sup>1)</sup>	28,296	637,919	(0.148)	0.052
<b>Commuter Operations Center (Basic Services + Software Upgrades)</b>				
July 2014 – June 2017	21,728	452,667	0.116	0.085
July 2011 – June 2014	25,641	554,668	0.258	0.121
Change <sup>1)</sup>	(3,913)	(102,001)	(0.142)	(0.035)

1) Change in emissions is due in part to reduction in emission factors from 2014 to 2017.

2) Telework! VA was not included in the FY 2012-14 TERM analysis.

## APPENDIX F – SAMPLE CMP DOCUMENTATION FORM

### CONGESTION MANAGEMENT DOCUMENTATION FORM FOR PROJECTS IN THE 2040 CLRP



1. Agency:

Secondary Agency:

2. Project Title:

	Prefix	Route	Name	Modifier
4. Facility:				
5. From ( _ at):				
6. To:				

7. Jurisdiction(s):

8. Indicate whether the proposed project's location is subject to or benefits significantly from any of the following in-place congestion management strategies:

- Metropolitan Washington Commuter Connections program (ridesharing, telecommuting, guaranteed ride home, employer programs)
- A Transportation Management Association is in the vicinity
- Channelized or grade-separated intersection(s) or roundabouts
- Reversible, turning, acceleration/deceleration, or bypass lanes
- High occupancy vehicle facilities or systems
- Transit stop (rail or bus) within a 1/2 mile radius of the project location
- Park-and-ride lot within a one-mile radius of the project location
- Real-time surveillance/traffic device controlled by a traffic operations center
- Motorist assistance/hazard clearance patrols
- Interconnected/coordinated traffic signal system
- Other in-place congestion management strategy or strategies (briefly describe below:)

--

9. List and briefly describe how the following categories of (additional) strategies were considered as full or partial alternatives to single-occupant vehicle capacity expansion in the study or proposal for the project.

a. Transportation demand management measures, including growth management and congestion pricing

--

b. Traffic operational improvements

--

c. Public transportation improvements

--

d. Intelligent Transportation Systems technologies

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## CONGESTION MANAGEMENT DOCUMENTATION FORM

e. Other congestion management strategies

f. Combinations of the above strategies

10. Could congestion management alternatives fully eliminate or partially offset the need for the proposed increase in single-occupant vehicle capacity? Explain why or why not.

11. Describe all congestion management strategies that are going to be incorporated into the proposed highway project.

12. Describe the proposed funding and implementation schedule for the congestion management strategies to be incorporated into the proposed highway project. Also describe how the effectiveness of strategies implemented will be monitored and assessed after implementation.



## **APPENDIX G – REVIEW OF CONGESTION MANAGEMENT STRATEGIES**

This appendix references the Table 17 and Table 18 on pages **Error! Bookmark not defined.** and **Error! Bookmark not defined.**, which are repeated on the next two pages for convenience.

### **General Characteristics**

#### ***Strategy Name and Number:***

The strategies down the left-hand side of the lists were developed based on the types of strategies being pursued in the region and elsewhere, and could be considered for implementation in our region. Inclusion of any given strategy on the list does not imply endorsement, but rather is included on the list only for consideration and comparison purposes.

Each strategy has a number associated with it (C.1.0, C.1.1, etc.) to make it easier to find and discuss the strategies. The number is not in any way a ranking.

Those listed in bold italics are the strategy categories and underneath them are the specific strategies in that category.

**Table G1: Congestion Management Process (CMP) Demand Management Strategies Criteria**

		QUALITATIVE CRITERIA									
		Impacts on Congestion									
		Reduces Overall Congestion	Reduces Incident-related Congestion	Supports/Promotes Multi-modal Transportation	Regional Applicability	Local Applicability	Existing Level of Deployment	Ease of Implementation	Cost	Cost Effectiveness	Enhance Existing Programs
<b>STRATEGY</b>											
<b>C.5.0 Alternative Commute Programs</b>											
C.5.1	Carpooling	xxx	x	x	xxx	xxx	xxx	xx	x	xxx	xxx
C.5.2	Ridematching Services	xxx	x	x	xxx	xxx	xxx	xx	x	xxx	xxx
C.5.3	Vanpooling	xxx	x	x	xxx	xx	xx	xx	x	xxx	xxx
C.5.4	Telecommuting	xx	x	x	xxx	xx	xx	xxx	x	xx	xxx
C.5.5	Promote Alternate Modes	xx	x	xxx	xxx	xxx	xxx	xxx	x	xx	xxx
C.5.6	Compressed/flexible work weeks	xx	x	x	xxx	xxx	xxx	xxx	x	x	xx
C.5.7	Employer outreach/mass marketing	xx	x	xxx	xxx	xxx	xx	xx	xx	xx	xxx
C.5.8	Parking cash-out	xx	x	xxx	x	xxx	x	x	xx	xx	x
C.5.9	Alternative Commute Subsidy Program	xx	x	xxx	xxx	xx	xx	x	x	xxx	xxx
<b>C.6.0 Managed Facilities</b>											
C.6.1	HOV	xx	x	xxx	xxx	xx	xx	xx	xxx	xxx	xxx
C.6.2	Variably Priced Lanes (VPL)	xxx	x	xx	xxx	xx	x	x	xxx	xxx	xx
C.6.3	Cordon Pricing	xxx	x	xxx	xxx	x	x	x	xx	xxx	xx
C.6.4	Bridge Tolling	xxx	x	x	xx	xx	x	x	xxx	xx	x
<b>C.7.0 Public Transportation Improvements</b>											
C.7.1	Electronic Payment Systems	xx	x	xxx	xx	xx	xxx	xx	xx	xxx	xx
C.7.2	Improvements/added capacity to regional rail and bus transit	xx	xx	xxx	xx	xxx	xx	x	xxx	xxx	xx
C.7.3	Improving accessibility to multi-modal options	xx	x	xxx	xx	xxx	xx	xx	xx	xx	xxx
C.7.4	Park-and-ride lot improvements	xx	x	xx	xx	xx	xx	xx	xx	xx	xx
C.7.5	Carsharing Programs	xx	x	xxx	xxx	xxx	xx	xxx	xx	xx	xxx
<b>C.8.0 Pedestrian, bicycle, and multi-modal improvements</b>											
C.8.1	Improve pedestrian facilities	xx	x	xxx	xx	xxx	xx	xx	xx	xx	xxx
C.8.2	Creation of new bicycle and pedestrian lanes and facilities	xx	x	xxx	xxx	xxx	xx	xx	xx	xx	xxx
C.8.3	Addition of bicycle racks at public transit stations/stops	x	x	xx	xxx	xxx	xx	xxx	x	x	xxx
C.8.4	Bike sharing programs	xx	x	xxx	xxx	xxx	xx	xxx	xx	xx	xxx
<b>C.9.0 Growth Management</b>											
C.9.1	Coordination of Regional Activity Centers	xx	x	xxx	xxx	xxx	xx	x	xxx	xxx	xx
C.9.2	Implementation of TLC program (i.e. coordination of transportation and land use with local gov'ts)	xx	x	xxx	xxx	xxx	xx	xxx	x	xxx	xxx
C.9.3	"Live Near Your Work" program	xx	x	xx	xxx	xx	x	xx	x	x	xx

- 1. Some Impact (x)
- 2. Significant Impact (xx)
- 3. High Impact (xxx)

**Table G2: Congestion Management Process (CMP) Operational Management Strategies Criteria**

		QUALITATIVE CRITERIA									
		Impacts on Congestion									
		Reduces Overall Congestion	Reduces Incident-related Congestion	Supports/Promotes Multi-modal Transportation	Regional Applicability	Local Applicability	Existing Level of Deployment	Ease of Implementation	Cost	Cost Effectiveness	Enhance Existing Programs
<b>STRATEGY</b>											
<b>C.1.0 Incident Mngt./Non-recurring</b>											
C.1.1	Imaging/Video for surveillance and Detection	xx	xxx	xx	xxx	xxx	xx	xx	xx	xxx	xxx
C.1.2	Service patrols	xx	xxx	x	xxx	xxx	xx	xxx	xx	xxx	xxx
C.1.3	Emergency Mngt. Systems (EMS)	x	xx	x	xx	xxx	xxx	xx	xxx	xxx	xxx
C.1.4	Emergency Vehicle Preemption	x	xx	x	x	xxx	xx	xx	xx	x	xx
C.1.5	Road Weather Management	x	xxx	x	xxx	xxx	xx	xx	xx	xx	xx
C.1.6	Traffic Mngt. Centers (TMCs)	xx	xxx	xx	xxx	xx	xx	xx	xx	xxx	xxx
C.1.7	Curve Speed Warning System	xx	xx	x	x	xx	x	xx	xx	xx	x
C.1.8	Work Zone Management	xx	xxx	x	xx	xxx	xx	xx	xx	xx	xx
C.1.9	Automated truck rollover systems	x	xx	x	x	xx	xx	xx	xx	xx	xx
<b>C.2.0 ITS Technologies</b>											
C.2.1	Advanced Traffic Signal Systems	xxx	xx	xx	xxx	xxx	xx	xx	xxx	xxx	xxx
C.2.2	Electronic Payment Systems	xxx	x	xx	xxx	xx	xx	xx	xx	xxx	xx
C.2.3	Freeway Ramp Metering	xx	x	x	xx	xx	x	xx	xx	xx	xx
C.2.4	Bus Priority Systems	x	x	xxx	xxx	xxx	x	xx	xxx	xx	xx
C.2.5	Lane Management (e.g. Variable Speed Limits)	xx	xx	x	xx	xxx	x	xx	xx	xx	xx
C.2.6	Automated Enforcement (e.g. red light cameras)	x	x	x	x	xxx	xx	xx	xx	xx	xx
C.2.7	Traffic signal timing	xxx	x	xx	xxx	xxx	xx	xxx	x	xxx	xxx
C.2.8	Reversible Lanes	xx	x	x	xx	xxx	x	x	xx	xx	xx
C.2.9	Parking Management Systems	xx	x	xx	xx	xxx	x	x	xxx	xx	xx
C.2.10	Dynamic Routing/Scheduling	xx	x	xx	xxx	xxx	x	x	xxx	xx	xx
C.2.11	Service Coordination and Fleet Mngt. (e.g. buses and trains sharing real-time information)	xx	x	xxx	xxx	xxx	x	x	xx	xx	xx
C.2.12	Probe Traffic Monitoring	xx	xxx	x	xx	xx	x	xx	xx	xxx	xx
<b>C.3.0 Advanced Traveler Information Systems</b>											
C.3.1	511	xx	xxx	xx	xxx	x	xx	xx	xxx	xx	xxx
C.3.2	Variable Message Signs (VMS)	xx	xxx	xx	xx	xxx	xx	xx	xx	xxx	xxx
C.3.3	Highway Advisory Radio (HAR)	x	xx	x	xx	xxx	xx	xxx	xx	x	xx
C.3.4	Transit Information Systems	xx	xx	xxx	xx	xxx	xx	x	xx	xx	xxx
<b>C.4.0 Traffic Engineering Improvements</b>											
C.4.1	Safety Improvements	x	xxx	x	x	xxx	xx	xxx	x	xxx	xxx
C.4.2	Turn Lanes	xx	x	x	x	xxx	xx	xx	xx	xx	x
C.4.3	Roundabouts	x	xx	x	x	xxx	x	x	x	xx	xx

- 1. Some Impact (x)
- 2. Significant Impact (xx)
- 3. High Impact (xxx)

### **Qualitative Criteria:**

The qualitative criteria listed across the top of the lists are used to show what kind of impact strategies have on various areas. The first three criteria listed are all impacts on congestion. However, there are several other criteria that could be looked at to determine if a strategy should be considered. The following is a definition of each criterion, and the questions we may want to ask when giving each strategy a “high,” “medium,” or “low” indicator:

- **Reduces Overall Congestion**
  - How much of an impact does a strategy have in reducing overall traffic congestion?
- **Reduces Incident-related Congestion**
  - How much of an impact does a strategy have in reducing incidents and incident-related congestion?
- **Support/Promotes Multi-modal Transportation**
  - Does this strategy play a particular role in supporting multi-modal transportation, such as the use of bus, rail, bicycling, or pedestrian facilities?
- **Regional Applicability**
  - Is this the type of strategy that would be easier to implement at the regional level (e.g. alternative commute programs across the region)?
- **Local Applicability**
  - Is this the type of strategy that would be easier to implement at the local level (e.g. Automated Enforcement, which depends greatly on the local laws and law enforcement)?
- **Existing Level of Deployment**
  - Is this strategy implemented anywhere in the region now, and if so, to what extent?
- **Ease of Implementation**
  - How easy is the strategy to implement? Not only in terms of complexity, but in also in terms of funding, and a local jurisdiction’s unique programs and laws. Some strategies are more common and more promising, while others may be more difficult to implement.
- **Cost**
  - How much does a strategy cost to implement?
- **Cost Effectiveness**
  - How much does the value outweigh the cost (i.e. how high are the benefits)? This is different than the previous “cost” category. For example, carpooling may be indicated as low in terms of cost, because the cost is generally low to implement. However, carpooling may be indicated as high in terms of cost effectiveness, because the benefits and value gained in the region far outweigh the cost.
- **Enhance Existing Programs**
  - How well does this strategy fit in with existing strategies in the region? Is it new and something that existing strategies would benefit from? This category, previously broken down into “DC,” “MD,” and “VA,” was collapsed into one category. It was found that when trying to determine if a strategy enhanced existing programs, there was not much variation among the jurisdictions.

### **Some, Significant, and High Indicators:**

Each strategy was given an indicator of “some impact (x),” “significant impact (xx),” or “high impact (xxx),” which was based on a similar nomenclature used in the TERM process. Each indicator was developed from the knowledge and research of what sorts of activities are going on in our region. By nature of various strategies, some will be evaluated with greater or lesser impacts (e.g. a strategy may

be listed as “low” for regional applicability but “high” for local applicability”). That being said, some strategies that are “low” in some categories may be of interest for other reasons.

To further explain and clarify the reason for these indicators, let’s walk through the indicators of one strategy, *C.8.1 – Improve Pedestrian Facilities*:

- Improving pedestrian facilities was thought to have a medium impact on reducing overall congestion in the region. Improving pedestrian facilities provides an alternative mode of transportation and takes some cars off the road.
- Its contribution to reducing incident-related congestion is limited; therefore it is indicated low in that category.
- Improving pedestrian facilities greatly support and promote multi-modal transportation, therefore indicated high.
- It is something that can be implemented region-wide, but is more likely to be applied more on a local level, given the unique programs and laws of jurisdictions (thus a medium indicator for regional applicability and a high indicator for local applicability).
- It has a fairly good existing level of deployment across the region (although given the high demand for pedestrian facilities in this region, some areas are lacking facilities).
- Ease of implementation for improving pedestrian facilities could be less expensive than building new roadways, and it could be easier to implement than ITS technologies. However, challenges such as local approval, and demand for these facilities, still remain. Indicator: medium.
- Cost is neither extremely low nor especially high, and it really depends on what type of pedestrian facility is being implemented. Cost effectiveness was indicated medium, as pedestrian facilities provide a good benefit for what it costs to implement them.
- Improvement of pedestrian facilities enhance existing programs. Pedestrian facilities support local growth management plans and provide access to transit options. Indicator: high.

### ***Tying It All Together:***

The strategy long lists are important to the regional CMP for several reasons:

- The lists outline various existing and potential strategies that could be considered for our region. As congestion is becoming and epidemic here and elsewhere, these strategies will serve as a point of reference to indicate what is being done in this region to address this.
- The “high,” “medium,” and “low” indicators characterize the impact strategies have. They provide a starting point for discussion show that there are various reasons why one may want to implement a strategy. While something may have a high cost, it may also have a high impact on reducing congestion and a high cost effectiveness.
- The lists address federal requirements, which state that the region should identify and evaluate anticipated performance and expected benefits of existing strategies.

As the region continues to grow these are just some of the strategies that could be considered for our region. Many strategies on these lists are ongoing and will continue to be implemented on a greater scale. For other strategies these lists may act as a starting point for future consideration. Regardless, congestion management strategies will be at the forefront of discussion as the Washington region continues to be a dynamic living and working environment.



## Detailed Descriptions of Strategies

Following is a list of congestion management strategies listed in the Strategy Long Lists. The numbers correspond with the numbered strategies in the list.

### **Operational Management Strategies:**

**C.1.0 - Incident Management./Non-recurring** - This category of strategies are aimed at reducing non-recurring congestion; congestion caused primarily by incidents and events. Many of these incident management systems are aimed at clearing an incident so that traffic can resume its normal flow.

- **C.1.1 – Imaging/Video for Surveillance and Detection**
  - Cameras throughout our transportation system, on roadways, at intersections, and at transit stations. Help detect incidents quickly, help emergency response units arrive quickly and help travelers safely negotiate around incidents.
- **C.1.2 – Service Patrols**
  - Specially equipped motor vehicles and trained staff that help in clearing incidents off a roadway and navigating traffic safely around an incident.
- **C.1.3 – Emergency Management Systems (EMS)**
  - EMS notify, dispatch, and guide emergency responders to an incident. Aid in detecting, tracking, and clearing incidents.
- **C. 1.4 – Emergency Vehicle Preemption**
  - Signal preemption for emergency vehicles use sensors to detect and emergency vehicle and provide a green signal to the vehicle. This is important to incident management in that it allows for emergency vehicles to get to the scene of an incident and clear it so that traffic can resume its normal flow.
- **C.1.5 – Road Weather Management**
  - Can take the forms of information dissemination, response and treatment, surveillance monitoring, and prediction, and traffic control. Helps prevent incidents due to inclement weather (snow, ice).
- **C.1.6 – Traffic Management Centers (TMCs)**
  - Centers that collect and analyze traffic data and then disseminate data to the public. Data collection elements might include CCTVs, cameras, and loop detectors. Might relay information to the public through radio, TV, or the Internet. This is important to the public, as it allows them to get information about existing traffic conditions and plan their route and timing accordingly.
- **C.1.7 – Curve Speed Warning System**
  - GPS and digital devices on a highway that assess and detect the threat of vehicles moving toward a curve too quickly. This is important in preventing incidents and thus preventing non-recurring congestion.
- **C.1.8 – Work Zone Management**
  - Can take the form of traffic workers, signs, and temporary road blockers used to direct traffic during an incident or construction. The temporary implementation of traffic management or incident management capabilities can help direct the flow of traffic, keep traffic moving, and prevent additional incidents.
- **C.1.9 – Automated truck rollover systems**
  - Detectors deployed on ramps to warn trucks if they are about to exceed their rollover threshold. If the data concludes a truck’s maximum safe speed is to be exceeded around a turn, then a message sign would flash, “TRUCKS REDUCE SPEED.” This is important in preventing incidents caused by large trucks, and thus preventing non-recurring congestion.

**C.2.0 – ITS Technologies** – This category of strategies can be defined as electronic technologies and communication devices aimed at monitoring traffic flow, detecting incidents, and providing information to the public and emergency systems on what is happening on our roadways and transit communities. Much of what is done with ITS helps in reducing non-recurring and incident-related congestion, and works hand-in-hand with those strategies listed in the above category (C.1.0).

**C.2.1 – Advanced Traffic Signal Systems**

- The coordination of traffic signal operation in a jurisdiction, or between jurisdictions. This is important to congestion, as it reduces delay and improves travel times.
- **C.2.2 – Electronic Payment Systems**
  - These systems can make transit use more convenient by allowing a user to pay for bus, rail, park-and-ride lots, and other transit services with one card. Convenience an appealing factor, and helps increase transit ridership and transfers among different transit modes.
- **C.2.3 – Freeway Ramp Metering**
  - Traffic signals on freeway ramps that alternate between red and green to control the flow of vehicles entering the freeway. This prevents incidents that may occur from vehicles entering the freeway too quickly, and also prevents a backup of traffic on the on-ramp.
- **C.2.4 – Bus Priority Systems**
  - Bus priority systems are sensors used to detect approaching transit vehicles and alter signal timings to improve transit performance. For example, some systems extend the duration of green signals for public transportation vehicles when necessary. This is important because improved transit performance, including a more precisely predicted time for bus arrivals, makes public transit a more appealing option for travelers.
- **C.2.5 – Lane Management (e.g. Variable Speed Limits)**
  - Variable Speed Limits are sensors used to monitor prevailing weather or traffic conditions, and message signs posting enforceable speed limits. These systems can promote the most effective use of available capacity during emergency evacuations, incidents, construction, and a variety of other traffic and/or weather conditions.
- **C.2.6 – Automated Enforcement (e.g. red light cameras)**
  - Still or video cameras that monitor things such as speed, ramp metering, and the running of red lights, to name a few. They are important to preventing non-recurring and incident related congestion.
- **C.2.7 – Traffic Signal Timing**
  - Traffic signal timing plans adjust traffic signals during an incident, during inclement weather, or to improve transit performance. The overall objective is to reduce backups at traffic signals and to increase the level of service.
- **C.2.8 – Reversible Lanes**
  - Traffic sensors and lane control signs reverse the flow of traffic and allow travel in the peak direction during rush hours. This is important to alleviating congestion that may occur in one direction during a peak hour.
- **C.2.9 – Dynamic Routing/Scheduling**
  - Public transportation routing and scheduling can automatically detect a vehicle's location, and dispatching and reservation technologies can facilitate the flexibility of routing/scheduling. This can help increase the timeliness of public transportation, keep transit on schedule, which in turn increases ridership.
- **C.2.11 – Service Coordination and Fleet Management (e.g. buses and trains sharing real-time information)**

- Monitoring and communication technologies in a vehicle that facilitate the coordination of passenger transfers between vehicles or transit systems. This is important and appealing to passengers that use more than one type of transit.
- **C.2.12 – Probe Traffic Monitoring**
  - Using individual vehicles in the traffic stream to measure the time it takes them to travel between two points and also to report abnormal traffic flow caused by incidents. Tracking could be done with the use of cellular phones, and in the future with the installation of a system in the vehicle which would send information to transportation operators. This is important to monitoring recurring and non-recurring congested locations, and travel time.

**C.3.0 – Advanced Traveler Information Systems** – Provide information to travelers which allow them to adjust the timing of their travels or the route that they take to avoid any incidents, construction, or weather problems.

- **C.3.1 – 511**
  - A variety of applications for travelers to use either before their trip or en-route, such as 511 telephone systems, internet websites, pagers, cell phones, and radio, to obtain up-to-date traveler information. This helps travelers plan their timing and routes accordingly.
- **C.3.2 – Variable Message Signs (VMS)**
  - One way ITS operators can share traffic information with travelers is through a Variable Message Sign (VMS) along the roadway. Such signs could provide information on road closures, emergency messages, weather message, and construction. This helps travelers plan their timing and routes accordingly. These signs can also prevent incidents from occurring as they provide warnings about speed, weather, construction, etc.
- **C.3.3 – Highway Advisory Radio (HAR)**
  - Another way ITS operators can share traffic information with travelers is through Highway Advisory Radio (HAR). The radio can provide information on road closures, emergency messages, weather, and construction (such as the Woodrow Wilson Bridge Project). Travelers can plan their timing and route accordingly.
- **C.3.4 – Transit Information Systems**
  - Can provide up-to-date transit information, such as arrival times for bus and rail. The WMATA Metrorail display signs depicting arrival times for trains are examples of this. Having this type of information available can increase transit ridership, and can also allow riders to make decisions on what type of transit to use based on up-to-date information.

**C.4.0 – Traffic Engineering Improvements** – Improvements implemented on roadways where congestion problems have occurred in the past or are anticipated to occur in the future. Some of these engineering improvements can be aimed at reducing incidents on a particularly dangerous section of roadway, while others may be attempting to relieve a choke-point or bottleneck.

- **C.4.1 – Safety Improvements**
  - Improvements done to increase safety and reduce incident-related congestion. Examples of some improvements include traffic calming devices, speed bumps, widening or narrowing a roadway, and textured pavement. These safety improvements can prevent incidents and non-recurring congestion resulting from incidents.
- **C.4.2 – Turn lanes**
  - Might be implemented to reduce the queuing of cars waiting to make a right or left turn at an intersection, thus reducing congestion.
- **C.4.3 – Roundabouts**

- Barriers placed in the middle of an intersection, creating a circle, and thus directing vehicles in the same direction. This can help reduce congestion by slowing the speed of cars on a street and/or preventing thru traffic on a neighborhood street.

**Demand Management Strategies:**

**C.5.0 – Alternative Commute Programs** – Provides travelers with options other than the single-occupant vehicle. These programs are aimed in reducing the amount of single-occupant vehicles are on our roadways.

- **C.5.1 – Carpooling**
  - Two or more people traveling together in one vehicle. This reduces the amount of vehicles on the road.
- **C.5.2 – Ridematching Services**
  - Enables commuters to find other individuals that share the same commute route and can carpool/vanpool together. This provides carpooling options for people who may not know of someone to carpool with, thus broadening the carpooling option.
- **C.5.3 – Vanpooling**
  - When a group of individuals (usually long-distance commuters) travel together by van, which is sometimes provided by employers. This reduces the amount of vehicles on the road, which is especially important for long-distance transportation modes.
- **C.5.4 – Telecommuting**
  - Workers either work from home or from a regional telecommute center for one or more days of the week. This reduces the amount of vehicles on the road, especially during rush hour when many commuters are going to work at once.
- **C.5.5 – Promote Alternate Modes**
  - Programs, such as Commuter Connections, or regional Transportation Management Areas (TMAs) provide information to the public on alternative commute programs. This gets the word out about commute options in the region, many who may not have considered alternative commute programs as an option before.
- **C.5.6 – Compressed/flexible workweeks**
  - Employees compressing their work week into a shorter number of days, which allows them to avoid commuting one or more days a week. This reduces the amount of vehicles on the road.
- **C.5.7 – Employer outreach/mass marketing**
  - Organizations, such as Commuter Connections, providing information to employers on the benefits of alternative commute programs for their employees. This allows employers to see the benefits that alternative commute programs can have in their organization.
- **C.5.8 – Parking cash-out**
  - Employees essentially pay their employees not to park at work. The employees receive compensation for the parking space they would have otherwise used if they did not walk, bike, take transit, etc. This encourages more people to leave their car at home in favor of another mode of transportation.
- **C.5.9 – Alternative Commute Subsidy Program**
  - Employees provide a transit subsidy to their employees, which encourages them to use public transit instead of driving to work. This reduces the amount of vehicles on the road.

**C.6.0 – Managed Facilities** – These facilities have restrictions for use of the roadways. In some cases, only those other than single-occupant vehicles can use the lane or roadway. In other cases, a fee is implemented for single-occupant vehicles. Still, in other case, a fee might be implemented for every

car on the roadway entering a city. They all have a common goal of reducing the amount of single-occupant vehicles on the roadways and promoting other forms of transportation.

- **C.6.1 - HOV**
  - High Occupancy Vehicle (HOV) are lanes reserved for vehicles with a driver and one or more passengers. This promotes the use of carpools, which can use a less-congested lane on the highway.
- **C.6.2- Variably Priced Lanes (VPL)**
  - Lanes which are typically used by carpoolers for free, while solo drivers pay tolls that change according to varying congestion levels. This encourages the use of carpooling, but also raises revenue for additional transportation projects that would reduce congestion.
- **C.6.3 – Cordon Pricing**
  - Cordon area congestion pricing is a fee paid by users to enter a restricted area in the city center. This is a way of promoting other alternative modes of transportation, while raising revenue for other transportation projects that would reduce congestion.
- **C.6.4 – Bridge Tolling**
  - Tolling over a bridge, in either one or both directions. This may decrease congestion on a bridge, as people may find an alternative route in lieu of paying the fee. Also, it raises revenue for transportation projects that would help in reducing congestion.

**C.7.0 – Public Transportation Improvements** – These improvements are done to the region’s public transportation to ensure that it remains a safe and viable mode for travelers. Improvements can maintain the amount of users and attract new ones who never considered public transit as an option before.

- **C.7.1 – Electronic Payment Systems**
  - These systems can make transit use more convenient by allowing a user to pay for bus, rail, park-and-ride lots, and other transit services with one card. Convenience an appealing factor, and helps increase transit ridership and ridership between different transit modes.
- **C.7.2 – Improvements/added capacity to regional rail and bus transit**
  - Added capacity and improvements to rail and bus to help keep up with increasing demand on public transportation. This is important in keeping with the growing demand on public transportation as an alternative mode.
- **C.7.3 – Improving accessibility to multi-modal options**
  - Ensuring that connections are provided to multi-modal options, such as bus, rail, and pedestrian and bicycle facilities. More connections makes it easier for people to access multi-modal options, thus increasing use.
- **C.7.4 – Park-and-Ride Lot Improvements**
  - Improvements to park-and-ride lots to keep up with increasing demand and growth in the region. Park-and-Ride lots allow people to access public transportation, who may not be able to access it from their home. Improvements to these lots can ensure that this growing need is met and that people can continue to have transit access.
- **C.7.5 – Carsharing Programs**
  - A convenient and cost-effective mobility option for those that typically do not have a need to own a car. This reduces the amount of cars on the road because generally the car is only used when needed, and public transportation or other modes are used most of the time.

**C.8.0 – Pedestrian, Bicycle, and Multi-modal Improvements** – Maintaining and creating new pedestrian, bicycle, and multi-modal facilities is improvement in that it improves accessibility. If something is accessible by a walk or bike path, people are more likely to leave their car at home.

- **C.8.1- Improve Pedestrian Facilities**
  - Improvement and addition of new pedestrian and bicycle facilities to keep up with a growing demand and ensure safety for users. This ensures that those using these facilities will continue to do so, and that potential users will find pedestrian facilities more appealing and accessible.
- **C.8.2 – Creation of new bicycle and pedestrian lanes and facilities**
  - Addition of new lanes to keep up with a growing demand and created new connections throughout the region. This will extend the option of bicycle and pedestrian lanes to those that may not already have access to it, as well as provide increased access to employment, recreation, retail, and housing in the region.
- **C.8.3 – Addition of bicycle racks at public transit stations/stops**
  - Allows people who bike to connect to other forms of transportation. This gives people another option for traveling other than a single-occupant vehicle.
- **C.8.4 – Bike sharing Programs**
  - A convenient and cost-effective mobility option for those that typically do not have a need to own a bicycle. This allows people to shift easily from other forms of transport to bicycle and back again.

**C.9.0 – Growth Management** – Growth Management is the term used in the Federal Rule, but really this term pertains to ensuring the coordination of transportation and land use. In terms of Growth Management we are talking about making sure that everyone has the option to public transportation and alternative modes no matter where they live or work in the region.

- **C.9.1 – Coordination of Regional Activity Centers**
  - Help coordinate transportation and land use planning in specific areas in the Washington region experiencing and anticipating growth. Focusing growth in Regional Activity Centers is important to congestion management, where transportation options for those who live and work there can be provided.
- **C.9.2 – Implementation of TLC program (i.e. coordination of transportation and land use with local governments).**
  - Provides support and assistance to local governments in the Washington region as they implement their own strategies to improve coordination between transportation and land use. The idea is to provide public transit options to everyone in the region.
- **C.9.3 – “Live Near Your Work” program**
  - Supporting the idea that locating jobs and housing closer together can provide alternative commuting options that may not have been options otherwise.